Trade of CSG by ESCAP Member Nations: A Gravity Analysis

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Abstract:

The study uses simple and extended gravity model to examine the impact of host of factors on imports of Climate smart goods (CSG) by 24 ESCAP member nations from other ESCAP members (57), the countries in the EU and the US in 2008 and 2002. Economic size, distance, similarity of endowments and demand structure and tariffs matter in that order for trade of CSG in 2008. The extended model shows the weak impact of regional trade agreement, policy and infrastructure variable on imports of CSG. The simple and extended gravity model are used to work out the import surge for bilateral trading partners of ESCAP. It is notable to find that countries imports do not surge automatically with the fall in import duty rates. Many other parameters of the economy tend to have impact on imports. This also shows that the elasticity of imports (value) with respect to its price (tariff duties) is inelastic. This can be one, among many, arguments for opening up the economy to CSG imports from the outside world to have cleaner and low carbon emission technologies. The impact of tariff reduction on imports of CSG for ESCAP nations under the aegis of preferential trading arrangements in 2008 has been significantly greater than what it were in 2002.

JEL Classification : F1

Key words: CSG, Gravity Analysis, Tariff Reduction, AHS, MFN, trade surge

Introduction:

The study uses gravity analysis to examine the impact of host of factors on imports of CSG[1] by ESCAP member nations from other ESCAP members, the countries in the EU and the US in 2008 [2]. Gravity model has been used quite extensively and successfully in quantitative analysis of international trade. Gravity model is used to explain the role of tariff barriers, preferential trading arrangements, economic size and endowments, general policy environment and overall

[1] Many of the 64 CSGs considered in the study are intermediate products to cleaner technologies. These are chemicals, filters, pumps, valves, turbines, metres, lasers, spectrometers, etc that may have multiple end uses. The latest negotiations on trade in CSG in WTO has in its agenda, among others, liberalization of environmental goods which have single use rather than multiple use. The results here indicate that the negotiations can gain by following the list approach and move ahead of earlier stand taken by countries to follow the project based approach(India), or follow the ITA and government procurement negotiations. The reason is that it may be beneficial for countries in ESCAP to liberalize their trade of CSGs for various reasons listed in the study below. The CSGs fall under environmental goods and not environmental services and are related to import liberalization of industrial products(agricultural goods like ethanol are not part of CSGs) .

[2] The study considers imports from country I to country j for CSG and its subcategories as dependent variable. The main reason for doing an import analysis is that in an earlier work on trade indices it was found that most of the countries in the ESCAP region are net importers of CSG technologies and products. The data base for imports and tariffs (MFN and Applied Tariff Duties) are from WITS. 2008 results are also given for comparison purpose. Another reason for not pursuing export analysis is that the WITS data base does not seem to give the import tariff figures for ESCAP countries exports to the EU after 2003. Also, many of the ESCAP nations have made strong commitment to improve the environment as reflected in the open market and procurement policies and significant public investment in environment cleanups.

infrastructure, distance between trading partner, membership of multilateral agreement, foreign direct investments, common language, colonial links and borders, among others on trade of such climate smart goods and sub categories. Theoretical Justification of the Gravity model have come from renowned trade economists like Linneman(1966), Deardorff(1984) Helpman and Krugman(1985),Helpman(1987), Bergstrand(1985,89), Baier and Bergstrand(2001) and Anderson and Wincoop(2003) in recent times. Anderson and Wincoop(2003) using their theoretical gravity model predict that large countries import more and then export more, larger bilateral trade barriers tends to lessen trade for given bilateral trade barriers and more 'remote' countries import(and export) less. In other words, the more isolated a country is from the rest of the world, which will be captured by a large price index, the less this country imports. Alternatively, a country which charges high prices will export relatively little. In their study price indices depend on relative size and relative trade barriers. Our study though will use the traditional variables like GDPs of exporting and importing country to capture economic size, distance for examining the impact of natural barrier to trade and PCGDP difference of bilateral partners to capture the endowment effect. The gravity model then will be extended to include some dummies for regional agreements, border, colonial links and common language, policy and infrastructure variables and FDI flows as independent variables.

This study will use simple gravity model and its extended form using cross sectional data for ESCAP members and its trading partners- other ESCAP members, the USA and countries in the EU in 2008. The study will consider bilateral trading partners (83 permutation 2=6806) from 83 countries (57 ESCAP plus 25 EU and the US) for each of the CSG imports and its sub categories for years 2002 and 2008 for our gravity analysis depending on the availability of data and decision of ESCAP countries to import in the years considered in the study[3]. The data base will be WITS for imports and tariffs. For GDPs and PCGDP World Development Indicators and ARTNET data base will be used. Distance data will be from CEPII. Policy, FDI and Infrastructure variables will be from the ARTNET data base. The study will consider both simple average and weighted average (by imports) MFN and Effective Applied duties imposed by each of the ESCAP country in its analysis

II. Methodology, Data and Data Sources:

The gravity analysis will use gravity equation which will relate imports of CSG of ESCAP member nation to tariff imposed (simple and weighted MFN and Effectively Applied Rates separately), distance between trading partners to capture trade costs, GDPs of importing countries to capture size and variety effects, PCGDP difference between importing and exporting country to capture the endowment effect. The model will be extended to include dummies for colonial links, contiguity, common language and borders, dummy for regional trade agreement, overall infrastructure score of each importing nation, general policy environment and FDI in importing and exporting country. All variables except dummies will be in log form to get estimates of elasticity of the determinants with respect to imports of CSG of ESCAP member

[3] The member nations who decided to import CSG in 2008 and for which uniform data is available are 24 only out of list of 57 ESCAP nations considered in the study. These are Afghanistan, Armenia, Australia, Azerbaijan, China, Fiji, Georgia, Hong Kong, India, Iran, Japan, Kazakistan, Kyrgyz Republic, Macao, Maldives, Mongolia, New Zealand, Pakistan, Papua New Guinea, Russia, Singapore, Solomon Islands, Turkey and Vanuatu. The trading nations are 58 in numbers from ESCAP, EU and the US for each of the 24 ESCAP nations. Similarly each of the bilateral trading partners of the ESCAP may not be 58 as member nations may not be trading with all.

nations. The MFN and Applied Effective rates are used separately on imports to study the differential impact of preferential tariff rates and MFN rates on imports. The preferential tariff rates imposed by countries may be due to participation in preferential trading arrangement or participation of developing countries of ESCAP in GSP schemes. The imports and all form of tariff data are culled out of UNCTAD TRAINS data in WITS. GDP and PCGDP and Imports are in US$. GDPs and PCGDPs are from the World Bank Word Development Indicators available for 2008(from worldbank website). Distance, Dummies, FDI, Infrastructure and policy environment scores figures are from UNESCAP artnet data base made available for latest year through interactive access. The distance is in kms.
The two models for Gravity analysis are given below. One is an abridged version which excludes dummies and policy variables (equation i) while the other takes into account all variables (Equation ii). All variables will be in natural log to get slope coefficients as elasticity(except dummies).

