TRADE REGULATION OF ENVIRONMENTAL GOODS IN AN OIL PRODUCING ECONOMY: A COMPUTATIONAL GENERAL EQUILIBRIUM ANALYSIS ON ABU DHABI

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Abstract: The reduction of trade barriers for environmental goods and services has been proposed by the World Trade Organization (WTO), Organization for Economic Co-operation and Development (OECD), and the Asia-Pacific Economic Cooperation (APEC) as one of the means to diffuse clean technologies. This paper examines the economic and environmental effects of the three proposed trade regulation schemes on oil producing economies using Abu Dhabi as an example. Using administrative trade data, a Computable General Equilibrium (CGE) model calibrated with Abu Dhabi's social accounting matrix is developed to analyze industrial outputs and CO_2 emissions reductions by sectors. The results shows that an elimination of import tariff for environmental goods lead to a drop in GDP by 0.012%, 0.014%, 0.027%, and reduction of CO_2 emissions by 0.015%, 0.018%, and 0.036% respectively under the WTO, APEC, and OECD proposals. The manufacturing and the construction industries contribute to most of the CO_2 emission reductions. While the OECD proposal reduces most CO_2 emissions, the elasticity of GDP change to Carbon emissions change are similar across all proposals.

Keywords: International Trade, CO_2 Regulation, Environmental Goods, Oil Producing Economies

1. Introduction

Climate change is a global environmental challenge that requires international cooperation to address. CO_2 emissions have been identified as one of the major contributors to climate change. Among the strategies to reduce CO_2 emissions, trade plays an important role in diffusing clean technologies. Reduction of trade barriers for environmental goods (EGs) and services helps to increase the scale economy of EGs, reduce their cost, encourage their deployment, and eventually lead to the reduction of CO_2 emissions.

In the World Trade Organization (WTO), negotiations are taking place under Doha Round on greater market opening in environmental goods and services, on the relationship between WTO rules and trade obligations set out in multilateral environmental agreement (MEAs), and on the exchange of information between those institutions. While the last two issues, arrived on draft ministerial decisions; the format of an outcome on the first issue is still open, although stated options and components have become clearer. It is unclear what challenges and opportunities Abu Dhabi will face in the upcoming WTO regulations in EGs. The issue is complex as EG trade regulation interacts with domestic economic activities.

This research aims at studying the effects of environmental and trade related policies on the overall economic and environmental performance of oil producing economies using Abu Dhabi, the largest emirate of the United Arab Emirates (UAE), as an example. UAE, as an oil producing economy, has experienced an economic boom in the past 10 years at a cost of rising CO_2 emissions. The emirate of Abu Dhabi accounts for 94% of UAE's oil reserves, more than 90% of its natural gas production, and emits most of the UAE's CO_2 [1]. Computable General Equilibrium modeling methodology is used to carry out the economic and environmental assessments.

The rest of this paper is organized as follows: Section 2 provides background to the UAE's foreign trade environment and the debate in the WTO on greater market opening for environmental goods. Section 3 presents the algebraic features of the model and the

data used. Section 4 presents a set of simulation analysis and their results. Section 5 will give the conclusion.

2. Background

The United Arab Emirates joined the World Trade organization (WTO) in 10th April, 1996 [2]. In line with its commitment as a WTO member, the UAE has taken steps to align its trade-related legislation on the WTO Agreements. It also established institutions to monitor this legislation. Under the supervision of the Ministry of Foreign Trade, a National Committee (NC) was created to deal with WTO related matters, acting as an advisory body to the UAE negotiating team [3].

As a member of the Gulf Co-operation Council (GCC), the UAE has harmonized its trade related legislation with that of the other members. Since the establishment of the GCC customs union on 1st January, 2003, the UAE has been applying the GCC Common Customs Law, and its Rules of Implementation and Explanatory Notes. In UAE, each emirate has its own customs authority. Customs procedures, however, are the same throughout the UAE.

In the area of international trade, three multilateral organizations have proposed different lists of environmental goods to regulate: (a) The WTO's Sample Core List of Environmental Goods, with 26 unique HS (Harmonized System) sub-headings. (b) APEC's Early Voluntary Sectorial Liberalization (EVSL), with 104 unique HS sub-headings. (c) OECD's Illustrative Categories of Environmental Goods, with 132 unique HS sub-headings.

