Environmental Taxation in Energy Sector - A Theoretical and Applied Analysis

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Abstract

A global multi-sectoral, multi-regional computational general equilibrium model is employed to assess carbon taxes under perfect competition and monopoly. We found that regional studies of carbon taxation maybe inaccurate due to the carbon emission spillover effects. Emission taxes have stronger impacts on the economy in monopoly rather than on perfect competition in terms of magnitude. In addition, carbon emission tax policy analysis which is based on perfect competition may also underestimate the losses of welfare compared with the case in imperfect competition.

JEL classification: D43, D58, L13

Keywords: environmental taxation, imperfect competition, Computable General Equilibrium

1 Introduction

Environmental taxes can have significant impacts for the international competitiveness of industries. As the relative production costs of energy related intensive goods rise in comparison to the relative costs of producing the same product elsewhere, emission reduction implies a loss of comparative advantage. Therefore, regions with emission control may suffer welfare losses relative the regions with no emission control.

Most of the existing energy environmental studies assume that energy sectors are operated in the perfect competition market structure (Boehringer *et. al.*(1997), Pezzey (1993) and Burniaus *et. al.*(1992). However, in the real world,

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energy sectors in most countries and regions are not in the perfect competition market structure but in monopoly or oligopoly structure, especially in the developing countries, monopoly in energy sectors are more prevailing. Therefore the assumption that energy sectors are operated under perfect competition may lead to inaccurate conclusion.

In addition, there did exist very few literatures regarding energy and environmental taxation under imperfect competition in regional or national level.(e.g. Boehringer *et. al*(2001). Most of the other studies consider only emission taxes under perfect competition in the regional or national level. (see Nwaobi(2004), Kainuma *et. al* (2004), Jensen *et al*(2000)). However, energy emission is as world economy becomes more integrated and emission , energy trade between regions at the global level needs to be considered.

This paper investigates the welfare implication of carbon emission tax under different market structures. In our study, we conduct a comparative analysis regarding CO_2 emission taxes on energy sectors in both perfect competition and imperfect competition(monopoly) in four regions (the USA, Japan, the EU and RoA1). The empirical analysis of this paper focuses on two questions: (1)to what extent the carbon emission taxes differ in imperfect competition (monopoly) relative to perfect competition; (2)what are the macroeconomic impact and sectoral effects incurred by carbon taxes under perfect competition and monopoly. We address these questions in the context of a static general equilibrium model with 8 aggregated global regions and 17 sectors based on Global Trade Analysis Project (GTAP)-E data base.

The results presented here confirm standard intuition from microeconomic theory and taxation literature: emission taxes increase the cost of production in energy sectors and result in losing output and employment in energy sectors. (see Goulder, 1994; Boehringer, *et. al*, 1997). Our calculation shows that carbon emission taxes have stronger adverse effects on the regions that have carbon emission abatement. The welfare and output decline relative to other regions without carbon emission abatement. More importantly, studies in this paper implies that emission taxes based on perfect competition scenario may underestimate the welfare losses of those countries that have carbon emission abatement targets. Furthermore, on the regional or national level, emission taxes may overlook the interregional energy trade and external emission spillover effects.

The results presented in this paper are subject to some important caveats. First, there exist some problems due to imperfect information when we calibrate the firm's cost function. The second limitation of the paper is that we do not consider sensitivity analysis in this study. Clearly, this study can be further extended to this direction.

The reminder of this paper is organized as follows: Section 2 is devoted to describe the model structure, which emphasizes the production, consumption and international trade. Data source and simulation design of the model are described in section 3. The interpretation of the model results is analyzed in section 4 and finally, concluding remarks is provided in section 5.

2 Modelling Framework

A modified version of GTAP model (Hertel (1997) with imperfect competition feature is established to evaluate the global welfare changes and sectoral effect in different market structures. This section briefly describes the model's structure, outlines the solution procedure, and discusses the data and parameters.

2.1 Environmental Framework

An extended version of GTAP-E [1], GTAP Technical Paper No.14[2] and GTAP-EF [3] is a global, multi-regional, multi-commodity, applied general equilibrium(AGE) model. It is composed of 8 regions and 17 commodities. As shown in Table 1, 7 commodities are agriculture related products, 5 are energy related products. This model incorporates global production, consumption, trade and offers a systematic way of determining the likely pattern of changes in factor and commodity prices, and production around the world in response to changes in environmental taxes. The complex linages among sectors and regions are taken into account.