Log of Imports(US$)= constant +b1 Log Tariff+b2 log Distance+ b3log GDP of Importing Country+ b4LogGDP of Exporting Country+b5(Log PCGDP of Importing Country-Log PCGDP of Exporting Country)+ error (i)

Log is natural log(base e)

Imports= Imports of CSG from other ESCAP members, countries in the EU and the US in US$, From WITS

Tariffs= Tariffs in percentage. Tariffs can be simple (average) and weighted (average) Effectively Applied and MFN rates depending on the analysis, from WITS

GDPs are in US$(current), World Development Indicators

PCGDP (current US$) divided by population, World Development Indicators

Distance in kms is geodesic distances calculated by using the great circle formula which uses latitudes and longitudes of the most important cities/agglomeration (in terms of population). (CEPII, 2004)

The full gravity model is given below. The statistical justification of extended model will come from the F test by checking significance of smaller set of variables. This test is called the Chow Rao test for significance of subset of variables.

Log of Imports(US$)= constant +b1 Log Tariff+b2 log Distance+ b3log GDP of Importing Country+ b4LogGDP of Exporting Country+b5(Log PCGDP of Importing Country-Log PCGDP of Exporting Country)+ b6 dum_contiguous+b7 dum_comlang_official+b8 dum_colony_link+b9ln_polcy_info_score_rep+b10 ln_polcy_info_score_par+b11ln_infrastruc_score_rep+b12 ln_infrastruc_score_par+b13ln_fdi_rep+b14ln_fdi_par+b15 dum_rgnl_agreement+error (ii)

For definition of variables tariffs, distance, GDPs, PCDGPs and PCGDPDifference see as above. For others in the full model

dum_contiguous is 1 if 2 bilateral trading partners are contiguous(share same borders);0 otherwise, Available from ARTNET data base

dum_comlang_official is 1 if two countries share official language(atleast 20% of population should speak the same official language);0 otherwise, Available from ARTNET data base

dum_colony_link is 1 if two bilateral trading countries ever had a colonial link; 0 otherwise, Available from ARTNET data base

dum_rgnl_agreement is 1 if both the bilateral trading partners fall under ASEAN, AFTA and SAARC; 0 otherwise, Available from ARTNET data base

ln_polcy_info_score shows the survey data from the Global Competitiveness Report 2006-07indicating the quality of information regarding changes in policies and regulations. In particular the following question is asked. Are firms in your country usually informed clearly by the government on changes in policies and regulations affecting your industry?(1=never informed, 7=always informed). The scores are for both reporter and partner. Available from ARTNET data base

ln_infrastruc_score are for both reporter and partner indicating the Overall infrastructure quality score. General infrastructure in the country is(1=underdeveloped,7=as extensive and efficient as the world's best). The data is again from the Global Competitiveness Report 2006-07. Available from ARTNET database

ln_fdi are FDI flow of reporter and partner in US$ million. Real FDI is a constant price in the year 2000 which is deflated by GDP deflator=1.6. The source of the data is unctad home page available at ARTNET data base. Available from ARTNET data base

III. Hypotheses for the Simple Gravity Model, Regression Results, Tariff Liberalization Effects, Discussion and Interpretation

III.1 Hypotheses

1) Larger Tariffs (imposed trade cost) and distances (natural cost) have negative impact on imports of CSG products. Larger distance may capture the remoteness of country in terms of higher prices prevailing in importing and exporting country which tend to lessen trade.
2) GDPs of exporting and GDP of importing country tend to have positive impact on imports. Higher the GDPs of the bilateral trading partners more are the possibilities of trading varieties of CSG technologies capturing the Helpman and Krugman's 'variety effect'. This relationship critically depends on supportive measures such as government policies, markets and social structures.
3) Lower the PCGDP difference (ln importerpcgdp – ln exporterpcgdp) higher is the possibility of trade in CSG trade. It seems that most of the trade in CSG (as in subcategories CCT and WE) is in the nature of intra-industry trade. Intra-Industry

trade is more when both countries have similar factor endowments. PCGDP difference captures the endowment effect of bilateral trading partners. Also, the more similar are countries in terms of factor endowments more is the possibility of trade of differentiated products due to similarity of demand structure in both countries. The trade may have element of the Linder Effect. Linder Hypothesis (1961) argues that trade will take place among countries with similar endowments once countries in their homes have saturated their demands for products. To reap economies of scale the countries look for trade and finds itself trading differentiated products with countries having similar tastes, maturity levels and endowments. Larger PCGDP difference may promote inter industry trade of CSG sub categories. Also, lower inequality in terms of relative country size (proxied by relative country endowments) promotes trade between countries.(Helpman and Krugman,1985)

III.2 Regression Results from Simple Gravity Model: Trade of CSG

The study at the first stage uses simple gravity equation to run regression of the log of imports on five independent variables. These are tariffs, distance, GDP of importing and exporting country and differences in per capita GDPs. All independent variables are in log form. The study has log variables on both left and right hand side so that each slope coefficient will indicate the elasticity of each independent variable with respect to imports. The regression uses only 915 observations on bilateral partners culled out of ESCAP member's imports from other ESCAP countries, countries in the EU and the USA. The results are for 2008. The study also estimates the differential impact of Applied Effective duties (AHS- preferential duties) and MFN tariff rates on imports based on simple and weighted averages of tariff rates. The study goes on to find the estimated imports using preferential rates and MFN rates. Import SURGE effect of tariffs in percentages are estimated by working out the difference between fitted imports from model which takes into account preferential duties over model which takes into account MFN tariff rates[4]. Leading bilateral partners who have gained in terms of surge in imports of CSG products and technologies are identified. The results are also given for all 915 bilateral trading partners in the appendix table. It may be noted from the whole list that there are many member nations which have negative surges due to tariff reduction (or positive surges because of moving from lower to higher duties). This is due to the fact that apart from tariffs other variables like income, size and endowments; among other policy variables do have impact on imports. The negative surges in CSG imports may have interesting implications for liberalizers of CSG products.

