The Economic Impact of a Nuclear Power Moratorium: Simulation Experiments by the CRIEPI Medium-Term Economic Forecasting System[1]

By
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Abstract

Nuclear power is an almost non-exhaustible energy source and produces no carbon dioxide (CO_2) emissions in the production process. However, many problems with nuclear power exist, such as the issue of nonproliferation and the processing and disposal of nuclear wastes. Most Western countries have recently reduced operation or even given up further development of nuclear power, mainly due to the increasing difficulty of getting public approval for the construction of nuclear power stations. If nuclear power generation were to be halted, what would happen to the national and world economies? This paper examines the economic impacts of a nuclear power moratorium by using the CRIEPI Medium-Term Economic Forecasting System. The simulation results state that a nuclear power moratorium, if jointly implemented by the G-7 countries, would have a stagflationary impact on the world and Japanese economies triggered by a drastic increase in fossil fuel prices. Despite the decrease in energy demand caused mainly by the price effects, CO_2 emissions would drastically increase because of the shift to oil and gas from nuclear as sources of electric power.

1. Introduction

Primary energy consumption in the world grew by about 60 percent during the past two decades (IEA, 1992). For the next two decades (1990-2010), the IEA forecasts that growth will further continue by 50 percent or more, reflecting increasing demand in developing countries as they are beginning to catch up to the levels of living standards in industrialised countries. In Japan, while slightly slowing during the 1970s, growth in energy demand revived upward again in the middle of the 1980s in conjunction with decreased energy prices, the expansion of the service sector in the economy, increasing desires for higher living standards and so on. Considering the growing threats of greenhouse warming and the potential supply restraint of fossil fuel resources in the 21st century, however, such a high growth rate in world energy

Manuscript received December 13, 1995. Revised November 21, 1996.
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[1] The earlier version of this paper was presented at the 10th International Conference on Input-Output Techniques, held in Seville, Spain, 1993. The authors are grateful to an anonymous referee of this paper for various helpful comments.

demand might not be sustainable in the long run unless some energy conservation measures are implemented.

One possible solution to overcome the energy and environmental problems that might limit the ceiling of economic growth is to increase nuclear power, which may cause some people uneasiness even though it is a clean and almost non-exhaustible energy[2]. As of 1990, nuclear energy accounted for about 17 percent of world electricity production and 27 percent in Japan, a bit higher than the average in the OECD area (24 percent). Despite the importance of nuclear energy, most Western countries have given up further development of nuclear power, mainly due to increasing difficulty in obtaining public acceptance of constructing nuclear power stations. Energy is essential to pursuing economic growth. In this regard, it is not only interesting but also important to investigate what would happen to the economy if this important source of energy were abandoned for some reasons, for example, the environmental risks in disposing of radioactive wastes, increasing construction costs of nuclear power stations, etc. (see OECD, 1989). The purpose of this paper is to quantitatively analyse the economic impacts of a nuclear power moratorium by using the CRIEPI Medium-Term Economic Forecasting System in which various interactions among world energy markets, Japanese macroeconomic activity and industrial structure, and energy demand and supply are consistently captured. In what follows, we first explain the basic structure of this forecasting system and then present the simulation results of the impact of a nuclear power moratorium.

2. The CRIEPI Medium-Term Economic Forecasting System

This economic forecasting system consists of four econometric models: a world energy supply-demand model, a multisectoral econometric model for the Japanese economy in which a feed-back mechanism between the macroeconomy and industrial activities is incorporated, an inter-energy competition model (an energy market model for Japan), and a nine-region econometric model, in which Japan is divided corresponding to the supply territories of nine major electric power companies.

As shown in Figure 1, these four models in the system are linked to each other in such a way that variables solved in one model are transferred to other models as exogenous variables. For example, international energy prices and world energy supply-demand determined in the world energy model are conveyed into both the multisectoral and inter-energy competition models. The multisectoral model then determines major economic variables for the Japanese economy such as GDP, employment, wages, prices, etc. at a detailed industrial sectoral level, and this information is then transferred to the inter-energy competition model to consistently determine domestic energy prices and demand for energy by type of use and category.

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[2] Though not taken into account in this paper, another option would be an expansion of renewable energy such as solar energy, biomass, geothermal energy, hydropower and wind, as emphasised by the World Bank (1992). According to energy experts, these energy sources cannot play an important role in energy supply until about 2010.

