Forecasting replacement demand of durable goods and the induced life cycle emissions: a dynamic waste input-output approach

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Summary

In developed countries, replacement demand of durable goods such as automobile is not only an important driving force of economic growth but also a key factor in the reduction in environmental impacts such as waste. If durable goods are newly purchased on one occasion and used for a long time, their goods are gradually degraded via physical wear and tear and finally they breaks down. The degradation and mechanical failure will consequently induce final demand of new products and contribute to steady economic growth.

On the other hand, the wastes, disposed of due to the degradation and mechanical failure, are flowing into domestic and foreign markets of secondhand goods or they are recycled into secondary materials through waste treatment activities such as dismantling. The supply of the secondhand goods and secondary materials remarkably affects markets of virgin materials and resource use. An important question is whether or not the supply of secondary materials induced by the disposal of old products is balanced with the demand of secondary materials required for the productions in primary materials industries. It should be noted that the demand of the secondary materials is largely influenced by business fluctuations.

If the supply of the secondary materials exceeds the demand, the wastes as their raw materials have nowhere to go and finally flow to landfill. As a result, this consequently leads to not only decreasing prices of waste treatment services but breaking waste recycling. In contract, if the demand of the secondary materials exceeds

the supply, primary material industries will have to secure technologically-substitutable virgin materials.

With this motivation, a crucial point is to forecast secondary material flows induced by the disposal and replacement of durable goods. In this paper, we propose a method to forecast future secondary material flows by reconciling a product lifetime distribution analysis with waste input-output analysis and present a case study of automobile. As a result, a dynamic waste input-output analysis has been constructed. More concretely, using the proposed forecasting method, we estimated the future supply of scrap iron (a secondary material) directly induced by shredding cars newly purchased during the recent decade: 2000-2009. We also estimated the future demand of scrap iron required for the productions of primary material industries such as crude steel industries (electric furnaces) indirectly induced by final consumptions of new cars and other goods and services. The study period is 50 years during 2000-2050.

The empirical result reveals that the future supply of scrap iron generated by shredding cars newly purchased during the recent decade: 2000-2009 significantly exceed the future demand of scrap iron associated with the replacement demand of new cars forecasted by the lifetime distribution analysis for cars newly purchased during the recent decade: 2000-2009. We also find that a strategic planning of capital formation such as residential constructions and public construction of roads will contribute to reducing the excess supply of scrap iron.

This paper is organized as follows: Section 2 reconciles lifetime distribution

analysis and waste input-output analysis; Section 3 presents a case study of automobile; Section 4 concludes the paper.