Table 1: Sectors, primary factors and regions in the general equilibrium model

	Sectors		Endowment		Region
1	Rice	1	Land	1	USA
2	Wheat	2	Lab	2	EU
3	CerCrops	3	Capital	3	EEFSU
4	VegFruits	4	NatlRes	4	JPN
5	Animals			5	RoA1
6	Forestry			6	EEx
7	Fishing			7	CHIND
8	Coal			8	RoW
9	Oil				
10	Gas				
11	OilPcts				
12	Electricity				
13	Water				
14	EnInt ind				
15	Oth ind				
16	MServ				
17	NMserv				

Source: GTAP-E document

[1] GTAP-E was developed by Jean-Marc Burniaux and Truong (2002)

[2] GTAP Technical Paper No 14, titled 'Scale Economies and Imperfect Competition' in the GTAP Model, was developed by Joseph F. Francois.

[3] GTAP-EF was extended by Roberto Roson (2003)

2.2 Economic Framework

2.2.1 Firm Production

Producers in all the sectors except energy sectors maximize profits and operate in perfect competitive market structure which implies that marginal costs equal commodity price. A commodity is produced from a composite input obtained by combining a composite primary factor (including energy input) and a composite intermediary product using a Leontief technology. The composite primary factor input is a constant elasticity of substitution (CES) composite of natural resource, land, labor and capital-energy composite inputs. The capital-energy composite inputs can be further decomposed to physical capital and energy composite capital. The production structure and capital-energy composite structure can be seen from Appendix A Figure 1 and Figure 2. The composite intermediate input consists of 17 composite commodity inputs[4]. Each of the 17 commodity inputs is derived from nested CES cost functions. There are two stages of composting intermediate inputs. In the first stage, the producer chooses the intermediate inputs from different regions, and then from domestic and foreign regions. The Allen partial elasticities of substitution for these CES functions can be found in GTAP-E document.

Product differentiation between imports and domestic products, and imports by region of origin are according to the Armington assumption(1969). All factor inputs are fully employed and immobile across the regions. Land and natural resources are perfectly mobile across sectors. All factors inputs expect capital energy composite inputs are homogenous.

Energy composite in this modified GTAP model is then combined with capital to produce an energy-capital composite, which is in turn combined with other primary factors in a value-added-energy (VAE) nest through a CES structure (see Figure 1). The substitution elasticity between capital and the energy composite (δ_{KE}) is still assumed to be positive. The values of the substitution elasticity at a lower level are set smaller according to GTAP-E model.

Each energy composite supplies services to 17 commodity producing sectors according to constant-elasticity-of-transformation (CET) function. Each of these 17 sectors uses land, natural resources and capital while each energy sector is capital specific. The CET functions, which restrict capital's mobility among sectors, allow energy composite capital to shift among economic sectors without losing capital's inherent productivity differences.

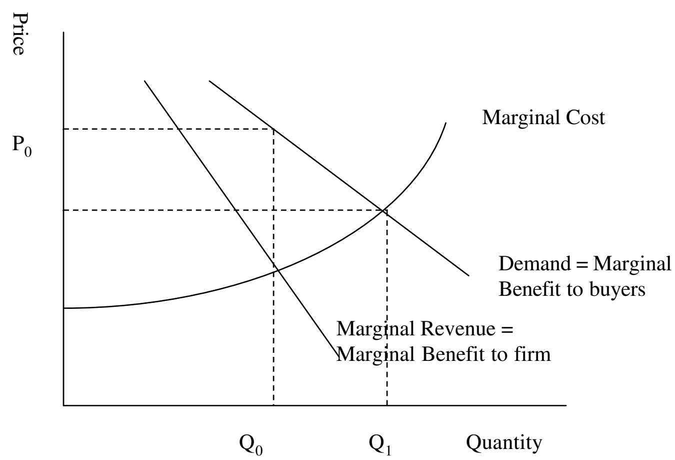
In single output sector, the final composite input is equal to sector output. Regional production of electricity, non-electricity, oil gas and other energy related sectors is the sum of production across the 7 capital specific energy sectors. Regional output of rice, wheat and other non energy sectors is the sum of production across respective sectors as well.

