

Using Virtual Laboratories for disaster analysis – A case study of Taiwan

Topic: Disaster Analysis

Author: Futu FATURAY

Co-Authors: Ya-yen SUN, Arunima MALIK, Arne GESCHKE, Manfred LENZEN

Due to its geographic location, Taiwan frequently experiences severe natural disasters earthquakes and typhoons that significantly interrupt business operations and subsequently cause extensive financial losses. Currently, there is a lack of extensive and detail assessment of natural disasters in Taiwan, while its importance cannot be overemphasized due to the high occurrence rate, tremendous loss and high uncertainty. The importance to understand the inter-sectoral influences in the disaster context is especially critical. The direct loss is generally easily observed and the business is greatly subsidized by governments, while in contrast the indirect losses by sectors and by regions also require public assistances and policy attention, which can only be revealed through the equilibrium analysis. Hsu et al. 2013, for example, estimated the earthquake vulnerability of hi-tech manufacturing in Taiwan, however their study lacked the economic loss assessment resulting from supply-chain interruptions.

In this study, we reveal the direct and indirect value-added impacts resulting from four selected natural disasters in Taiwan: the 1999 Chichi earthquake, the 2016 Tainan earthquake, the 2009 typhoon Morakot, and the 2016 typhoon Megi. We conduct our assessment in the new TaiwanLab, a collaborative virtual laboratory that is capable of generating a time-series of sub-national multi-region input-output (MRIO) tables, capturing inter-regional transactions between 267 sectors across Taiwan's 22 cities-counties. We use the method proposed by Steenge and Bořkarjova 2007 to study post-disaster consumption possibilities resulting from four selected disasters that hit Taiwan between 1999 and 2016. This method requires as an input information about reductions in production resulting directly from a disaster, such as damages to public facilities, agriculture, manufacturing sites, and utilities. This information is assembled in the so-called event matrix that quantifies the relative loss in total output by specific region and sector.

Using the Taiwan MRIO database, we have revealed the economic impacts of four selected natural disasters in Taiwan, in particular resulting from business and public facility damages, as well as supply-chain interruptions – two areas that researchers found difficult to model in the past. The Taiwan MRIO database is able to serve as a fundamental model for disaster impact assessment. Through the understanding of regional economic distribution, sectoral contribution, and inter-regional supply-chain flow, the Taiwan MRIO database provides a comprehensive picture of Taiwan's regional economic structure, and how the interconnections within it expose it to natural disasters. We, therefore, are able to identify critical economic sectors in regions of high vulnerability to natural disasters. Our assessment provides a credible reference to decision-making in determining regional and sectoral prioritisation for damage prevention and economic recovery plans.