The APEC's and OECD's lists of environmental goods contain more HS sub-headings and cover more items. The proposals also differ in the definition of EGs. For example, while low carbon chemical products are excluded from APEC list, products produced with clean technologies are included in OECD list but not APEC list.

On the effect of trade liberalization on pollution, Lee argues that tax reduces pollution until the marginal revenue product of pollution equals the tax. The paper shows that the pollution tax performance depends on the market structure which can also influence the abatement efficiency. In arriving to the least cost abatement approach though taxation, a different per-unit pollution tax for each firm is required [4]. Chuanyi presents a dynamic recursive general equilibrium model to explore the long-term impacts of carbon tax and complementary policies on the Chinese economy. Results of the analysis show that carbon tax reduces carbon emissions with a little negative impact on economic growth. It also shows that complementary policies used together with carbon tax helps cushion the negative impacts of carbon tax on the economy [5].

For oil producing economies, studies show positive effects of free trade on the economy. Vellinga, N., & Abdelgalil, E. analyzes the impacts of trade liberalization on the economy of Qatar with Computational General Equilibrium (CGE) analysis. Results of the analysis show that Qatar's economy is better off, in terms of GDP and wealth outcomes, in response to the policy shock of trade liberalization. Furthermore, as the tax base expands in response to the economy growth, the government tax revenue increases as well. The environmental effects of free trade in oil producing economies are however limited explored [6].

3. The Model

We develop a static CGE model based on the model of International Food Policy Research Institute (IFPRI) as described by Lofgren et al [7]. It contains four sets of linear and non-linear mathematical programs that characterize the price, production, institutional, and system constraints. Our model contains seven productive sectors that combine primary factors with intermediate commodities to determine the level of output.

The equilibrium condition requires comprehensive market coverage in balancing the economy, and accounting rules are the keystones of Walrasian general equilibrium conditions. The zero profit of enterprises indicates the total production's revenues must be allocated to production's costs including households as primary factor suppliers, payments for intermediate inputs and government taxes. This concept reflects constant returns to scale in production and perfectly competitive markets for produced commodities. The principle of budgetary balance reflects the value of equality between incomes and expenditure that each unit of expenditure has to acquire for some commodities. The primary factors accumulate to households as income that the households consume on purchasing goods. In principle, households' factor endowments are fully employed and no amount of any factor is left in an idle situation. The market clearance condition demonstrates the quantity of commodities produced for domestic and export production must be completely absorbed by the domestic institutions and the rest of the economy. The households' endowment of primary factors ought to be fully employed by firms.

(1) $$tm_{new} = (1 + Pencentage\ \ Change) \times tm_{original}$$

Table 1: Change in Import Tariff Revenue across Economic Sectors, at 2.5% and 0% import tariff rate for EGs

Manu	2.50%	0%
WTO	0.981064	0.962135
OECD	0.95561	0.911439
APEC	0.977291	0.954793

Table 2: Macroeconomic Variables Percentage Change after Reduction of Import Tariff Rate for EGs

Economic Indicator	Base Run Level (Billion USD)	Import Tariff rate	WTO	APEC	OECD
Absorption	268.7671	2.50%	-0.009%	-0.010%	-0.020%
		0%	-0.017%	-0.021%	-0.041%
Private Consumption	147.1151	2.50%	-0.009%	-0.011%	-0.022%
		0%	-0.019%	-0.022%	-0.044%
Fixed Investment	57.7812	2.50%	-0.015%	-0.017%	-0.034%
		0%	-0.029%	-0.035%	-0.068%
Government Consumption	63.87076	2.50%	-0.002%	-0.003%	-0.005%
		0%	-0.004%	-0.005%	-0.010%
Exports	261.6044	2.50%	0.008%	0.009%	0.018%
		0%	0.016%	0.019%	0.037%
Imports	-130.53	2.50%	0.016%	0.019%	0.038%
		0%	0.032%	0.038%	0.074%
GDP at market price	399.841	2.50%	-0.006%	-0.007%	-0.014%
		0%	-0.012%	-0.014%	-0.027%
Net Indirect Tax	146.5915	2.50%	-0.015%	-0.019%	-0.036%
		0%	-0.031%	-0.037%	-0.073%
GDP at Factor Cost	253.2496	2.50%	0.000%	0.000%	-0.001%
		0%	-0.001%	-0.001%	-0.001%

Table 3: Industrial Output Level Change Compared to Benchmark at 2.5% Import Tariff Change