Table I gives the results for the basic gravity model which takes into account preferential applied tariff rates(var3) which are weighted averages, weights been the imports from the trading partners. All the variables have the expected sign and have significant impact on imports individually (t values are significant) and collectively (F values are significant) on imports of CSG. Standardized beta coefficients are also given to study the relative effect of each of the variable on imports. Tariff duties (var3) tend to have negative and significant impact on imports with elasticity working out to be negative .07(inelastic). Physical distance (var 4) has a negative and significant effect on imports of CSG of ESCAP member nations with elasticity working out

[4] Import liberalization may mean moving from AHS (applied tariffs and generally lower) to applied MFN rates because they are generally higher. This would mean finding the difference between fitted imports using MFN less fitted imports using AHS. This study calculates the difference between AHS fitted imports less MFN fitted imports for working out the import surge and the capacity of countries to increasingly import components to cleaner technologies. In the WTO import liberalization means lowering MFN bound tariffs. An exercise can be done from moving from AHS duties (lower) to still higher bound tariffs.

to be negative 0.99(inelastic). GDPs of importer (var5) and exporter (var6) tend to have positive and significant impact on imports. The elasticity of exporter GDP is elastic with value of positive 1.23. The PCGDP difference (var9) has negative and significant effect on imports of CSG indicating that members with similar endowments and tastes in ESCAP region tend to trade in CSG technologies and products. It is also indicative that similar countries of ESCAP in terms of endowments tend to have more of intra-industry trade (trade in products with similar factor intensities like Wind Energy and Clean Coal Technologies). Trade in CSG is basically trade in components to cleaner technologies where in firms may trade in some of the similar products to reap economies of scale. The standardized beta coefficient indicates that GDP of exporter country has the greatest positive relative effect on imports, followed by GDP of importer country, then distance, endowment effect and finally the tariffs in that order. It seems that for ESCAP nations other factors besides tariffs are more important in explaining their imports. It may be noted that the preferential applied duties imposed by the 24 nations of the ESCAP ranges from 0%(by Singapore, Macao, Hong Kong, Armenia, Australia, Georgia, New Zealand, Turkey and Japan with all its trading partners to maximum of 50 % duty (only) on Iran's imports with Estonia followed by 43 % by Maldives on Ireland's exports of CSG, among others in the list. These duties on CSG imports seem to be relatively lower than duties imposed on other industrial products by the developing countries. Solar cells and panels (which are part of the 64 identified Climate Smart Good) enter most markets (including China and India) duty free. In China, MFN applied tariffs are mostly in the 8-12 percent range and the simple average is close to 10%. In India, most MFN applied tariffs are either 7.5 or 10%, with a simple average of slightly above 8 percent. Appendix Table(available with author on demand) lists the weighted average applied duties by trading partners in descending order of duty rates for CSG products.

The R^2 and F values indicate that the model is quite robust in explaining imports of the CSG products from its trading partners. Heteroscedasticity in the regression model is taken care by using the correct specification of the model in log form. The simple gravity model explains around 58.70 % of the variability in the imports due to variability of all its determinants. This implies around 42% of the variability is explained by other factors not accounted for the simple gravity model results. This would imply extending the model. This is done in the next section. Economic size, distance then the endowments and finally tariffs in that serial order have the greatest relative effect on imports of CSG.

Table I: Simple Gravity Model Results of Regressing Log of Imports on its determinants (with weighted average preferential applied tariff rates) for 2008

Source	SS	df	MS		Number of obs = 915
					F(5, 909) = 258.44
Model	8333.23261	5	1666.64652		Prob > F = 0.0000
Residual	5862.06918	909	6.448921	R-squared = 0.5870	Adj R-squared = 0.5848
Total	14195.3018	914	15.5309648	Root MSE = 2.5395	
Indvaria.	Coef.	Std. Err.	t	P>t	B(standardized)	Var1(Dependent Variable) LnImports(US$)
var3	-.0751772	.0298822	-2.52	0.012	-.0572208	LnweightedtariffAHS

var4	-.9975078	.1092749	-9.13	0.000	-.2024778	Lndistance
var5	.8652303	.0348005	24.86	0.000	.5627851	LnGDPImporter
var6	1.232598	.0474999	25.95	0.000	.613504	LnGDPExporter
var9	-.1992153	.0472188	-4.22	0.000	-.106159	(LnPCGDPImporter-LNPCGDPExporter)
_cons	-32.36461	1.659155	-19.51	0.000	.	Constant

Note: Stata is been used for the regression analysis.

Table II gives the Simple Gravity Model results of regressing log of imports on its determinants including now simple average preferential tariff rates. This model is different from the earlier in one way. It takes into account now simple average applied duty rates as one of the independent variable (var2). All the variables except coefficient related to simple applied preferential tariff rates are significant and all have expected signs. The two sets of results indicate that simple average does not take into account the differential duties imposed by each member in ESCAP on its imports from different partners. This may be the reason that weighted average applied duties tend to have significant and negative impact on imports. Again the simple model explains around 58% of the variability in the dependent variable due to variability in the independent variables. The elasticity of imports with respect to distance and exporter GDP is elastic for this set of regression result.

Table II: Simple Gravity Model Results of Regressing Log of Imports of CSG on its determinants (with simple average preferential applied tariff rates) for 2008

Source	SS	df	MS		Number of obs =915	
					F(5, 909)	256.9
Model	8312.4646	5	1662.49292		Prob > F =0	
Resi.	5882.8372	909	6.47176809	R-squared	R-squared 0.5856	
Total	14195.3018	914	15.5309648		Adj R-squared	0.583
				Root MSE	2.544	
	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
var2	-.0533729	.0303244	-1.76	0.079	-0.112887	0.0061411	Ln simpleaverage preferential applied tariff rates
var4	-1.009424	.1095085	-9.22	0	-1.224343	-0.794505	Lndistance
var5	.8663142	.0348611	24.85	0	0.7978965	0.9347319	LnGDPImporter
var6	1.233273	.0475847	25.92	0	1.139885	1.326662	LnGDPExporter
var9	-.1910917	.0476159	-4.01	0	-0.2845416	-0.0976418	(LnPCGDIFF.)
_cons	-32.28427	1.662823	-19.42	0	-35.54769	-29.02085	Constant

Note: Stata for regression results

Table III gives the results of the regression of log of imports on its determinants including weighted average MFN applied tariff rates. All the variables except for tariffs have significant impact on imports. The elasticity of imports with respect to weighted tariffs is -.059. It is to be noted that this figure is lower than elasticity of imports with respect to effectively applied preferential duties which is -.075. The preferential duties as applied by ESCAP nations tend to have greater import liberalization effect on an average than that for MFN duties.