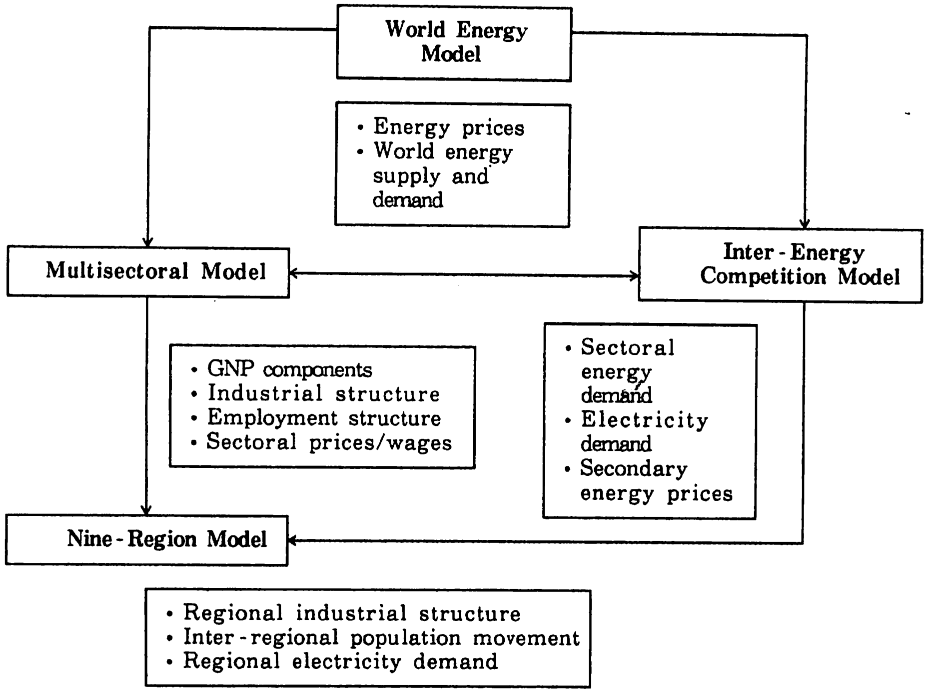

Figure 1: Overall Structure of the Medium-Term Economic Forecasting System

To capture the interactive features between energy and the economy, domestic energy prices determined in the inter-energy competition model affect in turn sectoral outputs and prices calculated in the multisectoral model. All these variables can be determined endogenously in the system as a whole. And of course, separate use of each model is also possible depending upon the purpose of the simulations. The major characteristics of each model are summarised as follows[3].

(a) World Energy Model

World energy prices and supply of and demand for energy by fuel type for each country or region are simultaneously determined in the model (for details of the model, see Kumakura, 1987). Energy demand is formulated as a derived demand system in response to energy prices and income factors such as GDP, while energy supply by country or region is a function of international energy prices and the OPEC oil supply volume, which is exogenously given. For oil and coal, the equilibrium prices and quantities are simultaneously determined in a way that supply of and demand for each energy source are balanced in world markets. So as to focus on the role of economically powerful countries in world energy markets, the model includes a

[3] The explanation of the nine-region model is omitted here as it is not utilized in the current simulation experiments. For details of this model, see Ohkawara, 1993.

detailed supply-demand model for each of the G-7 countries, where energy supply volume, conversion volume, final consumption and domestic energy prices are determined by type of energy (oil, coal, natural gas and electricity).

This model itself can be used to analyse the following issues:

(1) Interrelations between energy supply, demand and prices in world markets, for example, how OPEC's oil production affects world supply, demand and prices of oil;

(2) To what extent each energy could be substituted for others in response to changes in prices and supply-demand conditions;

(3) How and to what extent world oil markets would be affected by the adoption of alternative non-oil energy sources such as coal and nuclear power.

(b) Multisectoral Econometric Model

The multisectoral econometric model provides consistent annual forecasts of macroeconomic activity and changes in industrial structure of the Japanese economy (see Hattori and Sakurai, 1991). It is a macroeconometric and input-output linkage model in which the interrelationships between the macroeconomy and industrial activities are explicitly incorporated. The model describes three major aspects of Japanese economic activity on both aggregated and disaggregated levels: production, expenditures and income distribution. The major data sources used in this model are the new SNA (System of National Accounts) and time-series input-output data tables, the latter of which were compiled by using a revised RAS method (see Kaneko, 1988). Industries are disaggregated into eight major sectors (primary, materials, machinery, other manufacturing, construction, public utilities, services, and government) in the SNA, but in the input-output accounts a more detailed breakdown of industries (54 sectors) is available. In addition, institutional sectors are divided into three agents (households, enterprises and general government), thereby providing savings-investment balances and financial positions of each of these agents.

The model consists of eight major blocks: final demand, input-output, value-added formation, sectoral prices, employment and wages, potential output, income distribution, and institutional sectors (see Figure 2). The interdependencies among the blocks and variables can be outlined as follows.

The first step begins by assuming that each of the final demand components is determined on the basis of the given relative prices, income and other variables. These final demand items, including exports and imports, are then entered into the input-output block to determine sectoral outputs for the 54 input-output sectors. These sectoral outputs are, after aggregation into the eight SNA sectors, inputted into the value-added formation block to determine sectoral value-added, GDP deflators and the total intermediate inputs for the eight SNA sectors. GNP is *obtained* by adding up sectoral GDP, import duties, imputed bank service charges and net transfers of factor incomes from abroad. GDP by sector affects both the employment and wages as well as income distribution blocks. The prices and employment and wages blocks are also strongly interdependent: while sectoral output prices are determined mainly by the cost mark-up principle and partly by supply-demand gaps, sectoral wages are formulated by the Philips curve hypothesis. The supply-demand gap is defined as the difference

