Japan-Korea-China E3 Econometric Simulation of CDM through FDI: Energy Saving Investment of Japanese Firms in China

Mitsuo YAMADA[1] [2]
Chukyo University, Nagoya, Japan

1 Introduction

East Asian counties and regions with rapid economic growth after 1980's were called as "growth center of the world." Foreign direct investment and overseas production of the corporations from the developed countries including Japan has taken an important role in this economic development. After taking the open policy in 1978, China started to introduce the market mechanism in its economy, and began to utilize the foreign direct investment (FDI) to develop the economy. Actually Chinese economy has been keeping over 10 percent growth rate every year after 1990. The US and European countries have been investing in China because of the huge potential market. Many companies from Japan and Korea also are trying to enter into the Chinese market. As a result, the amount of trade among the three countries, Japan, Korea, and China, has been also growing.

In relation to the global environmental problem, to attain the official goal of the Kyoto Protocol (KP) for 2008-2012 periods, Japan has to make more effort in energy-saving measures[3] . Furthermore, the international negotiation about the new goal after the KP has started in IPCC and others. The developed countries including Japan have to keep the leading position to build a new framework including not-ratifying countries of the KP but also developing countries like China and India.

To solve the trade-off between the economic development and reducing CO_2 emission, improvement of the energy efficiency is one of the most important issues for China. How do they obtain the technology and fund for this purpose? Clean Development Mechanism, the corporative

[1] Professor, Department of Economics, Chukyo University,
email: yamada@mecl.chukyo-u.ac.jp,
address: 101-2, Yagoto-honmachi, Showa-ku, Nagoya City, 466-8666, Japan.
[2] This paper is for the presentation in the 17th Northeast Asia Economic Forum to be held in Tianjin, China on 26th-29th October 2008.
[3] Not only the voluntary energy saving activities of the Nippon Keidanren, but also usage of Kyoto Mechanism (JI, CDM, ET) and introduction of Carbon Tax are considered.

relations on economy and environment in government base, and private energy saving activities through foreign direct investment are considered as the possible channels of technology transfer from developed countries.

Because Korean domestic market is not as large as those of Japan and China, international trade and FDI are important for the development of Korea. Korea has interest in incubation of companies that have strong competitiveness in the international market. Textile industry became the leading industry at first, then Iron and steel, Chemical, Electronic machinery, and Transport equipment follows thereafter. Concentrating the resource into these industries to keep the comparative advantage has been an important measure for the economic development of Korea. Effective cooperation with Japan and China is also required.

Because the economies of Japan, Korea, and China are becoming strongly connected through international trade and FDI, policy measures of each country have affects not only own economy but also the other economies. Especially FDI from Japan and Korea affects not only the development of Chinese economies but also their own industries in the home countries through intra-industry trade. Recently FDI is expected as one of the important channels to introduce energy-saving technology into China.

In this paper, we develop an E3 multi-regional and multi-sectoral econometric model that links Japan, Korea, and China, and analyzes the effect of energy saving investment of Japanese companies in China by simulation technique.

2. Comparison of the Three Economies, Japan, Korea, and China

Here we compare the economies of three countries, Japan, Korea, and China. Table 1 shows the main socio-economic indices of three counties in 2003. The Population of China is 10.09 times larger than that of Japan. The population of Korea is 0.37 times smaller than that of Japan. Real GDP of China is 0.33 times smaller than that of Japan, and Korean real GDP is 0.12 times smaller than Japanese one. Then for the real GDP per capita, China is 0.03 times smaller than Japan, and Korea is 0.33 times smaller than Japan. Comparing the scale of real GDP, China has one-third of Japan, though China has one-thirtieth of Japan for per capita GDP because of huge population. Korea has attained economic development with smaller population comparing with Japan, and then

the GDP has become one-third of Japan for per capita base.

Figure 1 and Figure 2 show the real GDP in dollar and per capita real GDP in dollar after 1980 respectively. Looking these figures, we find that the continuous economic growth after 1990 in China and the catch up process of Korean economy.

For the consumption of primary energy, China consumes 2.68 times more than Japan, and Korea consumes 0.40 times of Japan. The CO_2 emission of China is 3.37 times larger than that of Japan, and that of Korea is 0.37 times of Japan. We can observe large amount of energy consumption and CO_2 emission in China, though per capita consumption in China is 0.27 times of Japan. Per capita CO2 emission in China is 0.33 times that of Japan. Per capita consumption in Korea is 1.07 times, almost same as that in Japan, and per capita CO_2 emission is 0.99 times of Japan.

Figure 3 shows the consumptions of the primary energy for three countries. The economic development in China induces the enlargement in the consumption of primary energy, especially in recent years. Figure 4 shows the trend of the CO_2 emissions. Increased energy consumption in China brings essentially the augment in the CO_2 emission[4] . Figure 5 and Figure 6 show per capita energy consumption and per capita CO_2 emission respectively. Korea economic structure has become similar to that of Japan in both per capita energy consumption and per capita CO_2 emission. This means that Korea has developed to have the same energy structure like Japan. On the other hand, though per capita energy consumption in China is growing, its level remains still lower than both countries.

In term of energy consumption per real GDP, China consumes 8.17 times of Japan in 2003, and Korea 3.25 times of Japan. CO_2 emission per real GDP in China is 10.28 times more than that in Japan. Korea emission is 3.01 times of Japan. Though the amounts of energy consumption per capita and CO_2 emission per capita are almost same as those of Japan, the amounts per real GDP are three times more than those of Japan. In this sense, the energy efficiency in Korea is still worse than that in Japan, which is brought the difference in the industrial structure of Japan and Korea.

Though the energy consumption per capita in China amounts one-third of that in Japan,

[4] We can observe the sudden decline in the CO2 emission for five years after 1995 and rapid recovery in the CO2 emission after that, though the energy consumption maintained relatively smoothing growth. Here some statistical problems might be included.

the volume per real GDP in China is eight times more than that of Japan, which means that China is energy inefficient economy. Figure 7 and Figure 8 show energy consumption per real GDP and CO_2 emission per real GDP. These figures show that China has changed the efficiency of energy consumption in terms of real GDP in the process of the economic development, and as the result, CO_2 emission per real GDP has been improved sharply. However, the amount is still large comparing those of Japan and Korea, which means that there is large room to improve the energy efficiency in China.

Figure 9 shows the change of CO_2 emission per primary energy consumption. The amount of China is 20-30 percent larger than those of Japan and Korea, because China depends on coal resource more than the other two countries.

Figure 10-12 show the values of export, import, and net export, respectively, by 14 sectors for Japan, China, Korea, the other East Asia, and the US in 2000[5] . Japanese export is concentrated in mainly both electrical machinery and transport equipment. General machinery and chemical industry follows. In Korea, export of electrical machinery is the highest, and textile and transport equipment follows. For China, electrical machinery is the greatest export sector, almost same value as that of Korea. The export of textile industry in China is more than in Korea.