[4]see Appendix B

2.2.2 Market Structure

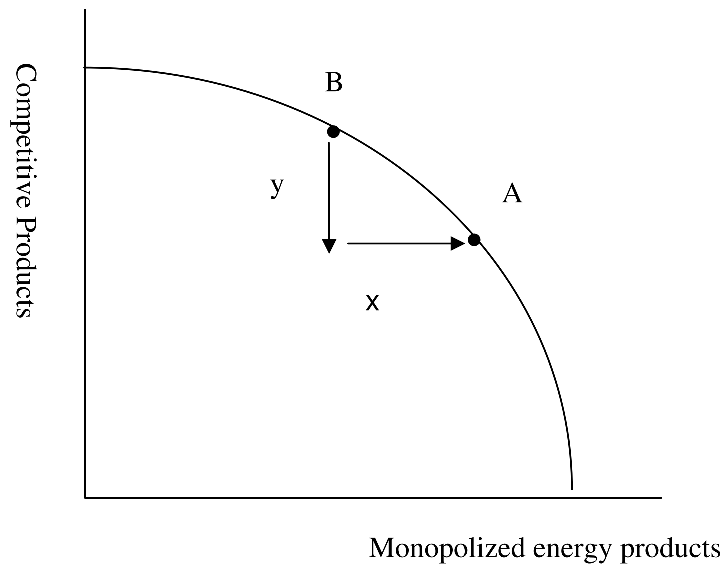
In our model, we assume that each region and each energy sector has a monopolistic firm. The monopolist faces a downward-sloping demand curve, or so-called the industry demand curve. The downward sloping demand curve implies that if the monopolist wants to sell more, it must lower its price. The firm can charge only one price (We assume that there is no price discrimination). Since the monopolist must lower price to sell more, the extra or marginal revenue it gets from selling another unit is less than the price it charges. Thus, its marginal revenue curve lies below its demand curve. In contrast, in the case of perfect competition, demand is identical with marginal revenue.

Figure 3. Perfect Competition vs. Monopoly



As shown in Figure 3, in order to maximize profit, the monopolist attempts to set marginal cost equal to marginal revenue, or reduce output to Q_0. While from the consumer's viewpoint, the best amount to produce would be Q_1. The firm will not have interest to produce beyond Q_0, since the marginal revenue curve is less than the extra cost of production, shown by the marginal cost curve. In contrast, extra output is in the interests of consumers because the extra benefit they get, shown by the demand curve, is greater than the extra costs of production.

Figure 4. Monopoly restricts output relative to Perfect competition



In terms of the production-possibilities frontier shown in Figure 4, in our model, we have energy sectors to be monopolized while all other industries are competitive in each region. Monopolists will produce at point B while in the perfect competition, producers (sellers are price takers)would produce at point A. Consumers would be better off at point A because the gain of x amount of monopolized energy goods has a greater value than the loss of y amount of competitive non-energy goods. In other words, marginal rates of substitution are not equal to marginal rate of transformation, the economy produces the wrong mix of products.

Theoretically, the effect of emission taxes varies depending on different market structures. Due to the externality involved by of energy sectors, the optimal environment taxation in a perfect competitive market, an emission tax equal to marginal external damages of pollution secures the socially optimal amount of output and pollution in the long run. While considering the case of monopolist, Buchanan (1969) pointed out that the use of effluent fees equal to marginal external damages of pollution, as in the case of competitive markers, will not lead to optimality and can even decrease social welfare. Katsoulacos *et. al.* (1996) and Barneet (1980) argue that in a monopolistic market, the optimal emission tax is less than marginal external damages of pollution. This optimal second-best tax balances, therefore, between welfare losses from restricting the already suboptimal monopolist output with welfare gains due to emission reductions. In our paper, we focus on the effects of same level of environmental taxes on the economy rather than what kind of the taxes are optimal.