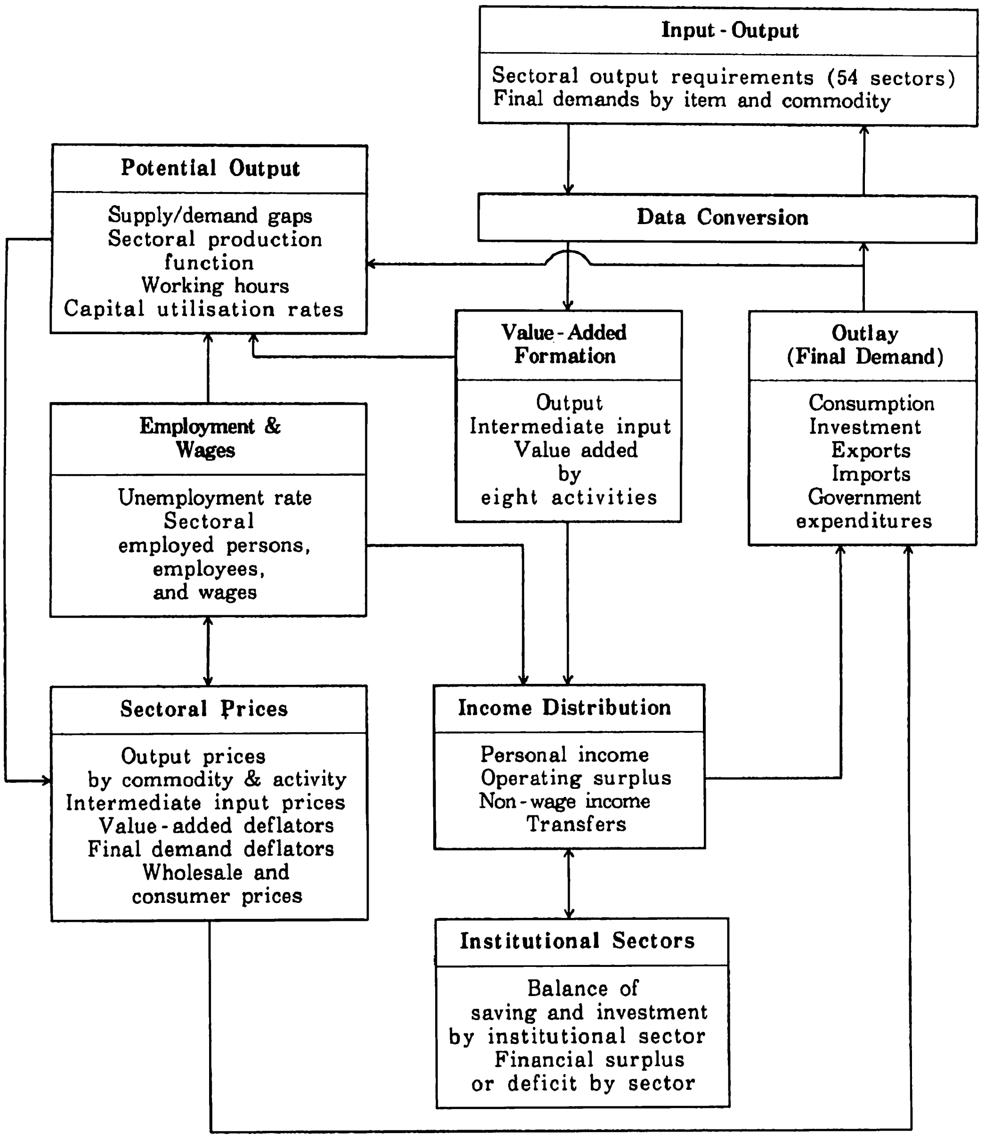

Figure 2: Basic Structure of Multisectoral Model

between actual and potential output. The potential output by industry is calculated by using a production function for industry assuming full utilization of labour and capital inputs. Wholesale and consumer prices as well as aggregate final demand deflators are then consistently determined as weighted averages of prices of sectoral output. Labour demand by sector is determined as a function of the output level and real wages. Based on the outputs, prices, incomes and other variables thus determined, the next iterative step starts again in the final demand block. A multisectoral temporary equilibrium can be achieved when all the endogenous variables have converged.

(c) Inter-energy Competition Model

This domestic energy model aims to analyse and forecast energy supply-demand for various energy sources in Japan (see Kumakura, Fujii, Nagata and Matsukawa, 1989). In particular, it determines energy demand by sector and by kind, focusing on a mechanism of inter-energy substitutions for various final consumers.

The model consists of two major blocks: the energy conversion block and the end-use energy consumption block. Namely, the domestic (supply) prices of energy are determined in the energy conversion block for each product of three energy conversion sectors, i.e., electricity, oil products and city gas. Although import energy prices play a dominant role in the determination of domestic energy prices in Japan, the model takes into account other effects such as cost structures of the conversion sectors, taxes and other institutional factors. Meanwhile, final consumption of energy is determined in the second block by sector (agriculture, mining, nine manufacturing sectors, construction, services, households, transportation and non-energy category) and by fuel type (coal, coke, oil, natural gas, electricity, etc.). The model determines energy demand in two steps. First, total energy demand by sector or by type of use is determined by sectoral output or income, energy prices, and changes in end-use technology. Second, demand for each type of energy in each sector or use is determined by share functions explained by relative energy prices. Finally, through the interactions between these two blocks, equilibrium levels of energy prices, final energy consumption, energy conversion volume as well as primary energy supply are consistently determined.

In addition to these two blocks, this model has a module for calculating CO_2 emissions in the energy conversion process and final consumption sectors, so as to calculate the level of CO_2 emissions depending upon different economic growth scenarios.

3. Measurement of the Effects of a Nuclear Power Moratorium

Using the above econometric system, we carried out simulation experiments to examine how and to what extent the suspension of nuclear power generation affects the energy prices and economic activities in the world and Japanese economies. This section presents major results of the simulation experiments[4] .

3.1. Simulation Scenarios

The following two scenarios were prepared for simulation experiments of nuclear power suspension:

[4] Published quantitative analyses of a nuclear power moratorium are few. In a more general scope, Dale W. Jorgenson Associates (1982) attempt to examine the economic effects of changes in energy supply conditions, including a nuclear power moratorium by the US government.

(1) *Immediate suspension case*: Assuming that half of the nuclear power plants currently operating in the G-7 countries (Japan, the US, Canada, France, Germany, Italy and the UK) is halted in 1990 and another half is completely abolished in 1991.

(2) *Phased suspension case*: Assuming that nuclear power generation in the G-7 countries is steadily reduced from 1990 and by the year 2000 is totally abolished.

The economic impacts of a nuclear power moratorium can be outlined in the model as follows. First, assume that a reduction in nuclear power generation is compensated for by increased thermal power generation, thus boosting fossil fuel demand in the world economy. The prices of fossil fuels would therefore rise (in the world energy model), pushing up their import prices in Japan as well. Because of the substitution of thermal power generation for nuclear power, the volume of imported fossil fuels to Japan would inevitably increase. The increase in both import prices and volumes of fossil fuels would invoke a stagflationary impact on the Japanese economy (in the multisectoral model). The rise in fossil fuel prices would also influence the volume and composition of energy demand in Japan through changes in relative prices of secondary energy (in the inter-energy competition model).

