Trade in Climate Smart Goods of Ecuador:

Quantitative Analysis Using Trade Indices, SMART and Gravity Analysis

By

Somesh K. Mathur[1]

Indian Institute of Technology Kanpur, Uttar Pradesh, India

Abstract

The study identified Climate Smart Goods (CSG) in which Ecuador has advantage in production and trade. The interest in the subject of Trade in Climate Smart Goods was fuelled by Ecuador´s positive trade balance with the rest of the Andean Community and MERCOSUR region in 2010. SMART tool in WITS has been utilized for evaluating the relative benefits of tariff liberalization of CSG with MERCOSUR, China, Japan, US, and EU27 separately in 2010. It provides the results on various variables such as, trade creation, trade diversion, tariff revenue, welfare and consumer surplus. Further, the study has also utilized a variant of Baier and Bergstrand (2001) gravity formulation for working out the basis of trade and export potential in CSG of Ecuador in 2010. The study concludes that trade in CSG will help Ecuador to promote alternative industries in the face of Global Economic Downturn. Also, it will help countries to look for safe, alternative and reliable energy source rather than believing in trade of crude and Petroleum Oil only or investing a great deal in nuclear energy. Ecuador can direct its social spending in promoting small industries which can provide CSG goods (low carbon emanating goods) at low cost. The Country-wise analysis reveals that for Ecuador as far as trade in CSG is concerned, it is better to liberalize trade with the Japan, the US and the China, the main suppliers (exporters) of CSG products. The study also finds that there is export potential of 34 million US $ in CSG with respect to four Latin American trading partners of Ecuador. The four Latin American Countries are Bolivia, Chile, Columbia and Peru. This is less than the export potential when Ecuador

[1] Associate Professor of Economics, Humanities and Social Sciences, Indian Institute of Technology Kanpur, Kanpur, Uttar Pradesh, India. Email: skmathur@iitk.ac.in

I would like to extend my appreciation to the staff of the ITT, UTE and Head ITT for hosting me as the Prometeo Researcher, 2012 and also providing very relaxed atmosphere for pursuing the research work in Quito, Ecuador. Also to SENESCYT for hosting me in Ecuador, Professor Zavalo, former Minister of Economy and Trade, Ecuador and the Indian Embassy in Columbia for their helpful advice.

liberalizes its trade of CSG with China, Japan and the US. Finally, on the basis of Gravity Analysis, some national and international policies are recommended for promoting CSG goods and limiting Climate change.

Keywords: Climate Smart Goods (CSG), Trade Indices, SMART Analysis and Gravity Analysis
JEL Classification Codes: F14, F18

1. Introduction

The Climate Smart Goods (CSG) forms part of the broader group named 'environmental goods and services (EGS). The Environmental goods and services industry consists of activities which produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco systems. This includes cleaner technologies, products and services which reduce environmental risk and minimize pollution and resource use.

An Environmental good can be understood as equipment, material or technology used to address a particular environmental problem or as a product that is itself 'environmentally preferable' to other similar products because of its relatively benign impact on environment. Environmental services are services provided by eco systems or human activities to address environmental problems. EGS can be also classified as Environmental Goods comprising of pollution management products, cleaner technologies and products, resource management products and environmentally preferable products. EGS also has Environmental services comprising of sewage services, refuse services, sanitation and similar services and others.

The EGS were first discussed as part of the liberalizing agenda in the DOHA round of the multilateral trading round in 2001. The countries had wanted the tariff and non-tariff barriers to go down for trade of such EGS as this may lead to adoption of cleaner and cost effective technologies by firms and country at large and possibly mitigate climate change and improve energy efficiency. Liberalization has followed three routes namely the list approach,

project/integrated approach and request for offer approach. Environmental Goods were always part of trade agenda but were subsumed within industrial or agricultural negotiations.

CSG are defined as components, products and technologies which tend to have relatively less adverse impact on the environment. CSGs constitute low carbon technologies such as solar photovoltaic systems, wind power generation, clean coal technologies and energy-efficient lighting. The term "climate smart" was chosen over the previously used classification of "climate friendly" owing mainly to the fact that many goods/technologies contained within the UNESCAP list are not only "friendly" to the climate (i.e. assist in mitigation efforts by reducing GHG emissions), but also contribute to fostering "climate-smart" development by improving adaptive capacity such as by conserving water or by improving access to energy.

CSGs constitute low carbon technologies such as solar photovoltaic systems (Industry Codes 850720, 853710, 854140), wind power generation (industry codes 848340 and 848360), clean coal technologies (840510) and energy-efficient lighting (853931)[2], among others (See Appendix table A1 for details). Trade and investment in CSGs and climate-smart services have recently received much attention as a triple win scenario where trade, climate and environment, and development all benefit (UNESCAP, 2011, a, b). Climate Smart Goods and technologies allow for production processes that have no or minimum Green House Gas (GHG) emissions and negative impact on environment and which are at least economically efficient and acceptable. Climate Smart Technologies consists of technology that improves efficiency and conservation of conventional fossil energy and enables the commercial and efficient use of renewable energy sources.

Promoting CSG trade has become important because of the need of such goods by countries in the wake of recent financial crisis in Europe and after events in Japan recently. Countries want to concentrate on low energy consumption and save them from relying entirely on nuclear energy which may be prone and be affected by natural disasters like what happened in Japan. Our Gravity analysis has shown that there is potential for trade in CSG by Ecuador and

[2] Climate Smart Goods list of 64 goods (UNESCAP,2011,a,b) include, among 'Other Industries', Industry Codes, Solar Photovoltaic systems (850720-Other Lead Acid Accumulators,853710-For a voltage not exceeding 1000V and 854140-Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels, light emitting diodes),Wind Power (848340-Gears and Gearing, Other Than Toothed Wheels, Chain Sprockets and other transmission elements presented separately, ball or rollers screws, gear boxes and other speed changers, including torque converters, 848360-Clutches and Shaft Couplings(Including Universal Joints),Clean Coal Technologies-(840510- Producer Gas or Water Gas Generators, With or Without Their Purifiers, Acetylene Gas Generators and Similar Water Process Gas Generators With or Without Their Purifiers), Energy Efficient Lighting-(853931-Fluorescent Hot Cathode).

trading nations alike. Countries need to design sustainable and climate smart growth that entails sharply reduced GHG emissions to a level of 450 ppm (or may be lower) and that limits the global temperature rise to not more than 2 degrees Celsius by the end of the century. Various efforts have been made by international community to tackle the climate change. These include the Rio Meet in 1992, Kyoto Protocol of 1997, Copenhagen accord in 2009, the COP 16 meeting, the Bali Action Plan of 2007 and the very ambitious, the Durban meeting of 2011. These meetings are besides the DOHA agenda on liberalizing trade in environmental goods and services.

Trade policies related to CSG though are the main focus of this study. The entire set of policies which can reduce GHG emissions and limit climate change can be structured into regulatory measures (including regulations, standards and labeling), economic incentives (including taxes, tradable permits and subsidies conforming to WTO laws and provisions), trade and investment policies and financial, energy and enterprise development policies, among others.

This study believes that economic growth, higher trade and environment sustainability, all three are possible at the same time and there is limited tradeoff between them. The debate on trade, growth and environment sustainability have arisen as trade and environment sustainability are not always positively related. Grossman and Krueger (1994) argues that trade affects environment through scale effects, technique effect and composition effect.

With the rapid increase of trade and investment in recent decades as a result of sustained liberalization, the ecological footprint – including GHG emissions – has also risen sharply. This is called the "scale effect". When renewable energy replaces traditional fossil fuels, trade and investment are no longer associated with Green House Gas (GHG) emissions. Instead trade and investment become principal components of efforts to mitigate climate change. The other two identified effects are the composition and technique effects. The composition effect refers to the way trade liberalization changes countries' comparative advantages towards emission-intensive or emission-friendly industries. For example, a changing comparative advantage as a result of trade liberalization may lead carbon-intensive industries to relocate from countries with strict regulations to countries (often developing countries) with less stringent regulations, which are known as "pollution havens" (and, thus, provide a large comparative advantage), leading to "carbon leakage". The net global composition effect of trade opening on GHG emissions is therefore not necessarily positive. The technique effect refers to the manner in which

technological improvements may be adopted to increase production efficiency and reduce emission intensity as a result of trade and trade liberalization. This may happen in two ways: (a) trade liberalization increases the availability of climate-smart technology; and (b) trade income increases incomes and wealth – people with more wealth tend to be more concerned about other aspects of well-being, including a clean environment (Grossmann and Krueger, 1994).

World Trade Organization (WTO) has recognized 153 environmental goods which have been broadly classified under the following headings: Air pollution control; Management of solid and hazardous waste and recycling systems; Clean up or remediation of soil and water; Renewable energy plants; Heat and energy management; Waste water management and potable water treatment; Environmentally preferable products (based on end use or disposal charactersitics); Natural risks management; Natural resources protection; Noise and vibration abatement. World Bank has identified 43 products out of the '153' products list proposed by proponents of Environmental Goods liberalization in the WTO. These 43 products comprise diverse products from wind turbines to solar panels to water saving shower. Also there has been a rapid growth in their imports and exports. What is common in all the lists floating around is that they consist of goods which tend to have benign impact on environment and lead to low carbon emanating processes.

Trade and investment in CSG offers opportunities to export international standards, promote the rule of law and good governance, and close the gap between the rich and poor. Trade in CSG will help Ecuador to promote alternative industries in the face of Global Economic Downturn. Also, it will help country to look for safe, alternative and reliable energy source rather than believing in trade of crude and Petroleum Oil only or investing a great deal in nuclear energy. Nuclear energy was in the brink of being affected in Japan due to recent Earthquake in Japan. Ecuador can direct its social spending in promoting small industries which can provide CSG goods at low cost. Countries can gain in terms of their comparative advantage and establish new industries. Positions keep changing in terms of the advantage of producing goods and services. Based on our analysis and review of studies done on CSG (UNESCAP,2011,a,b, ICTSD, WTO and World Bank) one may conclude that various national and international policies can be followed by Ecuador and its trading partners to promote trade of CSG goods for increasing welfare, diversification and promoting alternative sources of energy .

The present study is on trade in Climate Smart Goods (CSG) of Ecuador. The value of World CSG exports were worth 410 billion US $ in 2008. Ecuador´s export share in World exports of CSG has remained less than 0.02 % in 2002 through 2008. The Leading Exporters' Japan, US, Countries in the EU, China and Hong Kong´s export share is more than 3% in World Exports of CSG. The interest in the subject of Trade in Climate Smart Goods was fuelled by Ecuador´s positive trade balance with the rest of the Andean Community and MERCOSUR region in 2010. This may be a reflection of Ecuador´s maturity in dealing with environmental issues since the early 1980s and due to preferential trade policies followed by the ANDEAN countries. The basic thrust of the study came after looking at some Gross Exports and Gross Imports figures of Ecuador to and fro from other MERCOSUR[3] and ANDEAN[4] community for CSG for the year 2010 in Table 1.