2.2.3 Consumer Consumption

In each region, a representative household maximizes utility such that regional income is allocated in fixed value shares across private consumption, government services, and saving. Private house-hold demands are represented by the constant difference of elasticities (CDE) implicit expenditure function. Referring to the Armington(1969), domestic and foreign goods are distinguished by their origin. The third and fourth levels describe the choice between products from different geographical origins through CES functions. For imperfect competition sectors, a Dixit-Stiglitz formulation is used at the last level. The consumer chooses between horizontally-differentiated varieties of each good with a constant elasticity of substitution (see Figure 5).

2.2.4 International Trade

Savings finance investment. Global saving is the sum of regional savings. A global interests rate determines the capital investment and flows. Current account is not necessary balance for each country from the global aspect. If saving is greater than investment for one country, then it has trade surplus; otherwise it has trade deficit.

3 The data and Simulation Design

The economic data by region, sector, and commodity are taken from GTAP-E 6.1 version Jean-Marc Burniaux and Truong (2002). The elasticities of substitution between different factors of production in energy sectors are also based on GTAP-E data base.

In order to evaluate the effects of environment on energy sectors, we undertake the comparative analysis of perfect competition and monopoly by presenting estimated macroeconomic and sectoral output effects for our experiments. The first simulation results involve constant return to scale (CRTS) in perfect competition, and server as a reference experiment. The second experiment involves monopoly. We assume that there is one energy firm in each energy sector and each region has monopoly power features domestically or regionally. While all other 12 sectors in each region are in perfect competition and CRTS feature. The parameters, elasticities of substitution can be found in GTAP-E documents.

We impose similar closures and shocks as GTAP-E in the case of no emission trade scenario with perfect competition and monopoly. Please note that the regions where we have imposed carbon taxes are USA, EU, Japan and RoA1. In order to compare the same emission taxes in perfect competition and monopoly, we first impose GTAP-E shocks of emission target reduction to four regions in perfect competition scenario. Next we allow the computer system to calculate endogenously the nominal emission tax rate given fixed emission target reduction. Afterwards we use this calculated emission tax rates as exogenous shocks in monopoly scenario. The closure and shocks can be available upon request. We assume the revenue from the carbon tax is redistributed to private households in a lump sum fashion.

4 Interpreting the Model Results

4.1 Macroeconomic Effects

The following contents show the required rate of carbon tax and the induced percentage changes in macroeconomic indicators as compared to the benchmark level.

Table 2: Welfare Changes under Perfect Competition and Monopoly (million $)

EV	**Perfect Competition**	**Monopoly**
USA	-1419.39	-50775.52
EU	-34870.68	-66117.22
EEFSU	-2894.26	-1368.30
JPN	-21687.44	-31756.73
RoA1	-25620.91	-25296.09
EEx	-18958.45	-7033.40
CHIND	1186.31	-3741.06
RoW	5697.87	1293.54

Source: simulation results

Table 2 shows the effect of carbon emission reduction on welfare changes in all eight regions across the world given the same level of emission tax. Under both scenarios, welfare[5] does not change qualitatively in most of the regions except CHIND(China and India). The magnitude of changes in each region is slightly significant in the EU and the USA and insignificant in most other regions . Most of the regions have welfare losses under monopoly.

It is not surprising to see that CHIND has welfare gain under perfect competition while losses are under monopoly. Under perfect competition, CHIND gain due to no emission control target. However, China is one of the top three energy consumers in the global energy market. Under monopoly, global energy output decreases due to carbon emission control, CHIND suffers a loss due to import of higher price of energy related products.

Rest of the world (ROW) is most controversial one, partially due to potential controversial data aggregation and calibration. ROW is a huge group of many countries, which contains majority of the world population and lowest per capita GDP; it contributes to about 50% of most of global green house gas (GHG)

[5]The welfare of a country (region) is represented by EV (equivalent variation), which is computed as: EV(REGION) = U(REGION)* INC(REGION)/100, where U(REGION) is the percent change in per capita welfare in each country (region) and INC(REGION) represents income in each country (region).

emissions. In the context of this CGE modelling, we assume that ROW act as a single entity and there is one monopoly across the regions. Unlike all other regions, ROW has slightly higher welfare gain under monopoly than under perfect competition.

Table 3 provides the detailed information of rental rate, term of trade, GDP, private consumption, investment.