3.2. Impacts on World Energy Supply and Demand

Figure 3 outlines a mechanism of the impacts of a nuclear power suspension on world-wide energy supply and demand. In the short term, the electric power sector would respond to the nuclear power halt by raising capacity utilization of existing thermal power plants. In the long term, however, it will try to manage by building up new thermal power plants, the pace of which would be limited only by physical restrictions. For fuel consumed by newly constructed thermal power plants, we assume the ratio of oil to natural gas would be 2:1. We also impose the global warming restriction by assuming that only oil and gas would be consumed as substitutes for nuclear power, in spite of the fact that currently 41 percent of the power generation volume in the G-7 countries is produced by coal, 8 percent by oil and 10 percent by natural gas.

In general, the increased fossil fuel demand in the electric power sector of the G-7 countries would increase the world-wide demand for fossil fuels, thereby raising the prices of both fossil fuels and electricity, which in turn would lower the growth in the world economy. While the increase in energy prices, and the resultant fall in economic activities, decreases demand for energy, it also affects the supply-side in energy markets by increasing the supply of economically excavatable energy volumes. Accordingly, through the adjustment process of supply and demand, the model determines equilibrium levels of fossil fuel prices and electric power supply and demand at an international level.

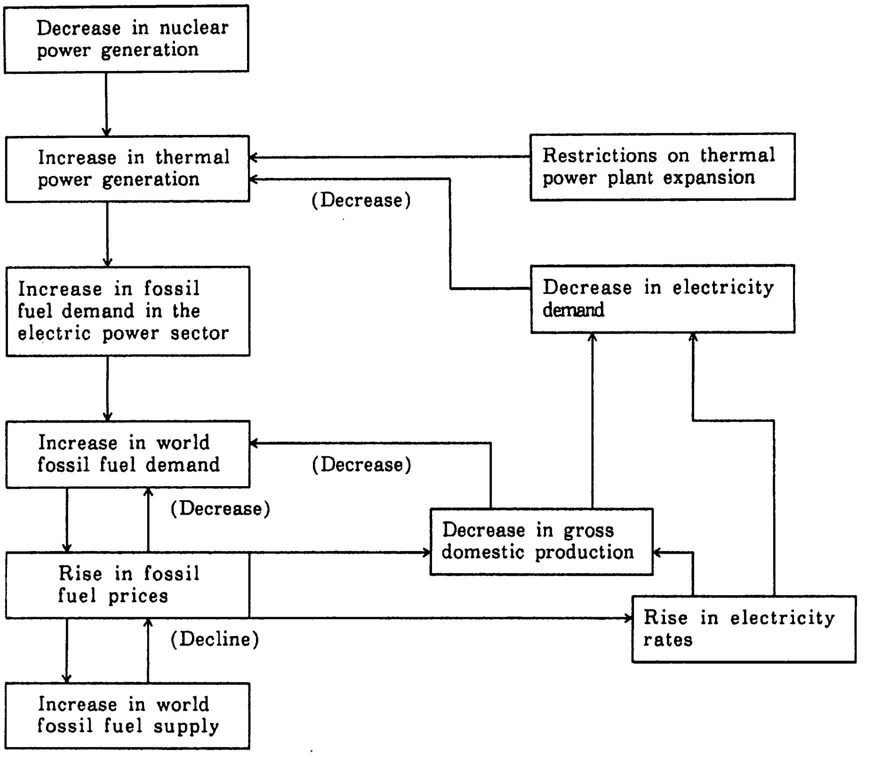

Figure 3: Impact of Suspension of Nuclear Power Generation on World Energy Supply and Demand

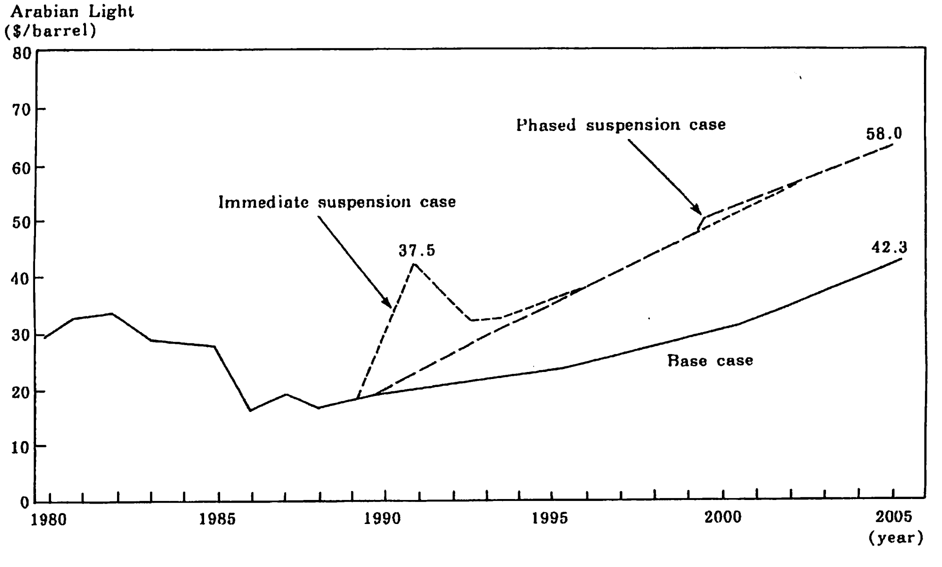

Figure 4: Impact on Oil Prices

Table 1: Impact on World Energy Supply and Demand

	1990	1991	1992	2005
Base case				
Electricity generated in G-7 countries (billion kWh)	5,210	5,313	5,409	6,792
Of which nuclear power generated (billion kWh)	1,354	1,388	1,422	1,951
Crude oil price ($/barrel)	18.5	19.5	20.5	42.3
Coal price ($/ton)	43.1	45.5	47.7	85.4
Case of suspension of nuclear power generation				
Electricity generated in G-7 countries (billion kWh)	4,930	4,826	4,887	6,157
Of which nuclear power generated (billion kWh)	635	0	0	0
Crude oil price ($/barrel)	31.3	37.5	29.1	58.0
Coal price ($/ton)	51.7	61.8	50.6	94.7

Note: Figures for 1990-1992 are in the case of immediate suspension; for 2005 are in the case of phased suspension.

