Will Ratification of the Kyoto Protocol Result in Economic Loss?

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Shonan Environmental Research Force

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0. Abstract

In March the U.S. government announced that it would withdraw from the Kyoto Protocol. One of the reasons given was that if the U.S. were to reduce its greenhouse gas emissions in accordance with the Protocol, it would impact negatively on that country's economy.

This research analyzes whether the limitations imposed by GHG reductions have a negative effect on the macroeconomy, the reason being that if there are no such effects, the U.S. loses a vital justification for quitting the Protocol. This analysis uses GTAP, which is widely acknowledged to be a good applied general equilibrium (AGE) model. Developed at Purdue University in the U.S., this model can analyze the impacts on the world economy due to a variety of changes such as energy price increases. For this analysis we used nine regions including the U.S. and Japan, and eight industry categories including agriculture, energy, and machinery.

Japan alone is placed in "disadvantageous" circumstances by having the U.S. reject the Kyoto Protocol, but having Japan ratify it. An additional 20% ad valorem tax is levied only on Japan's energy as the cost of reducing greenhouse gas emissions. This tax is more or less equivalent to \$30/t carbon. Under this assumption we calculated what changes would arise in the world economy, including the U.S. The analysis assumes two cases: a no-reform case and a reform case. In the former case businesses react passively to changes in energy taxes, meaning that they do not develop new products or reorganize themselves, but instead maintain their current production systems and organizations, and cope with soaring energy prices through production changes and product price hikes. In the latter case businesses cope proactively with higher energy prices through innovation such as new product development and energy conservation. As a result the industrial structure will evolve toward lower energy consumption.

The reform case is more realistic, as far as Japan's history to date shows. Limitations such as resource shortages and overpopulation have in fact served to promote technological and institutional

innovation. If that were not the case, it would have been impossible for a small island nation with nothing but a large population and no resources to build itself into the world's second-largest economy in only 100 years. A recent example would be the high added value created by Japan's machinery industry in order to remain competitive in the face of growing competition from other Asian nations, information technology innovation by other developed countries, and other challenges. Between 1986 and 1997 the value added rate of Japan's machinery industry increased about 8 points from 29.6% to 37.8%. A regression analysis reveals that this change is attributable to technological innovation and increases in real energy prices. That is to say, the effect of rising energy prices is to encourage technological innovation by industries that use relatively little energy, which makes them more competitive. This is among the assumptions fed into the reform case.

In the no-reform case only Japan's GDP declined, by about $6.5 billion (1995 base year), making Japan the only country to lose out. This decline corresponds to a decrease of about 0.1% of Japan's GDP. By contrast, the U.S. GDP increased about $5.2 billion. Although energy prices in Japan rose about 17%, prices in other sectors fell as a manifestation of economic stagnation, so prices overall increased only about 0.4%. On the other hand, the U.S. experienced an overall price rise of about 0.8% due to expanded demand generated by economic expansion. Except for prices, this is a manifestation of the economic loss that the U.S. claims will happen due to energy limitations. Japan's energy expenditures decreased about 9% in terms of value.

In the reform case the value added rate of Japan's machinery industry rose 0.8%, and its spillover effect was a 0.7% rise in the value added rate throughout the rest of Asia, and a 0.5% increase in that of Western Europe. As in the no-reform case, a 20% tax was levied on Japan's energy. Japan's GDP grew about $47.3 billion (1995 base year), which corresponds to a GDP increase of about 0.9%. GDP increases for the rest of Asia and Western Europe were $11.5 billion and $13.9 billion, respectively. On the other hand, the U.S. GDP decreased about $45.5 billion, or about 0.6%. In terms of prices, although Japan's energy prices jumped about 17%, the machinery industry realized increased productivity and lower prices. In other sectors prices rose because of the business expansion, putting the overall increase in prices at 0.7%. By contrast, deflation in the U.S. caused by economic contraction engendered an approximate 0.8% drop in prices. Japan's energy expenditures decreased about 11% owing to its increasingly energy-saving industrial structure.

