

September 26, 2011

Structural Change in Industry to Ease Downside of Power Shortage

– Avert Current Account Deficit by Shifting Resources to Machinery Industry –

Tatsuo Kobayashi, Senior Economist
Katsuaki Ochiai, Associate Senior Economist
Yuta Tachi, Economist

All nuclear power stations in Japan may be forced to cease operation in the wake of the disastrous accident at the Fukushima Daiichi nuclear power plant. We analyzed the overall economic impact of the accident in our 37th Medium-Term Economic Forecast, “Economic Losses Could Hit ¥7 Trillion if all Nuclear Plants Cease” (<http://www.jcer.or.jp/eng/economic/medium.html>). We estimated that Japan’s potential gross domestic product (GDP) could be reduced by as much as 1.6% points in fiscal year 2012 (April 2012 - March 2013) if all nuclear power plants were shut down. As late as FY2020 it could still be reduced by as much as 0.5%. We also noted our view that the current account could turn negative from FY2017. That said, we have not made a detailed analysis of the impact on local industry around the country. In the present report, we have used the JCER regional computable general equilibrium (CGE) model to estimate the impact over the medium to long term. Power shortages resulting from the shutdown of nuclear power stations and higher power costs associated with the substitution of thermal power generation are delivering shocks to the economy, but industrial restructuring could reduce the margin of decline to 0.4%. If Japanese industry could be structurally altered to power it through energy-saving technology, it might be possible to avoid a decline in the production of machinery, the nation’s mainstay industry. We also found that averting a current account deficit will require belt tightening in domestic demand (-0.6% in consumption and -0.3% in investment), and a shifting of resources to export industries (to boost exports by 0.7%). This promotion of competitiveness in industry with simultaneous belt-tightening in consumption may impose sacrifices in the livelihood of the Japanese public.

Bottom Line

- Substantially ease the impact of power shortages on GDP by restructuring industry.
- Leverage the positive implications for the machinery industry.
- Reduce the increase in fossil fuel imports by about ¥1 trillion compared with our 37th Medium-Term Economic Forecast.
- Avert current account deficit by restraining domestic consumption, giving priority to exports.

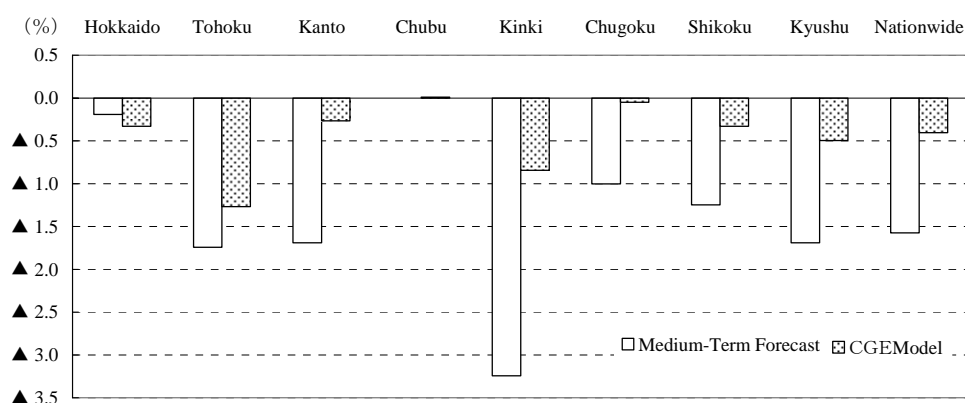
- Restructuring could cut negative impact to 1/4 of what it might otherwise be

In our Medium-Term Economic Forecast, we considered the impact of the power shortage on local areas from the standpoint of the past electric power sales. This methodology did not allow us to consider efforts which business firms might make to cope with increased electric power costs due to power shortages. Power shortages caused