Figure 4 represents trends in world oil prices up to 2005, the terminal year of the present forecast period for both simulation cases. While the two cases have similar impacts in the long term, the immediate suspension case reveals a more drastic up and down in oil prices in the short run, provoking large fluctuations in economic activities and energy supply and demand in the world economy. In what follows, we examine the short-run impacts of the nuclear power suspension by using the immediate suspension scenario and the long-run impacts by referring to the phased suspension case.

As shown in Table1, in the immediate suspension case, oil prices would drastically go up from $16.7/barrel as of 1989 to $31.3/barrel in 1990 and $37.5/barrel in 1991. Thereafter, they would fall to $29.1/barrel in 1992 due to both a decrease in demand for oil and an increase in the oil supply. However, this stabilized price of oil is still $7/barrel higher than that of the base case.

It is noted that a radical reduction of nuclear power generation would not be completely compensated for by an increase in thermal power generation and therefore would lead to a serious bottle-neck in the electricity supply, at least in the short run. According to the simulation results, total electric power generation would fall below the level of the previous year; about two-thirds of the reduction of nuclear power generation in both 1990 and 1991 (for 1991, it amounts to 1.4 trillion kWh, equivalent to 340 million tons of oil) would be compensated for by the increase in thermal power but the remaining one-third would not. As a result, the total amount of electric power generation in the G-7 area would decrease by 5.4 percent in 1990 and by 9.2 percent in 1991 when compared with figures in the base case. The negative effect would be the largest in 1992, falling 9.7 percent below the base case as demand for electricity is greatly restrained by the drastic rise in electricity prices. During this period, the GDP in the G-7 area would fall a maximum of 1.2 percent in 1991, and thereafter would remain 1 percent below the base case figure. Meanwhile, world demand for oil would rise by 7.3 percent in both 1991 and 1992 compared with the base case, but decrease thereafter due to higher oil prices.

Looking at the long-run effect, oil prices would gradually increase until 2005: they would go up to $29.4/barrel in 1995, $7 higher than the base case, and to $58.0/barrel

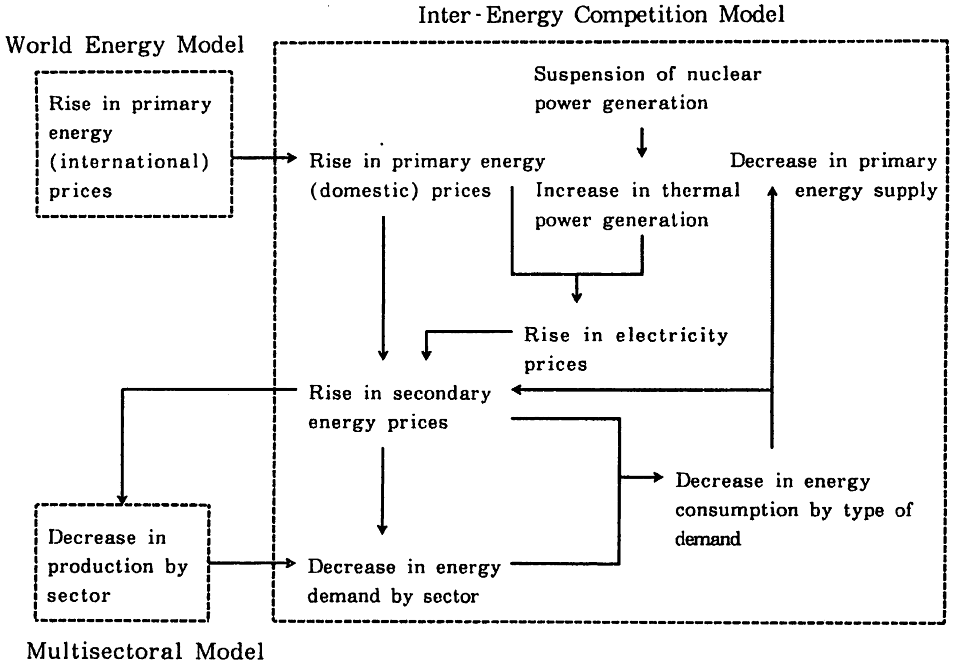

Figure 5: Effect of Suspension of Nuclear Power Generation on Inter-Energy Competition

in 2005, $16 higher than the base case. The growth rate of total electric power generation in the G-7 area would fall to 1.2 percent per annum, lower than the base case growth rate of 1.8 percent, so that the volume of electric generation would be 6.2 trillion kWh, 9 percent below the base case figure in 2005. Meanwhile, oil consumption in the world market economy would increase to 2.95 billion tons of oil, 7 percent higher than in the base case. Furthermore, the GDP in the G-7 area would be 1 percent ($120 billion) below the base case figure.

3.3. Impacts on Japan

(a) Impacts on Energy Supply and Demand

The impacts of the nuclear power suspension on energy supply and demand in Japan were simulated by the inter-energy competition model. As shown in Figure 5, the increase in international prices of primary energy would raise prices of both domestic primary and secondary energy. Other things being equal, the rise in secondary energy prices would reduce sectoral production and bring about a decrease in sectoral energy demand, which in turn bears on the price formation of secondary energy.

