

# Economic Losses from Long-Term Demand Shocks Caused by Multiple Large-Scale Natural Disasters: Evidence from Japan

Topic: Input-Output Analysis: Disaster analysis

Author: Nao Maeda

Co-Authors: Aoi Tsukioka, Shigemi KAGAWA, Yusuke Oga

Japan is one of the most disaster-prone countries in the world, accounting for 20% of global occurrences of earthquakes with a magnitude of 6.0 or greater, as well as a substantial share of global economic losses from natural disasters. In recent decades, large-scale exogenous shocks—including the 2011 Great East Japan Earthquake, the 2016 Kumamoto Earthquake, and the COVID-19 pandemic in 2020—have had profound impacts on the Japanese economy. These events not only damaged capital stocks and imposed supply constraints but also reduced final demand through declines in inbound tourism, thereby generating substantial ripple effects throughout the economy via inter-industry linkages.

Regional economies in disaster-prone countries such as Japan have suffered considerable damage over the past decade, resulting in large economic losses. Accurately assessing these impacts and understanding the magnitude of lost economic value are essential for designing effective disaster recovery and resilience policies.

The purpose of this study is to evaluate the economic ripple effects of multiple large-scale natural disasters and the pandemic on regional economies through changes in tourism demand, using Japan's input-output tables. By comparing the magnitude and structural characteristics of these impacts from a long-term perspective, this study examines how each disaster affects regional economic systems. The analysis focuses on changes in tourism demand as an exogenous shock and estimates induced production under the input structures prevailing during each disaster period. This approach enables an examination of how demand-side shocks caused by natural disasters and evolving industrial structures jointly determine differences in economic ripple effects.

The analysis uses Japan's linked input-output tables for 2005, 2010, 2015, and 2020, the latest available linked dataset. These tables were converted to 2020 constant prices and adjusted using the GRAS method to ensure intertemporal consistency. The dataset provides high-resolution coverage with 368 sectors and allows analysis using input-output data that closely correspond to the years of the major disasters examined in this study. Final demand vectors were constructed using data from the Survey of Foreign Visitors' Consumption in Japan, incorporating inbound tourism expenditures for the disaster years 2005, 2011, 2016, and 2020.

Tourism expenditure items were allocated to corresponding input-output sectors based on sectoral output shares, creating final demand vectors in which only tourism-related sectors have nonzero values. Using these datasets, the study estimates production induced by inbound tourism demand based on a Leontief demand-driven input-output model. By comparing induced production across study years between 2005 and 2020, the impacts of tourism demand shocks caused by natural disasters on domestic production are identified.

The results indicate that inbound tourism consumption declined substantially during the Great East Japan Earthquake and the COVID-19 pandemic, falling by approximately 50% compared with the non-disaster benchmark year of 2005. In contrast, no significant nationwide decline was observed during the Kumamoto Earthquake period, and tourism demand showed signs of recovery.

When comparing induced production across the entire Japanese economy, total induced production

declined by approximately 6% during the Great East Japan Earthquake period, whereas the decline during the COVID-19 period was about 3%. Despite the larger reduction in tourism consumption during the COVID-19 period, the overall economic loss was smaller than that observed following the Great East Japan Earthquake. These findings suggest that differences in industrial linkage structures, in addition to the magnitude of demand shocks, play a crucial role in determining the extent of economic ripple effects caused by natural disasters on regional economies.

This study demonstrates that the economic impacts of large-scale natural disasters cannot be explained solely by the scale of demand contraction but are shaped by interactions with the prevailing industrial linkage structure at the time of the shock. Even when demand shocks are similar in magnitude—or larger—their economic ripple effects may differ depending on the underlying industrial structure. By focusing on tourism demand shocks induced by natural disasters while accounting for structural changes in Japan’s inter-industry linkages, this study provides novel insights into the mechanisms through which natural disasters propagate throughout the economy from a long-term perspective. In a country where natural disasters are inevitable, such as Japan, quantitatively understanding these structural economic impacts is essential for assessing economic resilience and informing policy design to prepare for future disaster risks.