

The impact and effects of modal shift of waste transportation by IR-WIO (interregional waste input-output) analysis

Topic: Physical input-output tables

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The creation of a recycling society is one of the most urgent and important issues that could reduce global warming gases, use natural resources effectively, and reduce waste, especially for landfilling. The improvement of the efficiency of waste treatment and recycling is one of the issues to consider in creating such a society. In particular, policies for the implementation of a waste transportation system and the choosing of modes of transportation need to be created while considering such factors as cost, reducing the use of natural resources and reducing environmental loads, including global warming gasses. A modal shift, meaning the change of transportation means from automobile or air, to ship or railway is an effective method for dealing with such issues. In this study, we estimate the effect of a modal shift in the waste transportation.

In our previous work (Tsukui and Nakamura 2009), we constructed the interregional waste transportation model (IR-WTM) which is a very versatile model that can be used for the analysis of transportation in general, not just waste transportation alone. Through the use of this model, we can estimate energy consumptions, CO₂ emissions and SOX emissions for multiple means of transportation, such as by automobile, ship, railway, and air. To estimate the effect of a modal shift of waste transportation, we apply this IR-WTM to the interregional waste input-output (IR-WIO) analysis model which is one of the more powerful tools that can be used to analyze economic activities, waste emissions and waste treatments simultaneously (Nakamura et. al. 2002, Takase et. al. 2002, Urabe 2001 and Tsukui 2004, 2007).

In IR-WTM, the unit of measurement, freight ton kilometers, is used to estimate energy consumption, CO₂ emission, SOX emission and the cost of energy for each transportation means. For a case study, to demonstrate the usability of this model, we applied it to waste transportation in Japan in 2007, when the latest statistics were published. Japan is one of many countries which have a nation-wide railroad network. However, in recently history, this railway system has not been used for waste transportation, although it has been used for freight transport. As is well known, rail and ship transportation have a much lower energy consumption resulting in less environmental load which is typified by lowered CO₂ emissions. In 2007, the total amount of waste transportation between prefectures in Japan was 34.4 million tons; about 80.9 % is transported by truck and the rest by ship. However, when we use freight ton kilometer, units to look at this, the total amount of waste transportation is 6,063.5 million, with the ratio of truck to ship being approximately-equivalent at about 52.0% and 47.9% respectively. This shows that the ship transportation does have a not-insignificant part to play in the long distance transportation of waste. In this present study, we estimate the effect of modal shift from truck to railway transportation. Transportation by truck is mainly used for intermediate or short distance waste transportation between prefectures. We propose that the importance of rail transportation over these distance be raised. According to estimates by applying IR-WTM, if truck transportation is completely replaced by railway transportation, the modal shift from truck to railway may result in a reduction of 0.96 million t-CO₂ which is about 3.06 % of the total CO₂ emission of waste treatment sectors in Japan in 2007. The CO₂ emission of waste transportation by railway is about 69.5 thousand t-CO₂, which is much less than that by truck at 1,026.0 thousand t-CO₂.

By linking IR-WTM and IR-WIO analyses, we can estimate not only the direct effects of the modal shift concerning the cost of energy, energy consumption and environmental loads but also estimate

the spillover effects of the modal shift. We will also estimate the effects of a modal shift of long distance transportation of waste from truck to ship. In this study, we only considered the effect of the modal shift by simply changing the means of transportation. It is also important better to consider the effect of cost, energy consumption and environmental load in the maintenance of the transportation. Along with the popularization of railway transportation, we may have to widen our considerations about the effect on the demand of durable goods and inputs of fixed capital formation sectors, such as a decrease in demand for trucks, an increase in rail freight, and the creation and improvements of transshipment facilities. In practice, it is also important to include the introduction of laws and regulations facilitating a shift in the transportation of waste from road to rail.

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