3. Global Models

3.1 FUGI GLOBAL MODEL SIMULATIONS OF WORLD ECONOMY AND CO2 EMISSIONS, 1990-2000

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ABSTRACT

The purpose of this paper is twofold: the one is to introduce the new generation FUGI global model whose design concepts are reflected by the recent advancement of life frontier sciences and AI oriented expert system in computer software technology. The other is to make projections of the world economy under alternative policy scenarios on cutbacks of CO2 emissions against global warming in order to assess impacts of global changes in environment on the development of the world economy using the new generation FUGI global model.

INTRODUCTION: OUTLINE OF FUGI GLOBAL MODEL

The trend toward greater interdependence of the world economy on the global level is progressing. The appearance of complex and interrelated problems such as population, environment, energy, and development etc., has posed problems whose solution is quite impossible within the old frameworks of a single national economy. These facts help explain why, since the early 1970s, research was begun on the design of " FUGI global model."

In his own research on FUGI global models, Onishi has used a "dynamic soft systems approach," progressing from simple conceptual models to more complex theoretical ones, and then to computer models. The "first generation" FUGI global model (1.0) in early 1970s has developed into "seventh generation" model (FUGI global model 7.0). FUGI global model 4.0, M62 which has been used for projections and policy simulations of the world economy by the United Nations since 1981. FUGI global modelling system is supported by the development of both the hardware and the software of high-technology computer systems. Methodologically, the new generation of the FUGI global model has represented a new frontier in economics, stimulated by new possibilities in computer science and also by recent discoveries in biotechnology and brain physiology.

From 1991 a newest generation FUGI global model (7.0) is currently developed at the Soka University Institute for Systems Science (SUISS) in cooperation with IBM, Japan introducing artificial intelligence (AI) oriented expert system for FUGI global modelling.

A characteristic is that the economic system treated in the newest FUGI model (7.0) is extraordinarily large in scale. Not only is the world subdivided into 180 /and or 80 countries and country groupings, but into each of these national / regional economic models are incorporated 10 "sub-blocs," as follows: (1) labor and production; (2) expenditures on real GDP; (3) distributions of income: profits and wages; (4) prices; (5) expenditures on nominal GDP; (6) money, interest rates and financial assets; (7) government finance; (8) international balance of payments; (9) international finance; and (10) foreign exchange rates. In order to make the computations for such an

enormous global model, we require both a very high-capacity computer and a specially designed "software package" for use in modeling. This "software package," developed according to concepts which we developed in cooperation with IBM at the Soka University Institute for Systems Science, is called as "FGM" (FUGI Global Modelling System).

The FGM software system allows highly efficient, large-scale global modeling. It is designed in such a way that the following operations are consistently carried out: (1) as data bank for large-volume data processing; (2) estimation of the model's structural parameters; (3) dynamic simulation model testing; and (4) baseline projections and alternative scenario simulations. By applying this software, the necessary manpower needs for global modeling and alternative futures simulations are kept to a minimum, and the work of computation is accomplished quickly and efficiently. In the absence of such progress in software, large-scale econometric modeling for the global economy and reliable forecast simulation would probably be impossible to achieve.

Another characteristic of the FUGI global model is the special attention which it gives to analyzing interlinking of environment, economic development, peace and human rights in the relationships among countries.

It is worth noting that the energy model is incorporated into environment subsystem. Energy is classified into fossil and alternative energy. As a matter fact, fossil energy consists of oil, coal and gas. CO2 emissions are largely originating from the uses of fossil energy and deforestation. In this exercise we are focusing on CO2 emissions mostly from the use of fossil energy, in particular, coal.

SIMULATIONS OF ENERGY DEMAND/SUPPLY AND CO2 EMISSIONS

For simulations of world energy demand/supply and CO2 emissions in the decade of the 1990s, we have envisaged the following scenarios: (1) the baseline scenario; (2) 100% CO2 emission tax scenario; (3) three alternative global cooperation scenarios: (A), (B), and (C), each of which is expected to cutback CO2 emissions starting from 1991 toward a stabilization at the 1990 level by the year 2000.

SCENARIOS

Baseline Scenario

In order to compare alternative simulation results, we have introduced a "baseline scenario" which is based on the assumption that the policies being followed in the past by each nation will not undergo any drastic change in the future.

