The Impact of a Carbon Tax on CO2 Emission Transfers: Evidence from Japan

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The Japanese government plans to introduce a carbon tax in 2028. A carbon tax puts a price on CO2 emissions, providing an incentive to reduce CO2 emissions. However, there are some concerns about introduction of carbon tax. When a carbon tax is introduced in one country, while the amount of CO2 emissions in that country would be reduced, there is a risk of carbon leakage. Carbon leakage occurs when the production site of carbon intensive products (e.g., iron and steel) shifts from countries which have strict carbon tax regulations to other countries which have weaker regulations and it result in increasing of CO2 emission in countries with weaker regulations. Therefore, in regard to the implementation of the carbon tax in Japan, it is crucial to investigate the impact of the carbon tax on CO2 emission, taking into account the potential of the carbon leakage to foreign countries in order to clarify the effect of carbon tax.

This study aims to qualify the amount of change of CO2 emission in Japan and in foreign countries after carbon tax introduction in Japan. The novelty of this study is that we analyze the environmental impact of carbon tax introduction comprehensively, including carbon leakage. We use the multi-regional input-output table (GLORIA), which is composed of data from 120 industries and 164 countries and armington elasticity which denotes the elasticity of substitution between product of domestic country and foreign countries. This allows for a detailed quantification of the changes in CO2 emissions in foreign countries and industries resulting from carbon tax introduction in Japan, and the identification of countries and industries most significantly affected.

In this study, we conducted the analysis following four steps outlined below. First, based on the amount of fossil fuels imported to Japan, we estimate the carbon tax imposed on the domestic industries (upstream industries) which import fossil fuels. Carbon tax implementation on upstream industries will raise the production costs and prices of products produced by those industries. This cost increase pressure will affect the midstream industries (e.g., iron and steel) and eventually the downstream industries (e.g., automobile manufacturing) through the supply chain networks. As a result, not only the price of upstream products such as fossil fuels, but also the prices of intermediate products such as materials and components, and even the domestic prices of final products purchased by consumers, will increase.

Next, we calculate the price increase rate of 120 domestic industries due to the carbon tax implementation. Assuming that the prices of domestic industries increase while the prices of foreign industries remain unchanged, it can be expected that a demand change will occur, with a decrease in demand for domestic industries and an increase in demand for foreign industries, in regard to both intermediate and final demand.

Subsequently, we estimate the demand changes from each industry as the intermediate demand and from final consumers as the final demand for both domestic and foreign industries after the price increase of the domestic industries. As demand for foreign industries increase, the production of products exported to Japan will increase, and it will cause CO2 emissions in foreign countries to increase (carbon leakage).

Finally, we calculate the amount of CO2 emission in Japan and in foreign countries after the introduction of carbon tax in Japan.

From the result, we found that, when the carbon tax at a rate of 30 USD per ton of CO2 emissions is introduced in Japan, total CO2 emissions in the world caused by final demand in Japan would be reduced by approximately 1.2%. In this case, CO2 emissions in Japan required to meet final demand in Japan would be reduced by 3.2%, while CO2 emissions abroad increase by 2.7% due to carbon leakage. It is also revealed that, after carbon tax introduction in Japan, CO2 emissions increase in China, Qatar and the United States will account for a large proportion of total CO2 emission increase outside of Japan.

Furthermore, it is noteworthy that this study shows that if Japanese government providing economic protection to specific industries with carbon tax implementation, CO2 emissions increase outside of Japan could be reduced compared to the case of a typical carbon tax implementation. Therefore, to mitigate carbon leakage, it is crucial to implement policies that provide subsidies to specific industries shown in this study such as construction and civil engineering industries in order to encourage them to input products produced in Japan, and policies that suppress the price increases of final products shown in this study such as machinery and electronic equipment.