As we describe the model structure in Appendix A, energy sectors are capital intensive industry. Emission taxes in energy sectors increase the production cost, rental rates on energy intensive commodity decrease in all the regions in imperfect competition scenario when compared with in the perfect competition scenario. In perfect competition scenario, the regions that have emission taxes target control have lower rate of capital return. Only EEFSU, CHIND and RoW has a very small positive rate of return on capital. Under monopoly scenario, all the regions have negative rate of return on capital due to decline in capital intensive energy goods.

Term of trade,defined as the ratio of the prices of a country's exports to the prices of its imports, both suitably weighted, is a key mechanism influencing the distribution of losses and gains between regions. Carbon emission target reductions raise the costs of energy-intensive goods manufactured in countries with emission restriction, therefore change the term of trade and comparative advantage of energy sectors in those countries. Oil exporting countries such as EEx is hurt badly due to adverse of term of trade. Compared with perfect competition scenario, the term of trade of EU, EEx and Japan has adverse effects while term of trade of RoA1, USA, EEFSU, CHIND and ROW has improved under monopoly.

The results of investment share similar pattern as capital rate of return. Lower return on capital drives down investment in all the regions except RoA1. The increase in investment in RoA1 is due to significant improvement in term of trade related to the other regions.

It is not surprise to see that private consumptions fall down in all the regions except CHIND and ROW in the case of both scenarios. Welfare gains in CHIND and ROW mainly attribute to improvement of term of trade compared with other regions.

Total GDP changes in different regions vary due to the emission tax. Under perfect competition, it is obvious to observe that the GDP falls down in all the regions except CHIND and ROW. Under monopoly scenario, only EEFSU and EEx have about 2 % improvement in GDP compared with perfect competition.

4.2 Sectoral Effect Under Perfect Competition

The macroeconomic effects of carbon taxation under imperfect competition do not differ much qualitatively from those under perfect competition. Considering first the perfect competition case, as displayed in Table 4, on one hand, output of five energy sectors in most regions experiences significant decline due to emission taxes. In addition, the regions that have carbon emission target control(USA, EU, Japan, RoA1) have further decline in output, especially energy sectors are hit the hardest. So do the energy related sectors, which are complementing sectors related to energy sectors such as energy intensive industry(EnIntind) in these four regions suffer losses of output. On the other hand, agriculture sectors and some non-energy sectors in EEFSU, EEx, CHIND and RoW have a slight expansion.

These results satisfy the factor price equalization theory. The imposition of carbon emission taxes on energy sectors increase prices of primary factors in energy intensive sectors. Output of energy sectors drops while output in other sectors expands. Resources do not move from energy intensive sectors to non-energy intensive sectors until factor price equalize between all the sectors.

4.3 Sectoral Effect Under Imperfect Competition

Emission taxes reallocate the resources between sectors due to factor price equalization effect, and also change the comparative advantage between regions regardless the market structure. There are several interesting findings that we can see from these two experiments. First, under imperfect competition (Monopoly) scenario, output of energy sectors in most regions experience further reduction compared to the case in perfect competition. While output of agriculture in most of regions has further expansion. These impacts can be seen from Table 5. Furthermore, the impact of the emission taxes on energy sectors lead to resource reallocation according to sectoral substitution effects.

5 Discussion and Conclusion

In this paper, we examine how the impacts of environmental taxes depend on the underlying market structure. In the case of perfect competition, the increase or decrease of the output depends on the whether the regions are energy importer or exporter, term of trade effects. Under Monopoly , environmental taxes affect term of trade and reallocation resources between sectors and regions. Like the conventional wisdom on the behavior of monopoly, the monopoly firms tend to reduce output and result in welfare losses.

We employed a global level static computable general equilibrium model to contrast the effects of similarly introduced carbon tax under perfect competition and monopoly. We found that environmental tax has strong magnitude impacts on the economy under monopoly than that of under perfect competition case. Welfare and output would further decline in monopoly than in the perfect competition.