Table 1: **Gross Exports and Imports of CSG by Ecuador to and from the Partner Regions/Countries in 2010**

Product Code	Partner Name	Gross Exports	Gross Imports
CSG2002	All Countries	91319.906	487572.047
CSG2002	Andean Customs unión without Ecuador	49834.952	46908.311
CSG2002	Argentina	119.609	3312.600
CSG2002	Bolivia	573.611	13.377
CSG2002	Brazil	3.201	16427.403
CSG2002	Chile	7283.650	7755.537
CSG2002	China	3.685	61667.021
CSG2002	Colombia	17937.610	22124.861
CSG2002	EU27 --- EU27 Members --- EU27	375.621	61096.945
CSG2002	Japan	0.122	2054.675
CSG2002	Latin American Common Market-- merco	71477.799	55834.663
CSG2002	Peru	31200.921	4850.125
CSG2002	Paraguay	--	0.099
CSG2002	Uruguay	--	179.846
CSG2002	Venezuela	14359.197	1170.815
CSG2002	United States	1183.914	273645.369
Notes: i) 64 CSG list is based on HS 2002 but 2010 data; ii) The figures of ECU in 1000 USD.			
Source: WITS data base.			

[3]MERCOSUR, a common market, has the following core members-Argentina, Brazil, Paraguay, Uruguay and Venezuela. Associate members are Bolivia, Chile, Columbia, Ecuador and Peru. We consider all core and associate members of the MERCOSUR excluding Ecuador in our study because we consider Ecuadorian trade relations with other members.

[4] ANDEAN Region, a customs union, has the following core members-Columbia, Ecuador, Peru and Bolivia. The Associate members are Argentina, Brazil, Paraguay and Uruguay. We consider all core and associate members except Ecuador as we need to consider trade relations of Ecuador with all its trading partners.

After carefully looking at the figures for Ecuador one finds that Ecuador has a positive trade balance for CSG with the other ANDEAN and MERCOSUR countries.

1.2 Policy Questions

One would have least expected the same after finding that Ecuador is a net importer of Climate Smart Goods (basically components to cleaner technologies), as with the case of the entire Latin American region, from China, Japan, the US, the EU27 and World at large. Then why would it have a positive trade balance with its Latin American Trading Partners? Does this reflect the matured response of Ecuador on having growth with environment policies since early 1980s, reflected by its early ratification of Kyoto Protocol, Convention on Biological Treaty (CBT) and protection of its Amazon jungles? Would it also mean that that Ecuador has realized the benefits of CSG goods early to have positive trade balance with its neighboring countries?

It may be also due to preferential trade policies followed upon by member nations of the ANDEAN region. Or, the above trend can be just a consequence of their fast export growth. One, however, would like to establish with more certainty the association of various policies that have been put in place to help mitigate climate change and trade pattern changes.

The study will outline the national and international policies adopted by Ecuador as far as cleaner and environment friendly policies are concerned to answer the above. Would it further mean then that by further liberalizing trade with MERCOSUR and ANDEAN Countries would bring some further gains to Ecuador? Would Ecuador gain more by liberalizing Ecuador's trade with the most efficient suppliers of the CSG- the Japan, the Hong Kong, China, EU and the US? Would it further mean that Ecuador will have the same trend (positive trade balance) with all its Latin American in all other products and some identified specialized products? Liberalizing trade in this study would mean a scenario of zero tariffs for imported products. This would have total trade effects as sum of price or terms of trade effect and quantity effects as sum of trade creation and trade diversion effects. These effects along with consumer surplus, revenue effects and welfare effects will accrue to the importer. Such effects are estimated by SMART analysis.

In this study we have done liberalization simulation for Ecuador (importer) country only. Therefore, any export potential effects of Ecuador for imports coming into MERCOSUR or EU, the Japan, The China and the US is examined by not working on the liberalization efforts of its trading partners but by Gravity Analysis. It helps us to explain Ecuadorian trade of CSG products by identifying the host of determinants explaining such trade. Gravity model has also used to

work out the export potential (actual minus the predicted trade) of Ecuador and its trading partners for CSG products.

On the basis of above discussion, present study has following three main objectives:

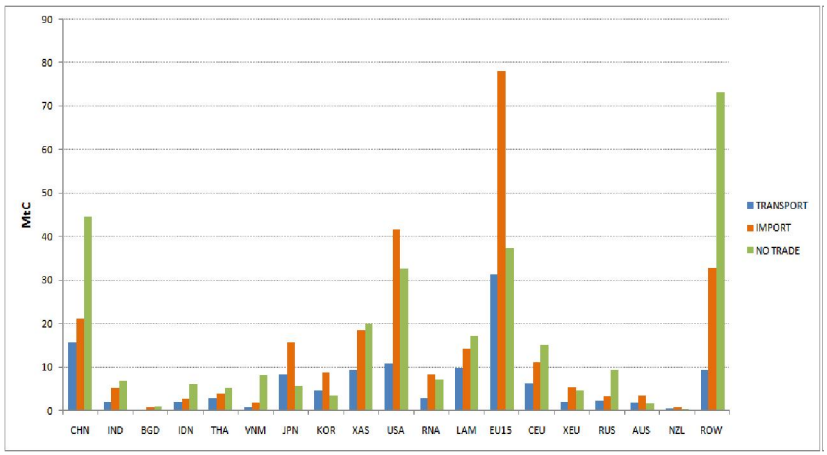
1. Evaluate the trade performance of Ecuador in CSGs and identify the goods in which Ecuador has comparative advantage by using various trade indices;
2. Calculate the impact of trade liberalization efforts of Ecuador in CSGs with MERCOSUR countries and the US, China, Japan and the EU27 by using SMART analysis.
3. Finally, apply Gravity analysis to explain Ecuadorian trade of CSG products by identifying the host of determinants explaining such trade. It also give us the figures of 'export potential' of Ecuador and its trading partners for CSG products.

For pursuing the abovementioned objectives, the present work has been divided into five sections including the present introductory one. Section 2 presents the Literature Review with focus on Background and Importance of the Climate Smart Goods. Database and Methodology utilized has been presented in Section 3. In Section 4, empirical results have been presented and discussed. Section 5 concludes the whole study and provides some noteworthy policy prescriptions.

2 Background and Importance of the Climate Smart Goods : Literature Review

The facts of international trade are that strong (trade-led) growth has led to sharp expansión of fossil fuel-intensive production and cargo transportation. The downside is that it has resulted in a surge of green house gas emissions, which accelerate climate change and its impacts. Developing countries are expected to be hardest hit. Therefore, there is a pressing need to improve ecological sustainability of trade-led growth strategies in the region.

The figure I, below shows the total carbon emissions from imports and international transport as compared to hypothetical "no trade" situation by taking 2004 as base year. Where imports had to be replaced by domestic production for selected countries and regions including Latin American Countries (LAM). The results show that no trading (imports) with the world may help Latin American Countries in reducing carbon emissions.

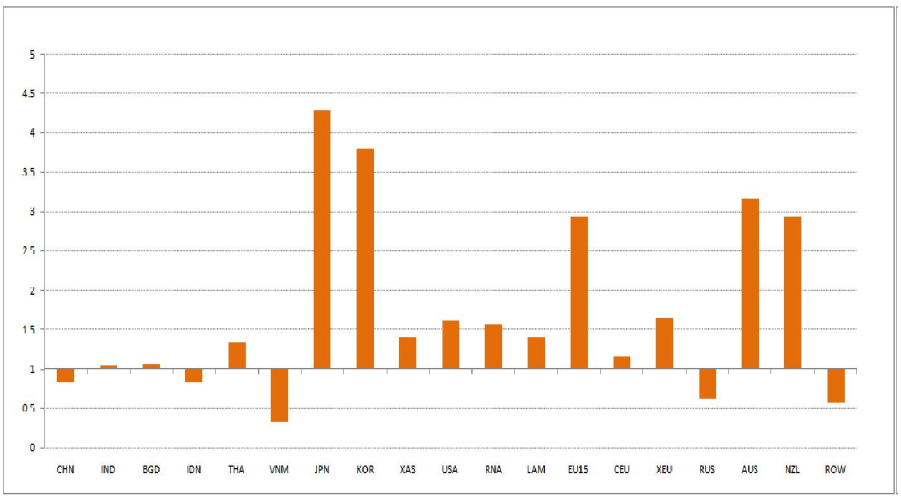


Source: Mikic (2011)

Figure I: Total carbon emissions from Imports and International Transport as compared to hypothetical "No Trade" situation.

Further, figure II below shows the import emission intensity index[5] for selected regions and countries of the world including Latin American Countries (LAM). For Latin American countries again the import emission intensity index is low in comparisons with other regions. It also shows the high import emission intensity of countries like Japan, Korea, EU, Australia and New Zealand in comparisons with other regions and countries.

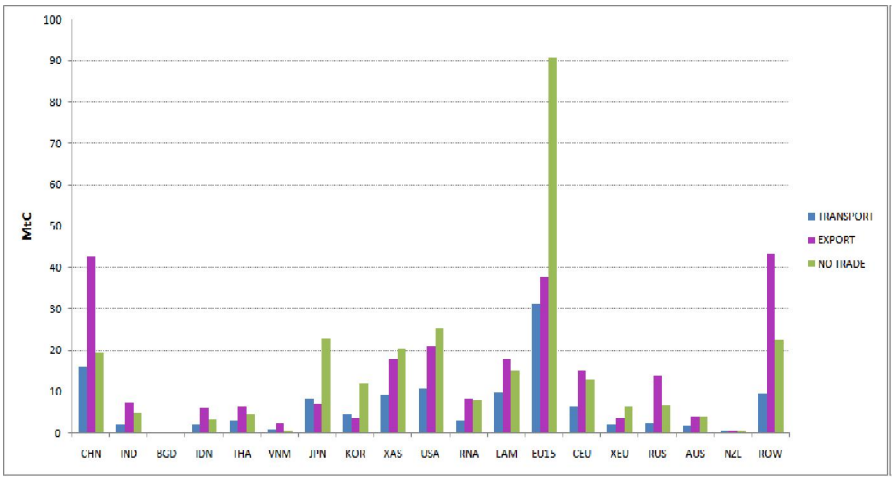
[5] Emission intensity indices of exports and imports are worked out. The values of these indices range from 0 to infinite but the important benchmark is a value equal to 1. For example, if the emission intensity index of imports is larger than 1, emissions embodied in goods produced overseas and transported to a destination are larger than the emissions that would have been caused by local production in that destination of the same amount of goods. In other words, from a climate change perspective, it would have been less damaging to produce these goods locally than to import them. In the opposite case, when the index is less than 1, the environment is less damaged by trade than when no trade takes place. The index value of 1 indicates that emissions associated with imports of goods are the same as those associated with local production replacing trade.



