

PRIMARY ENERGY PRICE SHOCKS AND THEIR IMPACTS ON AICHI PREFECTURE'S ECONOMY

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1. Introduction

Primary energy, especially oil represents one of the most important macroeconomic factors in the world economy and the crude oil market is the largest commodity market in the world. Japan had previously relied on nuclear power to meet about one fourth of its electricity needs, however, after the 2011 Fukushima Daiichi nuclear disaster all nuclear reactors have been progressively shut down for safety concerns. In the wake of the Fukushima nuclear incident, Japan's energy fuel mix shifted as natural gas, oil and renewable energy now provide larger shares and supplant some of the nuclear fuel¹⁾.

Japan, ranked as the world's largest liquefied natural gas importer, the second largest coal importer and the third largest net importer of crude oil and oil products, changes in primary energy prices will definitely make a strong impact on Japan's economy. Here, Aichi prefecture being one of the largest commercial centres in Japan, plays a pivotal role in the future of Japan's economic situation. Taking these backgrounds into account, this study aims to apply a Computable General Equilibrium (CGE) model²⁾ to evaluate the economic impacts and how economic growth can be affected by changes in primary energy prices taking Aichi prefecture in Japan as a study region.

2. CGE Analysis

2.1 Industry Classification

The underlying approach of this study is a CGE model. In our model, the economic agents are households, industries (Table 1), the government and the external sector. 35 markets are considered. They are 33 commodity markets, one labor market and one capital market. These are assumed to be perfectly competitive and in equilibrium in 2005.

2.2 Structure of Model

The industries use intermediate inputs, labor and capital to produce goods. Industries have the Cobb-Douglas technology with respect to labor and capital inputs, and Leontief technology for intermediate inputs. Each firm is assumed to maximize the profit, however cost minimization is considered due to the linear homogeneity of degree one in firm's technology.

3. Simulation Cases

This study considers 2 scenarios and they are compared with base case.

- (1) Base case: import price of mining, coal & petroleum are fixed at 1
- (2) Case 1: import price of mining, coal & petroleum are increased by 50%
- (3) Case 2: import price of mining, coal & petroleum are decreased by 50%

4. Results and Analysis

4.1 Industrial Output

Figure 2 shows the changes in industrial outputs of all the 33 sectors in Aichi prefecture. About 3% increment can be found in the total industrial output of Aichi prefecture in Case 1 and about 3% decrement in Case 2. In mining and coal & petroleum sectors, around 46% and 16% increment can be found when the price of the primary energy is increased by 50%. This is because when the price of primary energy goes up, less import will be made from overseas and therefore leads to higher production in mining and coal & petroleum sectors in Aichi prefecture. Approximately 7% of changes can be seen in gasoline vehicle sector which is highly related to the petroleum sector in both cases. On the other hand, negative results can be found in agriculture, forestry, fishery, electric, gas & heat supply and real estate sectors in Case 1. This can be explained by the fact that producers in Aichi prefecture were affected by higher producing price that came from an increase in primary energy price such as oil and petroleum, and therefore leads to lower industrial output.

Table 1 Classification of Industries

Industries			
1	Agriculture	18	Information & Communication Electronic
2	Forestry	19	Electronic Component
3	Fishery	20	Gasoline Vehicle
4	Mining	21	Aircraft
5	Food & Beverage	22	Other Transportation Equipment
6	Textile Product	23	Precision Equipment
7	Pulp, Paper & Wooden Product	24	Other Manufacturing Industrial Product
8	Chemical Product	25	Construction
9	Coal & Petroleum Product	26	Electricity, Gas & Heat Supply
10	Plastic Product	27	Water Supply & Sanitary Service
11	Ceramic	28	Commerce
12	Stone & Clay Product	29	Finance & Insurance
13	Iron & Steel Product	30	Real Estate
14	Non-ferrous Metal	31	Transportation
15	Metal Product	32	Telecommunication & Broadcasting
16	General Machinery	33	Service
17	Electrical Machinery		

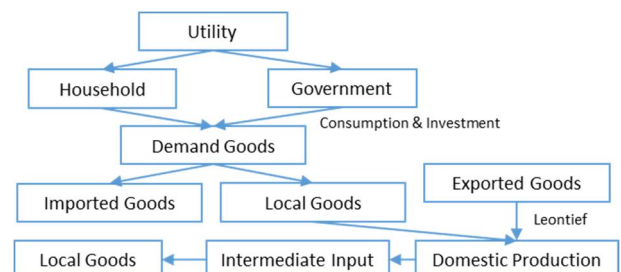


Figure 1 Hierarchical Structure of CGE Model

4.2 Real Import

Figure 3 shows the changes in real import volume in Aichi prefecture. As depicted in Figure 3, the total real import did not change significantly, exhibiting an increment of 4.3% in Case 1 and a decrement of 3.2% in Case 2. Regarding the coal & petroleum sector, in Case 1, where the price of primary energy is 50% higher, it actually reduced the real import of coal & petroleum product into Aichi prefecture by 10.4%. However, the volume of real import in Aichi prefecture surged up to 33.3% when the price of primary energy is cut into half. Besides coal & petroleum sector, another sector that marked a huge changes in terms of real import volume is electricity, gas & heat supply sector. The import volume of electricity, gas & heat supply sector increased by 5.3% in Case 1 and decreased by 5.0% in Case 2.