100% CO2 Emission Tax Scenario

For the reference purpose, we have introduced a "carbon tax" scenario on oil, coal, natural gas designed to lessen the consumption of fossils fuels which produce CO2 emissions. This is seen as a 2-step process, at the end of which a 100% tax is applied to oil, a 120% tax to coal, and a 80% tax to natural gas.. The first step, lasting approximately 1 year, beginning in 1991, involves a 30% increase in the tax on oil, and a proportional increase in the taxes on coal and natural gas. The full taxes are imposed in the course of 1992.

Global Cooperation Scenarios

Alternative Scenario A

It is expected that most of the member countries of the global society would (1) introduce " carbon dioxide emission taxes" in short " carbon taxes" of 10% on oil, 12% on coal, and 8% on natural gas in accordance with CO2 emissions and (2) reduce their economic growth rates by cutting back non-housing investment so as to stabilize their CO2 emissions at the 1990 level by the year 2000

Alternative Scenario B

In contrast to Scenario A, (1) most countries will not introduce so severe carbon dioxide emission taxes. Instead of introducing these taxes, (2) the developed countries will increase by 0.5 percent of GDP expenditures on R&D which is aimed at new technologies to reduce CO2 emissions, and (3) the developed countries will intensify technology transfer to the developing countries by increasing ODA, by amounts equal to 20% over and above total ODA in the baseline scenario, for the specific purpose of reducing CO2 global emissions to the 1990 level by the year 2000. In Scenario B, it is assumed that additional ODA and government R&D might be financed by arms reduction.

Alternative Scenario C

It is expected that (1) most countries are likely to cope with global warming effects by reducing CO2 emissions during the coming decade by introducing carbon dioxide taxes of at least 5% on fossil fuels, and that (2) the developed countries will increase R&D aimed at new technologies to reduce CO2 emissions from the present average of 0.04 percent of GDP to 0.25 percent of GDP, and (3) intensify technology transfer to the developing countries by increasing ODA, by amounts equal to 10% over and above total ODA in the baseline scenario, for the specific purpose of reducing CO2 global emissions to the 1990 level by the year 2000. It is also assumed that additional ODA and government R&D might be financed by arms reduction.

SIMULATION RESULTS

Baseline Scenario

It is assumed that the oil price increase from 17.9 dollars per barrel in 1990 to 32 dollars per barrel in the year 2000. Under such circumstances, the world economy will grow at a rate of 2.9 percent per year for the period, 1990-2000. The developed market economies will grow at an average rate of 2.6 percent per year, while the developing market economies will grow at a rate of 4.3 percent per year. The planned market economies will grow at a rate of 2.8 percent. Within this category, the USSR and Eastern Europe will grow at a rate of 1.0 percent, while China will grow at a rate of 4.6 percent. Among the developed market economies, the average growth rate of the Japanese economy is 3.9 percent, while that of the US economy is 2.2 percent. That of the EC is 2.6 percent.

Among the developing market economies, higher than average growth performance is expected in the Asia-Pacific region, where the growth rate of the ASEAN countries is 6.0 percent. The rate for the Middle East countries is 2.8 percent, and for Latin America averages 4.0 percent.

In the 1990s the world population will grow at a rate of 1.6 percent per year. The rate of population growth is only an average 0.6 percent per year in the developed market economies, but is a much higher 2.2 percent in the developing market economies. Therefore it is hardly to be expected that there will be any further narrowing of the North-South per capita income gap

Global CO2 emissions will grow at a rate of 2.3 percent per year, expanding from 6,118 MT-C (million metric tons in carbon equivalent) in 1990 to 7,674 MT-C in 2000.

CO_2 emissions originating in the developed market economies will increase from 2,957 MT-C in 1990 to 3,476 MT-C in 2000, with an yearly average increase 1.6 percent. CO_2 emissions originating in the developing market economies sharply increase from 984 MT-C in 1990 to 1,555 MT-C in 2000, with a yearly average increase of 4.7 percent. The planned market economies' production of CO_2 will grow from 2,107 MT-C in 1990 to 2,550 MT-C in 2000, with an average yearly increase of 1.9 percent. The main reason for the relatively low rate of increase in CO_2 emissions in the planned market economies as a whole is the low rate of economic growth in the Soviet Union and Eastern Europe. By contrast, China's increase in CO_2 emissions is 4.0 percent per year.