Percentage Change	WTO-2.5%	Ratio to WTO	APEC-2.5%	Ratio to WTO	OECD-2.5%	Ratio to WTO
Agr-C	-2.67E-06	1	-3.15E-06	1.182	-6.31E-06	2.364
Oil-C	1.88E-05	1	2.25E-05	1.199	4.41E-05	2.346
Manu-C	-3.99E-04	1	-4.78E-04	1.199	-9.35E-04	2.344
Elec-C	-1.53E-05	1	-1.83E-05	1.200	-3.60E-05	2.357
Water-C	0	1	3.89E-07	NA	3.89E-07	NA
Const-C	-2.23E-06	1	-2.68E-06	1.202	-5.23E-06	2.347
ROI-C	7.81E-05	1	9.37E-05	1.199	1.83E-04	2.344

For a given factor the quantities demanded by firms must completely exhaust the aggregate supply to the households [8].

Our analysis uses the 2007 Abu Dhabi Social Accounting Matrix (AD SAM) collected by the Abu Dhabi government in collaboration with other economic entities in the emirate to calibrate the CGE model. The AD SAM consists of nineteen activities and commodities. The utility sector is disaggregated into water and electricity sectors to produce higher resolution analysis that takes into accounts the different carbon intensities of these two sectors. The disaggregation process is based on the percentage share of one specific sector from the total expenditure of both sectors in Abu Dhabi Input-Output table of 1995. To match the classification of sectors in CO2 emission data, we aggregated the remaining eighteen sectors into five sectors based on the international standard industrial classification [9]. The resulting seven industrial activities are: (a) Agriculture, livestock and fishing (b) Crude oil and Natural Gas (c) Quarrying Petrochemicals & other manufacturing (d) Electricity (e) Water (f) Construction (g) Rest of Industry

In this Abu Dhabi CGE model, four changes are made to characterize local governmental and economic structures and meet data requirements. First, each activity is presented as a single producer of one aggregated commodity to be consistent with the available data. Secondly, the government agent is divided into two: the Abu Dhabi government and the UAE federal government, both of which consume commodities and services and transfer payments to each other. Thirdly, the tax types are divided into sales taxes, value-added taxes, and tariffs on imported commodities. Fourthly, the government subsidizes the production systems of both water and electricity activities. CPI is selected to be the numeraire.

The policy of liberalizing trade for environmental goods (EGs) is simulated by reducing Abu Dhabi's import tariff rates for each environmental goods from its benchmark level to the proposed level. For each proposed regulation scheme, we calculate the change of import tariff using trade volume data from the UAE Federal Customs Authority adjusted by Abu Dhabi's percentage of trade in the country. We adjust the import tariffs of environmental goods from the GCC Common Tariff 2007 import tariff rate to 2.5% and 0%, with the latter reflects an elimination of import tariff for environmental goods. Eq. (1) describes the new import tariff rate, reflecting the liberalization of trade in EGs in the CGE model.

The import tariff revenue of EGs is then mapped to the corresponding economic sector in the 2007 Abu Dhabi SAM. After calculation, The Quarrying Petrochemicals & other manufacturing sector is the only economic sector with change of tariff revenue to the government.

4. Results

Our analysis shows that the economy of Abu Dhabi is negatively affected by the liberalization of trade in EGs in the short run. This is demonstrated by the marginal decrease in GDP at market price, private consumption, government consumption, and absorption variables. The percentage change in import tariff revenue across economic sectors, at 2.5% and 0% import tariff rate for EGs is presented in Table 1. The flow of trade in imports and exports on the other hand, are better off. Table 2 captures changes in some aggregate macro variables under 2.5% and 0% import tariff rate on EG. Also, the industrial output by sector is change correspondingly which is shown in Table 3. From Table 3, we know the change is significantly big when choosing the OECD's list as OECD list is the most comprehensive one.

As the government tariff revenue drops, it drives down the level of government consumption. Also because of the drop in the tariffs, the production of domestic goods sold domestically decreases due to the price competition with imported goods. This leads to further drop in private consumption overall since the share of consumption of domestic goods in private consumption is higher than of the imported goods in general. As result of these changes, GDP decreases. The impact is most evident when adopting the OECD's list of EGs (most comprehensive amongst the three lists), and the least evident when adopting the WTO's (least comprehensive). In terms of the GDP at market price, the decreasing rate when adopting the OECD's list is more than double the decreasing rate of WTO's list, same as absorption, private consumption, fixed investment, government consumption, exports and imports.