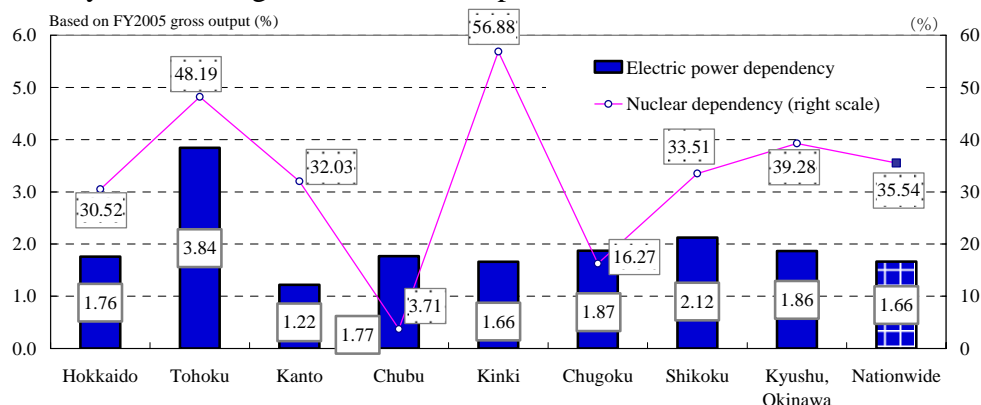
by a shutdown of all of Japan's nuclear power plants would impose direct constraints on production and could only be resolved by increasing electric power supplies through construction and expansion of thermal power plants. In the present report, we have employed a CGE model to determine the degree to which the impact of power shortages can be minimized through industry structure adjustments in the event of the kind of power shortages anticipated in our Medium-Term Economic Forecast (see Reference Table, p. 6). Our findings are shown in the upper frame of Figure 1.

Comparing the findings of our Medium-Term Economic Forecast with those resulting from our present CGE analysis shows that industrial restructuring could greatly ease the impact from electric power constraints. In our Medium-Term Economic Forecast, we found that the impossibility of bringing new thermal capacity online within FY2012 would probably shave 1.6% from potential GDP in that year. In our present analysis, however, we find that, even without an increase in thermal power generation, this negative impact could hold to one fourth of what it might otherwise be if efforts are made to restructure industry over the intermediate to long term. The impact would be different depending on the local area concerned, of course. As seen in the bottom frame of Figure 1, the negative impact would be comparatively severe in the Kinki region, which depends heavily on nuclear power generation, and in the Tohoku region, where electric power comprises a major share of the local industry.

Figure 1. Impact of Electric Power Supply Constraints on FY2012 GDP: Medium-Term Forecast vs CGE Model



Dependency of Each Region on Nuclear-Generated Power and Share of Electric Power Industry in the Region's Total Output



Source: *Inter-Regional Input-Output Tables, System of National Accounts* and other sources.

Note: Regional categories based on inter-regional input-output tables do not correspond with service areas of the respective power companies. Under inter-regional input-output tables, Hokuriku falls within

both Chubu and Kinki.

Industrial restructuring would ease the impact of power shortages on GDP through price mechanism. Because power shortages will remain in some areas even as thermal power generation is increased to offset nuclear power plants which are shut down, the price of electric power will rise. In their effort to maximize profit, business firms will shift capital and labor to industries which depend less on electricity or are more energy efficient. In estimating the amount of electric power generated, our model assumes that utilities will raise the operating rates of online plants and restart those that are idle. But the present analysis does not take into account any new generation capacity since it would take about ten years to complete the necessary environmental assessments and other procedures. Since our purpose is to determine the impact of the nuclear plant shutdown by local area, our model does not consider any transfer of factories or workers between regions. As a result, the rate of increase in electricity rates for each locality will differ but will be about 20% on average nationwide (Figures 2 and 3).

Figure 2. Impact of Electric Power Shortage by Industry (change in gross output)