Import of electrical machinery and transport equipment in the US is the largest, and textile, chemical, mining, and miscellaneous manufacturing follows. The US offers the largest import market for the world. For the electrical machinery, Japan, China, Korea, and the other East Asia enjoy relatively large import demand of the US. We can observe the intra-industrial trade in the electrical machinery sector.

Figure 12 show the net export, which is reduced import from export. Japan is the net exporter in general machinery, electrical machinery, and transport equipment. China, Korea and the other East Asia are also net exporter of electrical machinery. In China, textile and miscellaneous manufacturing, which includes plastic products, are also net export sector.

Table 2 gives the trend of FDI in IMF base. In the world total investment, the amount from US is the largest, its share is about 35 percent of the total investment in 2004. EU takes the second position, having 20.9 percent share. The investment from Japan amounts to 10-20 percent from 1985 to 1990, though recently 4-5 percent. Table 3 shows the FDI by countries in 2004; 36.5

[5] These values are from the 2000 Asian International Input-output Table by Institute of Developing Economies.

percent of the Japanese foreign investment is to EU, 13.2 percent to the US, 12.8 percent to China, 2.4 percent to Korea, 1.3 percent to Chinese Taipei, and 8.0 percent to the other Asia. Recently the investment from Japan to China has enlarged. Table 4 shows the acceptance of FDI in China. In the contract base in 2003, Hong Kong is the biggest, 35.4 percent of total FDI in China, Korea 8.0 percent, the US 5.8 percent, Japan 6.7 percent, Chinese Taipei 7.4 percent, and EU 5.1 percent. In actual inflow base, the share of Japanese investment is a little bit more, 7-9 percent of the total.

In this paper, we have interest in the overseas activities of Japanese company in East Asian region, especially in China. Recently Japanese companies have tendency to make energy-saving investment in East Asian region as a CDM project to acquire some certification of CO_2 emission. We would like to evaluate the effects on the concerned country and the other countries that have some international division of labor.

After 1985, many Japanese companies started overseas expansion. Recently one-third of Japanese FDI is implemented in East Asian region. As a new tendency, they introduce energy-saving technology in their overseas factories and save energy consumption there, to acquire the certification of CO_2 emission.

For example Panasonic Corporation implemented an energy-saving CDM project for 10 electrical machinery factories in Malaysia, to acquire certification of 8,100 ton per year for next ten years. They have a plan to make similar CDM project in China, to acquire 5000 ton per year, which is equivalent to 2.5 percent of CO2 emission in all their factories in Japan.

Japanese companies have such tendency to make energy-saving investment not in the domestic factories but overseas factories to acquire CO_2 emission right. This is because obtaining CO_2 emission right from their own overseas factories is cheaper than from domestic factories. In addition, such energy-saving investment becomes to be permitted as CDM project, which gives incentive to the application. For Chinese economy, such CDM project is recognized as one of the most important measures to overcome the trade-off problem of economic development and environmental improvement.

Japanese companies have been competing with Korean companies in the international market of electrical machinery sector. However, recent international network system of production brings cross intra-industry trade between Japan, Korea, and China. Such CDM project in China has some economic impacts on the production system not only in China but also in Japan and Korea,

which we would like to evaluate by our econometric model.

3. Structure of the model

Our model KY-MERIT-E3[6] is a multi-countries and multi-sectoral econometric model that links Japan, Korea, and China with an international trade flow sub-model. Each country sub-model has two characteristics; one is a multi-sectoral econometric model that integrates macro econometric model and input-output model, and the other is an economy-energy-environment (so called E3) model that covers not only variables of the economy but also variables with respect to energy and environment. In each country model, each variable is constructed from 21 sectors. Figure 13 show the flow chart of the model, which presents rough sketch of the model structure.

The basic structure of the country model is written in Yamada (2004). Here we explain the basic feature of Korea sub-model which is newly added. At first, because of data availability, Korea sub-model has not sectoral capital stock variables, which appears in Japan and China sub-models. So we can evaluate some demand effect of the new investment, though we cannot evaluate correctly the supply effect stemmed from the increase of the capital stock. Secondly, we can prepare sectoral employment data only after 1993, though almost other variables start from 1980. For this reason, the estimated equations for employment and wage rate by sector have relatively short sample periods, which restrict the specification of each equation. Thirdly, the structure in relation to the income distribution of SNA is simplified in our model. We explain the consumption function using the sum of compensation of the employee by sector. These aspects are remained for the future improvement.

The government expenditure multiplier of Korea sub-model is 1.81 for the first year, 2.46 for 7th year, in real term, and 2.05 for the first year, and 2.41 for 7th year with some declines at the intervals.

4. Simulation analysis and the results

[6] KY-MERIT-E3: Kinoshita-Yamada Multi-sectoral and Multi-regional Econometric Model for the Research on Industry and Trade – E3 version

In this section we conduct a simulation analysis assuming that some Japanese companies invest to settle energy-saving equipment in their own factories in China using CDM mechanism. Their main purpose is both saving the production cost and acquiring certification to CO_2 emission right. The more they shift the production factories to China, the more they could reduce CO_2 emission in Japan. For China, such FDI might become one of the important measures to introduce energy-saving technologies in its own county, because such investment reduces the demand of electricity.

Here we make the following assumptions for our simulation analysis[7] .

1) To shift one percent production of electrical machinery sector in China from Japan to China.
2) To improve energy efficiency of the added production and reduce electricity demand by 10 percent.

We investigate the effects on the economies of Japan, Korea, and China. Table 6 shows the effects on main variables; the differences the simulation values with the above assumptions from the referred simulation values. At first, in the simulation, Japanese companies of electrical machinery sector invest in China and expand their production by 1 percent amount of electrical machinery production in China. This expansion requires additional demands of intermediate input mainly in China. Textile and miscellaneous manufacturing product are induced, 0.121 percent and 0.218 percent in the 7th period respectively. Total product in China increases 0.12 percent in China, though agriculture, food, services reduces their own production. Thought the nominal GDP, in China, rises by 0.303 percent, the real GDP decreases by 0.160 percent, because of increase in GDP deflator by 0.5 percent.

The increase of production in electrical machinery sector induces demands in intermediate goods from abroad. Through the international trade, production in Japan and Korea is increased. This impact is stronger in Korea than in Japan. Though production of electrical machinery in Japan is shifted to China, it increases by 0.024 percent. The total production in Japan rises by 0.005 percent. Prices do not raise so much.