It is interesting to note that CO_2 emissions originating in Japan will increase at an average rate of only 1.58 percent, showing a tendency to stabilize toward the year 2000. CO_2 emissions originating in the United States will, in this baseline scenario, increase at an annual average rate of 1.75 percent, but without showing any tendency to decline toward the end of the decade. The USSR and China are similar to the United States, but different from Japan, are not showing any tendency for the rate of CO_2 increase to decline. Even though the rate of increase of CO_2 emissions in China is relatively high, per capita emissions in 2000 are nevertheless only 2/3 of the world average, about 1/3 of the figure for Japan, about 1/5 the figure for Australia, and about 1/8 the figure for the United States. The per capita CO_2 emissions in China are, however, in 2000 about twice the average for the developing market economies.

Under such situations the world energy requirements for the period 1990-2000 will be increased by an average annual 2.6 percent and coal demand/supply for the period will be increased by an average annual 2.5 percent.(See Table 2).

100% CO_2 Emission Tax Scenario

Today there are many economists who advocate the need to apply a surtax so called *"carbon tax"* to the consumption of fossil fuels in order to curb CO_2 emissions. However it has been hard for them to know, for example, how large such a tax should be to stabilize global CO_2 emissions at the 1990 level toward the year 2000. This is why we have made simulations of number of tax rates, ranging from just a few percent to some 200 percent.

By way of example, in our 100% tax scenario, it is expected that most of the developed market economies will achieve, or nearly achieve, a target of reducing CO_2 emissions in 2000 to the 1990 level. For example, in the developed market economies as a whole, this "rate of achievement" is 96%, and is accompanied by a drop in the average (over the period 1991-2000) economic growth rate of 1.1 percentage points compared with the baseline projections. It is interesting to note that, according our model, in the United States the 100% tax scenario is just enough to achieve the target, in which case the United States' average annual economic growth rate would decrease by 1.5 percentage points.

In the developing market economies as a whole, the "rate of achievement" is 67%., ranging from 79% in the Latin American NIES to 60% in India. The average drop in economic growth rate for the developing market economies as a whole is 0.5 percentage point.

Among the planned market economies, the "rate of achievement" in China is 82%, accompanied by a 2.2 percentage point drop in economic growth rate. In the CIS and Eastern Europe the level of CO_2 emissions in 2000 is stabilized at a level slightly less than in 1990, accompanied by a 1.2 percent point drop in economic growth rate (See Table 6).

Global Cooperation Scenario A

According to Scenario A, it is expected that the rate of world economic growth will decrease by an average annual 2.6 percentage points during the decade 1990-2000,

compared with the baseline projection.. The decrease in the annual average growth rate of the developed market economies as a whole is 2.1 percentage points (in Japan 3.3, in the USA 2.2, and in the EC 1.7).

On the other hand, the rate of economic growth of the developing market economies as a whole will decrease by an average annual 1.6 percentage points during the same period. It is of interest to note that the average decrease in growth rate for the Asian NIEs (Republic of Korea, Taiwan, Hong Kong and Singapore) is 2.1 percentage points, and for the Latin American NIEs (Brazil and Mexico) is 2.9 percentage.points. In the developing market economies of the Asia and Pacific Region as a whole, the decrease is 1.7 percentage points (2.2 percentage points in East Asia, 1.7 percentage points in the ASEAN group, and 1.2 percentage points in "Other Asia and Pacific"). In the Middle East, the decrease is 0.6 percentage point, in Africa it is 0.8 percentage point, while in Latin America and the Caribbean it is 2.3 percentage points.

It is worth noting that the annual average growth rate in the planned market economies as a whole will decrease by 2.0 percentage points during the 1990-2000 period. It is expected that the average annual decrease in the CIS will be 0.9 percentage points, while the decrease will be a much greater 3.0 percentage points in China. The major reason for this drastic fall in China's growth rate is that country's relatively higher proportion of coal as an energy source(See Table 3).

Global Cooperation Scenario B

In contrast to the simulation results of Scenario A, the average annual growth rate of the world economy as a whole will rise -- by 0.09 percentage point -- rather than fall, compared with the baseline projections for the period, 1990-2000

In the developed market economies as a whole, the average annual growth rate increases by a similar 0.09 percentage point (0.45 percentage point in Japan, 0.01 percentage point in the United States, and 0.02 percentage point in the EC).