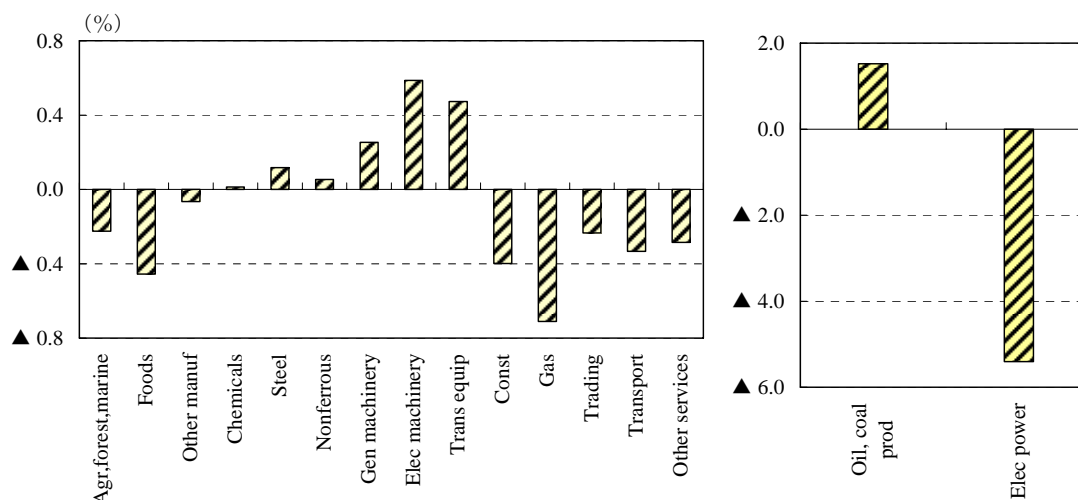
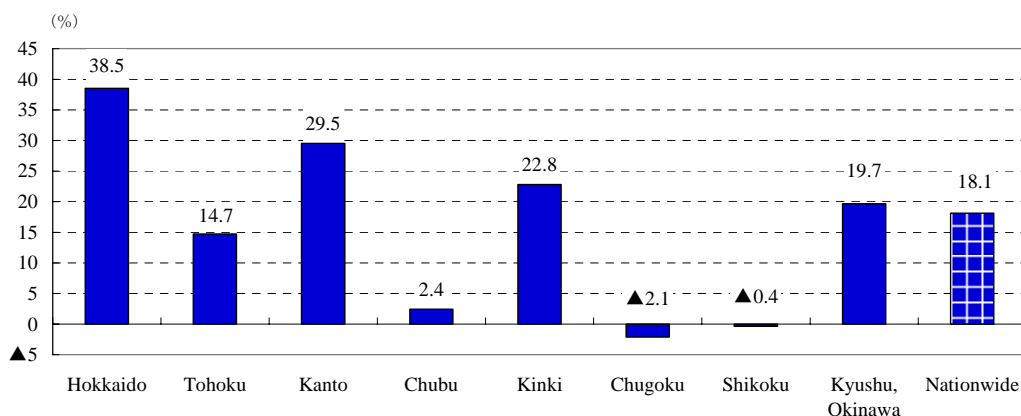


Figure 3. Change in Electricity Rates Following Nuclear Plant Shutdown



Note: Nationwide rate of change is an average of all respective regions and is weighted by total energy generated.

The nuclear plant shutdown will bring about major changes in industries such as electric power, as well as oil refining and other sectors of the oil and coal products industry. In other industries, growth will be positive in sectors of the machinery industry such as general or electrical machinery, and in the metals industries essential to

machinery production. The shift to thermal power generation to replace nuclear power plants being shut down will raise the cost of electric power, and factors of production such as capital (investment in plant and equipment) and labor (jobs) will concentrate in industries using comparatively less electricity.

- Reduce the Increase in Fossil Fuels by ¥1 Trillion

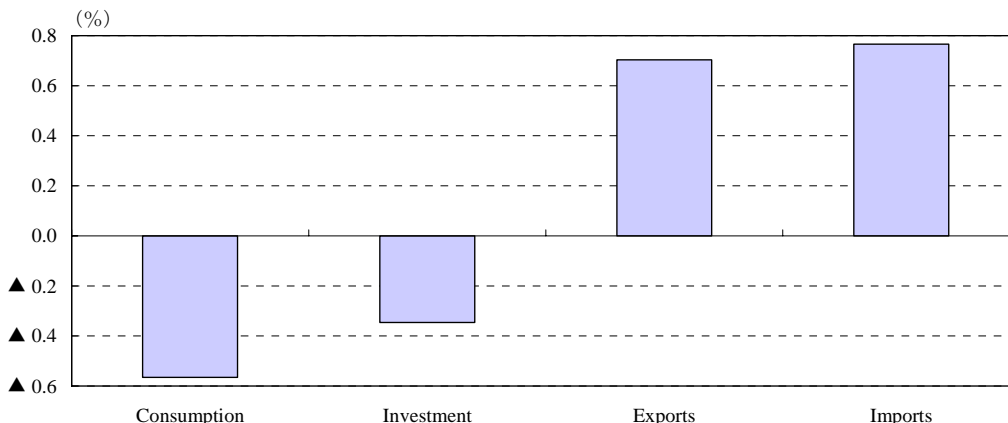
According to our estimates, the substitution of thermal power for nuclear will mean an increase of about ¥1 trillion in fuel imports. However, our model uses real prices with 2005 as a base year, and considering the 2005 crude oil price of \$56.70 per barrel and the currency rate that year of ¥110 to the dollar, the fuel cost at the present time would be just under ¥2 trillion. According to our updated forecast of June and estimates by the Japanese government, offsetting a complete stoppage of all nuclear power generation with thermal generation would result in a cost increase of ¥3 trillion. Our CGE analysis, however, indicates that the rise in electricity rates will further a shift toward a more energy efficient industrial structure, so that the fuel cost increase will not be as great as anticipated.