Table III: Simple Gravity Model Results of Regressing Log of Imports on its determinants (with weighted average MFN applied tariff rates) for 2008

Source	SS	df	MS	Number of obs = 915	
				F(5, 909) = 257.06	
Model	8314.77376	5	1662.954	Prob > F = 0.0000	
Residual	5880.52803	909	6.46922	R-squared = 0.5857	
Total	14195.30	914	15.5309	Root MSE = 2.5435	
				Adj R-squared = 0.5835	
lnimports2	Coef.	Std. Err.	t	Pvalue	Beta
var11	-.0591507	.0318181	-1.86	0.063	-.0409031
var4	-1.027682	.1083672	-9.48	0.000	-.2086027
var5	.8708814	.0349524	24.92	0.000	.5664608
var6	1.229987	.0476424	25.82	0.000	.6122042
var9	-.1859822	.0466646	-3.99	0.000	-.0991073
_cons	-32.13438	1.657543	-19.39	0.000	.

					Ln Weighted Average MFN Applied Duties
					Lndistance
					LnGDPImporter
					LnGDPExporter
					(LnPCGDIFF.)
					Constant

Source: stata for regression results

Table IV gives the Simple Gravity Model Results of Regressing Log of Imports on its determinants (with simple average MFN applied tariff rates). All the variables are significant except simple average MFN duties. All variables come with expected sign.

Table IV: Simple Gravity Model Results of Regressing Log of Imports on its determinants (with simple average MFN applied tariff rates) for 2008

Source	SS	df	MS			Number of obs 915	
						F(5, 909)	256.04
Model	8301.18782	5	1660.23756			Prob > F 0	
Residual	5894.113	909	6.48417379		R-squared	0.5848	
						Adj R-squared	0.5825
Total	14195.3018	914	15.5309648		Root MSE	2.5464	
	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]	
var10	-.0377357	.0324444	-1.16	0.245	-0.1014104	0.0259389	Ln simple MFN applied duties
var4	-1.032099	.1084817	-9.51	0	-1.245003	-0.8191955	Lndistance
var5	.8696332	.0350331	24.82	0	0.800878	0.9383885	LnGDPImporter
var6	1.231493	.0477173	25.81	0	1.137844	1.325142	LnGDPExporter
var9	-.1799577	.0470442	-3.83	0	-0.2722856	-0.0876298	(LnPCGDIFF.)
cons	-32.09744	1.659394	-19.34	0	-35.35413	-28.84075	Constant

Note: Econometric Software Stata used for the analysis

The regression results from the simple gravity model are summarized below. Most of the variables in the simple gravity model are significant except tariffs which have weak effects on imports of CSG.

SIMPLE GRAVITY ANALYSIS RESULTS: FACTORS INFLUENCING IMPORTS OF CSG IN 2008									
Imp CGS (regressions)	Weighted Average AHS Tariff.	Weighted Average MFN Tariff	Simple Average AHS	Simple Average MFN	Distance	GDP Reporter	GDP Partner	PC GDP Diff.	R2
i	-.075*				-.99*	.865*	1.23*	-.199*	0.58

ii			-.05**		-1.009*	0.866*	1.23*	-.191*	.58
iii		-.059**			-1.02*	0.871*	1.22*	-.185*	0.58
iv				NS	-1.03*	0.869*	1.23*	-.179*	0.58
									N=915

* significant at 5% level of significance
** significant at 10% level of significance

III.4. Import Liberalization Based on Simple Gravity Model

Table V works out the surge in imports(and % change) due to imposition of preferential weighted applied tariff rates over MFN weighted tariff duties for top 28 bilateral trading partners based on simple gravity model given in Table I and III. Appendix Table II lists the results for all trading partners(available with author). The average surge (in %) for all ESCAP bilateral trading partners (915) work out to be 0.684%. The import surge measures undertaken by countries are conscious efforts on part of the countries to increase efficiency and productivity by enhancing competition through preferential schemes and in the case of import of CSG to have cleaner and low carbon emission technologies in their respective countries. The import surge (%) values ranges from as high as 55.74 % for Kyrgyz Republic's imports from Azerbaijan to negative 16.74% for Iran's imports from Azerbaijan. Turkey features mostly in the top 28 list of import surges while many CIS republics feature in the top 28 trading partners import surge in percentage over MFN tariff rates. The latter list also features Australia's imports from US with import surge % change to be as high as 52.19 % and New Zealand-Singapore figure to be 48.02%. Australia and New Zealand seems to be major gainers due to import surge measures taken by these two countries with respect to other ESCAP nations for imports of CSG technologies in 2008. It may be noted that in the simple gravity model considered in this study the imposition of preferential tariff rates may not necessarily lead to increase in imports. This happens because income, distance and endowments also have impact on imports and elasticity of imports with respect to tariff rates may be inelastic. Also, some of the developing countries with mostly negative import surges and constrained with foreign exchange needs but conscious of having clean technologies may stand to gain with such trade of CSGs. Few examples would include countries of SAARC. Most of them have negative import surges due to imposition of preferential tariff rates. The fact that distance and incomes matter for imports it is beneficial for SAARC countries to trade among themselves (lower distance), adopt policies to boost incomes in their countries and simultaneously liberalize their trade of CSGs. They can also think of increasing tariffs from applied duties to MFN rates to have both clean technologies and increasing the government revenue.