Source: Mikic (2011)

Figure II: Import Emission Intensity Index (Base 2004).

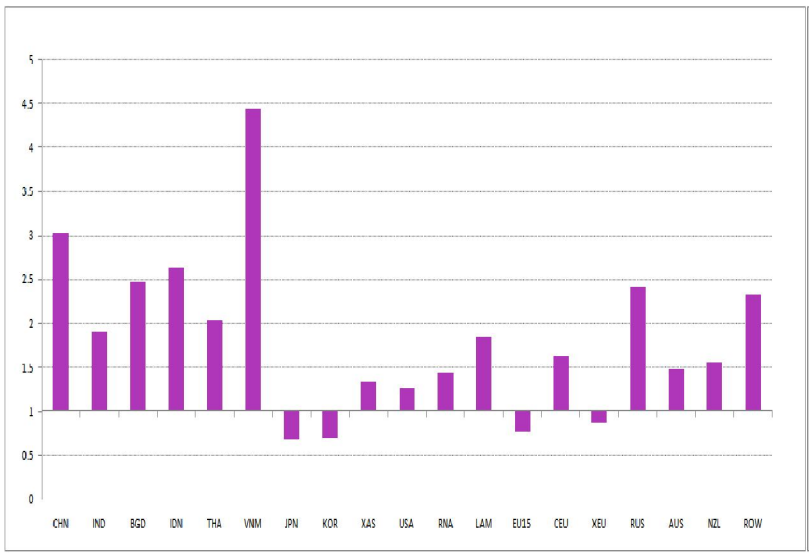
Figure III below presents the total carbon emissions from export and international transport as compared to hypothetical "No Trade" situation where imports had to be replaced by domestic production at 2004 base year. It shows how no trade (exports) can lead to increased emissions for the EU region but not for the Latin American Region.



Source: Mikic(2011)

Figure III: Total carbon emissions from export and international transport as compared to hypothetical "no trade" situation.

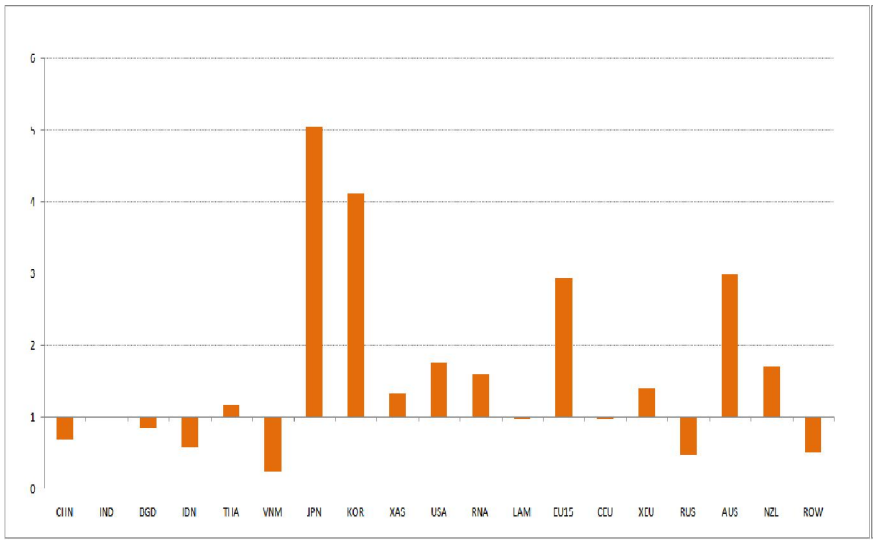
Further, figure IV shows export emission intensity index for selected countries and regions. The figure explains that for Latin American Region (LAM) exports are relatively less intensive in carbon emissions.



Source: Mikic (2011)

Figure IV: Export Emission Intensity Index for Selected Countries and Regions.

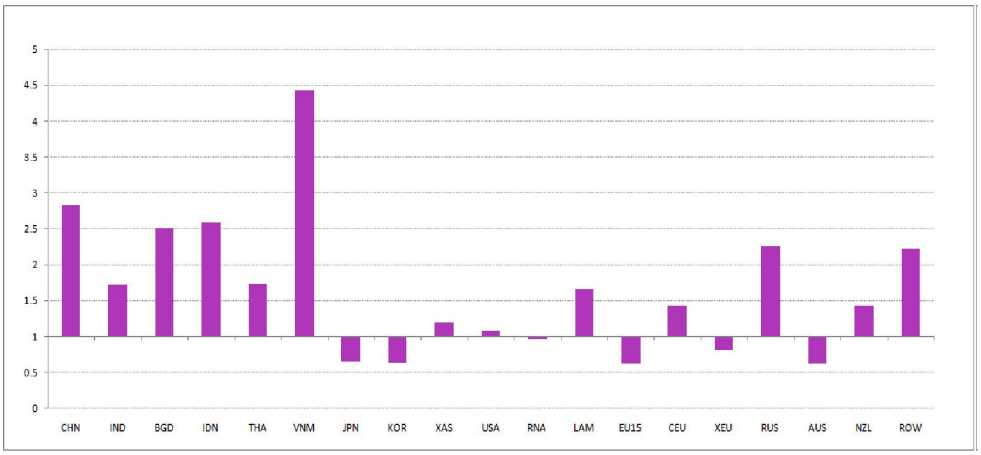
Figure V below shows the import emission intensity of climate friendly goods only. They are high for Japan, Korea, EU, Australia and New Zealand signifying that by domestically producing them they have become the most efficient suppliers of the same goods.



Source: Mikic (2011)

Figure V: Import Emission Intensity Index of Climate Friendly Goods Only.

Further, figure VI below may construe that for Latin American región if imports of climate friendly goods are made posible from efficient suppliers of the environmental friendly goods, then the Latin American región can focus on using their resources for other specialized products.



Source: Mikic (2011)

Figure VI: Export Emission Intensity Index of Climate Friendly Goods Only

3. Database and Methodology

The main databases used for the empirical analysis are World Integrated Trade Solution (WITS) by World Bank, World Economic Outlook, 2011 provided by International Monetary Fund (IMF), CEPII database (www.cepii.fr), TRAINS database included in WITS, World Development Indicators, 2010 by World Bank.

The study considers 62 trading partners for the year 2010. The sources and the variable construction have been given as follows:

- Import data to and from Ecuador of CSG goods-one category made of the list of 64 goods (under 6 Digit HS Combined) is taken from WITS data base for 2010;
- GDP data of trading partners is expressed in billions of US dollars and the basic source of data is the IMF, World Economic Outlook (April 2011 edition);
- Distance data is taken from the dist_cepii.xls file of CEPII data base;
- Tariff data is applied weighted tariff (%) on CSG goods for each country available from the TRAINS database;
- Inter country dispersion is product of two terms si *sj where si = GDPi/(GDPi+GDPj) and sj = GDPj/(GDPi+GDPj). *Si* and *Sj* is constructed from GDP data of trading partners; and

- Prices data of reporter (importer) and partner (exporter) from the GDP deflators available from the World Bank World Development Indicators available at the World Bank website for 2010.

All variables are in natural logs so the estimates of parameters will capture elasticity of explanatory variables with respect to imports.

3.2 Methodology

To pursue the study's objectives, three main methodologies have been utilized. To accomplish the need to evaluate the trade pattern of Ecuador, different trade indices have been calculated. Further, SMART analysis, a partial equilibrium tool, has been utilized to evaluate the impact of trade liberalization in CSGs. At last, OLS regression has been utilized to estimate the Baier and Bergstrand (2011) version of gravity analysis to estimate the factors affecting trade. Let us briefly explain all these methodologies as follows:

3.2.1 Trade Indices

The following trade indices have been used to evaluate the trade pattern of Ecuador:

Share of Product in Total Exports: It is the share of each export product (at a chosen level of disaggregation) in the country's total exports.

Competitiveness Index: Competitiveness in trade is broadly defined as the capacity of an industry to increase its share in international markets at the expense of its rivals. The competitiveness index is an indirect measure of international market power, evaluated through a country's share of world markets in selected export categories. It is the share of country *s* exports of good *i* in the total world exports of good *i*. It takes a value between 0 and 100 per cent, with higher values indicating greater market power of the country in question. Mathematically,

$$C = \frac{\sum_d X_{isd}}{\sum_{wd} X_{iwd}} \times 100$$

Revealed Comparative Index: The RCA index of country *i* for product *j* is often measured by the product's share in the country's exports in relation to its share in world trade: $RCA_{ij} = (x_{ij}/X_{it}) / (x_{wj}/X_{wt})$ Where x_{ij} and x_{wj} are the values of country i's exports of product j and world exports of product j and where X_{it} and X_{wt} refer to the country's total exports and world total exports. A value of less than unity implies that the country has a revealed comparative disadvantage in the product. Similarly, if the index exceeds unity, the country is said to have a revealed comparative advantage in the product.

It helps to assess a country's export potential. The RCA indicates whether a country is in the process of extending the products in which it has a trade potential, as opposed to situations in which the number of products that can be competitively exported is static. It can also provide useful information about potential trade prospects with new partners. Countries with similar RCA profiles are unlikely to have high bilateral trade intensities unless intra-industry trade is involved. RCA measures, if estimated at high levels of product disaggregation, can focus attention on other nontraditional products that might be successfully exported.

Export Specialization Index: The export specialization (ES) index is a slightly modified RCA index, in which the denominator is usually measured by specific markets or partners. It provides product information on revealed specialization in the export sector of a country and is calculated as the ratio of the share of a product in a country's total exports to the share of this product in imports to specific markets or partners rather than its share in world exports: $ES = (x_{ij}/X_{it}) / (m_{kj}/M_{kt})$ Where x_{ij} and X_{it} are export values of country i in product j, respectively, and where m_{kj} and M_{kt} are the import values of product j in market k and total imports in market k.

The ES is similar to the RCA in that the value of the index less than unity indicates a comparative disadvantage and a value greater than one indicates advantage of producing and exporting into the identified markets.

3.2.2 SMART Analysis: A Partial Equilibrium Analysis

The study has utilized the SMART (Single Market Partial Equilibrium Simulation Tool) included in WITS Database to calculate the trade liberalization effects (means zero tariffs) on the importer. Despite successive rounds of multilateral, regional and unilateral trade liberalization, some trade barriers (including tariffs) remain highly restrictive in many (both developed and developing) countries. For any government, it is crucial to be able to assess or to pre-empt the impact of different trade policy options. Market access analysis is a useful tool that can be used to anticipate the likely economic effects of various policy alternatives. The rationale for using the market access analysis is to calculate the impact of domestic as well as foreign trade reforms. For domestic policy change, it is often important to determine the distribution of the potential gains and losses from any contemplated policy changes. This will assist in anticipating any adjustment costs associated with reform implementation and when preparing for trade negotiations, market access analysis helps identify the sensitive sectors where negotiating efforts should be focused.