According to our revised Medium-Term Forecast, Japan would experience a chronic current account deficit from and after FY2017 because a stoppage of all nuclear power generation would mean not only increased fossil fuel imports but constrained exports, since power shortages would constrain the supply side.

Our CGE analysis assumes that Japan's current account balance remains at the level it was in 2005, or a surplus of about ¥18 trillion (based on 2005 prices). These results can also be regarded as indicating the structure of GDP amid efforts to avert a current account deficit. In the event of a complete stoppage of nuclear power generation, it would be necessary to increase imports by 0.7% over the level otherwise prevailing if they could be kept operating. For this reason, domestic demand would be constrained. For example, consumption would need to be constrained by about 0.6% (Figure 4). (In our revised Medium-Term Forecast, we anticipated that the price of crude oil would reach \$141 per barrel, or 2.5-fold higher than 2005, while the dollar-yen rate would reach ¥83.2, reflecting an appreciation of the yen by about 25%. Our estimates indicate that it will be impossible to maintain a nominal current account surplus of ¥18 trillion in 2020.)

Economic action to avert a current account deficit as indicated by our findings would in some respects require sacrifices in social well being, as through constraints on consumption, and would thus require some understanding on the part of the public.

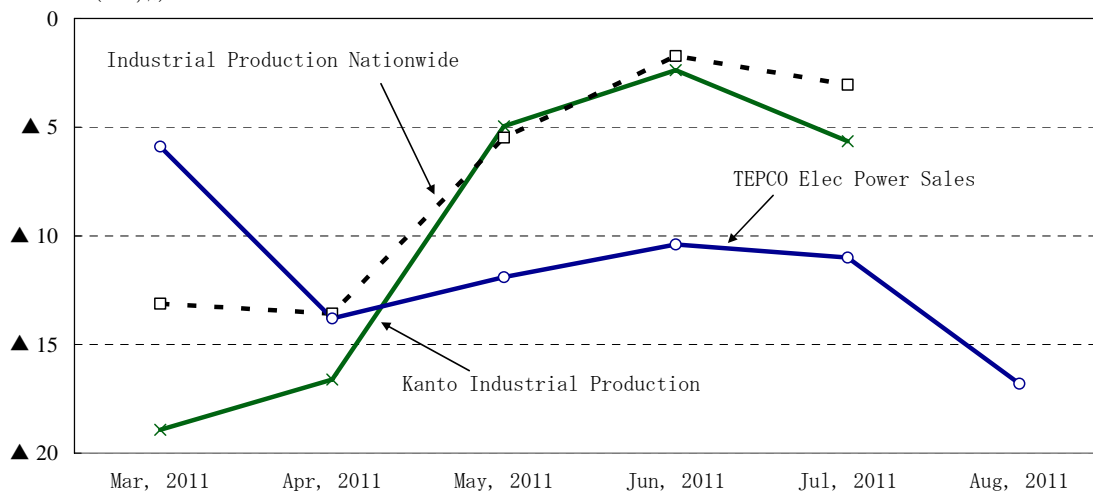
Figure 4. Growth in Main Components of Demand with Complete Nuclear Shutdown