As this shows, Japan could greatly benefit its own economy by taking the initiative and going ahead with ratification of the Kyoto Protocol. It is hard to understand why Japan's government and industry should hold back from ratification on the basis of a rationale like that of the U.S. To Japan, ratification could very well serve as an excellent springboard to break out of its long economic slump

1.Introduction

On March 28, 2001 the U.S. government announced its intention not to ratify the Kyoto Protocol to the United Nations Framework Convention on Climate Change. [1] In a June 11 press briefing, President Bush offered the following three grounds for the decision. [2]

(1) If the U.S. were to reduce its GHG emissions in compliance with the Kyoto Protocol, it would have a negative impact on the U.S. economy. Specifically, it would result in slower economic growth, worker layoffs, and price increases for consumers.

(2) It does not make sense that developing countries like China and India, which are large GHG emitters, are exempt from making reductions under Kyoto.

(3) Reduction targets are not based on science.

This discussion will focus on the first justification. [2a] If we rephrase the president's argument, he is saying that the issue is whether countries which do not participate in the Protocol will receive (occasional) economic benefit. We explored this question using the Applied General Equilibrium (AGE) model developed by the Global Trade Analysis Project.

1. GTAP

The Global Trade Analysis Project was founded in 1992 by Professor T. W. Hertel and others at Purdue University to assess the impacts of international trade liberalization on various countries, and the AGE model was developed by the project. [3]

The AGE model is a tool for analyzing market transactions based on utility maximization and profit maximization by economic entities such as households and businesses, as well as inter-market transactions. A characteristic of the model is its ability to quantitatively assess the impacts of economic policy changes on the industrial structure, resource allocation, income allocation, and other items through changes in relative prices and the changes in the behavior of economic entities in response to relative price changes. [4]

It has the following advantages and shortcomings. [5]

AGE model advantages and shortcomings

(Advantages)
・ It can have a proper microscopic context for policy analyses.
・ Its analyses are internally consistent.
・ It offers both logical solutions and numerical solutions.
・ It provides a view of changes in social welfare.

(Shortcomings)
・ The model's empirical background is weak. A priori parameters and functional forms are provided, but solutions can vary greatly depending on givens.
・ Nothing can be said about what will happen when not in a state of equilibrium, or during the process leading to an equilibrium.
・ The existence of an equilibrium solution is assured, but not uniqueness.

We chose to use GTAP for this analysis to examine developments in the Japanese and U.S. economies in connection with the world economy. Our reasoning was that although the AGE model has a variety of drawbacks, it is suitable for obtaining numerical and coherent solutions to problems that involve the world economy, such as the Kyoto Protocol.

2. The Model and Its Main Assumptions

1) Regions and Industrial Categories

We created nine regions. Japan and the U.S. are one region each unto themselves.

<Regions>

Symbol	Region name	Countries/economies
USA	U.S.	United States
JPN	Japan	Japan
CHN	China	People's Republic of China
OAS	Other Asia	South Korea, Indonesia, Malaysia, the Philippines, Singapore, Thailand, Vietnam, Hong Kong, Taiwan, India, Sri Lanka, other SE Asia
OOE	Western Europe	Great Britain, Germany, Denmark, Sweden, Finland, other EU members, EFTA members
FSU	Former Soviet Union, Eastern Europe	Former Soviet Union and Eastern European countries
OPC	OPEC countries	Other Middle Eastern countries (excluding Turkey)

	(excluding Indonesia and Venezuela)	
LAM	Central/South America	Mexico, Central American and Caribbean countries, Venezuela, Columbia, other Andean Group nations, Argentina, Brazil, Chile, Uruguay, other South American countries
ROW	Other (including Oceania and Canada)	Australia, New Zealand, Canada, Turkey, Morocco, other North African countries, Southern Africa Custom Union members, other Southern Africa countries, other sub-Saharan countries, other world countries

For industrial categories we chose eight sectors.