Also, it could be useful in the formation of negotiating coalitions in multilateral/regional negotiations (Amjadi, 2011).

The market access analysis tool included in the WITS package allows the researcher to investigate the impact of unilateral/preferential/multilateral trade reforms at home or abroad on various variables including: Trade flows (import, exports, trade creation and trade diversion), world prices, tariff revenue and economic welfare. The total trade effects are worked out by adding up the price effects (terms of trade effect) and quantity effects of trade by adding the trade creation and trade diversion effects. In addition the total welfare effect, consumer surplus effect and revenue effects of tariff reduction are also worked out. James and Olareagga (2005) explains the SMART methodology in the following mathematical notations:

Domestic prices are given by:

$$p^{d}_{g,c} = p^{w}_{g,c}(1 + t_{g,c}) \qquad \ldots \ (1)$$

Where $p^{w}_{g,c}$ is the world Price of good *g* imported from *c*, $t_{g,c}$ is the tariff imposed on imports of good *g* imported from *c*, and is defined as:

$$t_{g,c} = t^{MFN}_{g}(1 - \theta_{g,c}) \qquad \ldots \quad (2)$$

Where t^{MFN}_{g} is the Most Favored Nation (MFN) tariff imposed on good g, and $\theta_{g,c}$ is the tariff preference ratio on good *g* when imported from country *c*.

From equation 2,

$$\theta_{g,c} = \frac{1 - t_{g,c}}{t^{MFN}_{g}}$$

Trade Creation

Trade creation is defined as the direct increase in imports following a reduction on the tariff imposed on good *g* from country *c*.

To obtain this, SMART uses the definition of Price elasticity of import demand as:

$$\varepsilon_{g,c} = \frac{dm_{g,c} / m_{g,c}}{dp^{d}_{g,c} / p^{d}_{g,c}} < 0 \qquad \ldots \quad (3)$$

Solving 3 for $dm_{g,c}$ we obtain the trade creation evaluated at world prices and associated with the tariff reduction on good *g* when imported from country *c*.

$$TC_{g,c} = p^{w}_{g,c} dm_{g,c} = p^{w}_{g,c} \varepsilon_{g,c} m_{g,c} \frac{dt_{g,c}}{(1+t_{g,c)}} = \varepsilon_{g,c} m_{g,c} \frac{dt_{g,c}}{(1+t_{g,c)}} \qquad \ldots \quad (4)$$

Equation 4 defines the extent of trade creation on imports of good *g* from country *c*.

If the tariff reduction on good *g* from country *c* is a preferential tariff reduction (i.e. it does not apply to other countries, then imports of good from country *c* are further going to increase due to the substitution away from imports of g from other countries that becomes relatively more expensive. This is the definition of trade diversión in the SMART model.

In order to measure trade diversión, let us use the definition of the elasticity of substitution, $\sigma_{g,c\neq c}$ across imports of good *g* from country *c* and all other countries except *c*:

$$\sigma_{g,c\neq c} = \frac{d\left(\frac{m_{g,c}}{m_{g,\neq c}}\right)\frac{m_{g,c}}{m_{g,\neq c}}}{d\left(\frac{p^{d}_{g,c}}{p^{d}_{g,\neq c}}\right)\frac{p^{d}_{g,c}}{p^{d}_{g,\neq c}}} < 0$$

$$TD_{g,c} = dm_{g,c} = \frac{m_{g,\neq c} m_{g,c}}{m_{g,\neq c} m_{g,c}} \frac{dt_{g,c}}{1+t_{g,c}} \sigma_{g,c\neq c}$$

3.2.3 Gravity Analysis

Baier and Bergstrand (2001) in his gravity formulation (derived below) include among traditional variables (size of trading partners and distance and other trade cost), include term $s_i * s_j$ as indicator of dispersion of income between two countries and prices of traded goods in exporting and importing countries. The study also uses variant ofBaier and Bergstrand gravity formulation derived below. Beginning with general gravity equation given as,

$$\boldsymbol{X_{ij}} = \frac{\boldsymbol{Y_i Y_j}}{\boldsymbol{Y_w}} \left(\frac{\boldsymbol{t_{ij}}}{\boldsymbol{P_i P_j}} \right)^{1-\sigma}$$

Where σ elasticity of substitution is, $\boldsymbol{P_i P_j}$ are multilateral resistance factors.

$$\boldsymbol{t_{ij}} = \boldsymbol{b_{ij}} (\boldsymbol{d_{ij}})^{\rho}$$

b_{ij} is all other trade costs and d_{ij} is distance cost and $\sigma > 1$.

Trade costs have negative impact on trade. So,

$$U = \sum_{i=1}^{C} \sum_{j=1}^{N_i} \left(C_{ij}^{K} \right)^{\frac{\rho-1}{\rho}}$$

There are C countries and each is producing N_i varities. The utility derived by consuming such varieties in the j[th] country is given by equation. Assume that prices are same for each variety i.e. $C_{ij}^{k} = C_{jk}^{i}$. Now consumer problem is given by maximize utility function subject to,

$$Y_j = \sum_{i=1}^{C} N_i C_{ij} P_{ij}$$

The maximization function is given by,

$$L = \sum_{i=1}^{c} N_i (C_{ij})^{\frac{\rho-1}{\rho}} + \lambda \left(Y_j - \sum_{i=1}^{c} N_i C_{ij} P_{ij} \right)$$

First order conditions becomes :

$$a = \frac{\partial L}{\partial C_{ij}} = 0, \; b = \frac{\partial L}{\partial \lambda} = 0, \; c = \frac{\partial L}{\partial C_{ij}} = 0$$

a and b conditions show :

$$\frac{N_i \left(\frac{\rho-1}{\rho} \right) C_{ij}^{\frac{\rho-1}{\rho}-1}}{N_1 \left(\frac{\rho-1}{\rho} \right) C_{ij}^{\frac{\rho-1}{\rho}-1}} = \frac{\lambda N_i P_{ij}}{\lambda N_1 P_{1j}}$$

$$\Rightarrow \left(\frac{C_{ij}}{C_{1j}} \right)^{-\frac{1}{\rho}} = \left(\frac{P_{ij}}{P_{1j}} \right)$$

Now from condition c,

$$\Rightarrow C_{ij} = P_{ij}^{-\rho} P_{1j}^{\rho} C_{1j}$$

$$Y_j = \sum_{i=1}^{C} N_i P_{ij} C_{ij}$$

Putting the value of C_{ij}

$$Y_j = \sum_{i=1}^{C} N_i P_{ij}^{1-\rho} P_{1j}^{\rho} C_{1j}$$

$$P_j = \left[\sum N_i P_i^{1-\rho} \right]^{\frac{1}{1-\rho}}$$

$$Y_j = P_j^{1-\rho} P_{1j}^{\rho} C_{ij}$$

$$C_{ij} = P_j^{\rho-1} b_{ij}^{-\rho} Y_j$$

Now coming to the trade part,

$$X_{ij} = N_i P_{ij} C_{ij}$$

$$= N_i P_i T_{ij} C_{ij}$$

$$X_{ij} = N_i P_i T_{ij} C_{ij} = N_i P_i T_{ij} P_j^{\rho-1} P_{1j}^{-\rho} T_{ij}^{-\rho} Y_{ij}$$

$$X_{ij} = N_i (P_i)^{1-\rho} P_j^{\rho-1} Y_j$$

$$Y_i = N_i P_i \widehat{Y}$$

Where Y_i is the income in the i^{th} country.

$$X_{ij} = \frac{Y_i Y_j}{P_i \widehat{Y}} \left(\frac{T_{ij}}{P_j} \right)^{1-\rho} P_i^{1-\rho} = \frac{Y_i Y_j}{P_i^{-\rho} \widehat{Y}} \left(\frac{T_{ij}}{P_j} \right)^{1-\rho}$$

$$\log X_{ij} = \Delta \log Y_i Y_j + (1-\rho) \Delta \log T_{ij} - \rho \Delta \log P_i + (\rho - 1) \Delta \log P_j$$

$$Y_i Y_j = (Y_i + Y_j)^2 s_i s_j$$

Now the basic Baier and Bergstrand equation can be written as:

$$\Delta \log X_{ij} = 2\Delta \log (Y_i + Y_j) + \Delta \log s_i s_j + (1-\rho) \Delta \log T_{ij} - \rho \Delta \log P_i + (\rho - 1) \Delta \log P_j$$

$$s_i = \frac{Y_i}{Y_i + Y_j}$$

$$\left(s_i s_j \right)^2 = s_i^2 + s_j^2 + 2 s_i s_j$$

Thus, value of trade is the function of GDP, Dispersion, Trade Cost, Prices in exporting and importing. Here X_{cif}^{ij} is the real flow of bilateral trade between importing country j and exporting country i, $Y_i + Y_j$ is the sum of the real GDPs of two country and its impact on growth of trade is expected to be positive, $s_i s_j$ is the product of shares of two countries which is equivalent to

Helpman's size dispersion index and its expected sign is positive. Sum of GDPs represent in growth of nation's economy, thus increasing the trade flow among two countries. The product of shares captures the effect of income convergence, which is assumed to augment trade flow growth. Trade costs T_{ij} enter with negative coefficients because these factors increase the resistance in international trade and promote intra-national trade. The prices of exporting and importing countries are expected to have a negative effect on growth of trade.

3.3 Hypothesis for the Analysis

Following are the hypothesis and expected relations from the gravity analysis:

- Sum of GDPs (sizes) matter for imports of country. Positive sign is hypothesized
- Distance is negatively related to imports. Greater distance means larger transportation cost, maybe higher language barriers, no common borders and limited access to each other's goods because of limited open regionalism.
- Lower is the inter country dispersion of income (si*sj) higher is the trade between countries (Helpman and Krugman, 1985).
- Larger are the tariffs, lower will be the imports as tariffs are trade costs
- Higher prices in reporter country increases imports while lower prices in partner country lower imports.
- Higher the price in the exporter's country more is the incentive to supply CSG goods abroad.

4. Empirical Results

The empirical analysis of the study has been further divided into three sub-sections as per the study's objectives. In the first sub-section, calculation of various trade indices has been presented. Second sub-section explains the results of SMART analysis and provides economic interpretation to the results. The last sub-section shows the gravity analysis results and presents the trade potential of sample countries in CSGs.

4.1 Calculation of Trade Indices

To accomplish the first objective of the study, trade índices have been calculated for ecuador for CSGs. Firstly, the figures of competitiveness index for various groupings have been estimated. Table 2 shows the results of competitiveness index for the variouis groupings. Most of the

regions have improved on their competitiveness in 2008 as compared to 2002. However, for MERCOSUR the value is below one indicating that they are net importer of CSG goods.