TABLE V: Import Surge Figures Based on Simple Gravity Model (arranged in descending order) for First 28 Trading Partners in 2008

Import Liberalization(% change of Fitted Imports over MFN Fitted Imports	Reporter(Importer)	Partner(Exporter)	Ranking	Import Liberalization(change of Fitted Imports over MFN Fitted Imports (in US$)	Reporter(Imp)	Partner(Exp.)
55.74461	Kyrgyz Republic	Azerbaijan	1	1.34E+08	Turkey	Germany
55.45681	Kyrgyz Republic	Armenia	2	1.08E+08	Australia	United States
52.1908	Australia	United States	3	1.06E+08	Turkey	Italy
51.61402	Russian Federation	Armenia	4	93558171	Turkey	France
48.3975	Azerbaijan	Kazakhstan	5	85909367	Japan	China

48.02015	New Zealand	Singapore	6	76917569	Turkey	United Kingdom
47.86894	Kyrgyz Republic	Russian Federation	7	39900047	Turkey	Russian Federation
45.38938	Turkey	Ireland	8	36317898	Turkey	Spain
45.1358	Russian Federation	Kazakhstan	9	23303244	Turkey	Greece
44.90865	Australia	Singapore	10	22107464	Turkey	Netherlands
44.79925	Azerbaijan	Russian Federation	11	14674645	Turkey	China
44.37355	Russian Federation	Tajikistan	12	14607209	Turkey	Austria
44.36174	Russian Federation	Azerbaijan	13	13657456	Turkey	Poland
44.05316	Turkey	Portugal	14	11210009	Turkey	Belgium
43.23329	Australia	Thailand	15	10717093	Turkey	Sweden
43.14401	New Zealand	Australia	16	7443815	Turkey	Denmark
42.71185	New Zealand	Afghanistan	17	7132885	Japan	Turkey
42.43636	Turkey	Spain	18	7029267	Hong Kong, China	United States
42.09065	Australia	New Zealand	19	6426681	China	Hong Kong, China
42.08165	Turkey	France	20	6344753	Kazakhstan	Russian Federation
41.78399	Kazakhstan	Russian Federation	21	6060295	Japan	Indonesia
41.68867	Turkey	United Kingdom	22	5727834	Japan	India
40.89451	Australia	Papua New Guinea	23	5191375	Singapore	United States
40.4238	Turkey	Sri Lanka	24	5179275	Turkey	India
40.37231	Turkey	Belgium	25	5152570	Turkey	Finland
40.24876	New Zealand	Fiji	26	4652216	New Zealand	Australia
40.12763	Turkey	Netherlands	27	4409055	Turkey	Czech Republic
40.11793 Average for all 915 trading partners=0.684778%	Turkey	Sweden	28	4326490 Average for all 915 trading partners in ESCAP=-162396 US$	Turkey	Ireland

Source: authors calculations. The appendix table (available on demand) shows lists of countries which show negative surges by lowering tariffs on CSG products.

IV. Extended Model: The simple gravity model is extended to include policy variables and dummies for common language and regional trade agreements[5]. The gravity equation is as given in (ii). As in the case of the analysis above four extended models are estimated. Two have tariff rates, apart from other variables, simple MFN and effective applied duties as independent variables. The rest two, apart from other independent variables, consider tariff rates which are weighted MFN and effective applied. At the end the extended models with weighted tariffs have been used to work out the import surge and percentage change. Leading bilateral partners are identified as in the previous analysis based on the extended model.

Distance, GDP of importer and exporter country is significant and positive in all the four models given in Tables VI through IX. The number of observations has reduced (for getting uniformity of

[5] Chow Rao test is used for checking significance of the subset of variables. The null hypothesis is that all the dummies, policy, infrastructure and FDI variables in the extended gravity model have no impact on imports against the alternative hypothesis that all the variables together have significant impact on the imports. The F test used is F=(R2(Full Model)-R2(Abridged)/ Number of restrictions))/(1-R2(Fullmodel))/Number of observations – number of parameters in the model. The F value turns out be significant.

data for all partners) from 915 to 314 bilateral partners of ESCAP with its trading partner – other ESCAP countries, Countries in the EU and the USA. Table VI shows that for the extended model only distance, GDP of exporting and importing country and infrastructure score of the exporting country (partner) have significant impact on imports of CSG. A counter intuitive result is seen where the lower the FDI, the higher are the imports of CSG products (although it is statistically insignificant). This can be explained by the fact that the top CSG importers are low income ESCAP countries which have not attracted significant levels of FDI. R^2works out to be relatively high as 0.65 % and F value is significant confirming that all the variables together have significant impact on imports of CSG. The standardized beta coefficients indicate that GDPs of the exporting country, followed by GDP of the importing country, Overall Infrastructure, distance and then tariffs followed by all other variables in that serial order have the greatest relative effect on imports of CSG.

Table VI: Extended Gravity Model Results of Regressing Log of Imports of CSG on its determinants (with weighted average preferential applied tariff rates) for 2008

Dependent Variable: SER01(Ln Imports 2008)					
Method: Least Squares					
Date: 07/11/10 Time: 22:49					
Sample: 1 314					
Included observations: 314					
Variable	Coefficient	Std. Error	t-Statistic	Prob.	Standardized beta
C	-47.1739	6.050103	-7.79721	0	
lnweightedtariffapplied	-0.00981	0.06111	-0.16056	0.8725	-0.00966
lndistance	-1.04128	0.16051	-6.48731	0	-0.29641
lngdprep	1.151369	0.281848	4.085075	0.0001	0.443704
lngdppar	1.41475	0.127395	11.1052	0	0.664867
lnpcgdpdiff	-0.02963	0.084868	-0.34917	0.7272	-0.0205
dum_contiguous	-0.29845	0.545745	-0.54687	0.5849	-0.02095
dum_comlang_official	0.5791	0.323959	1.787573	0.0749	0.071924
dum_colony_link	-0.54021	0.689166	-0.78387	0.4337	-0.02802
ln_polcy_info_score_rep	0.01784	0.959835	0.018587	0.9852	0.001496
ln_polcy_info_score_par	0.060954	0.925213	0.065881	0.9475	0.004457
ln_infrastruc_score_rep	2.076533	1.143482	1.815974	0.0704	0.209948
ln_infrastruc_score_par	2.868848	0.756675	3.791386	0.0002	0.309987
ln_fdi_rep	-0.25034	0.363417	-0.68884	0.4915	-0.06656
ln_fdi_par	-0.17517	0.143408	-1.22148	0.2229	-0.08239
dum_rgnl_agreement	0.995554	0.532409	1.869907	0.0625	0.072056
R-squared	0.659038	Mean dependent var		16.28668	
Adjusted R-squared	0.641875	S.D. dependent var		3.043164	
S.E. of regression	1.821136	Akaike info criterion		4.08641	
Sum squared resid	988.3281	Schwarz criterion		4.277461	
Log likelihood	-625.566	F-statistic		38.39982	
Durbin-Watson stat	2.063728	Prob(F-statistic)		0	

Note: Eviews Results

Table VII give the Extended Gravity model results of Regressing Log of Imports on its determinants (with weighted average MFN applied tariff rates). The results are similar to the above results in Table VI. Infrastructure in the exporter country, distance and incomes in importing and exporting matter for CSG imports. Dummies for Regional Trade agreements and Common official language tend to have weak impact on import of CSG. They are significant only at 8% level of significance. Tariff has a negative impact on imports but it is insignificant statistically.