In the developing market economies as a whole, the average rise in growth rate during the same period is 0.04 percentage point. The increase is 0.07 percentage point in the Asian NIEs and 0.03 percentage point in the Latin American NIEs. In the developing market economies of the Asia and Pacific Region, the average increase is 0.05 percentage point (0.07 in East Asia, 0.09 in the ASEAN group, and 0.01 percentage point in "Other Asia and Pacific"). The increase is 0.05 percentage point in the Middle East, 0.01 percentage point in Africa, and 0.02 percentage point in Latin America and the Caribbean.

In the planned market economies as a whole, the average rise in growth rate during the same period is 0.12 percentage point (0.04 percentage point in the CIS, and 0.19 percentage point in China)(See Table 1).

Global Cooperation Scenario C

In Scenario C, which is a sort of compromise between Scenarios A and B, it is expected that the average annual growth rate of the world economy as a whole will decrease by 0.5 percentage point compared with the baseline projection during the period 1990-2000.

In the developed market economies as a whole, the average decrease in the growth rate during the same period is 0.37 percentage point (0.56 in Japan, 0.34 in the United States, and 0.25 in the EC).

In the developing market economies as a whole, the average decrease in the growth rate during the same period is 0.32 percentage point. In the Asian NIEs the decrease is 0.41 percentage point, while in the Latin American NIEs it is a considerably larger 0.64 percentage point. In the developing market economies of the Asia Pacific Region, the corresponding decrease is 0.32 percentage point (0.45 in East Asia, 0.32 in the ASEAN group, and 0.22 in "Other Asia and Pacific") The corresponding drop in

growth rate is 0.08 percentage point in the Middle East, 0.14 percentage point in Africa, and 0.49 percentage points in Latin America and the Caribbean.

In the planned market economies as whole, the average annual drop in growth rate during the decade 1990-2000 is 0.73 percentage points (0.16 in the CIS and 1.27 in China)(See Table 1).

CONCLUSION

As seen from figures of Tables 2,3,4,5 and 6 the world economic growth will be subjected by alternative scenarios on CO2 cutbacks. From a view point of global sustainable growth with environment, Scenario B where the role in technological advancement is emphasized would be most desirable. However there will be still an important role in reforestation during the coming decade, although technological advancement for curbing CO2 emissions originating from fossil energy will also stressed.

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TABLE 1 CO2 CUTBACK SCENARIO SIMULATIONS USING THE FUGI MODEL: SCENARIOS A, B AND C
ANNUAL GROWTH RATES OF REAL GDP FOR THE PERIOD, 1991-2000 UNIT: %

	BASELINE	DEVIATIONS FROM THE BASELINE CO2 CUTBACKS SCENARIOS		
		A	B	C
WORLD	2.9	-1.978	0.089	-0.426
DEVELOPED MARKET ECONOMIES	2.6	-2.082	0.093	-0.370
OECD	2.6	-2.103	0.095	-0.374
THE MAJOR SEVEN	2.7	-2.281	0.102	-0.382
JAPAN	3.9	-3.233	0.447	-0.556
USA	2.2	-2.201	0.011	-0.341
EC	2.6	-1.682	0.019	-0.247
DEVELOPING MARKET ECONOMIES	4.3	-1.605	0.037	-0.312
OIL EXPORTING COUNTRIES	3.7	-1.412	0.048	-0.265
NON OIL EXPORTING COUNTRIES	4.6	-1.692	0.033	-0.333
NIES	4.9	-2.594	0.046	-0.557
ASIAN NIES	6.0	-2.044	0.070	-0.408
LATIN AMERICA NIES	4.4	-2.903	0.032	-0.639
ASIA AND PACIFIC	5.9	-1.601	0.053	-0.295
EAST ASIA	6.0	-2.183	0.070	-0.440
ASEAN	6.0	-1.638	0.087	-0.254
OTHER ASIA	4.3	-1.179	0.013	-0.229
MIDDLE EAST	2.8	-0.597	0.047	-0.072
AFRICA	3.6	-0.822	0.013	-0.137
LATIN AMERICA AND CARIBBEAN	4.0	-2.329	0.024	-0.490
PLANNED MARKET ECONOMIES	2.8	-1.972	0.121	-0.727
CIS AND EAST EUROPE	1.0	-1.050	0.043	-0.197
CIS	1.0	-0.896	0.038	-0.161
CHINA AND OTHER ASIAN PMES	4.6	-2.882	0.191	-1.232

SOURCE: PROJECTIONS AND SIMULATIONS USING THE FUGI MODEL.