Table 2: Competitiveness Index for Selected Regions							
Regions/Years	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
ASEAN	2.786994	2.917963	3.130218	3.181071	2.961447	2.880867	2.686154
APTA	7.006773	7.099632	7.805999	9.262968	10.6568	11.76774	14.00801
ESCAP	13.8172	13.22633	14.13342	14.60488	14.89492	15.93055	17.20917
SAARC	0.022279	0.288209	0.323972	0.439404	0.633056	0.679728	0.897801
NAFTA	10.71362	8.816577	8.948009	8.774753	8.579115	9.32466	7.998433
EU	17.19749	17.77679	16.93082	16.82007	17.42265	18.55833	18.8394
MERCOSUR	0.387354	0.385097	0.409375	0.452821	0.53415	0.549345	0.51425
Source: Author's calculation							

Further, the results of RCA index in Table 3 reveals that there are two products in which Ecuador has a comparative advantage in production in 2010. These two industrial codes have RCA>1 in 2010 and hence Ecuador has a comparative advantage in the production of such products. These products are 732111 consisting, Solar driven stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non- electric Domestic appliances, and parts thereof, of iron or steel and 732190 consisting Stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric Domestic appliances, and parts thereof, of iron or steel.

Table 3: Revealed Comparative Analysis for CSG Products for Ecuador in 2009 and 2010.			
Reporter Name	**Year**	**Product code**	**RCA**
Ecuador	2009	732111	21.3407
Ecuador	2009	732190	0.9324
Ecuador	2009	841940	0.4864
Ecuador	2009	850163	0.7601
Ecuador	2010	732111	14.9076
Ecuador	2010	732190	4.1008
Note: Please note that Ecuador has advantage in the production of CSG Products 732111 and 732190 in 2010.			
Source: Author's calculations from WITS data base.			

To know the export specialization in CSGs, the Export Specialization index has been calculated and results are presented in Table 4. It identifies the markets for two of the CSG products in which Ecuador has an advantage in production. They are Chile, Columbia and Peru in 2010.The export specialization (ES) index is a slightly modified RCA index, in which the denominator is usually measured by specific markets or partners. It provides product information on revealed specialization in the export sector of a country and is calculated as the ratio of the share of a product in a country's total exports to the share of this product in imports to specific markets or partners. A Value greater than one indicates advantage of producing and exporting into the identified markets.

Table 4: Export Specialization Index for Specialized CSG Products for Ecuador in 2010

Country				
From	**To**	**ES Index Value**	**Industry Code**	**Product Description**
Ecuador	Chile (CHL)	1.1882	732111	Solar driven stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non- electric domestic appliances, and parts thereof, of iron or steel.
Ecuador	Peru (PER)	1.2300	732190	Stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel.
Ecuador	Peru (PER)	1.3135	732111	Solar driven stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel.
Ecuador	Colombia (COL)	1.9122	732111	Stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel.
Notes: Text in brackets are the country codes.				
Source: Author´s work in WITS				

Further, with the help of product concentration index calculated in Table 5, one can see the greatest product concentration in Ecuador's total exports of CSG products lies in product 732111(0.42).

Table 5: Product Concentration (PC) of CSG Products in Ecuador's Exports for the year 2010

IND. CODE	PC	IND. CODE	PC
392010	0.0115	847989	0.0222
392690	0.0124	848340	0.0003
730820	0.0004	850161	0.0005
730900	0.0024	850162	0.0008
732111	0.4214	850163	0.0003
732190	0.0336	850300	0.0015
841182	0.0028	850440	0.0016
841869	0.0029	853710	0.0018
841950	0.0007	853931	0.0004
841989	0.0020	903210	0.0011
Source: Author's work in WITS			

4.2 Trade Liberalization of CSG Products: SMART Analysis in WITS

SMART reports the results of any trade policy shock on a number of variables. In particular, it reports the effects on trade flows (i.e. imports from the different sources). It also decomposes those trade effects in trade creation and trade diversion. Trade creation is defined as the direct increase in imports following a reduction on the tariff imposed on good *g* from country *c*. If the tariff reduction on good *g* from country *c* is a preferential tariff reduction (i.e. it does not apply to other countries, *c*), then imports of good *g* from country *c* are further going to increase due to the substitution away from imports of good *g* from other countries that becomes relatively more expensive. This is the definition of trade diversion in the SMART model. For exporting countries, total trade effect is made of trade diversion and trade creation. In SMART, beneficiaries of the tariff reduction enjoy both positive diversion effect and positive creation effect while all other partners will suffer from negative diversion effect and no trade creation effect. In the SMART modeling framework, a change in trade policy (say preferential tariff liberalization) affects not only the price index/level of the composite good but also the relative prices of the different varieties. Despite the export supply elasticity, the import demand elasticity

and the substitution elasticity[6], it will lead to changes in the chosen aggregate level of spending on that good as well as to changes in the composition of the sourcing of that good. Both channels affect bilateral trade flows. The values will depend on import demand elasticity, substitution elasticity and supply elasticity.

Simulation I: **Liberalization of CSG Trade with MERCOSUR countries in 2010**

The first simulation is the liberalization impacts of zero tariffs on imports of CSG from the rest of the nine MERCOSUR countries. We summarize the results in Tables 6 through 8 (Simulation I). Table 6 gives the total trade effect (sum of price-terms of trade effect, and quantity effects-trade creation and trade diversion effects) of tariff liberalization undertaken by Ecuador in context of MERCOSUR countries (simulations) in 2010. Price effects in these simulations are zero because we assume Ecuador to be the 'small country'. Colombia gains the most in terms of total trade effects followed by Argentina and Peru. Chile has negative total trade effects because Chile already has a free trade policy with most of its Latin American Partners. Total trade effect for the US is negative and relatively higher as there is trade diversion from US to MERCOSUR countries for trade in CSG goods. For saving space the trade diversion impact on all countries is not shown.

Table 6: Trade Creation, Trade Diversion and Total Trade Effects of Tariff Liberalization with MERCOSUR Countries only for CSG Imports

Country	Trade Total Effect	Trade Creation Effect	Trade Diversion Effect	Old Simple Duty Rate	New Simple DutyRate
Argentina	283.918	163.449	120.469	3.05	0.00
Bolivia	2.521	1.301	1.220	1.90	0.00
Brazil	407.221	266.318	140.903	3.10	0.00
Chile	-35.802	0.000	-35.802	0.00	0.00
Colombia	3,856.045	2,526.573	1,329.472	8.30	0.00
Paraguay	0.152	0.076	0.076	3.39	0.00

[6]Import Demand Elasticity: Values used by default in SMART have been empirically estimated for each country and every HS 6-digit product. For more details see Hiau LooiKee, Alessandro Nicita and Marcelo Olarreaga, 2008. "Import Demand Elasticities and Trade Distortions," The Review of Economics and Statistics, MIT Press, vol. 90(4), pages 666-682, 07. Substitution Elasticity: Is the substitution elasticity value between partners. Substitution elasticity entails a product by product simulation, which is based on the assumption that any product is independent of another product. SMART uses 1.5 as the default value. However, one can change this default value. It is recommended to keep it at 1.5 for industrial products but to increase it for primary goods. The reason being that the higher the substitution elasticity, the higher the substitutability of the same product from different suppliers. However, the more sophisticated a product is, the higher its rigidity of being substitutable.
Supply Elasticity: Is the export supply elasticity value. By default, SMART uses 99 for an infinite elasticity for all products and partners. The reason being that we are dealing with a single-country simulation tool, so one country is too small compared to the rest of the world in order to have an impact on the price level. However, if you consider imports of a certain product from a bigger entity (like the European Union e.g.) to be relatively high and have a real impact on the world price level, you can lower the supply elasticity.

Venezuela	73.243	35.232	38.011	9.33	0.00
Uruguay	0.506	0.285	0.222	1.52	0.00
Peru	224.942	118.401	106.541	7.26	0.00
United States	-637.852	0.000	-637.852	7.01	7.01
Spain	-74.646	0.000	-74.646	7.85	7.85
United Kingdom	-16.162	0.000	-16.162	6.29	6.29
Mexico	-183.279	0.000	-183.279	5.97	5.97
Italy	-110.727	0.000	-110.727	7.27	7.27
Germany	-106.627	0.000	-106.627	7.61	7.61
China	-305.511	0.000	-305.511	6.73	6.73
India	-12.172	0.000	-12.172	6.15	6.15
World	3,111.634	3,111.634	0.000	6.44	5.18
Notes: i) Price effects are zero as we assume that Ecuador is 'Small Country'; ii) Figures are in thousand USD except duty rates.					
Source: Author's work in WITS.					

The total trade effect on the World is 3111.64 1000 US $. SMART also calculates the impact of the trade policy change on tariff revenue, consumer surplus and welfare. A tariff revenue change on a given import flow is computed simply as the final Ad Valorem tariff multiplied by the final import value minus the initial Ad Valorem tariff multiplied by the initial import value. It should be noted that tariff revenue change is made of two opposite effects:

1. A tariff revenue loss at constant import value, which corresponds to a transfer from the state to consumers and is equal to Q0*(t0-t1); and
2. A tariff revenue gain through the increase in imports which enlarges the tax base and is equal to (Q1-Q0)*t.

Using SMART internal import demand elasticity values, the tariff liberalization simulation returns a negative tariff revenue change (that is revenue gain from increased imports not enough to dominate revenue loss due to tariff decrease) in most cases. Further, the Welfare Effect defined as the benefits consumers avail in the importing country derived from the lower domestic prices after the removal or reduction of tariffs. Table 7 below shows that the welfare effects of tariff liberalization for CSG products.

Table 7: Revenue and Welfare Effects of CSG Liberalization undertaken by Ecuador with MERCOSUR Countries

Product Code	Welfare Effect	Revenue Effect	Trade Total Effect	Trade Value
csgcomb	351.763	-2,276.697	3,111.634	252,746.147

Notes: Figures are in thousand USD.
Source: Author's work in WITS.

The welfare effect works out to be 351.76 thousand US $ while the total imports before tariff reduction is 252,746.147 thousand US$. The revenue effect works out to be -2,276.697 thousand US $. The total import change is 3111.634 thousand US$ due to reduction in tariffs on imports of CSG from MERCOSUR.

Table 8 below shows the tariff change in revenue of -3029.456 thousand dollors while the consumer surplus due to reduction in tariffs on CSG coming from MERCOSUR countries. This work out to be 180.812 thousand US dollars.

Table 8: Consumer Surplus and Tariff Change in Revenue for Ecuador after its liberalization with MERCOSUR in Trade in CSG Products

Imports Before	Import Change	Tariff Revenue	New Tariff Revenue	Change In Tariff Revenue	Consumer Surplus
252,746.147	3,111.634	16,282.010	13,252.550	-3,029.456	180.812
Notes: Figures are in thousand USD.					
Source: Author´s work in WITS					

Simulation 2: Liberalization of CSG trade with US, Japan and China

This simulation defines the liberalization of CSG trade with the main suppliers of CSG goods, i.e., the US, Japan and China. Table 9 below shows the trade creation, trade diversion and total trade effects of liberalization of CSG trade with the main suppliers of CSG goods, i.e., the US, Japan and China (Simulation 2). The highest total trade effect occurs in the US of the tune of 8023.8 thousand US$ followed by China worth 5338 thousand US$ while the country which has the highest negative total trade effect is Columbia (-787.63 thousand US$). Mexico has total negative trade effect of -379.09 thousand US$ while Germany is the most affected country in Europe of the tune of -369.29 thousand US$. The total import price change with all countries is 9702.19 thousand US$.