For the primary energy supply, the rate of decrease from the base case is 3.7 percent in 2000 and 4.3 percent in 2005. Though larger in the immediate suspension

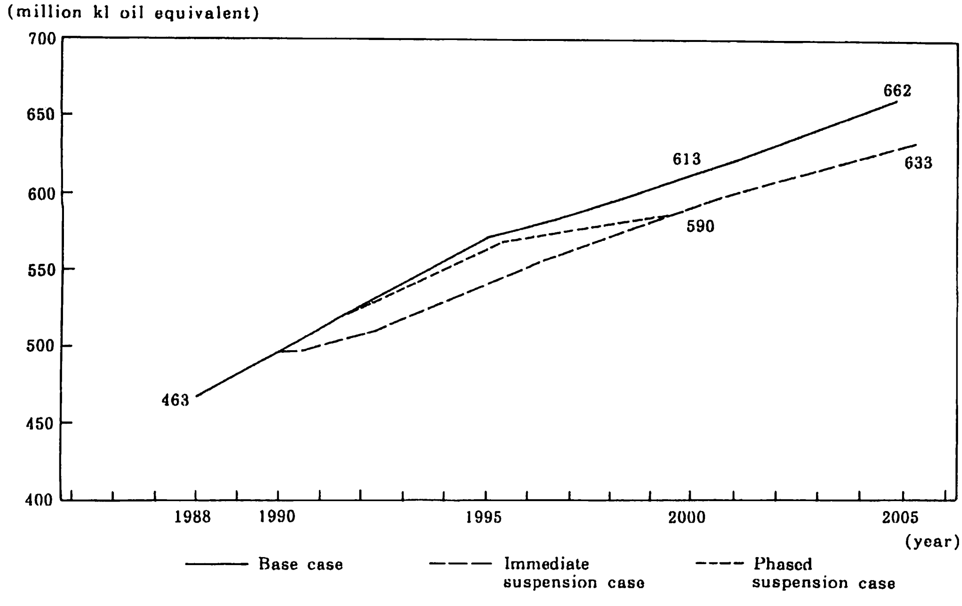

Figure 6: Impact on Primary Energy Supply

case in the short run, both suspension cases have similar degrees of impact after the year 2000 (Figure 6). By type of primary energy, the rates of increase in the LNG and crude oil supply from their base case levels will be 27 percent and 17 percent, respectively, as nuclear power is totally replaced by these alternative energy sources by 2005.

On the other hand, the rate of difference of secondary energy prices in 2005 between the two simulation cases and the base case is 15.5 percent for oil products, 11.4 percent for coke, 14.5 percent for city gas and 25.9 percent for electricity. This relatively large increase in electricity prices can be explained by (1) higher depreciation costs caused by the shutdown of nuclear power plants, (2) additional construction costs of new thermal power plants and (3) increased consumption of fossil fuels at higher costs.

Reflecting the relatively high increase in electricity prices and lower economic activity, electricity demand (including auto-generation demand) would decrease by 6.6 percent from the base case figure in 2005, whereas total energy consumption would decrease by 4.2 percent (Figure 7). Among different uses of electricity, the rate of decrease in electricity demand is the highest in the industrial sector and lower in the commercial and transportation sectors, where substitution possibilities for other energy sources are technologically limited (Figure 8).

These drastic changes in electricity demand can be traced by examining the degree of income and price effects on electricity demand. The income effects on electricity demand through the decrease in production and income (measured by GDP, etc.) are rather small, explaining a decrease of 0.5 to 1.0 percent of electricity demand in 2005 (in terms of rates of difference from the base case, shown in Figure 8). On the

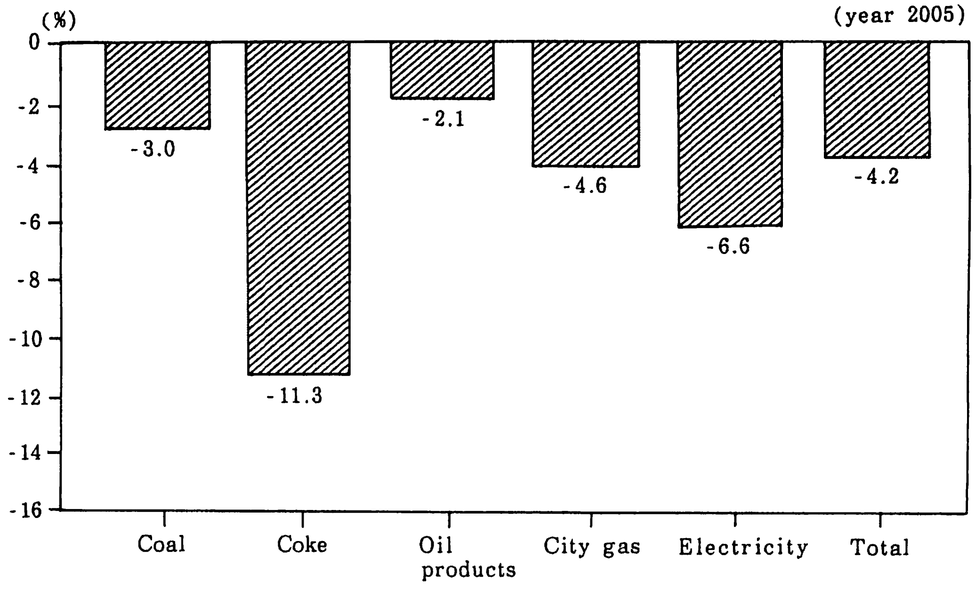

Figure 7: Impact on Final Energy Consumption (Rates of difference from base case)