The total CO_2 emission in UAE is 174.4 million tons, while the Abu Dhabi emits 56% of the total UAE CO_2 emission. With the combination of sector Manufacturing and Construction, the sectorial CO_2 emission percentage is shown as Table 4 [10]. We took the 2000 as benchmark to calculate the carbon intensity based on the quantity level of each sector got from our CGE model. Then we change the import tariff rate to analyze the overall CO_2 emissions change. Fig. 1 tells us that CO_2 emission will decrease with liberalization of the Environmental Goods. The decreasing rate of CO_2 emission is higher

Table 4: Percentage of the Sectorial CO_2 Emissions

Sector	Percentage
Agriculture	1%
Oil	14%
Manufacture & Construction	37%
Electricity	33%
Rest of Industries	15%

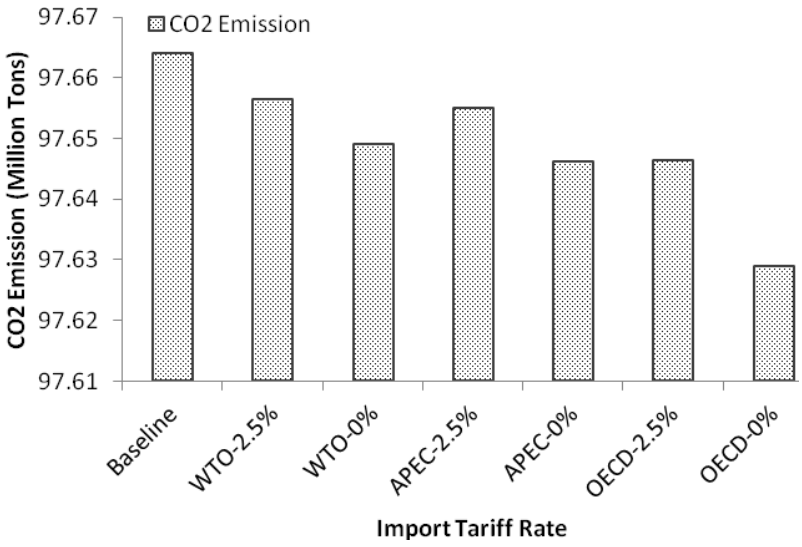

Figure 1: CO_2 Emission under different Import Tariff Rate Policy

Table 5: GDP Change/CO_2 Emission Change Matrix

Import Tariff Rate	GDP Change	CO2 Emission Change	Elasticity
WTO-2.5%	-0.003%	-0.008%	2.47395
WTO-0%	-0.006%	-0.015%	2.47414
APEC-2.5%	-0.004%	-0.009%	2.47417
APEC-0%	-0.007%	-0.018%	2.47501
OECD-2.5%	-0.007%	-0.018%	2.47493
OECD-0%	-0.014%	-0.036%	2.47663

than the decreasing rate of GDP as indicated in Table 5. The elasticity of the CO_2 emission to the GDP change under different import tariff rate change policies are all around 2.47.

5. Conclusion

The paper analyzes the economic and environmental effects of environmental goods regulations on the economy of Abu Dhabi. A Computable General Equilibrium (CGE) model that characterizes Abu Dhabi's economy is used as a tool to quantify the economy-wide costs and macroeconomic effects of policies on the economy of Abu Dhabi.

As negotiations take place under Doha Round on greater market opening in environmental goods and services, the study identifies the expected effects of upcoming WTO regulations in environmental goods (EGs) on the economy of Abu Dhabi. Results of the analysis show that the economy is negatively affected by the liberalization of trade in EGs in the short run. The impact is very slight due to the small share EGs contribute to the total import volume in Abu Dhabi, and the fact that applied tariff rates are originally low. Results of imposing a 0% import tariff rate on EGs show a drop in GDP at market price level by 0.012%, 0.014%, 0.027%, when adopting the WTO, APEC, and OECD lists of EGs respectively. The CO_2 emission will reduce 0.015%, 0.018%, and 0.036% when imposing a 0% import tariff rate on EGs with adopting the WTO, APEC, and OECD respectively.

In addition to tariffs, access to and affordability of climate change mitigation technologies is determined by other factors, including technical assistance and intellectual property related costs. In general, the consequence of an adoption of the OECD proposal is more significant due to the broader scale of coverage in the proposal. The CO_2 emission decrease is higher than the GDP decrease which also indicates that reducing the import tariff rate is beneficial to the environmental even sacrifice the GDP comparatively.

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