Table 9: Trade Creation, Trade Diversion and Total Trade Effects of Tariff Liberalization of CSG Trade with China, Japan and the US for Simulations Undertaken by Ecuador in in 2010

Country	Trade Total Effect	Trade Creation Effect	Trade Diversion Effect	Old Simple Duty Rate	New Simple DutyRate

China	5,338.083	3,870.511	1,467.572	6.73	0.00
Japan	407.789	261.120	146.669	5.10	0.00
UnitedStates	8,023.866	5,570.565	2,453.301	7.01	0.00
Argentina	-149.808	0.000	-149.808	3.05	3.05
Bolivia	-0.777	0.000	-0.777	1.90	1.90
Brazil	-288.973	0.000	-288.973	3.10	3.10
Chile	-106.380	0.000	-106.380	0.00	0.00
Colombia	-787.637	0.000	-787.637	8.30	8.30
Peru	-59.719	0.000	-59.719	7.26	7.26
Paraguay	-0.140	0.000	-0.140	3.39	3.39
Uruguay	-0.450	0.000	-0.450	1.52	1.52
Venezuela	-26.459	0.000	-26.459	9.33	9.33
Canada	-124.123	0.000	-124.123	6.50	6.50
Germany	-369.291	0.000	-369.291	7.61	7.61
Italy	-317.928	0.000	-317.928	7.27	7.27
Mexico	-379.093	0.000	-379.093	5.97	5.97
Spain	-292.742	0.000	-292.742	7.85	7.85
Taiwan, China	-112.799	0.000	-112.799	6.53	6.53
World	9,702.196	9,702.196	0.000	6.44	2.85
Notes: i) Price effects are zero as we assume that Ecuador is 'Small Country'; ii) Figures are in thousand USD except duty rates.					
Source: Author's work in WITS.					

Table 10 below gives the revenue and the welfare effects of tariff liberalization undertaken by Ecuador (simulations only) with respect to China, Japan and the US. The Welfare effect works out to be 786.20 thousand dollars for Ecuador. The figure is higher (more than double) with what it was when Ecuador liberalized its trade of CSG products with the MERCOSUR countries.

Table 10: Revenue and Welfare Effects of CSG Liberalization undertaken by Ecuador (Simulations Only) with China, Japan and the US in 2010

Welfare Effect	Revenue Effect	Trade Total Effect	Trade Value
786.220	-7,274.732	9,702.196	252,746.147
Notes: Figures are in thousand USD.			
Source: Author's work in WITS.			

Table 11 shows that consumer surplus effect is higher than when Ecuador liberalized its trade of CSG with MERCOSUR countries.

Table 11: Simulation Results: Consumer Surplus and Tariff Change in Revenue for Ecuador after its liberalization China, Japan and the US in Trade in CSG Products

Imports	Import	Tariff	New Tariff	Change In	Consumer

Before	Change	Revenue	Revenue	Tariff Revenue	Surplus
	9.702.196	16,282.010	7,491.704	-8,790.301	450.986
Notes: Figures are in thousand USD.					
Source: Author´s work in WITS					

Simulation 3: Liberalization of CSG trade with EU27

Table 12 indicates that Germany, Italy and Spain are the greatest gainers due to liberalization of Ecuadorian trade with EU27. The total trade effect for Germany works out to be 2686.755 thousand US$ (export surge), followed by Italy of the tune of 2035.086 thousand US$ followed by Spain of the tune of 1362.69 thousand US $. United States, Columbia and China are the countries who have the greatest trade diversion effects because of preferences given by Ecuador to EU27 countries. The total trade effect (total import surge with respect to all countries) works out to be 5601.571 thousand US $.

Table 12: Trade Creation, Trade Diversion and Total Trade Effects of Tariff Liberalization of Ecuadorian CSG Trade with the EU 27 for Simulations Undertaken by Ecuador in in 2010.

Country	Trade Total Effect	Trade Creation Effect	Trade Diversion Effect	Old Simple Duty Rate	New Simple DutyRate
Sweden	286.873	179.537	107.336	6.06	0.00
Spain	1,362.694	880.241	482.453	7.85	0.00
Netherlands	472.833	321.712	151.121	6.60	0.00
Italy	2,035.086	1,277.382	757.704	7.27	0.00
Germany	2,686.755	2,089.803	596.952	7.61	0.00
Argentina	-75.200	0.000	-75.200	3.05	3.05
Australia	-7.953	0.000	-7.953	6.29	6.29
Austria	45.128	21.019	24.109	4.92	0.00
Belgium	396.383	277.261	119.121	7.11	0.00
Bolivia	-0.645	0.000	-0.645	1.90	1.90
Brazil	-110.155	0.000	-110.155	3.10	3.10
Bulgaria	0.020	0.010	0.009	3.13	0.00
Canada	-31.145	0.000	-31.145	6.50	6.50
Chile	-52.725	0.000	-52.725	0.00	0.00
China	-475.419	0.000	-475.419	6.73	6.73
Colombia	-319.996	0.000	-319.996	8.30	8.30
UnitedKingdom	362.098	241.962	120.136	6.29	0.00
UnitedStates	-928.260	0.000	-928.260	7.01	7.01
Uruguay	-0.635	0.000	-0.635	1.52	1.52
Venezuela	-7.869	0.000	-7.869	9.33	9.33
World	5,601.571	5,601.571	0.000	6.44	4.65

Notes: i) Price effects are zero as we assume that Ecuador is 'Small Country'; ii) Figures are in thousand USD except duty rates.
Source: Author's work in WITS.

Table 13 shows the consumer surplus effects of liberalization equivalent to 310.696 thousand US$, an amount less than when Ecuador liberalized CSG trade with China, Japan and the US, but more than when Ecuador liberalized its trade with MERCOSUR countries

Table 13: Consumer Surplus and Tariff Change in Revenue Effects of Liberalization of Ecuadorian CSG Trade with EU27 Countries					
Imports Before	**Import Change**	**Tariff Revenue**	**New Tariff Revenue**	**Change In Tariff Revenue**	**Consumer Surplus**
252,746.147	5.601.571	16,282.010	12,016.081	-4,265.925	310.696
Notes: Figures are in thousand USD.					
Source: Author´s work in WITS					

Table 14 shows the welfare effects of liberalizing Ecuadorian CSG trade with EU27 Countries. The amount works out to be 534.350,1000 US$, less than when Ecuador liberalized its trade with China, Japan and the US, but more than when it's liberalized its trade with Mercosur Countries

Table 14: Welfare and Total Trade Effect of Liberalizing Ecuadorian CSG Trade with EU27 Countries				
Product Code	**Welfare Effect**	**Trade Total Effect**	**New Weighted Rate**	**Old Weighted Rate**
csgcomb	534.350	5,601.571	4.65	6.44
Notes: Figures are in thousand USD except rates.				
Source: Author's work in WITS.				

In Summary, SMART Analysis helps us to establish that it is better and more beneficial to liberalize Ecuadorian CSG trade with the Japan, the US and the China, followed by EU 27, the main suppliers (exporters) of CSG products rather than MERCOSUR countries

4.3 Gravity Analysis

The gravity analysis has been utilized to explain the basis of trade of CSG between Ecuador and countries in MERCOSUR (nine excluding Ecuador), EU27, NAFTA (03 countries), East Asia (11) and India in 2010. We do this regression exercise on cross sectional data for 2010. Gravity Analysis helps us to explain basis of trade of merchandize and services. Gravity model examines

the role of tariff barriers, inter country dispersion of income, prices, trade costs, preferential trading arrangements, trade resistance terms, inflations, economic size and endowments, general policy environment and overall infrastructure, distance between trading partner, membership of multilateral agreement, foreign direct investments, common language and borders, common colony, among others on trade of merchandize and services. For Example Gravity Model can explain what is the basis of trade in Climate Smart Goods (64 goods list defined by the UNESCAP). CSG are defined as components, products and technologies which tend to have relatively less adverse impact on the environment. CSGs constitute low carbon technologies such as solar photovoltaic systems, wind power generation, clean coal technologies and energy-efficient lighting.

The study has utilized variant of the Baier and Bergstrand (2001) Gravity formulation. The study uses gravity analysis which explains log of imports as a function of log of sum of GDPs of the trading partner, log of distance (capturing trade cost in the form of transportation cost, maybe language barriers, common border and common preferential trading arrangement), log of inter-country dispersion (log of si*sj), log of tariffs-weighted applied tariffs log (1+tariffs) and log of prices in reporting (importer country) and log of prices in partner (exporter country).

All variables explaining imports of Ecuador of CSG to and from its trading partners come with the usual sign except partner countries prices (See Table 15). May be CSG goods which have relatively low tariffs are traded at free trade prices and lower prices increases import demand. All are statistically significant except tariffs. R^2 is 0.66 showing a good fit. White consistent standard errors take care of hetroscedasticity. F-test indicates overall importance of all variables taken together.

Table 15: Regression Results of Gravity Equation Estimation

Dependent Variable	**Log of Imports**	
Independent Variable	**Coefficient Value**	**P-Value**
Constant	-1.3619	0.8134
Ln tariffs	-0.0671	0.8371
Ln sum of GDPs	4.5814*	0.0000
Ln distance	-1.6028*	0.0000
Ln sisj	4.0256*	0.0001
Ln price importer	1.6175*	0.0099
Ln price exporter	-1.1204*	0.0035
R-Square	0.66	--

Adjusted R-square	0.63	--
D-W Stat	2.2869	--
F-Stat	18.3790*	0.0000
Notes: * represent the coefficients are significant at 1 percent.		
Source: Author's Calculations in Eviews.		

Standardized beta coefficients (not shown) results show that size of trading partner is the most important explanatory variable explaining trade of Ecuador of CSG with its trading partner. Then comes inter country dispersion of income, followed by distance, followed by reporter(importer) country's prices followed by exporter country's prices and then at the last are the tariffs (any way relatively lower for CSG products than what are with respect to total trade of Ecuador or trade of specialized products). Then, why do we need tariff liberalization for CSG goods. Tariff liberalization may lead countries to achieve positive effective protection level if that is in country's interest. Trade in CSG consists mostly of component trade (inputs) to cleaner technologies and thus is also associated with transfer and investment into new technologies. Also, those Latin American countries who have a sufficiently large domestic market to develop cost effective manufacturing capacities at different stages of the supply chain may be more interested in liberalizing imports of certain intermediate products (such as solar cells, silicon ingots, gear boxes, and electronic control equipment). On the other hand, some of the Latin countries including Ecuador may need a certain level of tariff protection to build up local capacities and probably attract some FDI as well. Also, one cannot undermine the role of tariffs as trade of CSG is component trade (components to clean low carbon technologies) and such products cross custom boundaries many times.

