

Assessment of Overall Economic Impact of a Disaster to Industry Considering Recovery Process: A Computable General Equilibrium Approach

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Projecting economic impacts of a natural disaster is essential for evaluating countermeasures to reduce the impacts before the event. Effective combination of ex-ante and ex-post measures are important to for reducing economic losses and make the industries more resilient. In order to evaluate alternatives composed of ex-ante and ex-post measures , it is necessary to evaluate overall economic impacts of the disaster taking account of recovery process.

This study proposes a framework for projecting overall economic impact of an earthquake taking account of recovery scenario. In the framework, a regional economic model is developed integrating damage of utility lifelines and production capital and their recovery scenario, economic loss in each recovery phase is calculated, and the overall losses are calculated.

In order to evaluate the overall economic impact of a natural disaster, we have to pay attention to double counting of the losses. This is called as consistent measurement of economic loss, which is a method starting to be investigated recently. The method proposes that overall economic loss of a natural disaster can be measured by recovery cost plus forgone profit. However, it did not consider the impacts on households due to the price changes. It is not evident how to aggregate the economic impact on households and firms taking account of the effect of prices change. This study proposes how to consistently measure the overall impact of a natural disaster aggregating losses of firms and households considering price changes.

In addition, estimating damages in production capital is another essential part in the projection of economic impacts. In the previous studies, damages in production capital was estimated based on housing damage data. However, as our field survey in the Niigata Chuetsu earthquake found, operation levels of firms are not affected if the damage of building is not critical for their business. In this case, it is not valid to estimate the damages in production capital based only on information of housing damage.

This study proposes a method for adversely estimating the damages of production capital from production loss data. For the purpose, fragility curves for operation level of business firms are estimated based on the ground motion data and questionnaire survey for the impact on business sectors of the 2004 Niigata Chuetsu earthquake. These fragility curves are jointly used with regional production data to estimate the decrease in production due to a disaster. This method is superior in that it can use detail data of production in regional industry, which is relatively publicly established.

These methods are integrated to a computable general equilibrium model (CGE), which is a regional economic model based on optimization behavior of economic agents and market equilibrium conditions. Economic losses can be calculated by the model with input of damage in capital and utility lifelines and their recovery scenario. The proposed framework will be applied to economic impact assessment of the 2004 Niigata Chuetsu earthquake and overall economic impact of the earthquake will be calculated.