

Overview and Application of the KEEI Global Top-Down Model

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Gyeong L. Cho

Korea Energy Economics Institute

Kyoto Protocol

- **Target Reduction:**
 - 5.2% form 1990 levels
- **Kyoto Mechanism:**
 - Emission Trade
 - Joint Implementation
 - Clean Development Mechanism
- **Greenhouse Gases:**
 - CO₂, CH₄, N₂O, HFCs, PFCs, SF₆, CFCs

Scope of the preliminary Analysis

- **Greenhouse Gas : CO₂**
- **Instrument to achieve the commitment:**
 - domestic carbon and Tradable Permit
- **Commitment period : 2010**

Main Purpose

- Impacts of Annex 1 countries' commitments on Korean Economy
- Differences of policies adopted by Annex 1 countries for Korean economy
- Impacts of participation of Korea in emission reduction on Annex 1 countries' economy

Model

- **KEEI Carbon Emission/Trade Model**
 - Global Computable General Equilibrium Model
 - Based on the benchmark data set and economy structure of GREEN and EPPA
 - Using MPSGE in GAMS language

Model Dimensions

- **Time period(1985 - 2030) with 5 year time interval**
- **13 regions**
 - USA, Japan, EEC(12 member countries of the European Union), OOE(the rest of OECD), EET(Eastern and central Europe), Brazil, China, India, DAE(dynamic Asian economies, FSU(Former Soviet Union), EEX(Energy Export countries), Korea, ROW
- **8 production sectors**
 - Agriculture, Energy Intensive Industries(iron and steel, pulp and paper), Crude oil, Natural gas, Coal, Refined Oil, Electricity, Other industries and Services

Model Dimensions

- **4 Consumption Sectors**
 - Food and Beverage, Fuel and Power, Transport and communication, Other goods and services
- **One government and One investment sector**
- **Backstop Technology**
 - Carbon liquids backstop
 - Carbon-free electric backstop
- **Bilateral Trade**
 - Two step of Armington specification

Model Dimensions

- **Exogenous trends of the rate of population and labor productivity growth, energy efficient growth**
- **Endogenous changes in capital stocks and fixed factor supplies**
- **For BAU, capital productivity is calibrated in order to achieve a given target for GDP growth.**
- **For scenarios, capital productivity is exogenous, and the growth rate of GDP is endogenous**

BAU Scenario

Carbon Emission of Selected Regions and Years : million TC

	1990	2010	2020	Avg. Annual Growth
				1990 - 2020
USA	1331	1771	1935	1.3
JPN	303	371	414	1.0
EEC	806	944	1025	0.8
OOE	286	372	399	1.1
FSU	945	982	1219	0.9
EET	319	359	448	1.1
KOR	65	165	204	3.9

Emission Profile for Annex I

1990 = 100

± ⁹ i	2000 ³ ā	2005 ³ ā	2010(Kyoto Target)
USA	102.0	98.0	93.0
JPN	98.0	96.0	94.0
EEC	98.0	96.0	92.0
OOE	105.0	101.0	97.0
FSU	64.7	87.1	100.0
EET	71.7	91.8	93.0

Scenarios

- Given emission profile for Annex I Countries,
Korea's Emission Reduction Target

Scenario 1 : 0 % from BAU

Scenario 2 : 20% from BAU

Scenario 3 : 40% from BAU

Individual Carbon Tax

Carbon tax in 2010 ('85 US\$)

	USA	JPN	EEC	OOE	FSU	EET	KOR
Scenario 1	189.3	373.0	223.0	140.2	5.2	27.1	0.0
Scenario 2	189.6	378.5	224.0	141.6	5.3	27.3	71.4
Scenario 3	190.0	381.6	224.9	142.4	5.3	27.4	175.6

Individual Carbon Tax

Percent of BAU GDP in 2010

	USA	JPN	EEC	OOE	EEX	CHN	FSU	KOR
Scenario 1	-0.55	-0.93	-0.84	-1.34	-2.07	0.19	-0.30	0.97
Scenario 2	-0.55	-0.95	-0.84	-1.35	-2.06	0.19	-0.29	0.02
Scenario 3	-0.55	-0.96	-0.84	-1.36	-2.07	0.20	-0.28	-1.49

Tradable Permit

Price of tradable permit in 2010 ('85 US\$)

	Scenario 1	Scenario 2	Scenario 3
2010	853	850	89.1

Tradable Permit

Quotas, Use, and Net Purchases in 2010 (million TC)

		USA	JPN	EEC	OOE	FSU	EET	KOR
Scenario 1	Initial Quotas	1238	285	741	278	945	297	0
	Carbon Emission	1468	360	870	301	577	215	180
	Net Purchases	230	75	129	23	-374	-84	0
Scenario 2	Initial Quotas	1238	285	741	278	945	297	132
	Carbon Emission	1473	362	873	302	579	215	123
	Net Purchases	235	77	131	24	-373	-83	-10
Scenario 3	Initial Quotas	1238	285	741	278	945	297	99
	Carbon Emission	1461	361	869	300	569	212	121
	Net Purchases	223	75	128	22	-382	-86	21

Tradable Permit

Percent of BAU GDP for Korea in 2010

	Individual Carbon Tax	Tradable Permit
Scenario 1	0.97	0.50
Scenario 2	0.02	-0.81
Scenario 3	-1.49	-0.93

Conclusion

- Without emission reduction target, Korea would be better off in individual carbon tax than in emission trade.
- Participation of Korea with high (with low) target would lead to increase(decrease) price of permit and individual carbon tax of Annex 1 regions.
- Korea, as its target is high, would be better off in tradable permit scheme than individual carbon tax system.

Conclusion

- Further Improvement for the KEEI model
 - Update the base year(1985)
 - Extend to Fully Dynamic Model
 - Incorporate capital vintaging specification