<Industrial Categories>

Symbol	Sector	Sub-sectors included
AGR	Agriculture	Rice, wheat, other grains, vegetables/fruits/nuts, rape oil, sugarcane/beets, vegetable fiber, other agricultural crops, livestock products cattle, sheep, goats, horses, and other animals, raw milk, wool and silk, forestry, fisheries
ENE	Energy (primary)	Coal, oil, gas
PCP	Oil and coal products	Oil and coal products
MCN	Machinery	Motor vehicles and their parts, other transportation machinery, other machinery and equipment
ELG	Electricity and gas supply	Production and supply of power and gas
SVC	Services	Water, trade/transport, administrative services / education / medical care / police, housing
OTM	Other manufacturing	Meat, meat products, vegetable oils/oils and fats, dairy products, processed rice, sugar, other processed foods, beverages/tobacco products, clothing, leather products, wood products, paper products/publishing, chemical/rubber/plastic products, other mineral products, iron, other metals, metal products, other manufactured products, financial/business/entertainment services
OTH	Other industries	Other minerals, construction

Ordinary global environmental models treat energy in great detail while giving other industrial sectors a very rough breakdown. [5a] But because our calculations observe the industrial structure changes that occur in conjunction with energy price changes, industries outside of the energy sector are divided into machinery, services, other manufacturing, and other fields. As noted previously, the purpose is to observe the changes in the industrial structure occurring because of Protocol participation, and the changes in general economic benefit occurring as a result.

This simulation calculates the production, imports and exports, consumption, and other items of the world's countries in nine regions and eight industrial categories.

2) The Cases

In order to analyze whether the U.S. rejection of the Protocol will be an economic benefit to that country, Japan was purposely placed in "disadvantageous" circumstances. While Japan is the only country to levy a high energy tax, the U.S. and other regions do not adopt such policies. Although this scenario is somewhat unrealistic, it is useful in showing distinctly where the problem lies, the reason being that if the U.S. government's argument is correct, Japan will be put at an economic disadvantage while the U.S. gains an advantageous position. Because Japan's energy is taxed an additional 20%, its energy is more expensive than that of other regions.

Our two cases were the no-reform case and the reform case. The AGM model observes the effects of policies and other factors by seeking the change amounts in each case from calculated absolute values. Thus when finding a standard solution (energy taxes as at present) and establishing the above two cases, we checked to see what kind of changes came about in economic variables. As noted above, the no-reform case imposes an energy tax increase on Japan alone. The reform case assumes that, in addition to this tax increase, Japan's machinery-related companies will undertake technological innovation to overcome this limitation. We shall begin by examining the significance of the reform case.

3) **Significance of the Reform Case**

According to the U.S. argument, levying energy taxes in order to attain Protocol targets will result in a GDP decline, higher prices, and increased unemployment. It is indeed quite possible that producers will respond to higher energy prices with passive behavior, which is the no-reform case.

But in reality business managers are not so foolish; the more such obstacles are put in their way, the more they will think of ways to get around them. In other words, capable managers will find opportunity in a crisis. Such managers can now be found in recent American information technology companies and throughout the world. The advances achieved by Japan's automotive industry shows that they can also be found in Japan.

Arthur Hailey's 1971 book Wheels, which became a best-seller in the U.S., wrote about the bad impression that industrialized countries had of Japanese cars in the early 1970s, which was that in quality they simply could not be compared to American cars. And in fact Japanese car quality at that time was perhaps not very good.

But now three decades later Japanese cars (eight-company total) have about 25% of the U.S. market, and the share of the Big Three is falling toward 65%. [7] Japanese cars occupy a primary place in the U.S. market, ranking with American and European cars. So what happened in Japan's automobile industry during those 30 years? Let us take Honda as an example. [8]

In the late 1960s U.S. Senator Edmund Muskie called for legislation that would toughen controls on motor vehicle exhaust and reduce its carbon monoxide, hydrocarbon, and NOx by at least 90%. This later became the 1970 Clean Air Act, and the restrictions were to be implemented in the mid-1970s. Automakers set to work on reducing vehicle emissions while at the same time asking that the deadline be extended, and there was not a single automaker in the world that expected it could meet the stipulated target. However, this turned out to be a good opportunity for Honda -- which had gotten a late start as a four-wheeled vehicle manufacturer -- to catch up to established automakers. At that time there were two conceivable ways of reducing vehicle emissions: One was making engines burn cleaner, and the other was catalytic conversion.

