

## Title

An Assessment of Nuclear Power Shutdown in Japan Using the Computable General Equilibrium Model

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## Abstract

The accident at the Fukushima Daiichi nuclear power station has made it difficult for the government to give permission to allow the idle nuclear power reactors to resume activity after their scheduled inspection. Japan might have to balance its electricity supply and demand with zero or very few operating nuclear power reactors in 2013. In that case, the gap between electricity supply and demand would have to be closed using high-cost fossil fuel power generation.

The purpose of this study is to assess the economy-wide impacts of total nuclear power shutdown in Japan using a multi-regional, multi-sectoral, static computable general equilibrium model. The model in this study divides Japan into 8 regions (i.e., Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku, Shikoku, and Kyushu). Kanto, Chubu, and, Kinki include Tokyo, Nagoya, and Osaka respectively. There are 18 production sectors in each region, including the electricity sector. Electricity is generated by four distinct generation technologies (i.e., nuclear, fossil fuels, hydro, and renewables) in the model. Production sectors trade their products with each other within their region and across regions. They can also import and export their products to foreign countries. A representative household and a local government exist in each region and serve as the final consumers. The central government exists only to transfer tax revenue levied from all production sectors and households to the latter. All goods markets are assumed to be perfectly competitive, such that demand equals supply and zero profits are earned. The model assumes that production sectors and households emit carbon dioxide (CO<sub>2</sub>) with the combustion of fossil fuels, petroleum and coal products, and gas-based products.

The results of this study indicate that immediate total nuclear power shutdown in Japan would have a considerable negative impact on the country's economy and carbon

dioxide emissions. Based on the simulation, total nuclear power shutdown could decrease Japan's real GDP by 0.60–2.14%. On average, Japan has maintained a real GDP growth of about 1% between 1990 and 2010. Considering the average growth, the simulation result concerning the change in the real GDP is considerable. From the viewpoint of the regional economy, the result indicates that the economic impacts would differ among the regions depending on their nuclear dependency. Differences in electricity prices among regions might accelerate the increase in regional economic disparity in the long term. From an environmental point of view, total nuclear power shutdown could increase Japan's CO<sub>2</sub> emissions by 19.5–21.7% due to the energy switching the production sectors would be forced to undertake as well as the resulting increase in fossil fuel-based power supply. Power generation using nuclear power was an important option to reduce CO<sub>2</sub> emissions for Japan. There is little doubt though that Japan's nuclear power dependency will decrease in the future. In order to reduce CO<sub>2</sub> emissions, the power source share of renewables such as photovoltaic solar power, wind energy, and geothermal power generation, would have to be increased.

Keywords: Nuclear power shutdown, Japan, CGE model