4.3 Other Variables

Other variables of Aichi prefecture is depicted in Figure 4. As shown in the graph, the external sector's saving has the biggest changes, around 7.2% in both cases. In Case 1, when the import price of primary energy is higher compared to the base case, much more money is spent on it and hence, there is a decrease in external sector's saving. Nevertheless, regarding the government sector, in Case 1, increases in direct and indirect tax, 1% and 5% respectively, result in an increase in government revenue, government consumption as well as government saving. In addition, household income goes up when current transfers from the government to households increase resulting from an increase in government revenue. In addition, about 1.7% of increment can also be seen in current transfers from the government to the external sector and government saving as a results of increase in primary energy prices by 50%. Last but not least, the positive result in equivalent variation shown in Figure 4 indicates that economic welfare of Aichi prefecture actually grows when the price of primary energy goes down in Case 2.

5. Summary

Based on the results obtained, we can conclude that:

- (1) Total industrial output of all the 33 sectors in Aichi prefecture increases by 3% in Case 1 where the price of primary energy increase by 50%.
- (2) Mining and coal & petroleum sector see a huge increment of 46% and 16% respectively in terms of industrial output in Case 1 due to less import made by the producer.
- (3) Real import of coal & petroleum sector decreases by 10.4% in Case 1 and increases by 33.3% in Case 2.
- (4) External sector's saving has the biggest changes, around 7.2% in both cases.
- (5) Increase in primary energy prices leads to an increase in government revenue as well as household income.
- (6) Economic welfare of Aichi prefecture grows when the price of primary energy goes down as shown in Figure 4.

References

- 1) IEA (International Energy Agency), 2013 World Energy Outlook, Japan, 2) J.B.Shoven and J.Whalley, Applying General Equilibrium, Cambridge Survey of Economic Literature, 2007, Cambridge University Press

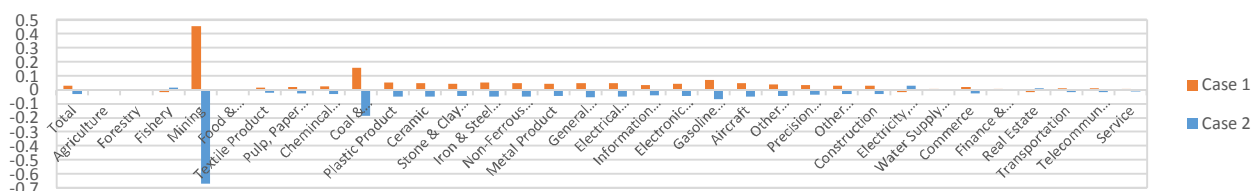


Figure 2 Changes in Industrial Output

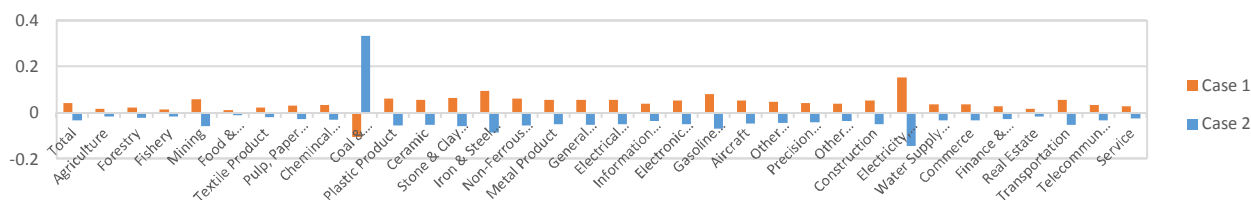


Figure 3 Changes in Real Import

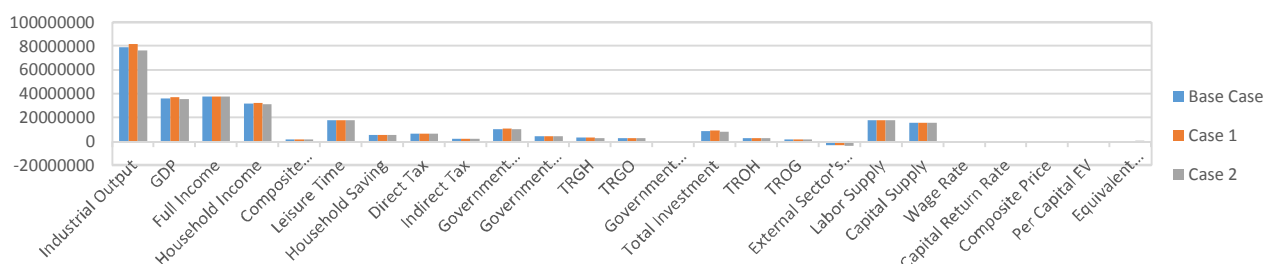


Figure 4 Other Variables