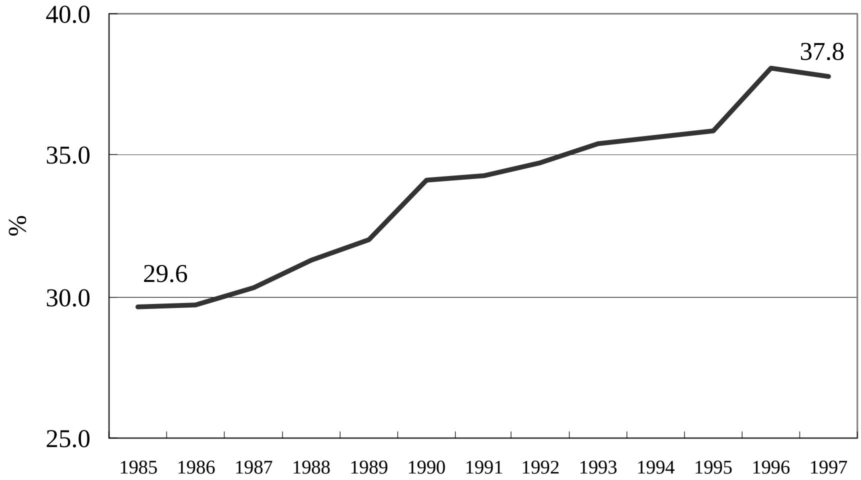
Other automakers tried catalytic conversion, but Honda developed a cleaner burning engine (CVCC). USEPA testing showed that this engine met the requirements for CO, NOx, and HCs, and when fitted with this engine the Honda Civic became the first car to qualify under the standards. In this way Honda used the restrictions as an opportunity to become one of the world's front-rank automakers. In 1982 Honda capitalized on the two subsequent oil shocks -- which fueled demand for small, economical cars -- by becoming the first Japanese automaker to build a plant in the U.S. (Ohio) that assembled complete cars. In 1990 the Accord became the top-selling car in the U.S., and Honda is now a world-class automaker. This example illustrates the fact that as circumstances become increasingly formidable, superior entrepreneurs will come up with more technological innovations to overcome them.

4) Reform Case Specifics

Ordinarily economic efficiency and production drop due to limitations like those on resources, but as the foregoing illustration shows, such limitations actually increase overall economic efficiency and production because businesses use them as opportunities to achieve a quantum leap in progress. In this simulation the reform case incorporates the assumption of such resilient responses by business. Specifically, this case assumes that the Japanese machinery industry's value added rate will rise in response to higher energy taxes.

This is not such a curious assumption. Fig. 1 shows the value added rate of Japan's machinery industry from 1985 to 1997. It changes instead of remaining steady as assumed by ordinary AGE models and other models. The following equation estimates the factors causing the change.

Fig. 1 Value Added Rate (%) of Japan's Machinery Industry (1985-1997)



Source: Economic Planning Agency, SNA Inter-industry Relations Tables for various years

Estimate period: 1986-1997

Machine industry value added rate = 10.8 + 0.67 * time trend + 19.2 * real oil price

Determination coefficient = 0.97, standard error = 0.45, DW ratio = 2.1

Japan's machinery industry raised its value added rate through technological advances (time trend) and energy price increases. In the reform case we decided to enter this in the assumptions, i.e., we assumed that because energy prices rose due to energy tax additions, the machinery industry's value added rate increased by 0.9%. It was assumed that its spillover effect raised the value added rates of the machinery industries in the OAS (0.7%) and OOE (0.5%) regions.

In performing assessments we compared the reform and no-reform cases with the base data, which involves application of a method called comparative statics. GTAP is a static system in which parameters ordinarily do not change, but two states are compared by comparing the results obtained before and after changing parameters.

3. Calculation Results

1) Summary (Effects on GDP and Prices)

<Effects on GDP>

In the no-reform case only Japan's GDP fell, by $6.5 billion from the base data, corresponding to 0.1% of GDP, while the U.S. realized a $5.2 billion GDP gain.

But in the reform case, Japan's GDP increased by $47.3 billion, or 0.9% of base data GDP.

Similarly, the GDPs of Other Asia and Western Europe increased by $11.5 billion and $13.9 billion, respectively, while that of the U.S. decreased by $45.5 billion.