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Appendix A: Model structure of the GTAP-E

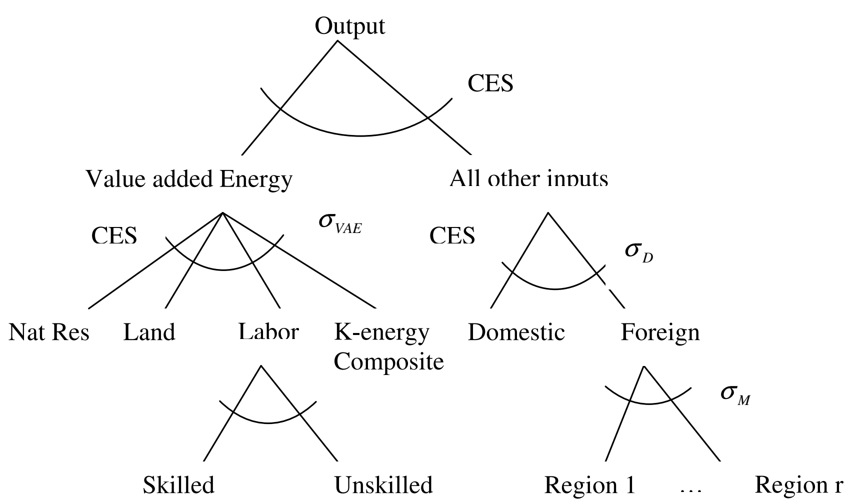

Figure 1. GTAP-E Production Structure

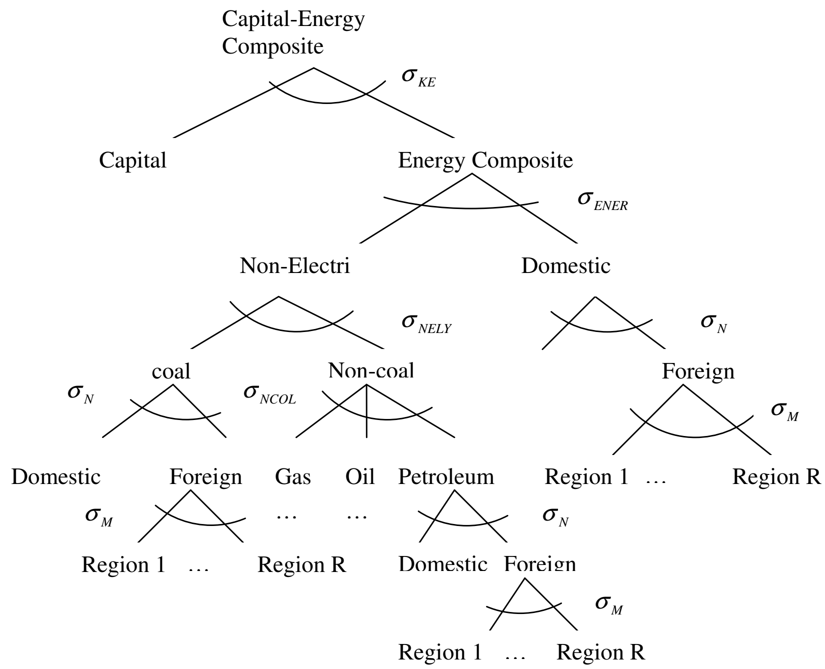

Figure 2. GTAP-E Capital-Energy Composite Structure

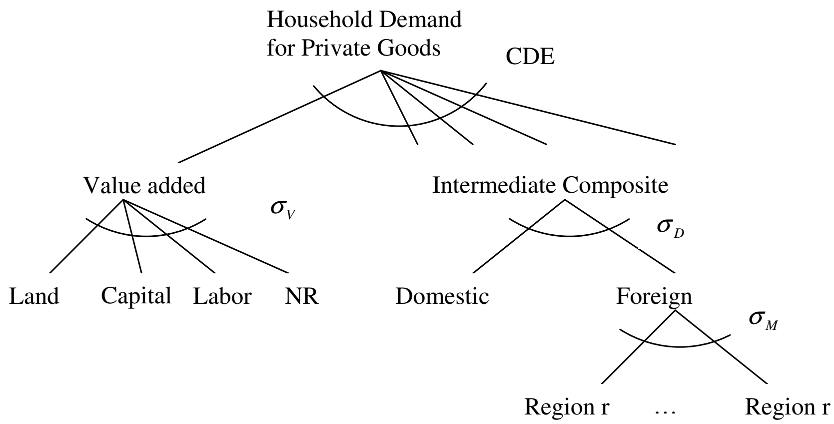

Figure 5. GTAP-E consumer demand structure

Appendix B: Specifying Regional and Sectoral Disaggregation

New Code	Sectoral Description	Comprising GTAP V5 Countries/Regions
Agriculture	Primary Agric., Forestry, Fishing	paddy rice; wheat cereal grains n.e.c; veget, fruit, nuts; oil seeds; sugar cane, sugar beet; cattle, sheep and goats; rat milk; animal products n.e.c.; wool, silk-worm cocoons; forestry; fishing plant-based fibers; crops n.e.c.; bovine
Coal	coal Mining	coal
Oil	Crude Oil	oil
Gas	Natural Gas Extraction	gas; gas manufacture, distribution
OilPcts	Refined Oil Prods	petroleum, coal products
Electricity	electricity	electricity
EnIntInd	Energy Intensive Industries	minerals n.e.c.; chemical, rubber, plastic prod; mineral products n.e.c.; ferrous metals; metals n.e.c.
OtherIndSe	Other Industry, Sve	Bovine cattle, sheep and goat; meat products; veg oils and fats; dairy products; processed rice; sugar; food products n.e.c.; beverages and tobacco products; texiles; wearing apparel; leather products; wood products; paper products; publishing; metal products; motor vehicles and parts; transport equipment n.e.c.; electronic equipment; machinery and equipment n.e.c.; manufactures n.e.c.; water; construction; trade; transport n.e.c.; water transport; air transport; communication; financial services n.e.c.; insurance; business services n.e.c.; recreational and other services; public admin. And defense, edu; ownership of dwellings

Source: GTAP-E document

New Code	Region Description	Comprising GTAP V5 Countries/Regions