Table VII: Extended Gravity Model Results of Regressing Log of Imports of CSG on its determinants (with weighted average MFN applied tariff rates) for 2008

Dependent Variable: SER01(Ln Imports)					
Method: Least Squares					
Date: 07/11/10 Time: 22:50					
Sample: 1 314					
Included observations: 314					
Variable	Coefficient	Std. Error	t-Statistic	Prob.	Standardized beta
C	-53.9663	7.716446	-6.99367	0	
lnweightedtariffMFN	-0.19939	0.147498	-1.35179	0.1775	-0.1742864
lndistance	-0.98338	0.152323	-6.45586	0	-0.2799277
lngdprep	1.65017	0.45632	3.616253	0.0004	0.6359269
lngdppar	1.400414	0.127439	10.98892	0	0.6581304
lnpcgdpdiff	5.88E-05	0.086365	0.000681	0.9995	0.0000408
dum_contiguous	-0.19675	0.545939	-0.36039	0.7188	-0.0138113
dum_comlang_official	0.574433	0.322685	1.780167	0.0761	0.0713445
dum_colony_link	-0.54828	0.687119	-0.79794	0.4255	-0.0284345
ln_polcy_info_score_rep	0.138891	0.937202	0.148198	0.8823	0.011641
ln_polcy_info_score_par	0.002416	0.922855	0.002618	0.9979	0.0001766
ln_infrastruc_score_rep	1.856671	1.142676	1.624844	0.1053	0.1877185
ln_infrastruc_score_par	2.971683	0.75756	3.922704	0.0001	0.3210984
ln_fdi_rep	-0.93778	0.614196	-1.52685	0.1279	-0.2493552
ln_fdi_par	-0.16888	0.142917	-1.18165	0.2383	-0.0794259
dum_rgnl_agreement	0.934201	0.528901	1.766304	0.0784	0.0676155
R-squared	0.661087	Mean dependent var		16.28668	
Adjusted R-squared	0.644027	S.D. dependent var		3.043164	
S.E. of regression	1.815657	Akaike info criterion		4.080383	
Sum squared resid	982.3896	Schwarz criterion		4.271435	
Log likelihood	-624.62	F-statistic		38.75204	
Durbin-Watson stat	2.069112	Prob(F-statistic)		0	

Note: Eviews Results

Table VIII gives similar results as expressed above. Infrastructure of exporter, distance and incomes in trading nations matter for imports of CSG. Infrastructure of importer, dummy variables for regional trading arrangements and common language have weak effects on imports (significant at 9% level of significance). Tariff comes with an opposite sign and it is insignificant.

Table VIII: Extended Gravity Model Results of Regressing Log of Imports of CSG on its determinants (with simple average preferential applied tariff rates) for 2008

Dependent Variable: SER01(Ln Imports)					
Method: Least Squares					
Date: 07/11/10 Time: 22:51					
Sample: 1 314					
Included observations: 314					
Variable	Coefficient	Std. Error	Standardized beta	t-Statistic	Prob.
C	-45.1376	6.114685		-7.38184	0
lnsimpletariffapplied	0.046493	0.065526	0.046201	0.709537	0.4785
Lndistance	-1.10599	0.16218	-0.31483	-6.81949	0
Lngdprep	1.022104	0.287188	0.393889	3.559	0.0004
Lngdppar	1.415627	0.127242	0.66528	11.12549	0
Lnpcgdpdiff	-0.02253	0.084382	-0.01559	-0.267	0.7897
dum_contiguous	-0.35635	0.544646	-0.02501	-0.65428	0.5134
dum_comlang_official	0.561253	0.324141	0.069708	1.731511	0.0844
dum_colony_link	-0.53426	0.688662	-0.02771	-0.7758	0.4385
ln_polcy_info_score_rep	0.208598	0.96306	0.017483	0.216599	0.8287
ln_polcy_info_score_par	0.105042	0.925188	0.007681	0.113535	0.9097
ln_infrastruc_score_rep	1.995616	1.138819	0.201767	1.752356	0.0807
ln_infrastruc_score_par	2.882061	0.755799	0.311415	3.813262	0.0002
ln_fdi_rep	-0.07622	0.369237	-0.02027	-0.20641	0.8366
ln_fdi_par	-0.16902	0.143367	-0.07949	-1.17892	0.2394
dum_rgnl_agreement	0.949391	0.531195	0.068715	1.787274	0.0749
R-squared	0.659583	Mean dependent var			16.28668
Adjusted R-squared	0.642448	S.D. dependent var			3.043164
S.E. of regression	1.819679	Akaike info criterion			4.084808
Sum squared resid	986.7466	Schwarz criterion			4.27586
Log likelihood	-625.315	F-statistic			38.49321
Durbin-Watson stat	2.062291	Prob(F-statistic)			0

Note: Eviews Result

Table IX give the Extended Gravity Model Results of Regressing Log of Imports on its determinants (with simple average MFN applied tariff rates). The results indicate that distance, economic size in terms of GDPs of bilateral partners and policy information on regulation affecting the industry in the reporter country matter for imports of CSG.

Table IX: Extended Gravity Model Results of Regressing Log of Imports of CSG on its determinants(with simple average MFN applied tariff rates)

Dependent Variable: SER01					
Method: Least Squares					
Date: 07/11/10 Time: 22:52					
Sample: 1 314					

Included observations: 314					
Variable	Coefficient	Std. Error	t-Statistic	Prob.	Standardized beta
C	-46.3089	7.920482	-5.84673	0	
lnsimpletariffMFN	0.014324	0.155221	0.092279	0.9265	0.01286
lndistance	-1.05791	0.154537	-6.84568	0	-0.30115
lngdprep	1.091932	0.469736	2.324564	0.0208	0.420799
lngdppar	1.41555	0.127368	11.11387	0	0.665243
lnpcgdpdiff	-0.02967	0.086455	-0.34316	0.7317	-0.02053
dum_contiguous	-0.31545	0.544546	-0.5793	0.5628	-0.02214
dum_comlang_official	0.5752	0.324153	1.774471	0.077	0.07144
dum_colony_link	-0.53914	0.689258	-0.7822	0.4347	-0.02796
ln_polcy_info_score_rep	0.051661	0.937834	0.055085	0.9561	0.00433
ln_polcy_info_score_par	0.073049	0.926578	0.078838	0.9372	0.005341
ln_infrastruc_score_rep	2.07344	1.151635	1.800432	0.0728	0.209635
ln_infrastruc_score_par	2.864808	0.761161	3.763736	0.0002	0.30955
ln_fdi_rep	-0.16941	0.626411	-0.27044	0.787	-0.04504
ln_fdi_par	-0.17373	0.143407	-1.21142	0.2267	-0.08171
dum_rgnl_agreement	0.990747	0.531568	1.863818	0.0633	0.071708
R-squared	0.659018	Mean dependent var		16.28668	
Adjusted R-squared	0.641855	S.D. dependent var		3.043164	
S.E. of regression	1.821189	Akaike info criterion		4.086468	
Sum squared resid	988.3853	Schwarz criterion		4.277519	
Log likelihood	-625.575	F-statistic		38.39644	
Durbin-Watson stat	2.062789	Prob(F-statistic)		0	