＜Effects on Prices＞

Table 1 shows the changes in domestic market prices for both the no-reform and reform cases. In both cases, Japan's energy prices rose by about 17%, and there were price increases of approximately 1 to 2% in the secondary energy industries of oil/coal products and electricity/gas. [8a]

Table 1　Domestic Market Price Changes in Both Cases

(% Change from Base Data)

a) No-reform case

% Change	USA	JPN	CHN	OAS	OOE	FSU	OPC	LAM	ROW
Agriculture	0.1	-0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Energy (primary)	0.1	17.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Oil/coal products	0.1	1.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Machinery	0.1	-0.2	0.1	0.0	0.1	0.1	0.1	0.1	0.1
Electricity/gas	0.1	0.8	0.1	0.1	0.1	0.1	0.2	0.1	0.1
Services	0.1	-0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Other manufacturing	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Others	0.1	-0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1

b) Reform case

% Change	USA	JPN	CHN	OAS	OOE	FSU	OPC	LAM	ROW
Agriculture	-0.4	0.5	-0.3	0.2	0.0	-0.1	-0.1	-0.3	-0.2
Energy (primary)	-0.3	17.0	-0.2	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
Oil/coal products	-0.3	1.9	-0.3	0.2	0.0	-0.2	-0.1	-0.3	-0.2
Machinery	-0.6	-1.3	-0.5	-1.5	-1.1	-0.3	-0.3	-0.5	-0.4
Electricity/gas	-0.5	1.8	-0.4	0.5	0.0	-0.2	-0.1	-0.5	-0.3
Services	-0.6	0.8	-0.4	0.6	0.1	-0.3	-0.1	-0.5	-0.3
Other manufacturing	-0.6	0.9	-0.3	0.5	0.1	-0.2	-0.1	-0.5	-0.3
Others	-0.6	0.8	-0.4	0.4	0.1	-0.3	-0.1	-0.5	-0.3

Table 2 GDP Change (Million US$)

	No-refor m	Reform
USA	5179	-45536
JPN	-6463	47328
CHN	459	-3038
OAS	1082	11482
OOE	7098	13941
FSU	687	-2034
OPC	803	-647
LAM	1461	-7631
ROW	1527	-5656
Totals	11832	8209

Table 3 Current Account Balance Change (Million US$)

	No-refor m	Reform
USA	-1427	7331
JPN	5463	-5357
CHN	-73	737
OAS	-416	-1401
OOE	-2207	-5436
FSU	-172	689
OPC	-386	100
LAM	-359	1785
ROW	-427	1545
Totals	-3	-6

Table 4 Changes in Imports and Exports (Million US$)

1) No-reform case

	U.S.		Japan		Other Asia	
	Exports	Imports	Exports	Imports	Exports	Imports
Agriculture	-6	-10	5	109	-1	-21
Energy (primary)	7	-46	-151	114	6	-66
Oil/coal products	11	-8	-34	-90	53	-7
Machinery	-440	-745	3438	620	-181	-179
Electricity/gas	0	-1	0	0	0	0

Services	17	-73	352	338	-6	-54
Other manufacturing	140	-265	431	272	241	-193
Others	3	-7	8	46	9	-16
Totals	-269	-1155	4050	1409	123	-537

2) Reform case

	U.S.		Japan		Other Asia	
	Exports	Imports	Exports	Imports	Exports	Imports
Agriculture	280	84	-13	-190	-201	-82
Energy (primary)	12	276	-153	355	-123	22
Oil/coal products	29	47	-72	-167	52	-17
Machinery	-8753	1717	2250	1611	4381	3521
Electricity/gas	0	9	0	0	-2	-9
Services	1990	1049	-850	-1117	-1496	-781
Other manufacturing	6011	4383	-3623	-3280	-4434	-1890
Others	107	93	-21	-135	-215	-127
Totals	-325	7656	-2481	-2873	-2037	637

Table 5 Industrial Structure Changes (Value of Production)

1) No-reform case

	U.S.	Japan	Other Asia
Agriculture	-17	154	19
Energy (primary)	34	-71	14
Oil/coal products	-13	-267	66
Machinery	-997	2871	-465
Electricity/gas	-26	-720	-1
Services	132	1536	-10
Other manufacturing	166	-1198	62
Others	663	-2554	254
Totals	-59	-250	-62

2) Reform case

	U.S.	Japan	Other Asia
Agriculture	1043	-1032	-794
Energy (primary)	178	-85	-144
Oil/coal products	-115	-586	9
Machinery	-14178	12474	11572
Electricity/gas	-71	-1416	-162

Services	**2800**	**226**	**-1474**
Other manufacturing	**10789**	**-12739**	**-7497**
Others	**-2642**	**7060**	**1885**
Totals	**-2195**	**3902**	**3394**

Note: This table shows the differences between cases in the values obtained when values in millions of US$ are divided by price indexes.