USA	United States	United States
EU	European Union	Austria; Belgium; Denmark; Finland; France; Germany; United Kingdom; Greece; Ireland; Italy; Luxembourg; Netherlands, Portugal; Spain; Sweden
EEFSU	Eastern Europe and FSU	Hungary; Poland; Rest of Central Eurpean Assoc: FFSU
JPN	Japan	Japan
RoA1	oth. Annex 1 Countries	Australia; New Zealand; Canada; Switzerland; Rest of EFTA
EEx	Net Energy Exporters	Indonesi; Malasia; Vietnam; Mexico; Colombia; Venezuela; Rest of Andean Pact: Argentina; Rest of Middle East; Rest of North Africa; Rest of Southern Africa, Rest of Sub-Saharan Africa; Rest of World
CHIND	China and India	China; India
RoW	Rest of the World	Hongkong; Korea; Republic of Taiwan, Philippine; Singapore; Thailand; Bangladesh; Sri Lanka; Rest of South Asia; Central America and Caribbean; Peru; Brazil; Chile; Uruguay; Rest of South America; Turkey; Morocco; Botswana; Rest of SACU; Malawi; Mozambique; Tanzania; United Republic of; Zambia; Zimbabwe; Uganda

Source: GTAP-E document

Table 3: Carbon tax and macroeconomic effects (percentage change)

Capital rate of return	Perfect Competition	monopoly
USA	-0.98	-3.24
EU	-1.95	-2.96
EEFSU	0.44	-1.69
JPN	-3.05	-3.42
RoA1	-7.01	-6.21
EEx	-0.43	-1.36
CHIND	0.58	-5.32
RoW	0.55	-1.57
Term of Trade		
USA	0.28	0.29
EU	0.39	-0.08
EEFSU	-0.74	-0.32
JPN	1.77	0.17
RoA1	-0.95	0.38
EEx	-2.69	-1.04
CHIND	0.13	0.66
RoW	0.43	0.28
Investment		
USA	0.14	-0.16
EU	0.06	-0.69
EEFSU	-0.18	-0.21
JPN	0.02	-0.53
RoA1	-1.24	0.01
EEx	-0.53	-0.34
CHIND	0.05	0.06
RoW	-0.05	-0.46
Private consumption		
USA	-0.02	-0.42
EU	-0.49	-0.28
EEFSU	-0.38	0.18
JPN	-0.59	-0.51
RoA1	-1.89	-1.87
EEx	-0.88	-0.23
CHIND	0.10	1.21
RoW	0.22	0.71
GDP		
USA	-0.02	-0.58
EU	-0.55	-0.75
EEFSU	-0.10	0.00
JPN	-0.70	-0.73
RoA1	-1.54	-1.68
EEx	-0.03	-0.01
CHIND	0.07	-0.23
RoW	0.06	0.05