Note: Eviews result

Table X presents the import surge figures based on extended gravity model based on the results obtained in tables VI and VII. Top 28 trading partners are identified. The average percentage change for all 314 bilateral trading partners of ESCAP nations over the MFN rates are 0.867% .This latter figure is higher than the figure when the simple gravity model was used for the analysis. This points to having all policy and infrastructural variable at place to have significant impact of the tariffs on imports. New Zealand and China figures prominently in the import liberalization list (in percentage).

Table X: Import Surge Figures Based on Extended Gravity Model (arranged in descending order) for First 28 Trading Partners in 2008

Import Liberalization(% change of Fitted Imports over MFN Fitted Imports)	Reporter(Importer)	Partner(Exporter)	RANK	Import Liberalization(change of Fitted Imports over MFN Fitted Imports (in US$)	Reporter(Imp)	Partner(Exp.)
44.19076	New Zealand	Australia	1	1.2E+09	China	Korea, Rep.
33.35427	China	Korea, Rep.	2	6.28E+08	China	United States
28.40517	New Zealand	Singapore	3	4.07E+08	Australia	United States

25.85569	China	Bangladesh	4	1.71E+08	China	Germany
25.84215	New Zealand	Thailand	5	1.25E+08	China	France
25.31482	New Zealand	Korea, Rep.	6	1.13E+08	Hong Kong, China	United States
25.27318	New Zealand	Greece	7	83971727	New Zealand	United States
24.04999	New Zealand	Luxembourg	8	82299502	Singapore	Slovak Republic
23.65406	New Zealand	Italy	9	57485035	China	United Kingdom
23.61475	China	Singapore	10	54704579	Turkey	France
23.4982	Australia	New Zealand	11	53694795	Turkey	Germany
23.06077	New Zealand	Poland	12	25283774	New Zealand	Australia
22.81011	New Zealand	Germany	13	23433759	China	Spain
22.54821	New Zealand	United States	14	23419555	Turkey	United Kingdom
21.49105	New Zealand	United Kingdom	15	22429461	Hong Kong, China	Germany
21.17213	New Zealand	Spain	16	21161912	China	Netherlands
20.45844	New Zealand	Indonesia	17	19886650	China	Singapore
20.22941	New Zealand	Austria	18	19032910	China	Italy
20.20921	Hong Kong, China	Philippines	19	17144387	Turkey	Italy
20.11735	New Zealand	Vietnam	20	17135921	Russian Federation	Spain
20.04844	China	Cambodia	21	15896156	Hong Kong, China	Korea, Rep.
19.39911	China	Sri Lanka	22	14675162	Hong Kong, China	China
19.35968	New Zealand	Netherlands	23	14358318	China	Denmark
19.00051	New Zealand	Belgium	24	12604413	China	India
18.78219	New Zealand	Malaysia	25	11805869	China	Sweden
18.58188	Hong Kong, China	Vietnam	26	11741586	Hong Kong, China	France
18.50083	New Zealand	China	27	11387836	Turkey	Spain
18.49687 Average for 314 ESCAP trading partners=0.867555%	New Zealand	Sweden	28	10789127 Average for 314 ESCAP trading partners= 4228250 US$	Turkey	Austria

Source: Author's calculations

VI. REGRESSION RESULTS FOR IMPORT OF CSG IN 2002 & IMPORT LIBERALIZATION VALUES: USING EXTENDED GRAVITY MODEL

The regression of imports on reporter(importer) GDP, partner(exporter GDP), distance, dummies for common border(contiguity) and common official language spoken and effective applied rates(weighted by imports) for 2002 as given in Table XI. All variables are in log forms except the dummies. The slope coefficients give elasticity of the variable in question with respect to import. The results are similar to the 2008 results except that common official language spoken in trading countries is significantly impacting imports of CSG in 2002. This variable may be a reflection of information needs of such trade. All countries should be aware of the domestic regulations, certifications and standards for trade of CSG. Common languages spoken in trading nations allows this to happen. As before economic size and distance matters for trade. Tariffs have insignificant impact although they come with right signs. Distance and partner GDP have elasticity greater than one (elastic). The results have been worked out for the other three models. These are with Simple average applied rates, Simple average and weighted MFN rates. All show similar effects on imports. For saving space the results are not shown. Economic size and distance have the greatest relative effect on imports of CSG in 2002.

Table XI: Gravity Model: Regressing Imports on its Determinants including applied effective tariff rates, 2002

Dependent Variable: SER01(LNIMPORTS)					
Method: Least Squares					
Date: 07/12/10 Time: 14:42					
Sample: 1 339					
Included observations: 339					
Variable	Coefficient	Std. Error	t-Statistic	Prob.	Standardized coefficient
C	1.764121	1.597016	1.104636	0.2701	
SER02(LN REPORTERGDP)	0.940711	0.068873	13.65856	0	0.5664465
SER03(LNPARTNER GDP)	1.090422	0.07804	13.97263	0	0.6692767
SER04(LNDISTANCE)	-1.39637	0.217235	-6.42793	0	-0.3541098
SER05 (dum_contiguous)	0.628868	0.568483	1.106222	0.2694	0.0511651
SER06(dum_comlang_official)	1.267929	0.411119	3.084095	0.0022	0.1208197
SER08(LN WEIGHTED AVERAGE EFFECTIVELY APPLIED PREFERENTIAL RATES)	-0.02929	0.05901	-0.49642	0.6199	-0.0197086
R-squared	0.495477	Mean dependent var		12.54529	
Adjusted R-squared	0.486359	S.D. dependent var		3.157101	
S.E. of regression	2.262654	Akaike info criterion		4.491386	
Sum squared resid	1699.708	Schwarz criterion		4.570389	
Log likelihood	-754.29	F-statistic		54.34128	
Durbin-Watson stat	1.91913	Prob(F-statistic)		0	

Source: Eviews output

All the results for this gravity equation above help to get the import liberalization values and % changes over MFN rates for the year 2002. These are given in Table Appendix Table IV(available with author on demand). First few trading partners (28) are identified for the largest surge in imports of CSG goods (given in Table XII). The maximum percentage change is nearly 5.4% as opposed to more than 45 % in 2008 achieved by top liberalizers in 2008. It confirms of the greater commitment of import liberalization measures of member states in year 2008 as opposed to 2002. This may be due to heavy reliance on preferential schemes than WTO based trade on MFN duties.