On the other hand, Japanese electrical machinery companies improve the electricity consumption in their own factories in China by 10 percent. Chinese final consumption of electricity

[7] Our simulation analysis focuses on the evaluation of both production shift of Japanese companies from Japan to China and their energy-saving investment, using an E3 econometric model linking Japan, Korea, and China. However, this time, we cannot include the effect through investment demand increase, because of lack of sufficient information on the cost of the investment, which we have to improve in the next research.

is saved by 0.041 percent, and primary energy supply is reduced by 0.05 percent, which brings the reduction in CO2 emission, 0.055 percent in the 7th period. In Japan and Korea, production increase, brought by their export increase, induces augment in energy consumption; both electricity consumption and primary energy consumption, though not so much volumes. This effect is bigger in Korea than in Japan. The reduction of Chinese energy consumption is larger than the sum of increase in Japanese and Korean energy consumption in value terms. So we expect that CO_2 emission of Japan, Korea, and China will be reduced as a whole.

5. Concluding Remarks

In China, production in electrical machinery sector is continuously increasing. In this sector, many foreign companies have invested, and Japanese companies are not exceptional. Recently, Japanese companies in this sector, try to invest in their own factories to improve energy-efficiency as CDM project. This project is expected to contribute to the energy-saving and reduction of CO_2 emission in China and other developing countries. However, their spillover effects to the other sectors might offset the above-mentioned positive effect.

Japanese electrical machinery companies might shift their production base to the developing countries like China to acquire the certification of CO_2 emission right. However, the production of this sector in the home country might increase because of augment in import demand in China. This brings one question whether both energy consumption and emission of CO_2 can be actually reduced or not. Here we evaluate the overall effects of CDM project, in which energy saving investment is implemented to acquire the certification of CO_2 emission right, including three economies of Japan, Korea, and China.

Though our E3 econometric model of Japan, Korea, and China might have some points to be improved, we conclude the followings from our simulation analysis. Even if the production shift from Japan to China is observed, total effect on the domestic production is enlarged, because import demand from China is larger than the original production reduction. The energy saving activities in electrical machinery sector in China brings the reduction in the energy consumption in the economy as a whole, so the reduction in CO_2 would be expected in China. The energy consumption in Japan and Korea might be increased a little bit, but not so large comparing the

reduction in China. Then we expect that the energy consumption in three counties would be reduced, which brings reduction in CO_2 emission in three countries, as a whole. This implies that there are some rooms for the concerned government to act cooperatively to promote such investments in the private sectors.

Reference

Ito, Kokichi, Yasuhiro Murota, et.al. (2000), “An Econometric Analysis of China and Korea using Long-term Macro Economic Model with Energy Balance”, Energy Economics, the Institute of Energy Economics, Japan, pp.1-15, (in Japanese).

Inoue, Toshihisa (2004), The Development of Korean Economy – An Input-Output Analysis, Nihon Tosho Suppankai, (in Japanese).

Kinoshita, Soshichi ed.,(1990), *Development and Structural Adjustment of Pan-Pacific Economies*, Nagoya University Press, (in Japanese).

Kinoshita, Soshichi ed.,(2002), *An Econometric Analysis of the Growth Pattern and Interdependence of East Asian Economies*, The International Centre of the East Asian Development, Working Paper Series Vol. 2002-14 (in Japanese).

Yamada, Mitsuo (2004) "Interdependence among Economy, Energy, and Environment in China: An Econometric Analysis 2000-2020," Institute of Economics, Chukyo University, Discussion Paper No.0311, March, p.28.

Yamada, Mitsuo (2006), “E3 Econometric Analysis of CDM and Technology Transfer between Japan and China”, Institute of Economics, Chukyo University, Discussion Paper No.0508, p.31, February.

Yamada, Mitsuo (2007), "Interdependence among Economy, Energy, and Environment in China: An Econometric Analysis 2000-2020" *The Journal of Econometric Study of Northeast Asia*, Economic Research Institute for Northeast Asia, Vol.6 No.1, pp.29-56, November 2007.

Table 1 Socio-economic Indices in Japan, Korea, and China in 2003

Variables	Unit	Japan	China	Korea
Population	Million Persons	127.7	1288.4	47.8
Nominal GDP	Billion US Dollar	4231.2	1641.0	608.1
Real GDP	Billion US Dollar in 2000 market prices	4756.8	1557.7	585.9
Primary Energy Consumption	Million OE-ton	516.1	1381.3	206.3
CO2 Emission	Million ton-CO2	1231.3	4143.5	455.9
Per capita Nominal GDP	US dollar per person	33129.1	1273.6	12709.7
Per capita Real GDP	US dollar in 2000 market prices per person	37243.8	1209.0	12245.2
Per capita Primary Energy Consumption	OE-Ton per person	4.0	1.1	4.3
Per capita CO2 Emission	Ton-CO2 per person	9.6	3.2	9.5
Primary Energy Consumption per Real GDP	OE-Ton per Thousand US dollar in 2000 market prices	0.108	0.887	0.352
CO2 Emission per Real GDP	Ton-CO2 per Thousand dollar in 2000 market prices	0.259	2.660	0.778
CO2 Emission per Primary Energy Consumption	Ton-CO2 per OE-Ton	2.4	3.0	2.2
Population	Ratio to Japan Value	1.00	10.09	0.37
Nominal GDP	〃	1.00	0.39	0.14
Real GDP	〃	1.00	0.33	0.12
Primary Energy Consumption	〃	1.00	2.68	0.40
CO2 Emission	〃	1.00	3.37	0.37
Per capita Nominal GDP	〃	1.00	0.04	0.38
Per capita Real GDP	〃	1.00	0.03	0.33
Per capita Primary Energy Consumption	〃	1.00	0.27	1.07
Per capita CO2 Emission	〃	1.00	0.33	0.99
Primary Energy Consumption per Real GDP	〃	1.00	8.17	3.25
CO2 Emission per Real GDP	〃	1.00	10.28	3.01
CO2 Emission per Primary Energy Consumption	〃	1.00	1.26	0.93

Data Source: World bank, WDI.