Higher incomes a mean larger demand for climate smart components for cleaner technologies (based on knowledge from research on environmental Kuznetz curve). Higher incomes also lead to generation of resources to adopt cleaner technologies often with higher FDI and better infrastructure. However, in many developing countries a number of non technological and economic factors stand in a way for deployment of cleaner technologies. These include insufficient technical knowledge and absorption capacity to produce these innovative technologies locally, insufficient market size to justify local production units and insufficient purchasing power and financial resources to acquire the innovative products (Jha, 2009).

The extended gravity model used in the study (Mathur, 2011) analyzed ESCAP countries trade of CSG with host of countries. The study found a weak positive impact of regional trade

agreements, mitigation policy and infrastructure on import of CSGs. Perhaps an inclusion of variables such as carbon taxation and domestic regulations would improve the model's explanatory power. Other possible variables including environmental subsidies, funding of environmental research projects, degree of industrialization, privatization and deregulation of markets, domestic standards and certification requirements, and domestic policies related to IPR, all of which could potentially improve the model. However data on such possibly useful variables are not available for a sufficient number of countries in the region. In addition, from the analysis done by Mathur (2011) it appears that language, domestic regulations, and the level of certifications and standards could play a particularly important role in stimulating trade in CSGs. The analysis also showed that tariffs do not appear to play a huge role in determining trade in CSGs.

4.3.2 Trade Potential for Ecuador in CSG Products for the year 2010

The study uses the estimated equation of the gravity model to predict the values of imports (log). If the actual imported values of CSG exceed the fitted values, then we call it import potential for the importing country or export potential for the Exporting Country. The results are shown in Table 16. The first column depicts the import potential of the reporter or the importing country (second column) or the export potential of the Ecuador. Positive values mean positive export potential (for exporters-Ecuador) or import potential (for importers). Ecuador seems to have positive export potential for CSG products with respect to Bolivia, Chile, Colombia, Peru and Singapore. The export potential with respect to its four Latin American Partners works out to be 34.84 million US $. There is, however, negative potential for exports of CSG to all its Latin American partners taken together (Argentina, Bolivia, Brazil, Chile, Columbia, Paraguay, Peru and Venezuela of the tune of negative 4.9 million. This is because of high negative potential with respect to Venezuela, Argentina and Brazil. These countries may be are more inclined towards exporting the CSG products to Ecuador rather than importing it. SMART analysis had shown that it is more beneficial for Ecuador to liberalize its trade with the China, Japan and the US. Both Ecuador and the trading partners China, Japan and the US gain by such a move. The next table (next section) confirms the same. There is lot of potential gains (for both Exporters and for Ecuador importing the CSG product) if Ecuador liberalizes its trade with the China, Japan, the US and the EU.

Table 16: Export Potential of Ecuador in the year 2010			
Potential	**Importing Country**	**Potential**	**Importing Country**
-18.35.84	Argentina	-95.03	Korea, Rep
487.72	Bolivia	-1573.93	Mexico
-4150.26	Brazil	-9.46	Paraguay
-862.018	Canada	20942.54	Peru
2383.047	Chile	94.40	Singapore
-438.082	China	-2395.80	United States
10977.05	Colombia	-78399.10	Venezuela
-15.03	Hong Kong		
Source: Author's Calculations in Eviews.			

4.3.3 Export Potential in CSG for Other Countries targeting Ecuador

Table 17 presents the results of the export potential for China, Japan and the US and it works out to be 95 million US $ in CSG. The export potential of the Latin American partners (Columbia, Argentina, Brazil, Paraguay, Uruguay, Chile, Peru, Bolivia and Venezuela) works out to be little more than 13 million US $. This confirms the SMART results earlier that for Ecuador, it is more beneficial for Ecuador to liberalize its CSG trade with the China, Japan, the US and EU27 rather than with MERCOSUR countries. There are more gains for both Ecuador and its trading partners if it liberalizes its trade of CSG with the most efficient suppliers of CSG products, the Japan, the China, EU27 and the US.

Table 17: Export Potential for Other Countries in the year 2010					
Potential	**Exporting Country**	**Potential**	**Exporting Country**	**Potential**	**Exporting Country**
3129.99	Argentina	-341.04	Greece	1.96	Peru
57.94	Austria	691.60	Hong Kong	-395.72	Poland
305.90	Belgium	-26.29	Hungary	-467.58	Portugal
25.18	Bolivia	295.57	India	211.12	Romania
14801.86	Brazil	404.86	Indonesia	1376.68	Singapore
-12.62	Bulgaria	-402.86	Ireland	-38.94	Slovak, Rep
-3734.29	Canada	8499.42	Italy	1.57	Slovania
2276.63	Chile	2646.39	Japan	2596.05	Spain
49086.83	China	852.47	Korea, Rep.	1058.54	Sweden
-7397.70	Colombia	2.24	Latvia	291.89	Thailand
-1.05	Cyprus	-2.76	Lithuania	-521.27	United Kingdom
-181.13	Czech Rep.	-26.38	Luxembourg	44045.36	United States
85.81	Denmark	920.07	Malaysia	182.40	Uruguay
4131.62	Finland	1908.02	Mexico	2.24	Venezuala

-1660.14	France	250.05	Netherland	-14.11	Vietnam
5637.11	Germany	3.23	Paraguay		
Source: Author's Calculations in Eviews.					

5. Summary and Policy Prescriptions

According to the International Panel on Climate Change (IPCC) there is compelling evidence that GHG emissions cause climate change and that most GHG emissions are due to anthropogenic factors. The changes in climate foreseen towards the end of this century involve a gradual warming of the planet, with a temperature increase ranging from 1.1°C to 6.4°C above pre-industrial levels during the twenty-first century. Therefore, there appears to be a certain urgency to initiate actions to curb global GHG emissions and drastically reduce the unsustainable use of so-called carbon sinks, such as the world's forests and oceans, in order to prevent global temperatures from rising by more than 2°C, which is the rate at which climate change can still be managed. This study details various policies including trade and investment policies in Climate Smart Goods(CSGs) to limit climate change.

Climate Smart Goods are defined as broadly as products, components and technologies that tend to have less adverse impact on climate change (greenhouse gas emissions[7]) and environment in general. The study considers a 64 goods list of CSG floated by the UNESCAP-APTIR (2011), basically constituting low carbon emanating industries. Access to CSG is very important for implementation of various strategies of technological transformation deemed necessary to mitigate climate change. For example, CSGs consists of articles of iron and steel and aluminum, machinery and mechanical appliances, electrical machinery equipment, ships, boats and floating structures, glass and glass ware articles, among others. One of the subcategories of CSGs clean coal technology which aims to improve energy efficiency and reduce environmental impacts, including technologies of coal extraction, coal preparation and coal utilization. Wind technology another sub category of CSGs focuses on wind energy generation and is composed of three integral components: the gear box, coupling and wind turbine. Wind power and turbine production has experienced stupendous growth over recent years and is now one of the most widespread forms of climate smart technologies. As the Latin American region will have to come to terms with the expected effects of climate change, there is

[7]**Greenhouse gas:** a gas that "traps" infrared radiation in the lower atmosphere causing surface warming; water vapor, carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, and ozone are the primary greenhouse gases in the Earth's atmosphere.

a collective need to increase trade and investment in these goods, which would benefit companies in different parts of the supply chain, and, hence all countries, no matter what their stage of development.

The interest in the subject of Trade in Climate Smart Goods was fuelled by Ecuador's positive trade balance with the rest of the Andean Community and MERCOSUR region in 2010. This may be a reflection of Ecuador's maturity in dealing with environmental issues since the early 1980s. It may be also due to preferential trade policies followed upon by member nations of the ANDEAN region. Or, the above trend can be just a consequence of their fast export growth. One, however, would like to establish with more certainty the association of various policies that have been put in place to help mitigate climate change and trade pattern changes. The study looks closely at the trade indices, worked out for Ecuador's total trade, CSG trade and specialized products and uses gravity analysis which help in finding the export potential for trade in CSG and other products. As Ecuador in the Latin American region probably continues to design policies more conducive to fostering climate smart development, their domestic capacity to meet the increased domestic demand for climate smart goods and services, and then foreign demand through exports, is likely to increase. Depending on the relative strengths of the incentives between those in the region and outside, trade flows and patterns of the region is being affected possibly by reorienting the Ecuadorian trade more towards the intra-regional focus and hence the positive trade balance with the ANDEAN and MERCOSUR region. Whatever may be the exact reason, one thing which surely comes out of the study is that for Ecuador it will be better to liberalize CSG trade with the leading suppliers of the CSG goods, the China, Japan and the US.

In particular, Ecuador had a comparative advantage in the production of two Industries out of 64 goods list. These industries are 732111 consisting Solar driven stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel and 732190 consisting Stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel.

These industries have potential for greater trade and inward foreign direct investment. The study identifies the markets for the same using the Export Specialization Index. These are

Chile, Columbia and Peru. Gravity analysis helps us to work out the export potential of Ecuador for 64 goods list of CSG. The export potential of Ecuador to four Latin American –Bolivia, Chile, Columbia and Peru is 34.79 million US$. However, the greater potential lies with the other countries marketing the CSG goods in Ecuador. These countries include the most efficient suppliers of CSG goods, the China, Japan and the US.SMART results confirm that Ecuador will gain more(in terms of total trade effect, welfare and consumer surplus effects) by liberalizing its imports of Climate Smart Goods with the China, Japan and the US instead of MERCOSUR and EU27 countries.

5.2 Policy Prescriptions

Trade in CSG will help Ecuador to promote alternative industries in the face of Global Economic Downturn. Also, it will help country to look for safe, alternative and reliable energy source rather than believing in trade of crude and Petroleum Oil only or investing a great deal in nuclear energy. Nuclear energy was in the brink of being affected in Japan due to recent Earthquake in Japan. Ecuador can direct its social spending in promoting small industries which can provide CSG goods at low cost. Countries can gain in terms of their comparative advantage and establish new industries. Positions keep changing in terms of the advantage of producing goods and services. Based on our analysis and review of studies done on CSG (APTIR, 2011, ICSTD, WTO and World Bank) one may conclude that various national and international policies can be followed by Ecuador and its trading partners to promote trade of CSG goods. Gravity analysis will reinforce the below points:

- Keep focusing on increasing growth rates of GDP of all. Larger size promotes trade of Climate Smart Goods.
- Lower inter country dispersion of income for promoting trade of CSG among countries
- Lower trade costs between countries by having open regionalism policies, reduce transportation costs within and between countries, lower border disputes to have open trade between neighboring countries.
- Increase prices for exporters and lower prices of CSG goods in importers country by focusing on having sound competition policies, effective legislations for sound environmental policy(say increasing paper less trade and single window clearance as a starting point, carbon tax and regional emission trading system), appropriate regulatory framework, financial infrastructure and investment climate for production of CSGs,

employ feed in tariffs for promoting CSGs, have appropriate standards and labels, mechanism of technology transfer, mechanisms to promote CSG trade among countries by coordination and cooperation and promoting R&D activities for CSG products among countries

- Lower tariffs by small countries in the American Peninsula for imports of CSG from Ecuador. In particular there is potential to reduce tariffs(Applied duties) by Dijbouti (26%), Belize (15%), Costa Rica (10%), Guaetmala (11.97%), Honduras (9.87%), Nicaragua (12.49%), Cuba (8.99%) and El Salvador (12%).