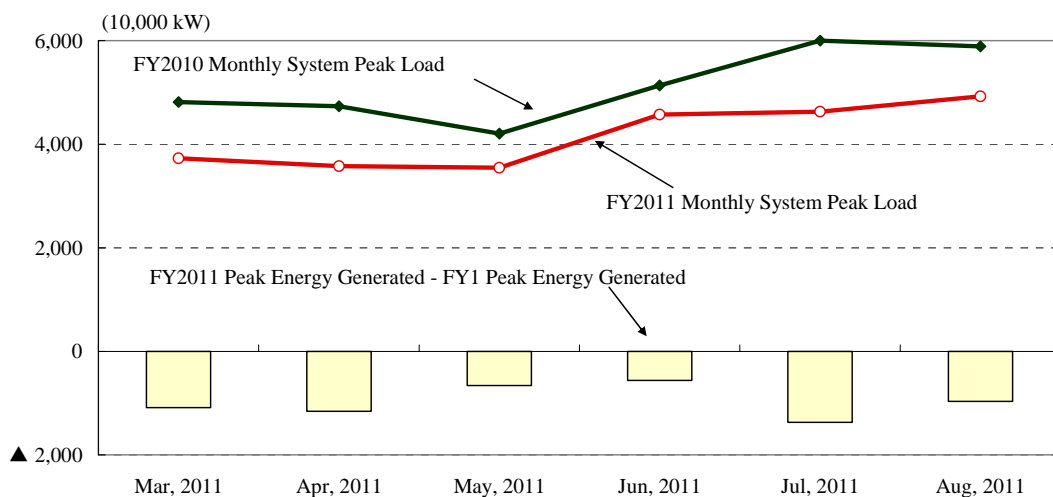
However, in view of the trend in industrial production and changes in (TEPCO's) electric power sales in the Kanto region, it is by no means clear what influence the electric power shortage will have on production activity. During the restrictions on use of electric power in the Kanto region from July, the system peak load fell by more than 20% from July of 2010. Production, however, fell by -5.7% versus the same month of the previous year, and since nationwide production fell by -3.0% over the same period, it appears that the electric power shortage did not have a major impact on production activity (Figure 5 upper and lower frames).

The question is whether the shortage rates anticipated under our Medium-Term Forecast and our present analysis are appropriate. In coming reports we will analyze these questions in more detail in order to refine the accuracy of our estimates.

Figure 5. TEPCO Electric Power Sales and Production Activity (YoY, %)



Decline in TEPCO System Peak Load (FY2010 vs FY2011)



Source: Tokyo Electric Power website, Index of Industrial Production.

Reference Table: Rates of Power Shortages Underlying Estimates

Power Co.	Output needed (10k kW)	Output available (10k kW)	Power shortage (10k kW)	Power shortage rate (%)	Power shortage rate for each region	
Hokkaido Elec	115.8	22.7	93.1	17.0	Hokkaido	17.01
Tohoku Elec	244.9	105.5	139.4	9.5	Tohoku	9.51
Tokyo Elec	1,322.4	398.9	923.5	15.4	Kanto	15.36
Chubu Elec	299.6	299.6	0.0	0.0	Chubu	0.00
Hokuriku Elec	120.6	51.9	68.7	12.6	Kinki	11.80
Kansai Elec	852.6	493.7	358.9	11.7	Chugoku	3.08
Chugoku Elec	36.0	0.0	36.0	3.1	Shikoku	5.55
Shikoku Elec	89.0	57.0	32.0	5.6	Kyushu+Okinawa	11.76
Kyushu Elec	469.9	270.6	199.3	11.8		
Total	3,550.7	1,699.8	1,850.9	10.7		

Note: Hokuriku Electric's service area is included in Kinki region since it has no classification in 2005 Inter-Regional Input-Output Tables.

Box: The CGE Model

The computable general equilibrium (CGE) model estimates the impact of shocks on the economy using two assumptions: (1) Through the utility maximizing behavior of households and the profit maximizing behavior of business firms, labor (people) and capital (factories) will move into industries experiencing rising demand, and (2) price adjustments will operate in each market, including that for goods, labor and capital, until supply and demand balance again. There will arise no

unemployment or idle facilities (no “demand gap” is anticipated), and adjustments based on economic principles will result in stable consumption, investment and industrial structure.

The present estimates are based on “comparative statics” and do not clearly define the period required for the adjustments. (The model assesses the impact of shocks by comparing the situation prior to an adjustment (the benchmark equilibrium) with that after the adjustment. Since changes in industrial structure normally require time, estimates can be interpreted as applying over a medium to long-term period. Also, a constraint is applied under which the current account balance is regarded as fixed at the benchmark level, so an increase in fossil fuel imports means a corresponding growth in exports (implying the possibility of economic resources moving into the machinery industry). The present model looks at the impact of a nuclear power plant shutdown by region and to the extent possible is configured based on the assumptions that, given environmental regulations and other factors, about ten years will be required for the construction of large thermal power plants, that capital and labor will not move between regions, and that no new power plants will be built to substitute for nuclear power generation.

For inquiries regarding this paper, please contact Tatsuo Kobayashi of the JCER Economic Research Department at t.kobayashi{at mark}jcer.or.jp. *Please change {at mark} to @