TABLE 2 BASELINE PROJECTIONS OF WORLD ENERGY REQUIREMENTS AND CO2 EMISSIONS
ANNUAL AVERAGE INCREASING RATES FOR THE PERIOD, 1990-2000

UNIT: %

	TOTAL ENERGY REQUIREMENT	FOSSIL ENERGY	(COAL)	ALTERNATIVE ENERGY	CO2 EMISSIONS
WORLD	2.6	2.3	2.5	4.3	2.3
DEVELOPED MARKET ECONOMIES	2.3	1.7	1.9	4.4	1.6
OECD	2.3	1.7	2.0	4.4	1.7
THE MAJOR SEVEN	2.1	1.7	1.7	4.1	1.6
JAPAN	2.5	1.8	2.5	5.3	1.6
USA	1.7	1.8	1.9	0.2	1.7
EC	3.2	1.7	1.9	6.2	1.7
DEVELOPING MARKET ECONOMIES	4.9	4.7	5.3	5.9	4.7
OIL EXPORTING COUNTRIES	5.0	5.0	4.7	5.2	4.9
NON OIL EXPORTING COUNTRIES	4.9	4.6	5.3	6.0	4.6
NIES	5.6	5.5	6.3	6.1	5.5
ASIAN NIES	5.9	5.6	6.5	7.2	5.7
LATIN AMERICA NIES	5.4	5.4	6.0	5.6	5.3
ASIA AND PACIFIC	5.4	5.3	5.6	6.2	5.3
EAST ASIA	5.9	5.6	6.5	7.2	5.7
ASEAN	6.1	6.0	8.6	7.8	5.9
OTHER ASIA	4.8	4.8	5.0	4.2	4.8
MIDDLE EAST	3.7	3.6	3.3	4.8	3.6
AFRICA	4.7	4.7	4.8	4.6	4.6
LATIN AMERICA AND CARIBBEAN	4.9	4.3	5.2	6.1	4.2
PLANNED MARKET ECONOMIES	1.8	1.8	2.3	1.8	1.9
CIS AND EAST EUROPE	0.9	0.9	0.2	1.3	0.8
CIS	1.0	0.9	0.8	1.7	0.8
CHINA AND OTHER ASIAN PMES	3.9	3.9	4.0	4.4	3.9

SOURCE: PROJECTIONS AND SIMULATIONS USING THE FUGI MODEL.

TABLE 3 ALTERNATIVE PROJECTIONS OF WORLD ENERGY REQUIREMENTS AND CO2 EMISSIONS
ANNUAL AVERAGE INCREASING RATES FOR THE PERIOD, 1990-2000
SCENARIO A

UNIT: %

	TOTAL ENERGY REQUIREMENT	FOSSIL ENERGY	(COAL)	ALTERNATIVE ENERGY	CO2 EMISSIONS
WORLD	0.9	0.8	0.9	1.4	0.8
DEVELOPED MARKET ECONOMIES	0.4	0.2	0.3	0.9	0.2
OECD	0.4	0.2	0.3	0.9	0.2
THE MAJOR SEVEN	0.2	0.1	0.1	0.3	0.1
JAPAN	0.4	0.3	0.4	1.0	0.3
USA	0.1	0.1	0.0	0.1	0.1
EC	0.8	0.5	0.5	1.4	0.5
DEVELOPING MARKET ECONOMIES	3.2	3.0	3.7	3.9	3.0
OIL EXPORTING COUNTRIES	2.8	2.7	2.0	4.1	2.6
NON OIL EXPORTING COUNTRIES	3.3	3.2	3.8	3.9	3.2
NIES	2.6	2.4	3.6	3.3	2.5
ASIAN NIES	3.8	3.6	4.0	5.0	3.6
LATIN AMERICA NIES	1.6	1.4	2.4	2.4	1.4
ASIA AND PACIFIC	3.8	3.7	3.9	4.3	3.7
EAST ASIA	3.7	3.5	4.0	5.0	3.5
ASEAN	4.4	4.3	7.3	5.8	4.3
OTHER ASIA	3.5	3.5	3.5	2.9	3.5
MIDDLE EAST	3.0	3.0	3.5	3.9	2.9
AFRICA	3.7	3.7	3.8	3.8	3.6
LATIN AMERICA AND CARIBBEAN	2.3	1.5	1.9	3.8	1.5
PLANNED MARKET ECONOMIES	0.5	0.5	0.7	0.2	0.5
CIS AND EAST EUROPE	0.0	0.0	-0.1	-0.2	0.0
CIS	0.2	0.1	-0.0	0.1	0.1
CHINA AND OTHER ASIAN PMES	1.5	1.5	1.5	1.9	1.5