Figure 1

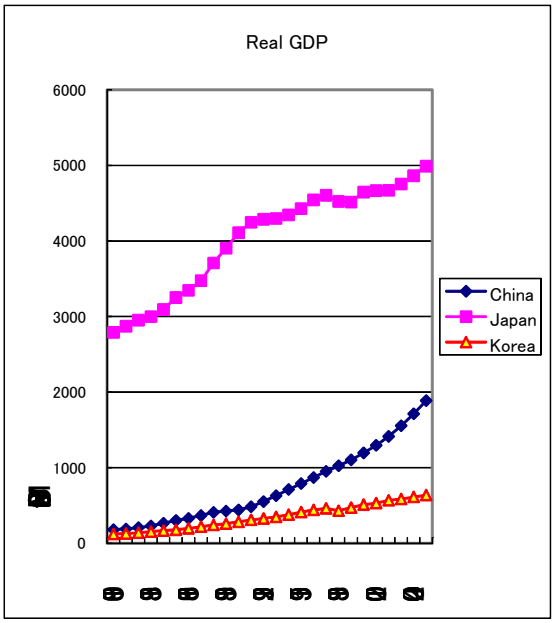

Figure2

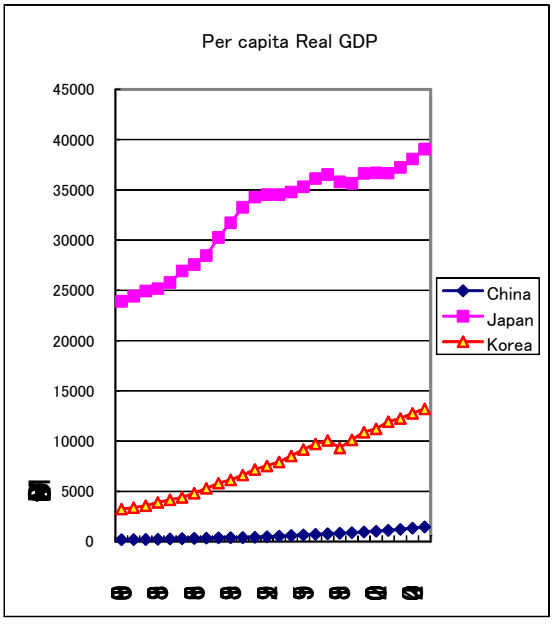

Figure 3

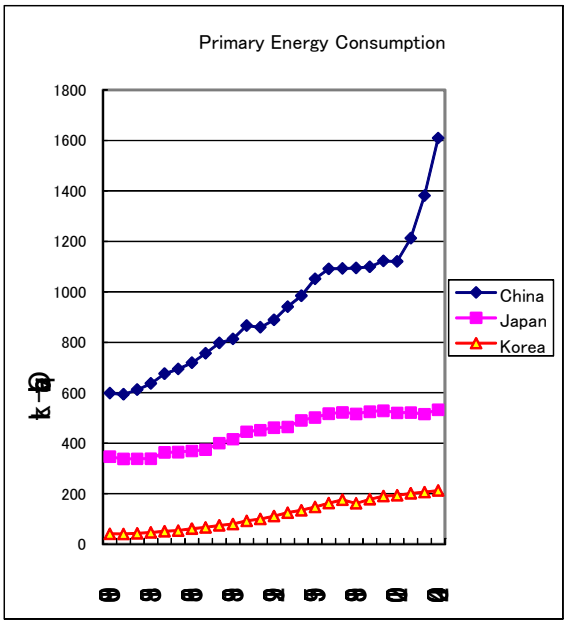

Figure 4

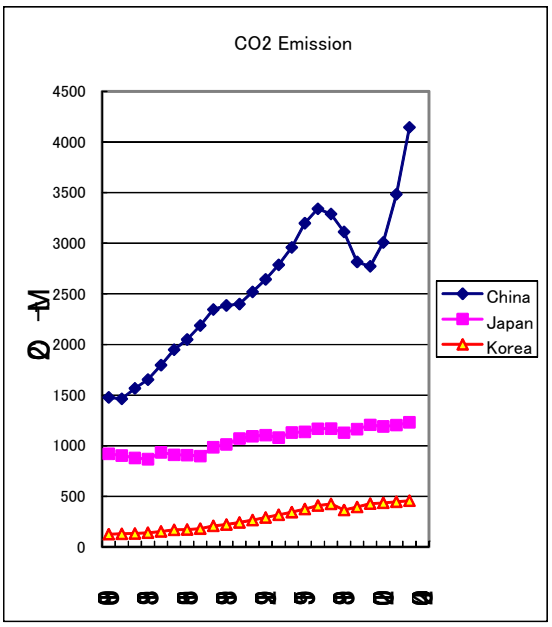

Figure 5

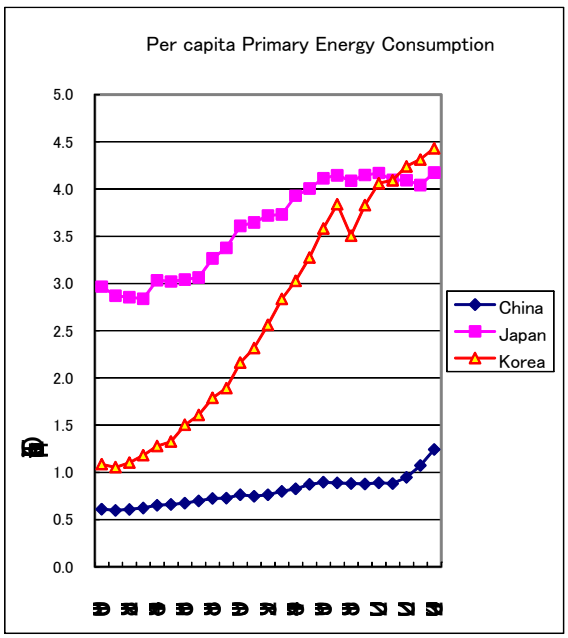

Figure 6

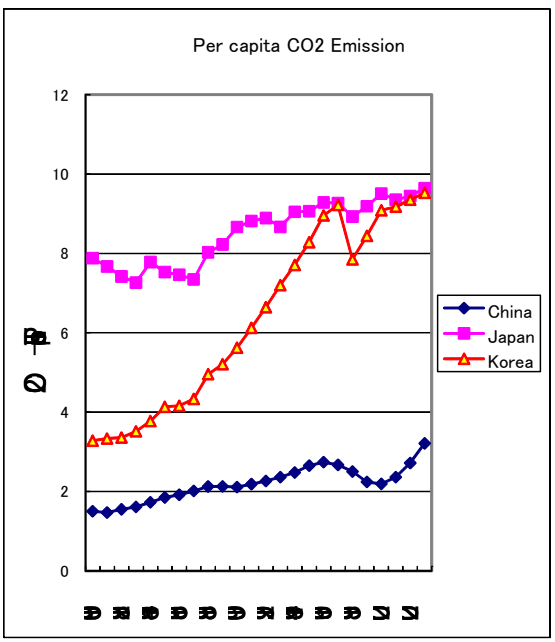

Figure 7

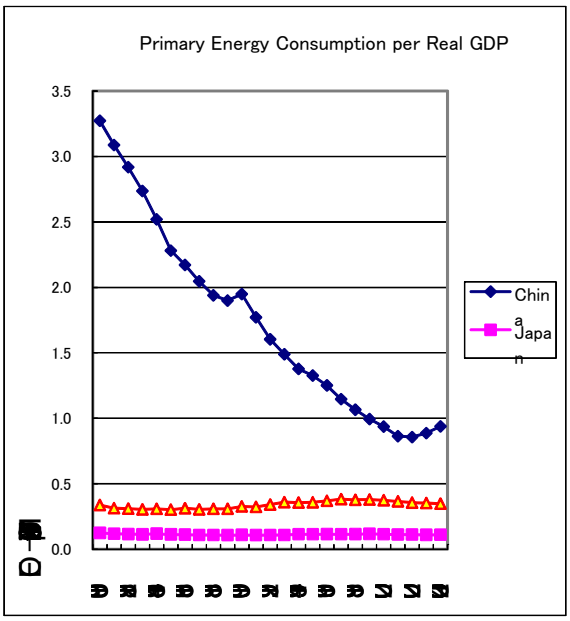

Figure 8

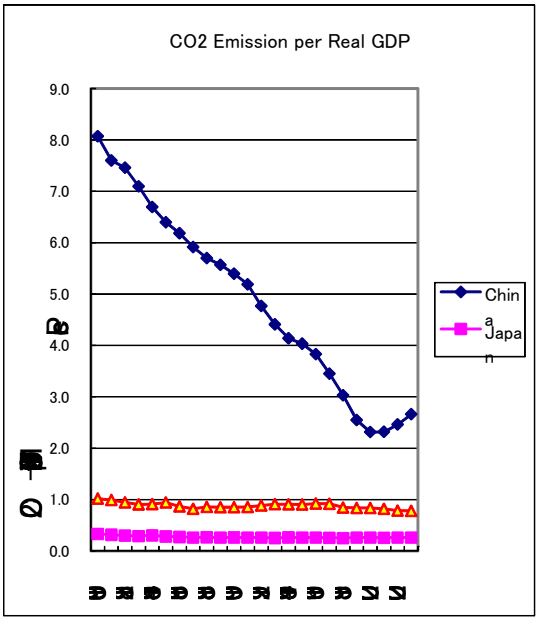

Figure 9

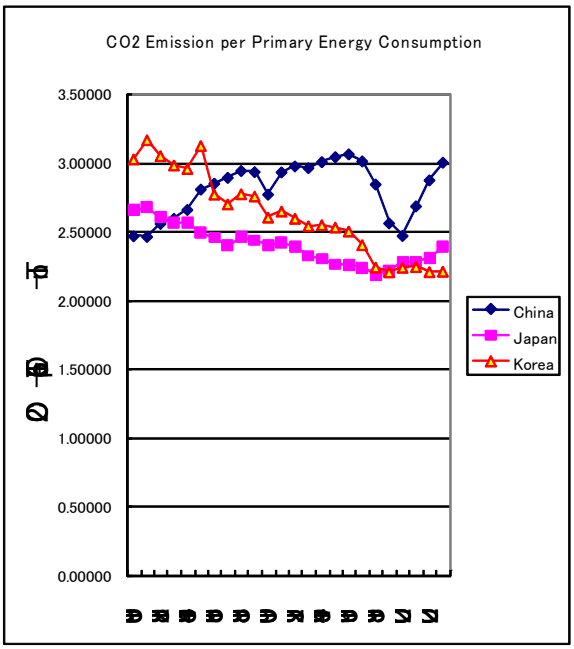

Figure 10

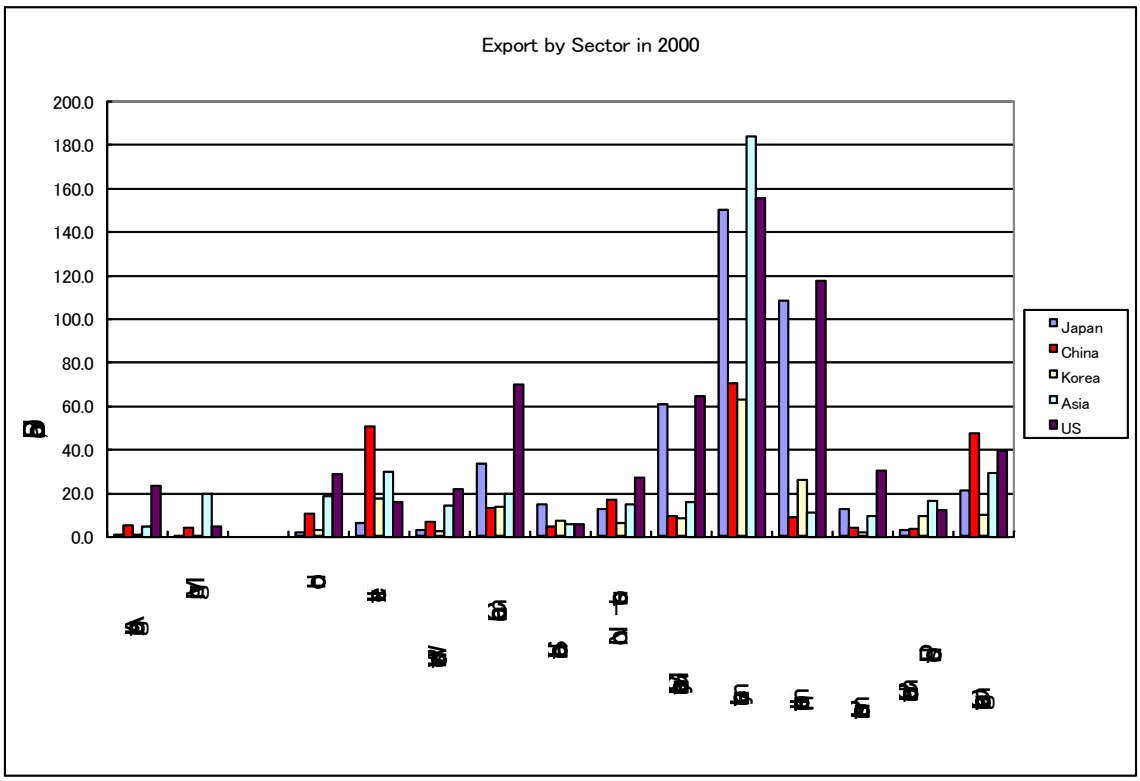

Figure 11

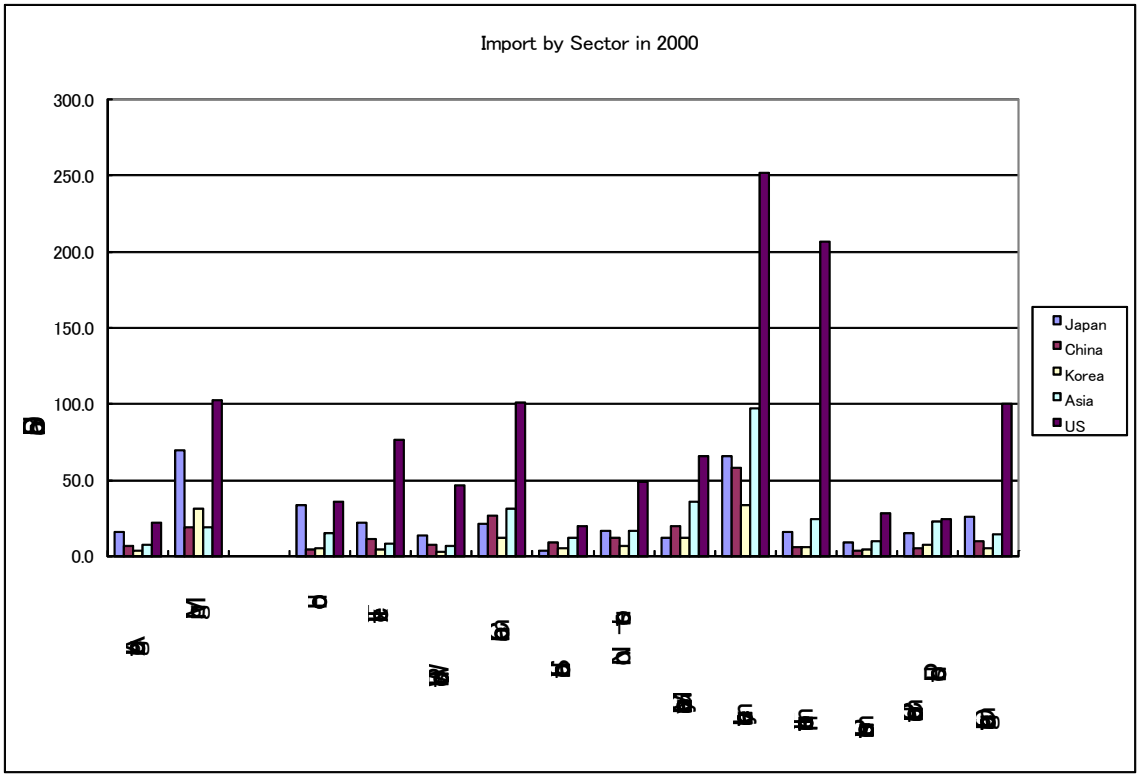
