Name	Counterpart	Title
Nunung Nuryartono, Mohammad Iqbal Irfany, Muhamad Amin Rifai	**C10**	The analysis of inequality using carbon footprint approach in Indonesia

Background

Development with economic, social and environmental sustainability as the main pillars is an important theme in the 21st century. Human activity is the leading contributor to the rise in global emissions, particularly since the industrial revolution (IPCC 2013). In Indonesia, over the last few years, household consumption has played a role in the increase of carbon dioxide (Jakob et al. 2014, Irfany and Klasen 2017). But carbon production is affected by inequalities in income between households. The main objectives of this research were therefore to estimate the determinants of the household carbon footprints in Indonesia, to understand the differences in carbon inequality against income and to estimate determinants of carbon inequality.

Data and Method

The data used was the emissions database from the Global Trade Analysis Project Environmental Account (GTAP-E), the Indonesian Input-Output table, and the Indonesian household expenditure survey (SUSENAS) database from the years 2013 and 2017. We then determined the household carbon footprint as follows. First, we calculated an energy table IO by combining the IO tables and emissions data of the economic sectors. This calculation provided the emission intensity of the products, both services and goods. We then integrated the household expenditure survey data with the emission intensity to give the household carbon footprint. We also applied ordinary least square (OLS) regression, Panel Data regression and Gini coefficient measurement.

Results and Conclusion

SUSENAS data (2014-2016) showed that household expenditure is mostly for consumption of „food and beverage". Although households consume more food than non-food, the highest carbon footprint comes from non-food consumption, namely for fuel, electricity and transportation. The share of household expenditure related to the carbon footprint, the higher the share of a particular expenditure, the greater the carbon footprint from that expenditure. Our analysis of socio-economic characteristics indicated that non-poor households produce more carbon than poor households. In addition, based on the income group category, we showed that the higher the income group the higher the carbon footprint produced. When households were classified based on the main occupation it was clear that the highest carbon footprint is produced by households in the classifications of finance, real estate and business services. However, the lowest carbon footprint is produced by households classified in the agricultural sector. Urban households produced higher carbon footprint than rural households.

The most influential factor for the carbon footprint is household expenditure. The positive coefficient of household expenditure indicates that the higher the household expenditure, the higher the carbon footprint produced. Control variables such as marital status, poverty level, household size, household location, and age have positive relationships. The quadratic regression model shows that there is no turning point relationship between income and carbon footprint. This is indicated by the positive coefficients of income and income squared. This means that when household income increases, the carbon footprint produced will continue to increase and there is no turning point. Quantile income considerations indicated that the higher household income level, the higher the carbon footprint produced.

Analysis of the inequality of income and carbon produced shows that carbon inequality is higher than income inequality. Then, to identify further, income was divided into 5 groups from the lowest to the highest income. The results show that the inequality of income and inequality of carbon footprint have a u-shaped pattern from the lowest income to the highest income groups. Income and carbon footprint inequalities are the highest in income group 5 (high income group), followed by income group 1 (low income group). Middle income groups, however, have lower inequality than those in income groups 1 and 5. Based on the analysis of income and carbon inequalities, the highest

inequality in income and in carbon footprint arise in households where the head of household works in the electricity, gas and water supply sectors.