Source: simulation results

Table 4: Change in Output under Perfect Competition (percentage change)

Output	USA	EU	EEFSU	JPN	RoA1	EEx	CHIND	RoW
Rice	-0.78	-0.83	0.68	-1.32	1.06	1.32	0.13	-0.03
Wheat	-1.08	-0.68	0.92	-0.43	-1.1	1.55	0.18	0.2
CerCrops	-0.66	-0.57	0.84	-0.97	-0.37	0.79	0.1	0.02
VegFruits	-0.71	-0.52	0.61	-0.23	-0.3	0.42	0.16	0.13
Animals	-0.62	-0.66	0.59	-1.08	0.62	0.69	0.11	0.01
Forestry	-0.57	-0.42	0.44	-1.85	0.25	0.9	0.02	-0.11
Fishing	-0.04	-0.18	0.82	-2.64	-0.47	0.31	0.24	0.26
Coal	-37.06	-41.54	-5.97	-30.74	-41.22	-16.6	-6.11	-16.15
Oil	-4.37	-4.31	-2.72	-7.23	-3.99	-3.61	-2.51	-3.01
Gas	-16.58	-29.92	-2.14	-52.99	-21	-8.17	-0.57	0.45
OilPcts	-5.86	-6.43	1.54	-19.04	-20.42	2.11	2.09	2.76
Electricity	-4.97	-6.69	7.99	-2.68	-13.57	1.99	0.84	3.7
Water	-0.17	-0.98	0.01	-0.85	-0.33	-0.16	0.36	0.41
EnIntind	-0.17	-1.88	4.28	-2.9	-7.52	3.15	1.24	2.2
Othind	-0.49	-0.73	0.78	-1.35	0.72	1.59	0.24	-0.07
MServ	-0.09	-0.23	-0.03	-0.24	-0.73	-0.04	0.15	-0.04
NMserv	0.07	0.02	-0.42	-0.56	-0.53	-0.6	0.03	0.15
CGDS	0.14	0.06	-0.18	0.02	-1.24	-0.53	0.05	-0.05

Source: simulation results

Table 5: Change in Output under Monopoly (percentage change)

Output	USA	EU	EEFSU	JPN	RoA1	EEx	CHIND	RoW
Rice	3.89	16.1	4.14	0.48	5.28	0.47	13.39	3.61
Wheat	-2.38	3.24	4.38	3.05	8.75	4.94	12.86	8.48
CerCrops	3.55	8.1	4.17	4.84	5.65	6.24	1.13	4.19
VegFruits	6.73	11.84	5.57	6.93	6.81	4.03	-1.37	4.82
Animals	2.85	4.92	4.42	1.15	1.5	0.83	-3.91	3.18
Forestry	-0.06	0.56	0.17	-1.54	-0.77	-0.2	-3.35	-2.64
Fishing	3.36	2.87	4.38	1.93	2.77	4.69	2.64	3.26
Coal	-27.27	-31.7	1.61	-3.84	-8.38	-0.99	-0.5	-0.36
Oil	-16.64	-6.01	-2.22	-9.94	-9.02	-5.48	-2.5	-3.52
Gas	-21.76	-21.69	0.5	-45.09	-16.82	-3.51	-0.85	-0.36
OilPcts	-20.19	-7.77	1.35	-17.04	-18.4	1.53	-1.1	0.99
Electricity	-3.05	-3.91	4.8	-1.15	-7.44	1.31	0.78	1.83
Water	2.36	0.78	0.39	-0.21	-0.42	0.17	-2.42	0
EnIntind	-1.58	-0.77	3.06	-1.74	-6.27	1.86	-0.49	1.69
Othind	1.17	1.32	1.23	0.27	-0.42	0.15	-3.08	0.01
MServ	-1.07	-1.34	-1.14	-0.85	-1.01	-0.36	-1.88	-1.26
NMserv	-1	-1.72	-1.36	-1.12	-0.81	-0.48	-0.19	-1.21
CGDS	-0.16	-0.69	-0.21	-0.53	0.01	-0.34	0.06	-0.46

Source: simulation results