Import by Sector in 2000
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Japan
China
Korea
Asia
US

Figure 12

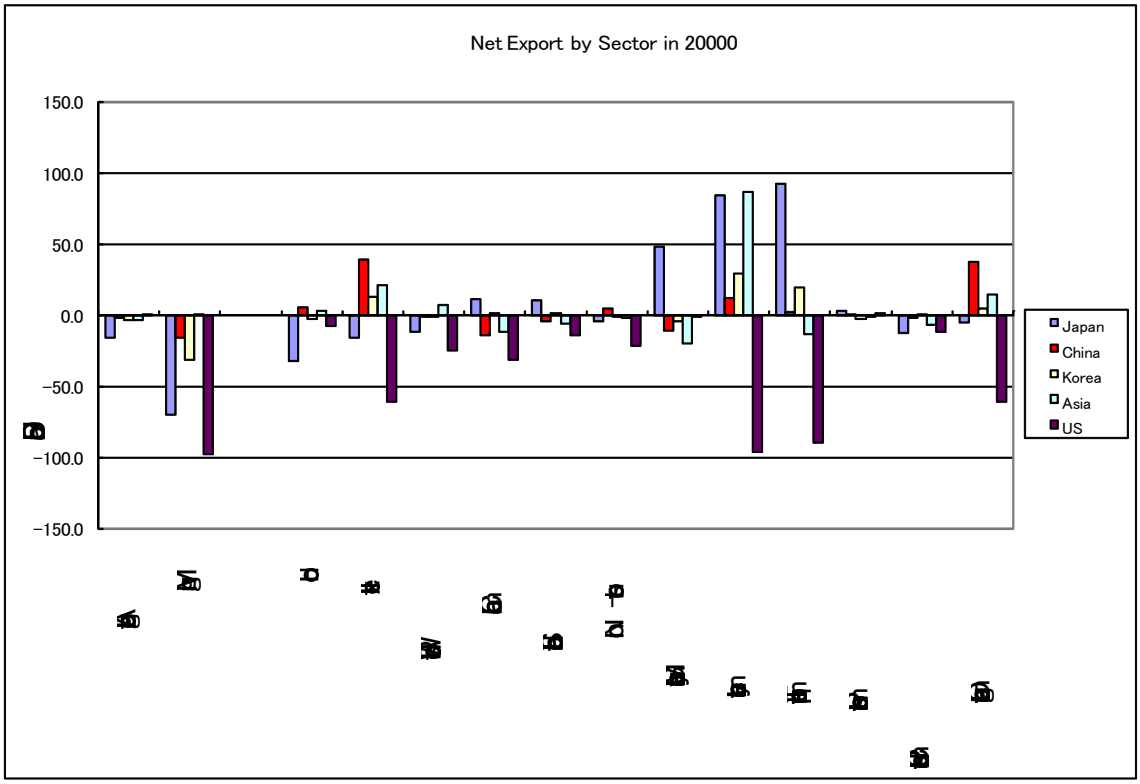
Net Export by Sector in 20000
150.0
100.0
50.0
0.0
−50.0
−100.0
−150.0
Japan
China
Korea
Asia
US

Table 2

IMF Foreign Direct Investment %, Mil.US$

(%)	1985	1990	1995	2000	2001	2002	2003	2004
Japan	10.7	20.6	6.7	2.4	4.7	5.0	4.5	4.4
China	1.0	0.3	0.6	0.1	0.8	0.4	0.0	
HongKong				4.5	1.4	2.8	0.9	5.7
Korea	1.0	0.4	1.1	0.4	0.3	0.4	0.5	0.7
Taipei	0.1	2.1	0.9	0.5	0.7	0.8	0.9	1.0
USA	23.2	15.2	29.6	12.0	17.3	21.3	27.1	35.5
EU				30.5	34.6	26.8	23.9	20.9
World	60578	245090	334191	1329387	823329	634347	642237	700885

Table 3

Japan's Foreign Direct Investment 100Mil. Yen

	1989	1990	1995	2000	2001	2002	2003	2004
China	0.6	0.6	8.7	2.1	4.5	4.8	8.7	12.8
HongKong	2.8	3.1	2.2	1.9	1.1	0.6	1.1	1.8
Korea	0.9	0.5	0.9	1.7	1.7	1.7	0.8	2.4
Taipei	0.7	0.8	0.9	1.0	1.0	1.0	0.4	1.3
Other Asia	7.1	7.4	11.3	5.6	12.2	7.3	6.7	8.0
USA	48.4	46.0	44.1	25.2	20.0	22.3	29.3	13.2
EU	21.8	25.1	16.7	49.9	32.8	41.9	35.0	36.5
World	90339	83527	49568	54193	40413	44930	40795	38210