Countries including Ecuador need to design sustainable and climate smart growth that entails sharply reduced GHG emissions to a level of 450 ppm(or may be lower) and that limits the global temperature rise to not more than 2 degrees Celsius by the end of the century. The study lists such policies and is not confined to trade policies alone. Trade policies related to CSG though are the main focus of this study. The entire set of policies which can reduce GHG emissions and limit climate change can be structured into regulatory measures(including regulations, standards and labeling), economic incentives(including taxes, tradable permits and subsidies conforming to WTO laws and provisions), trade and investment policies and financial, energy and enterprise development policies, among others.

Regional climate-smart value chains could provide new opportunities for many less developed economies in the region to become parts and components suppliers to the leading CSG exporters in Latin American Region and other regions. At the same time, the capacity of domestic SMEs in the area of CSGs should be enhanced so that they can evolve into suppliers of low-carbon products and become effectively integrated with low-carbon value chains.

Potential Barriers

Following are the potential barriers to production, trade and investment of CSG. Ecuadorian governments need to attend to the following points:

• Low level of competition
• Limited foreign ownership
• Inefficient transmission and grid interconnection
• Limited access to local financing
• Inadequate training and skills to produce CSGs
• Weak Intellectual property rights enforcement

****

References

Amjadi A., Schuler, P., Kuwahara, H. and Quadros, S. (2011), *User Manual*, World Integrated Trade Solutions (WITS), World Bank, Washington, DC.

Baier, S and Bergstrand, J. (2001), "The Growth of World Trade: Tariffs, Transport Costs, and Income Similarity", *Journal of International Economics*, 53, 1-27.

European Commission (2007), *Ecuador Strategy Paper*, 2007-13.

Feenstra and Tayor (2008), *Text book on International Economics*, Worth Publishers, US.

Gene, M. G. and Krueger, A.B. (1994), "Economic Growth and the Environment", NBER Working Papers 4634, National Bureau of Economic Research Inc.

Helpman and Krugman (1985), *Market Structures and Foreign Trade*, Cambridge, MIT Press.

Hiau, L. K., Nicita, A. and Olarreaga, M. (2008), "Import Demand Elasticities and Trade Distortions", *The Review of Economics and Statistics*, 90(4), 666-682.

IMF (2011), *World Economic Outlook*, April 2011 edition.

James, O.and Olareagga (2005), *Explaining SMART and GSIM*, World Bank.

Jha, V. (2008), "Environmental Priorities and Trade Policy for Environmental Goods: A reality Check", *ICTSD Issue Paper*, No 7.

UNCTAD (2010), *The World Investment Report*, Geneva.

Mathur, S.K. (2011), "Trade Analysis of CSG subcategories for Regional Groups and Some Selected Member States of ESCAP in 2002-2008" , *Ovidius University Annals, Economic Sciences Series*, XI (1), 1264-1279.

Mikic, M. (2011), "Trade in Climate Smart Goods: Trends and Opportunities in Asia and the Pacific", International Seminar on Outstanding Issues on Services, Trade and Development, 3-5 May 2011, Manila, Philippines.

UNESCAP (2011,a), *Asia Pacific Trade Investment Report, 2011: Post Crisis Trade and Investment Opportunities*, Bangkok, Thailand.

UNESCAP (2011,b), *Climate Smart Trade and Investment in Asia and the Pacific: Towards a Triple Win Outcome*, Bangkok, Thailand.

****

Appendix

Appendix Table A1: Climate Smart Goods		
1	380210	Activated carbon
2	392690	Articles of plastics & arts. Of oth. mats. of 39.01-39.14, n.e.s. in Ch.39
3	392010	PVC or polyethylene plastic membrane systems to provide an impermeable base for landfill sites and protect soil under gas stations, oil refineries, etc. from infiltration by pollutants and for reinforcement of soil.
4	560314	Nonwovens, whether or not impregnated, coated, covered or laminated: of manmade filaments; weighing more than 150 g/m2 for filtering wastewater.
5	701931	Thin sheets (voiles), webs, mats, mattresses, boards, and similar nonwoven products.
6	730820	Towers and lattice masts for wind turbine.
7	730900	Containers of any material, of any form, for liquid or solid waste, including for municipal Or dangerous waste.
8	732111	Solar driven stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel.
9	732190	Stoves, ranges, grates, cookers (including those with subsidiary boilers for central heating), barbecues, braziers, gas-rings, plate warmers and similar non-electric domestic appliances, and parts thereof, of iron or steel.
10	732490	Water saving shower.
11	761100	Aluminum reservoirs, tanks, vats and similar containers for any material (specifically tanks or vats for anaerobic digesters for biomass gasification).
12	761290	Containers of any material, of any form, for liquid or solid waste, including for municipal Or dangerouswaste.
13	840219	Vapor generating boilers, not elsewhere specified or included hybrid.
14	840290	Super-heated water boilers and parts of steam generating boilers.
15	840410	Auxiliary plant for steam, water, and central boiler.
16	840490	Parts for auxiliary plant for boilers, condensers for steam, vapor power unit.
17	840510	Producer gas or water gas generators, with or without purifiers.
18	840681	Turbines, steam and other vapor, over 40 MW, not elsewhere specified or included.
19	841011	Hydraulic turbines and water wheels of a power not exceeding 1,000 kW.
20	841090	Hydraulic turbines and water wheels; parts, including regulators.
21	841181	Gas turbines of a power not exceeding 5,000 kW.
22	841182	Gas turbines of a power exceeding 5,000 kW.
23	841581	Compression type refrigerating, freezing equipment incorporating a valve for reversal of cooling/heating cycles (reverse heat pumps).
24	841861	Compression type refrigerating, freezing equipment incorporating a valve for reversal of cooling/heating cycles (reverse heat pumps).

25	841869	Compression type refrigerating, freezing equipment incorporating a valve for reversal of cooling/heating cycles (reverse heat pumps).
26	841919	Solar boiler (waterheater).
27	841940	Distillingorrectifyingplant.
28	841950	Solar collector and solar system controller, heat exchanger.
29	841989	Machinery, plant or laboratory equipment whether or not electrically heated (excluding furnaces, ovens etc.) for treatment of materials by a process involving a change of temperature.
30	841990	Medical, surgical or laboratory stabilizers.
31	848340	Gears and gearing and other speed changers (specifically for wind turbines).
32	848360	Clutches and universal joints (specifically for wind turbines).
33	850161	AC generators not exceeding 75 kVA (specifically for all electricity generating renewableenergyplants).
34	850162	AC generators exceeding 75 kVA but not 375 kVA (specifically for all electricity generatingrenewableenergyplants).
35	850163	AC generators not exceeding 375 kVA but not 750 kVA (specifically for all electricity generatingrenewableenergyplants).
36	850164	AC generators exceeding 750 kVA (specifically for all electricity generating renewable energyplants).
37	850231	Electric generating sets and rotary converters; wind-powered.
38	850680	Fuel cells use hydrogen or hydrogen-containing fuels such as methane to produce an electric current, through an electrochemical process rather than combustion.
39	850720	Other lead acidaccumulators.
40	853710	Photovoltaicsystemcontroller.
41	853931	Dischargelamps, (ex ultraviolet), fluorescent.
42	854140	Photosensitive semiconductor devices, including photovoltaic cells whether or not assembled in modules or made up into panels; light-emitting diodes.
43	900190	Mirrors of other than glass (specifically for solar concentrator systems).
44	900290	Mirrors of glass (specifically for solar concentrator systems).
45	903210	Thermostats.
46	903220	Manostats.
47	700800	Multiple-walled insulating units of glass
48	730431	Tubes, pipes & hollow profiles (excl. of 7304.10-7304.29), seamless, of circular cross-section, of cold-drawn/cold-rolled (cold-reduced) steel
49	730441	Tubes, pipes & hollow profiles (excl. of 7304.10-7304.39), seamless, of circular cross-section, of stainless steel, cold-drawn/cold-rolled (cold-reduced)
50	730451	Tubes, pipes & hollow profiles (excl. of 7304.10-7304.49), seamless, of circular cross-section, of alloy steel other than stainless steel, cold-drawn/cold-rolled (cold-reduced)
51	840682	Steam turbines &oth. vapour turbines (excl. for marine propulsion), of an output not

		>40MW
52	841012	Hydraulic turbines & water wheels, of a power >1000kW but not >10000kW
53	841013	Hydraulic turbines & water wheels, of a power >10000kW
54	850239	Electric generating sets n.e.s. in 85.02
55	850300	Parts suit. for use solely/princ. with the machines of 85.01/85.02
56	850440	Staticconverters
57	902830	Electricity meters, incl. calibrating meters therefor
58	903020	Cathode-ray oscilloscopes & cathode-ray oscillographs
59	903031	Multimeters
60	903039	Instruments & app. for meas./checking voltage/current/resistance/power (excl. of 9030.31), without a recording device
61	890790	Floating structures other than inflatable rafts (e.g., rafts (excl. inflatable), tanks, coffer-dams, landing-stages, buoys & beacons)
62	847989	Machines & mech. appls. having individual functions, n.e.s./incl. in Ch.84
63	842129	Filtering/purifying mach. & app. for liquids (excl. of 8421.21-8421.23)
64	842139	Filtering/purifying mach. & app. for gases, other than intake air filters for int. comb. engines
Note: The study is able to define 64 such goods under 6 digit HS code (2002) by putting together various lists that have been defined by various international organizations recently. The list is arrived by defining concordance series from series of list given by the World Bank, ICTSD, WTO, APEC and the OECD. The study consider these 64 CSG as one category and calculates various trade indicators for this category. This list builds on the 43-product list amalgamated by the World Bank, which was tabled as an initial starting point for discussions. The list at UNESCAP proposes an additional 21 products that appeared on one of the recent ICTSD lists (Renewables and Buildings) and also on the APEC, OECD or WTO list. In total, the list comprises of 64 climate smart goods classified by H.S. 2002 codes at the 6-digit level.		
Source: UNESCAP, APTIR, 2011		