Factors that influence the carbon footprint inequality in Indonesia are the amount of carbon footprint produced, RGDP, and poverty levels. The results show that carbon footprint and poverty have positive effect on carbon inequality. The increase of carbon footprint and poverty will increase carbon inequality. In addition, the RGDP has a negative effect on carbon inequality. This means that the increase of RGDP per capita at the province level will reduce the carbon inequality.
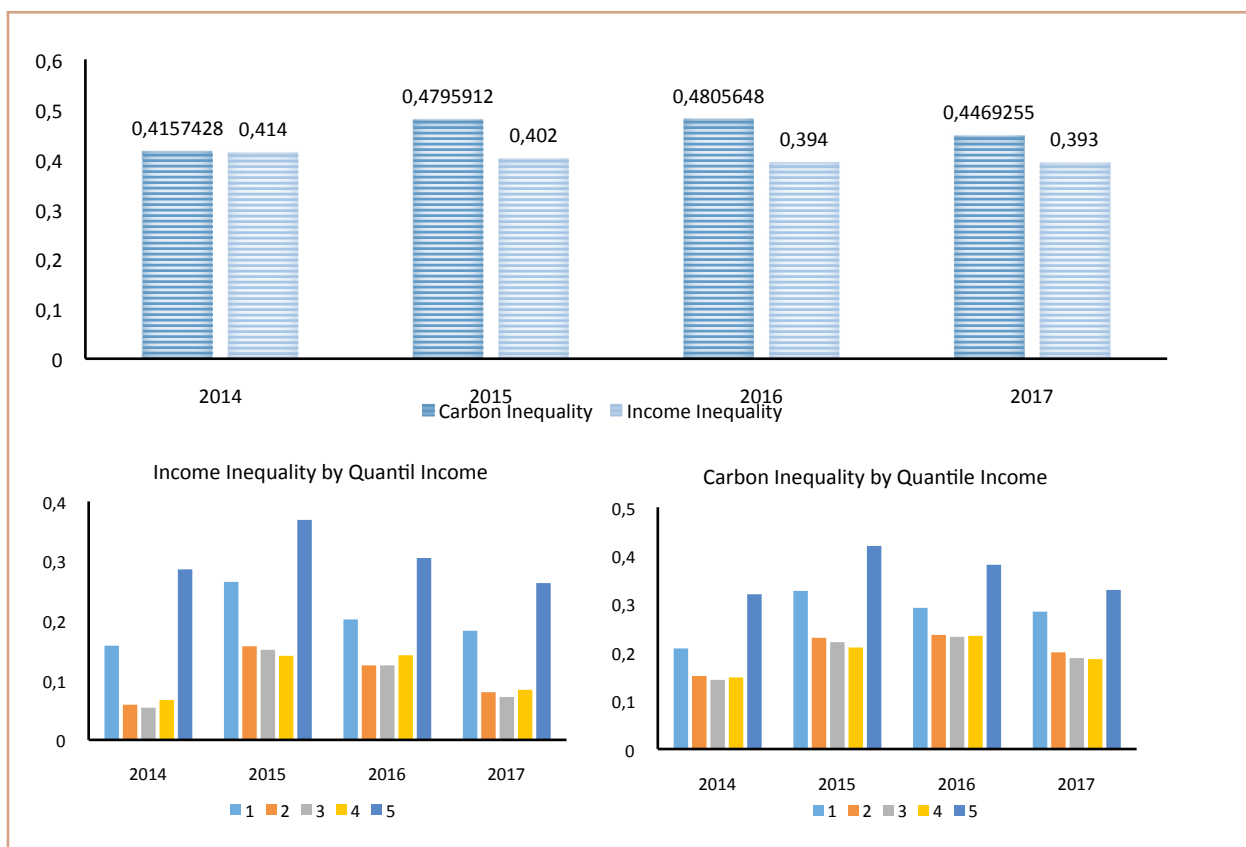

Figure 1. Income inequality and carbon inequality in Indonesia

References

Intergovernmental Panel on Climate Change (IPCC) (2013) The 5th IPCC report, 2013. IPCC, Geneva

Irfany, M. I., & Klasen, S. (2017). Affluence and emission tradeoffs: evidence from Indonesian households' carbon footprint. Environment and Development Economics 22 (5), 546-570.

Jakob, M., Steckel, J. C., Klasen, S., Lay, J., Grunewald, N., Martínez-Zarzoso, I., & Edenhofer, O. (2014). Feasible Mitigation Actions in Developing Countries. Nature Climate Change 4 (11), 961-968.