Table 4

China's Foreign Direct Investment (Inflow) Contract Base %, Mil.US$

(%)	1985	1990	1995	2000	2001	2002	2003
Japan	7.4	6.9	8.3	5.9	7.8	6.4	6.9
HongKong	0.0	58.1	44.9	27.2	29.9	30.4	35.4
Korea	0.0	0.0	3.3	3.8	5.0	6.4	8.0
Taipei	0.0	0.0	6.4	6.5	10.0	8.1	7.4
USA	18.2	5.4	8.2	12.8	10.9	9.9	8.8
EU	0.0	0.0	0.0	0.0	7.4	5.4	5.1
World	6333.2	6596.1	91281.5	62379.5	69194.6	82768.3	115069.7

China Statistics of Foreign Invetstment and International Trade

China's Foreign Direct Investment (Inflow) Actual Base %, Mil.US$

(%)	1985	1990	1995	2000	2001	2002	2003
Japan	16.1	14.4	8.3	7.2	9.3	7.9	9.4
HongKong	0.0	53.9	53.5	38.1	35.7	33.9	33.1
Korea	0.0	0.0	2.8	3.7	4.6	5.2	8.4
Taipei	0.0	0.0	8.4	5.6	6.4	7.5	6.3
USA	18.3	13.1	8.2	10.8	9.5	10.3	7.8
EU	0.0	0.0	0.0	11.7	9.6	7.7	8.0
World	1956.2	3487.1	37520.5	40714.8	46877.6	52742.9	53504.7

China Statistics of Foreign Invetstment and International Trade

図１３　Structure of the Model: KY-MERIT-E3

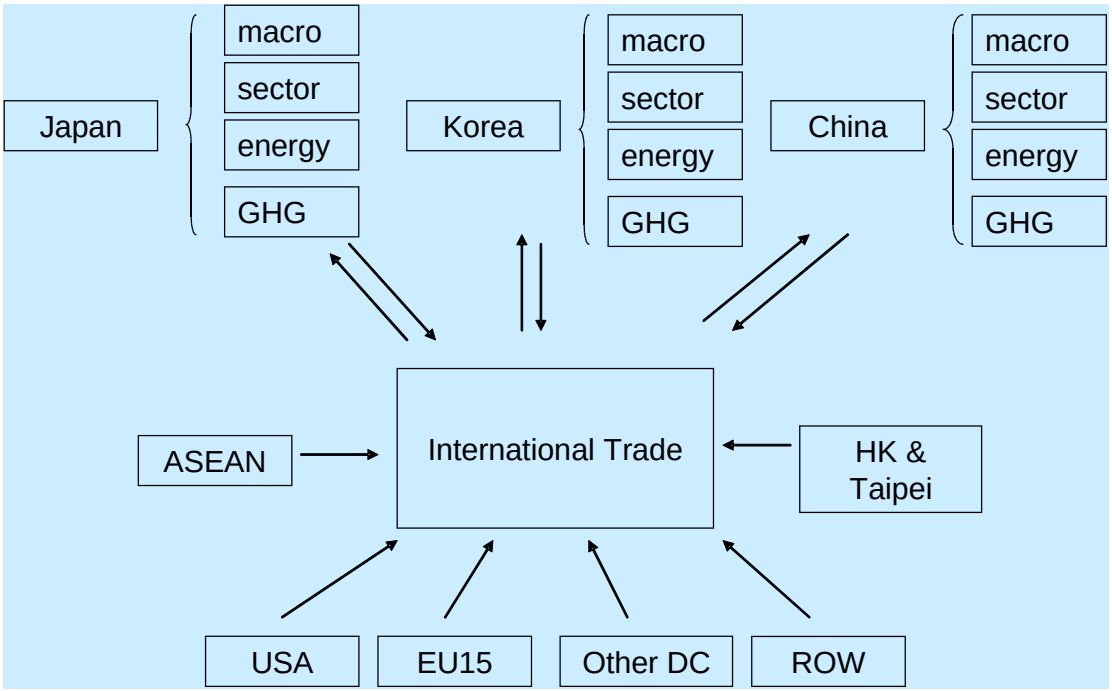

Table 5 Multiplier of the Government Expenditure in Korea Model

	Real Multiplier	Nominal Multiplier
1	1.81	2.05
2	1.95	−0.19
3	2.02	0.65
4	2.18	0.78
5	2.30	1.26
6	2.31	1.69
7	2.46	2.41

Table 6 Effects on Sectroal Products, and Other Key Variables

Unit: %

Agriculture, Forestry, and Fishery				Chemical				Transport Equipment			
X01	China	Japan	Korea	X06	China	Japan	Korea	X11	China	Japan	Korea
1	−0.055	0.000	0.006	1	0.107	0.001	0.012	1	−0.046	0.001	0.001
2	−0.042	0.001	0.020	2	0.138	0.003	0.023	2	−0.016	0.001	0.004
3	−0.057	0.001	0.020	3	0.121	0.003	0.019	3	−0.049	0.001	0.003
4	−0.062	0.001	0.018	4	0.137	0.004	0.036	4	−0.015	0.001	0.002
5	−0.033	0.001	0.018	5	0.151	0.006	0.025	5	0.035	0.002	0.004
6	−0.014	0.002	0.018	6	0.207	0.010	0.026	6	0.029	0.003	0.004
7	0.001	0.003	0.022	7	0.239	0.013	0.032	7	0.008	0.005	0.005

Mining(expt. Coal, Petroleum, and Nati				Non−metallic Minerals				Electrical Machinery			
X02	China	Japan	Korea	X07	China	Japan	Korea	X12	China	Japan	Korea
1	0.114	0.002	0.012	1	−0.028	0.001	0.002	1	1.171	0.002	0.001
2	0.105	0.003	0.014	2	−0.022	0.002	0.005	2	1.032	0.002	0.001
3	0.142	0.002	0.012	3	0.024	0.001	0.006	3	0.881	0.001	−0.004
4	0.055	0.002	−0.004	4	−0.015	0.003	0.003	4	0.803	0.011	−0.005
5	−0.040	0.003	0.004	5	−0.028	0.004	0.004	5	0.804	0.019	−0.008
6	0.007	0.005	0.002	6	−0.002	0.007	0.005	6	0.878	0.021	−0.005
7	0.028	0.007	0.005	7	−0.001	0.009	0.005	7	0.914	0.024	−0.005

Food Products				Primary Metal				Miscellaneous Manufacturing			
X03	China	Japan	Korea	X08	China	Japan	Korea	X13	China	Japan	Korea
1	−0.057	0.000	0.006	1	0.225	0.005	0.016	1	0.018	0.001	0.003
2	−0.046	0.000	0.020	2	0.215	0.007	0.013	2	0.081	0.001	0.009
3	−0.042	0.000	0.015	3	0.176	0.006	0.011	3	0.148	0.001	0.010
4	−0.051	0.000	0.014	4	0.170	0.004	−0.017	4	0.139	0.002	0.011
5	−0.035	0.000	0.013	5	0.179	0.007	0.000	5	0.150	0.003	0.012
6	−0.023	0.001	0.014	6	0.212	0.010	−0.006	6	0.193	0.005	0.014
7	−0.030	0.001	0.015	7	0.251	0.012	−0.002	7	0.218	0.005	0.017