SOURCE: PROJECTIONS AND SIMULATIONS USING THE FUGI MODEL.

TABLE 4 ALTERNATIVE PROJECTIONS OF WORLD ENERGY REQUIREMENTS AND CO2 EMISSIONS
ANNUAL AVERAGE INCREASING RATES FOR THE PERIOD, 1990-2000
SCENARIO B

UNIT: %

	TOTAL ENERGY REQUIREMENT	FOSSIL ENERGY	(COAL)	ALTERNATIVE ENERGY	CO2 EMISSIONS
WORLD	0.8	0.1	0.2	3.9	0.1
DEVELOPED MARKET ECONOMIES	0.4	-0.6	-0.7	3.8	-0.6
OECD	0.5	-0.5	-0.6	3.7	-0.6
THE MAJOR SEVEN	0.2	-0.6	-0.9	3.2	-0.7
JAPAN	1.3	-0.1	0.5	5.9	-0.3
USA	-0.5	-0.5	-0.6	0.2	-0.6
EC	1.3	-0.5	-1.0	4.8	-0.6
DEVELOPING MARKET ECONOMIES	3.1	2.4	3.0	6.0	2.4
OIL EXPORTING COUNTRIES	2.9	2.7	2.5	5.2	2.7
NON OIL EXPORTING COUNTRIES	3.2	2.2	3.0	6.1	2.3
NIES	3.9	3.2	4.0	6.2	3.2
ASIAN NIES	4.0	3.4	4.2	7.3	3.4
LATIN AMERICA NIES	3.7	3.1	3.6	5.6	3.0
ASIA AND PACIFIC	3.4	3.0	3.3	6.3	3.0
EAST ASIA	4.1	3.4	4.2	7.3	3.4
ASEAN	4.0	3.7	6.2	7.8	3.6
OTHER ASIA	2.6	2.5	2.6	4.4	2.5
MIDDLE EAST	1.5	1.4	1.1	4.8	1.4
AFRICA	2.7	2.4	2.5	4.6	2.3
LATIN AMERICA AND CARIBBEAN	3.5	2.0	2.9	6.1	1.9
PLANNED MARKET ECONOMIES	-0.1	-0.3	0.1	1.9	-0.3
CIS AND EAST EUROPE	-1.1	-1.3	-2.0	1.4	-1.4
CIS	-1.0	-1.3	-2.3	1.6	-1.4
CHINA AND OTHER ASIAN PMES	1.9	1.8	1.8	4.6	1.8

SOURCE: PROJECTIONS AND SIMULATIONS USING THE FUGI MODEL.

TABLE 5 ALTERNATIVE PROJECTIONS OF WORLD ENERGY REQUIREMENTS AND CO2 EMISSIONS
ANNUAL AVERAGE INCREASING RATES FOR THE PERIOD, 1990-2000
SCENARIO C