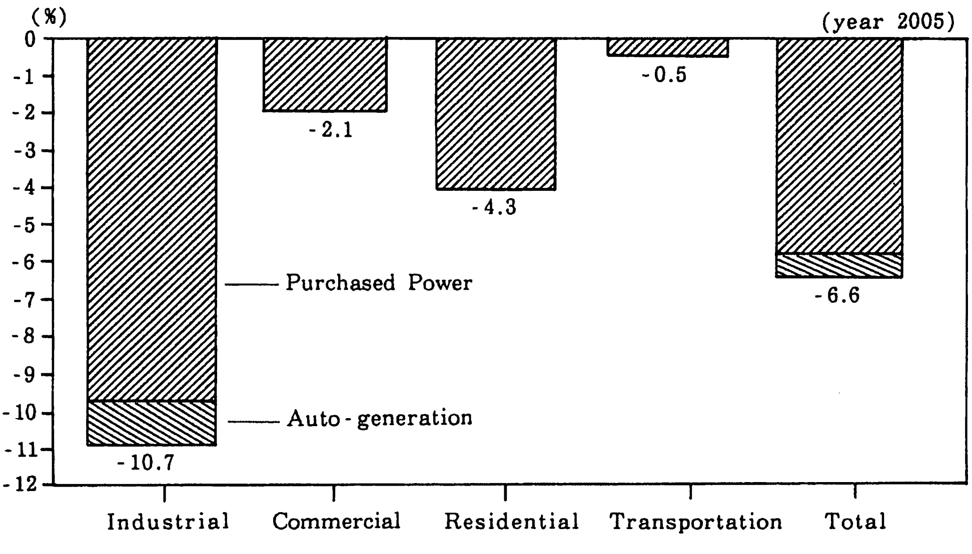

Figure 8: Impact on Electricity Demand by Sector (Rates of difference from base case)

other hand, the price effects on electricity demand are much larger, accounting for a decrease of about 10 percent for the industrial sector, 1 percent for the commercial sector and 3 percent for the residential sector. This large impact of price effects mainly comes from the sharp increase in electricity prices[5].

Finally, it is interesting to see the impact on the environment, namely, changes in the level of CO_2 emissions between simulation cases and the base case. The CO_2 emissions would reach 409 million tons in 2005 for the two nuclear power suspension cases, about 14 percent higher than that of the base case and 50 percent higher than the 1990 emission level.

The major source of this increase comes from the electric power sector, whose CO_2 emission level is about 46 percent higher than the base case level and accounts for 40 percent of total CO_2 emissions in 2005. The underlying reason for this strong increase in CO_2 emissions can be explained by the higher use of alternative primary energy sources (notably, crude oil and LNG) to compensate for decreasing use of nuclear power energy, even though total energy demand declines relative to that in the base case. Accordingly, the emissions of CO_2 would drastically increase in the electric utility sector because massive substitutions between primary energy sources would occur within this sector, although CO_2 emissions in the commercial and residential sectors would slightly decrease along with their declining energy demand[6].

(b) Impacts on the Economy

Lastly, the impact of a nuclear power suspension on Japanese economic activity can be shown by the simulation results from the multisectoral model. Figure 9 outlines how this impact affects economic activity in Japan with a stagflationary process.

The simulation results are summarised as follows (Table 2). For the immediate suspension case, the sharp increase in imported oil prices and the depreciation of the yen would raise wholesale and consumer prices by 3.1 percent and 1.1 percent, respectively, in the first year (1990). The inflationary process is aggravated in the next

[5] The energy demand functions in our energy model were estimated using share functions by sector, and by type of demand. Although different specifications were used for each function, the level of estimated income and price elasticities of electricity roughly ranges from 0.5 (transportation sector) to 0.9 (residential sector) for income elasticities, and from 0.0 (transportation sector) to -0.5 (industrial sector) for price elasticities. Typically, the price elasticities are high in energy-intensive industries and those using alternative energy sources. Since the rate of decrease in real GDP is about 1 percent in 2005 (see Table 2) and the increase in relative prices of electricity is on average about 20 percent, the resulting impact is much larger for the price effects.

[6] Primary energy consists of crude oil, coal, natural gas, nuclear, and so on, while final or secondary energy is the final form of energy which becomes directly available for final users through the process of primary energy conversions. Electricity is a representative final energy source. The simulation results exhibit that although final energy demand would decrease in every sector due to slower growth in economic activities and the rapid increase in energy prices (see Figure 7), demand for crude oil and LNG would sharply increase in order to substitute for nuclear energy. This primary energy substitution would cause a net increase in CO_2 emissions because carbon intensities are high for crude oil and LNG, but nil for nuclear energy.

Table 2: Impact on the Japanese Economy

%

	Case of immediate suspension			Case of phased suspension	
Year	1990	1991	1992	1995	2005
Real GNP	-0.9	-1.5	-1.7	-0.5	-1.0
Private consumption	-0.5	-1.2	-1.4	-0.8	-1.9
Private housing	-1.1	-2.4	-2.7	-1.4	-2.4
Private equipment	-0.5	-1.2	-1.7	-0.5	-1.2
Exports	-0.2	-2.0	-4.1	1.6	3.0
Imports	0.9	-2.1	-4.3	-0.3	-1.3
Current accounts	-523	-678	-366	-347	-839
Wholesale prices	3.1	6.4	6.0	3.2	7.0
Consumer prices	1.1	2.8	3.4	2.0	4.6
Real GDP	-1.0	-1.6	-1.8	-0.6	-1.2
Materials	-2.4	-2.4	-2.6	-1.3	-1.7
Machinery	-0.7	-1.7	-2.5	0.0	-0.3
Services	-0.8	-1.3	-1.5	-0.6	-1.3
Real energy imports	0.91	1.36	1.36	1.67	3.11

Note: Figures denote rate differences from the base case, excluding current accounts (0.1 billion dollars) and real energy imports (trillion yen).