Textile and Apparel				Metal Products				Construction			
X04	China	Japan	Korea	X09	China	Japan	Korea	X14	China	Japan	Korea
1	0.010	0.000	0.003	1	0.045	0.001	0.002	1	−0.162	0.001	0.000
2	0.051	0.001	0.008	2	0.060	0.002	0.005	2	−0.175	0.002	0.002
3	0.084	0.002	0.011	3	0.010	0.001	0.004	3	−0.180	0.001	0.002
4	0.100	0.003	0.011	4	0.009	0.002	0.004	4	−0.164	0.001	0.001
5	0.100	0.004	0.014	5	0.011	0.003	0.005	5	−0.164	0.001	0.002
6	0.115	0.007	0.015	6	0.033	0.006	0.005	6	−0.168	0.005	0.003
7	0.121	0.008	0.019	7	0.040	0.007	0.006	7	−0.194	0.006	0.003

Pulp and Paper				General Machinery				Transport and Communication			
X05	China	Japan	Korea	X10	China	Japan	Korea	X15	China	Japan	Korea
1	0.039	0.001	0.013	1	0.016	0.001	0.000	1	0.009	0.001	0.003
2	0.060	0.001	0.031	2	0.006	0.002	0.000	2	0.013	0.001	0.009
3	0.117	0.001	0.036	3	−0.060	0.000	−0.003	3	−0.003	0.001	0.008
4	0.086	0.002	0.034	4	−0.033	0.000	0.005	4	−0.001	0.001	0.007
5	0.075	0.003	0.045	5	−0.007	0.001	0.002	5	0.004	0.002	0.007
6	0.101	0.004	0.067	6	0.001	0.004	0.001	6	0.026	0.004	0.007
7	0.122	0.004	0.058	7	−0.011	0.005	0.002	7	0.060	0.004	0.008

Table 6 Effects on Sectroal Products, and Other Key Variables

Unit: %

Services				Electric Power, Gas, and Heat				Electric Power, Final Consumption			
X16	China	Japan	Korea	X21	China	Japan	Korea		China	Japan	Korea
1	−0.002	0.000	0.003	1	0.050	0.001	0.007	1	0.047	0.000	0.004
2	−0.020	0.001	0.007	2	0.074	0.001	0.015	2	0.015	0.000	0.009
3	−0.046	0.000	0.009	3	−0.034	0.001	0.018	3	−0.033	0.000	0.012
4	−0.048	0.001	0.009	4	0.005	0.002	0.017	4	−0.056	0.000	0.009
5	−0.026	0.001	0.008	5	0.074	0.003	0.019	5	−0.064	0.000	0.010
6	−0.011	0.002	0.009	6	0.115	0.004	0.017	6	−0.048	0.000	0.011
7	0.009	0.003	0.010	7	0.135	0.005	0.020	7	−0.041	0.000	0.011

Coal Mining				Total Industry				Primary Energy Supply			
X17	China	Japan	Korea	XT	China	Japan	Korea	ETOPS	China	Japan	Korea
1	0.006	0.00	0.00	1	0.062	0.001	0.004	1	−0.007	0.000	0.003
2	0.075	0.00	0.00	2	0.072	0.001	−0.002	2	−0.027	0.001	0.008
3	0.053	0.00	0.00	3	0.040	0.001	0.006	3	−0.056	0.001	0.011
4	0.095	0.00	0.00	4	0.049	0.002	0.007	4	−0.075	0.001	0.010
5	0.141	0.00	0.00	5	0.069	0.003	0.008	5	−0.071	0.001	0.010
6	0.161	0.00	0.00	6	0.101	0.005	0.009	6	−0.057	0.001	0.011
7	0.114	0.00	0.00	7	0.120	0.005	0.013	7	−0.050	0.002	0.012

Oil and Natural Gas				Real GDP				CO2 Emission			
X18	China	Japan	Korea	GNP	China	Japan	Korea	GTOPS	China	Japan	Korea
1	0.086	0.00	0.00	1	−0.123	0.000	0.003	1	0.009	0.000	0.004
2	0.052	0.00	0.00	2	−0.139	0.000	0.004	2	−0.018	0.001	0.009
3	0.070	0.00	0.00	3	−0.139	0.000	0.004	3	−0.053	0.001	0.012
4	0.175	0.00	0.00	4	−0.164	0.000	0.004	4	−0.077	0.001	0.012
5	0.043	0.00	0.00	5	−0.167	0.000	0.003	5	−0.076	0.001	0.012
6	0.325	0.00	0.00	6	−0.153	0.000	0.005	6	−0.063	0.002	0.013
7	0.439	0.00	0.00	7	−0.160	0.000	0.005	7	−0.055	0.002	0.014

Petroleum Products				Nominal GDP				Change in Primary Energy			
X19	China	Japan	Korea	GNPV	China	Japan	Korea	ETOPS	China	Japan	Korea
1	0.028	0.001	0.008	1	0.091	0.000	0.004	1	−76.0	1.9	5.8
2	0.026	0.001	0.017	2	0.146	0.001	0.000	2	−293.7	3.5	14.3
3	−0.016	0.001	0.011	3	0.172	0.001	0.001	3	−578.3	3.6	16.4
4	0.040	0.001	0.012	4	0.216	0.001	0.002	4	−898.6	3.8	15.2
5	0.015	0.002	0.009	5	0.241	0.002	0.002	5	−814.6	5.3	15.4
6	0.089	0.003	0.008	6	0.275	0.003	0.004	6	−647.1	7.1	16.6
7	0.159	0.004	0.013	7	0.303	0.004	0.006	7	−630.7	11.0	18.5

Coal Products				GDP Deflator				Change in CO2 Emission			
X20	China	Japan	Korea	PGDP	China	Japan	Korea	GTOPS	China	Japan	Korea
1	0.222	0.002	0.012	1	0.2	0.0	0.0	1	0.29	0.01	0.02
2	0.202	0.003	0.011	2	0.3	0.0	0.0	2	−0.58	0.01	0.04
3	0.108	0.002	0.013	3	0.3	0.0	0.0	3	−1.62	0.01	0.05
4	0.120	0.002	−0.007	4	0.4	0.0	0.0	4	−2.70	0.01	0.05
5	0.067	0.003	0.004	5	0.4	0.0	0.0	5	−2.60	0.02	0.05
6	0.131	0.006	0.001	6	0.5	0.0	0.0	6	−2.11	0.02	0.05
7	0.214	0.007	0.004	7	0.5	0.0	0.0	7	−2.11	0.04	0.06