The Economic and CO_2 Emission Effects of Japan's Denuclearization and Renewable Energy Promotion after the Tohoku-Pacific Ocean Earthquake

— Some Implications resulted from the Integrated Model of Multi-sectoral Macroeconomy and Energy —

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Keywords Multi-sectoral Macroeconomic and Energy Model, Denuclearization, Renewable Energy Promotion, Model Simulation, Economic and CO_2 Emission Effects.

Abstract This paper assesses the economic and CO_2 emission effects of Japan's denuclearization and renewable energy promotion after the Tohoku-Pacific Ocean Earthquake. Our analysis is based on a disequilibrium dynamic model, the MSME model that is an integrated model of multi-sectoral macroeconomy and energy shown in Table 1, and some model simulation outputs of the economic and CO_2 emission effects under some alternative scenarios that could be taken by the government's policy after the Earthquake.

As the government is investigating the way to reduce Japan's dependency on nuclear power by promoting alternative energy sources in the short term, the simulation period is set to be from 2011 to 2020. And we set the key assumptions of the simulation as shown in Table 2. The BaU case is assumed that the number of nuclear power plants in operation would be fixed with the level as of September 2011. In our model simulation, eight cases are set up by various combinations of the number of nuclear power plants and alternative energy sources to be balanced between Japan's electricity demand and supply.

Based on our model simulation outputs, we examine the impacts of increase in the electricity prices by the substitution for nuclear power and by renewable energy introduction not only on macroeconomic variables, but also on CO_2 emission, energy consumption and production amounts by 19 industrial sectors. In addition, we evaluate the effect of production inducement by the introduction of renewable energy, and the its impact on each industrial sector.

Table 1 : Outline of the Integrated Model of Multi-sectoral Macroeconomy and Energy

Area	Japan
Time period	Estimation period：From 1991 to 2008(18 years) in annual data
Model scale	Number of equations：902
Macroeconomic model (including IO model)	・Combination of commodity×commodity(SNAIO) and industry×industry(SNA) ・Industry classifications are as follows; 1.Agriculture, forestry and fisheries, 2.Mining , 3.Food , 4.Textiles, 5.Pulp, paper and wooden products, 6.Chemical products, 7.Petroleum refinery and coal, 8.Ceramic, stone and clay products, 9.Iron, steel and metal, 10.Metal products and machinery, 11.Transport machinery, 12.Miscellaneous manufacturing products, 13.Construction, 14.Electric power, gas supply and steam and hot water supply, 15.Trade, 16.Communication, 17.Service, 18.General government, 19.Private non-profit organizations serving household
Classification of energy consumption (Energy model)	Industry classification：13 classifications listed in the Comprehensive Energy Statistics Transport classification：9 classifications listed in the Comprehensive Energy Statistics Household and service classification：10 classifications listed in the EDMC Handbook of Energy & Economic Statistics in Japan
Exogenous variables	Government expenditure, World trade amount, Import prices of energy, Tax ratio, etc.
Endogenous variables	CO_2 emission, GDP, Production value, Number of employees, Energy consumption, etc.

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Table 2: Key assumptions of the simulation

Case	Key assumptions	Alternative energy for nuclear power generation	
A1(BaU)	The number of nuclear power plants in operation decreases annually at the rate of x %.	Thermal power generation (its component ratio of the total thermal power generation is fixed with the level in 2010).	
A2		Renewable energy introduction (Solar and wind power)	Introduction amounts increase linearly.
A3			Introduction amounts increase in the learning curve.
A4			Large scale introduction by the government in the short term
B1	The number of nuclear power plants in operation is fixed with the level as of September 2011.	Thermal power generation (its component ratio of the total thermal power generation is fixed with the level in 2010).	
B2		Renewable energy introduction (Solar and wind power)	Introduction amounts increase linearly.
B3			Introduction amounts increase in the learning curve.
B4			Large scale introduction by the government in the short term

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