UNIT: %

	TOTAL ENERGY REQUIREMENT	FOSSIL ENERGY	(COAL)	ALTERNATIVE ENERGY	CO2 EMISSIONS
WORLD	0.7	0.1	-0.2	3.5	0.0
DEVELOPED MARKET ECONOMIES	0.4	-0.3	-0.8	3.2	-0.4
OECD	0.5	-0.3	-0.7	3.2	-0.4
THE MAJOR SEVEN	0.3	-0.3	-1.0	2.8	-0.4
JAPAN	0.8	-0.3	-0.2	4.6	-0.5
USA	-0.1	-0.2	-0.7	0.8	-0.3
EC	1.1	-0.5	-1.2	4.1	-0.6
DEVELOPING MARKET ECONOMIES	3.0	2.3	2.8	5.7	2.3
OIL EXPORTING COUNTRIES	2.7	2.5	2.6	5.0	2.5
NON OIL EXPORTING COUNTRIES	3.1	2.2	2.8	5.8	2.2
NIES	3.4	2.7	3.5	5.6	2.8
ASIAN NIES	3.8	3.1	3.7	6.9	3.2
LATIN AMERICA NIES	3.1	2.4	2.9	4.9	2.4
ASIA AND PACIFIC	3.3	3.0	3.0	5.9	2.9
EAST ASIA	3.8	3.1	3.7	6.9	3.1
ASEAN	4.1	3.8	6.7	8.0	3.7
OTHER ASIA	2.6	2.4	2.4	3.8	2.4
MIDDLE EAST	1.8	1.7	2.1	4.6	1.7
AFRICA	2.7	2.4	2.4	4.4	2.4
LATIN AMERICA AND CARIBBEAN	3.2	1.6	2.2	5.9	1.6
PLANNED MARKET ECONOMIES	-0.4	-0.6	-0.6	1.6	-0.6
CIS AND EAST EUROPE	-1.0	-1.2	-2.0	1.3	-1.4
CIS	-0.9	-1.1	-2.2	1.3	-1.2
CHINA AND OTHER ASIAN PMES	0.8	0.6	0.6	3.2	0.6

SOURCE: PROJECTIONS AND SIMULATIONS USING THE FUGI MODEL.

TABLE 6 CO2 CUTBACK SCENARIO SIMULATIONS USING THE FUGI MODEL: 100% CARBON TAX
ANNUAL GROWTH RATES OF REAL GDP FOR THE PERIOD, 1991-2000

UNIT: %

	BASELINE	DEVIATIONS FROM THE BASELINE 100% CO2 EMISSION TAX				RATE OF ACHIEVEMENT
		1991	1992	1993	1990-2000	(CO2IN 1990/2000)
WORLD	2.9	-2.329	-4.134	-1.995	-1.129	89.5
DEVELOPED MARKET ECONOMIES	2.6	-3.411	-5.976	-2.333	-1.115	96.1
OECD	2.6	-3.426	-6.068	-2.368	-1.132	95.6
THE MAJOR SEVEN	2.7	-3.199	-5.838	-2.856	-1.156	97.0
JAPAN	3.9	-1.747	-2.454	-0.871	-0.220	86.3
USA	2.2	-4.197	-6.780	-2.603	-1.503	99.6
EC	2.6	-2.920	-6.535	-3.580	-1.233	93.6
DEVELOPING MARKET ECONOMIES	4.3	-0.596	-1.074	-0.812	-0.543	67.4
OIL EXPORTING COUNTRIES	3.7	-0.039	-0.576	-0.970	-0.390	66.9
NON OIL EXPORTING COUNTRIES	4.6	-0.863	-1.310	-0.732	-0.611	67.6
NIES	4.9	-1.570	-2.407	-1.307	-1.060	66.5
ASIAN NIES	6.0	-4.912	-6.342	-0.721	-1.354	66.7
LATIN AMERICA NIES	4.4	0.0	-0.550	-1.531	-0.905	79.2
ASIA AND PACIFIC	5.3	-1.614	-2.441	-0.701	-0.677	64.7
EAST ASIA	5.9	-5.469	-7.140	-0.635	-1.398	67.1
ASEAN	6.0	-0.575	-1.949	-1.576	-0.849	64.9
OTHER ASIA	4.3	0.0	0.036	-0.032	-0.058	63.3
MIDDLE EAST	2.8	0.0	-0.367	-0.735	-0.229	71.1
AFRICA	3.6	0.0	0.327	-0.316	-0.113	65.2
LATIN AMERICA AND CARIBBEAN	4.0	0.0	-0.445	-1.119	-0.672	71.8
PLANNED MARKET ECONOMIES	2.8	0.0	-0.452	-1.980	-1.740	95.3

CIS AND EAST EUROPE	1.0	0.0	-0.289	-1.400	-1.191	103.8
CIS	1.0	0.0	-0.227	-1.166	-0.910	102.7
CHINA AND O THER ASIAN PMES	4.6	0.0	-0.641	-2.613	-2.267	82.0

SOURCE: PROJECTIONS AND SIMULATIONS USING THE FUGI MODEL.