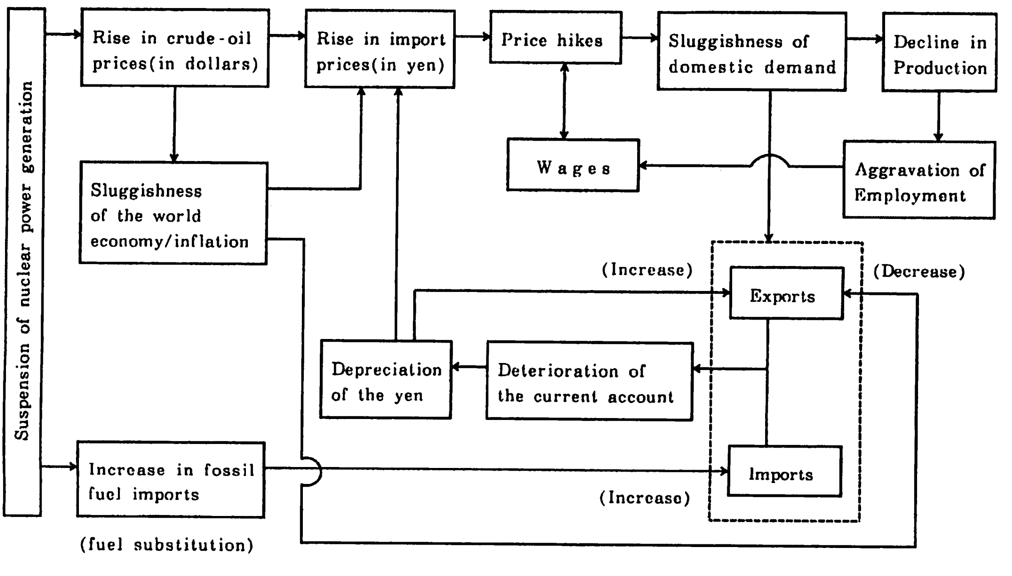

Figure 9: Macroeconomic Impact of Nuclear Power Suspension

couple of years, and imports of fossil fuels in nominal terms would amount to 3.9 trillion yen in 1990 and 5.7 trillion yen in 1991.

Real GNP would decline appreciably because of increased import prices, large outflows of domestic income abroad, and the decline in exports due to a world-wide recession: relative to the base case, domestic GNP would decrease by 0.9 percent in 1990 and 1.7 percent in 1992. In the fifth year (1994), the loss of GNP becomes the largest, about 2.2 percent below the base case GNP (9.4 trillion yen). GNP growth rates would be lower than those of the base case by 0.9 percentage point in 1990, 0.6 percentage point in 1991 and 0.3 percentage point in 1992, so that the GNP growth rate would fall by 0.5 percentage point annually on average during the first five years. The major factors in this decline are a drop in housing and business investments. During this process, the current account surplus would also fall rapidly, due to both the increase in energy imports and the decline in exports: in 1990 the current surplus would be 52 billion dollars less than the base case and would become negative by the sixth year of the simulation. Looking at industrial production, the impact is uneven across sectors. The production of the materials manufacturing sector reveals the biggest decline, dropping by 2.4 percent in 1990 and 2.6 percent in 1992. The influence on the machinery sector's production is much lower in 1990 (0.7 percent), but the decline becomes worse thereafter due to stagnant exports in later years.

Next, the long-term impacts of a nuclear suspension are summarised as follows. Compared with the short-term impacts, export performance would play a more decisive role in the long-term changes of the economy, mitigating the negative impacts on the economy from a nuclear power suspension. Specifically, although exports would be 4.1 percent less than in the base case in 1992, they would eventually increase to 3.0 percent more than in the base case in 2005, mainly because of the continuing depreciation of the yen induced by energy price increases. Domestic demand, however, would decline by 1.9 percent (12 trillion yen) in 2005 from the base case figure, and the major contributors to this decline are stagnant growth in private consumption and housing investment, indicating relatively large welfare losses in the household sector. Meanwhile, imports would remarkably increase in nominal terms, whereas they would decrease in real terms by 1.3 percent due to falling domestic demand. As a result, the Japanese real GNP would be 1.0 percent lower in 2005 (6.3 trillion yen) than in the base case, which is 0.05 percentage point less than the base case GNP growth rate during 1990 and 2005. Wholesale prices would be 7.0 percent and consumer prices 4.6 percent higher in 2005, and an inflationary trend would continue during the whole period. Between 1990 and 2005, the average rate of increase in consumer prices would be 2.7 percent per annum, 0.3 percentage point higher than in the base case. Moreover, the current account surplus would fall rapidly, owing to increasing payments for energy imports. For production activity, the materials manufacturing industry would show a sharp decline of 1.7 percent in 2005, while the machinery sector would suffer slightly, only 0.3 percent, because higher exports would partly compensate for the decline in domestic demand for this sector.

4. Conclusion

Using the CRIEPI Medium-Term Economic Forecasting System, this paper has tried to evaluate the possible impacts of a nuclear power moratorium on the world and Japanese economies. The simulation results show that two scenarios (immediate suspension and phased suspension) have similar effects in the long term, but significantly different effects in the short term. When examining the short-term impact, world oil prices rise to $37.5/barrel in the second year of the simulation period (1991), which is $18 higher than the base case level. This 'oil shock' impact raises the wholesale price level in Japan by 6.4 percent and reduces Japanese real GDP by 1.6 percent (5 trillion yen), resulting in huge economic costs in the second year of a nuclear moratorium. Meanwhile, long-term impacts of a nuclear power halt are also very costly, and GDP would decline by 1.0 percent for the G-7 countries as a whole and by 1.2 percent for Japan in 2005.

These results indicate that any nuclear suspension policy, whether drastic or gradual, would have a significant stagflationary impact on the economy. Although the costs to maintain or build up nuclear power stations are high, this implies that the opportunity costs of doing without nuclear power are also huge. Therefore, nuclear suspension policies, if implemented at all, should be accompanied by other policies to mitigate negative impacts on the economy and world energy markets. Though not explicitly stated in our model, another important implication is that nuclear moratorium policies once planned in several industrial countries would have an unfavourable impact on most oil-importing developing countries by deteriorating their terms of trade and by shrinking the market for their exports. These potential global economic impacts should be conscientiously taken into account whenever a country consider a nuclear moratorium.

Finally, a nuclear suspension policy would lower the demand for energy in Japan mainly through price effects, and at the same time would drastically increase CO_2 emissions because of the fuel shift to oil and gas from nuclear as an electric power source.

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