Each case shall be examined individually below.

3) No-Reform Case

This case assumes that a 20% tax is levied on energy in Japan (assuming current oil prices this comes to about $30/t carbon), and that no reforms such as technological innovation occur.

Japan's GDP alone fell about $6.5 billion (corresponding to 0.1% of base GDP), while the U.S. GDP climbed about $5.2 billion. Consumer prices in Japan increased overall only about 0.4% because although the energy tax pushed primary energy up about 17%, prices in other sectors declined owing to economic stagnation. On the other hand, prices in the U.S. increased about 0.8% due to expanded demand generated by a surging economy.

In terms of current account balances, the U.S. had a $1.4 billion deficit increase while Japan realized a $5.5 billion surplus increase (Table 3). The main reasons for the expanded U.S. deficit were increased imports by its machinery sector and other manufacturing sectors, and lower machinery exports. The primary factor that contributed to Japan's increased surplus was expanded machinery exports (Table 4). This shows that even without any reforms such as technological innovation, Japanese manufacturers responded to higher energy prices by working hard at machinery exports.

Industrial structure changes (production value divided by price indexes for each sector) show that in the U.S., energy, services, other manufacturing, and other industries expanded production (Table 5), while in Japan there was expanded production in machinery and services, but production decreases in energy-related industries (energy, oil/coal products, electricity/gas), other manufacturing, and other industries.

Imposition of energy taxes reduced the value of Japan's energy consumption by about 9%.

4) Reform Case

In this case Japan's machinery industry increased its value added rate through technological innovation. Specifically, companies responded to rising energy prices by actively working on innovations, such as new product development and energy conservation. Innovation in turn made the industrial structure less energy-consumptive. An increase of 0.8% in the value added rate of Japan's machinery industry engendered a spillover effect that raised the value added rates of Other Asia and Western Europe by 0.7% and 0.5%, respectively. This case assumed the same energy taxes as the no-reform case.

Japan's GDP increased by about $47.3 billion, corresponding to a GDP increase of 0.9%. At the same time the GDPs of Other Asia and Western Europe rose $11.5 billion and $13.9 billion, respectively. On the other hand, the United States' GDP fell about $45.5 billion, corresponding to 0.6% of that nation's GDP.

Energy prices in Japan increased about 17%, but machinery prices declined because the machinery industry improved its productivity, and prices rose in other sectors owing to economic expansion. As a result, prices overall increased 0.7%. By contrast, the U.S. economy contracted because of deflation, and prices declined about 0.8%.

While the U.S. current account balance experienced a $7.3 billion surplus increase, Japan had a $5.4 billion increase in its deficit (Table 3). The U.S. surplus was attributable to a slight decrease in exports and a large decrease in imports. There was a considerable decline in machinery sector exports (Table 4). The reasons primarily responsible for Japan's increased deficit were decreased exports by other manufacturing, and increased imports due to the strong economy.

Industrial structure changes in the U.S. consisted of production value decreases in machinery and other industrial sectors (Table 5). Although production increased in the energy industry (primary), there was a real decrease in the secondary energy sector due to higher prices in the electric power and gas sectors. On the other hand, the machinery sectors in Japan and Other Asia had substantial production increases. Calculations showed that other manufacturing industries experienced production declines because the simulation did not assume technological innovation for them, but it is worth noting that if there were technological innovations in other manufacturing industries as well, they could have expected the same effect as the machinery industry.

Although Japan's GDP expanded, its energy consumption value declined about 11% because industry became less energy-consumptive.

5. Implications of the Calculation Results

Our calculation results have the following implications.

When energy taxes are imposed only on Japan, in the no-reform case (i.e., when the machinery industry attempts no technological innovation to surmount limitations) it is true that the U.S. economy takes a favorable turn and Japan's GNP falls. But if Japan's machinery industry finds opportunity in high energy prices, makes the necessary technological innovations, and succeeds in raising added value (i.e., the reform case), the positions of the two countries will reverse. This is the more realistic scenario in view of past experience, in which Japan's machinery industry, including its automakers, succeeded in incorporating technological innovations in a bid to overcome whatever limitations arose.

In the reform case, the lack of energy taxes or other means by the U.S. government to reduce greenhouse gas emissions resulted in only a slight production increase by the energy industry, while the machinery industry went into a severe slump. The impacts would likely vary considerably from one state to another. Table 6 shows the 10 states with the highest production values in coal and oil, in order from the highest. Texas and Louisiana are head and shoulders above the others. Table 7 lists the 10 highest states in terms of the machinery industry's production value. California, Texas, Michigan, Ohio, and New York are states with high production. Because some states are listed in both tables, excluding them in the reform case shows that, in simple terms, Louisiana and Wyoming will come out ahead, while California, Michigan, Ohio, and other states could sustain heavy impacts.

Table 6 Top 10 States in Coal and Oil Production

		Coal/Oil
1	Texas	37284
2	Louisiana	17800
3	Wyoming	3826
4	Alaska	3369
5	California	3107
6	Oklahoma	3051
7	West Virginia	2974
8	New Mexico	2941
9	Colorado	2462
10	Kentucky	2329

Table 7 Top 10 States in Machinery Production (1998 performance, millions of $, GDP base)

		Machinery
1	California	79798
2	Texas	40935
3	Michigan	39302
4	Ohio	33810
5	New York	25810
6	Illinois	25156
7	Indiana	21737
8	Pennsylvania	20629
9	Oregon	17245
10	Massachusetts	15871

Note: Machinery is the total of industrial machinery, electrical equipment, motor vehicles, other transportation machinery, and precision machinery.
Source: Bureau of Economic Analysis, "Gross State Product"

In view of the foregoing calculation results, it seems quite strange that Japan makes no move to take the initiative in signing the Kyoto Protocol. In an editorial the Mainichi Shimbun asked, "Why Hesitate to Ratify?" [9] and notes the justification by the Ministry of Economy, Trade and Industry that "Japanese industry would be put at a disadvantage if Japan reduced emissions [under the Kyoto Protocol] without U.S. participation." That is exactly the rationale of the Bush administration. It is all the more curious when one considers that, in light of the technological innovation capabilities of Japan -- especially its machinery industry, it is throwing away a good opportunity.

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Notes

1. Nihon Keizai Shimbun, April 2, 2001, morning edition.

2a. See Y. Murota and K. Ito [10] for our views on the issue of CO2 emissions by developing countries.

3. On general equilibrium models see Shoven and Whalley [1] and Ginsburg and Keyzer [2]. On the GTAP see Hertel [3], Kawasaki [4], and Economic Planning Agency [5]. The GTAP database used here is ver. 4.0 and RunGtap is ver. 2.00.

4. Economic Planning Agency [5], p. 2.

5. On the advantages, see Borges [6] and on the shortcomings see McKitrick [7] and Alston et al. [8].

5a. For example, McKibbin et al. [11] divide industries into 12 sectors, but in entertainment too is included, six sectors are resource-related, and manufacturing industries are merely divided into durable and nondurable goods.

7. Nikkei Sangyo Shimbun, June 15, 2001.

8. Ide, Koya. The Story of Honda. WAC, 1999 (in Japanese).

9. Calculations showed that if the 17% price increase in Japan's primary energy sector is shifted totally (assuming a vertical demand curve) to the prices of other sectors in inter-industry relations table (Economic Planning Agency 1995 data), price increases would be about 6% in the oil and coal products sector, 1.5% in the electric power sector, and 2.3% in the gas sector. But because in actual economies 100% price shifting is not realistic, it is reasonable to expect that these sectors will have far smaller price rises.

9. Mainichi Shimbun, "Why Hesitate to Ratify?" June 20, 2001 editorial.