Table XII: Import Surge Based on Extended Gravity Model (arranged in descending order) for First 28 Trading Partners in 2002

Reporter	Partner	Import Liberalization(% change of Fitted Imports over MFN Fitted Imports	Rank	Import Liberalization(change of Fitted Imports over MFN Fitted Imports (in US$)	Reporter(Imp)	Partner(Exp.)
Turkmenistan	Japan	5.381359	1	3779667.427	Malaysia	Singapore
Turkmenistan	Italy	5.284817	2	625550.904	Philippines	Japan
Turkmenistan	India	5.253128	3	393708.6748	Philippines	United States
Turkmenistan	Spain	5.123303	4	357773.0772	Malaysia	Indonesia
Turkmenistan	Netherlands	5.077712	5	254863.3359	Indonesia	Malaysia
Papua New Guinea	Italy	5.007951	6	246632.3512	Indonesia	Japan
Turkmenistan	Poland	4.990487	7	211617.0799	Malaysia	Thailand
Turkmenistan	Austria	4.984223	8	107902.5676	Indonesia	United States
Turkmenistan	Belgium	4.976413	9	86131.61199	Indonesia	Thailand
Turkmenistan	Pakistan	4.973393	10	74831.9463	Papua New Guinea	United States
Philippines	Bangladesh	4.902925	11	61029.58717	Turkmenistan	Japan
Papua New Guinea	Spain	4.888897	12	59018.18552	Malaysia	Japan
Papua New Guinea	Netherlands	4.826077	13	47574.72074	Indonesia	United Kingdom
Turkmenistan	Czech Republic	4.793606	14	45763.1733	Malaysia	Philippines
Papua New Guinea	United Kingdom	4.792622	15	44139.12502	Philippines	China
Papua New Guinea	Sweden	4.736743	16	38696.8768	Turkmenistan	United States
Papua New Guinea	Belgium	4.72501	17	38248.33806	Malaysia	United States
Malaysia	Kazakhstan	4.717748	18	38128.24828	Turkmenistan	Italy
Malaysia	Cambodia	4.717092	19	36164.20378	Turkmenistan	India
Turkmenistan	Azerbaijan	4.647613	20	35445.26357	Philippines	United Kingdom
Papua New	Finland	4.637389	21	30392.30851	Philippines	Germany

Guinea						
Malaysia	Slovak Republic	4.599494	22	29639.84953	Turkmenistan	France
Malaysia	Nepal	4.553281	23	23898.96375	Papua New Guinea	Japan
Turkmenistan	Georgia	4.450982	24	20191.2676	Malaysia	Bangladesh
Turkmenistan	Armenia	4.388322	25	18437.83705	Philippines	Bangladesh
Turkmenistan	France	4.341131	26	17894.25794	Papua New Guinea	United Kingdom
Papua New Guinea	Pakistan	4.330343	27	17703.40952	Indonesia	Germany
Turkmenistan	Kyrgyz Republic	4.282057	28	15015.74568	Turkmenistan	Germany
		Average for all339 Regional Trading Partners 0.015359		Average for all339 Regional Trading Partners US$ 2121.743876		

Source: authors calculation culled from the appendix table below(available with author on demand). The appendix table shows lists of countries which show negative surges by lowering tariffs on CSG products.

Conclusions: The simple and extended gravity model are used to work out the import surge for bilateral trading partners of ESCAP. It is notable to find that countries imports do not surge automatically with the fall in import duty rates. Many other parameters of the economy tend to have impact on imports. This also shows that the elasticity of imports (value) with respect to its price(tariff duties) is inelastic. This can be one, among many, arguments for opening up the economy to CSG imports from the outside world to have cleaner and low carbon emission technologies. On the other hand many countries would also see this as an opportunity for not lowering their tariff rates under preferential trading arrangements as the move would reduce tariff revenue (inelasticity of tariffs on imports of CSG). It will be interesting to find that for such countries(which have negative surges) what would happen if they raise their tariff rates(inelastic) from applied to MFN or to border tariff rates as defined by the WTO(inelastic). Clearly, the tariff revenue will increase and if imports value do increase because of inelastic demand) then these countries may gain by not only having clean coal technologies but also by increasing the government revenue. In the latter sense multilateral liberalization would make sense for countries who show lower elasticity of imports of CSG with respect to tariffs imposed by such countries.

It may make sense to reduce tariff rates of CSG for trade, developmental, environmental gains and also simultaneously reduces production and consumption distortions in the economy. It is quiet evident from the regression results above that tariffs do not tend to significantly impact the imports(and revenue). However, tariff reduction on CSG imports (components) may lead countries to achieve positive effective protection figure for some nations depending on the countries need at that moment. Trade in CSG is basically component trade (inputs) to cleaner technologies. Also, those developing 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). Also, tariff reduction may make the goods cheaper in their home country. On the other hand some of the developing countries may need a certain level of tariff protection to build up local capacities and probably attract some FDI as well.

The simple gravity model could explain around 58% of the variability in the imports while the extended model could explain around 65% of the variability in the dependent variable. Economics size, distance, resource endowments and tariffs in that order have significant relative impact on imports using the simple gravity model. Higher incomes are signs of maturity of society and governments and this maturity go together with governments designing legislations for climate mitigation responses. Higher incomes also mean larger demand for climate smart components for cleaner technologies. 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 (Veena Jha, 2009).

The extended model shows the weak impact of regional trade agreement, policy and infrastructure variable on imports of CSG. Maybe one needs to include variables like carbon taxation and domestic regulations for explaining the trade of climate smart goods. Also, subsidies, environmental projects, degree of industrialization, privatization and deregulation of markets, domestic standards and certification requirements and domestic policies relating to IPR are possibly other determinants of trade of CSG. The gravity results of 2002 are similar to the 2008 results except that common official language spoken in trading countries is significantly impacting imports of CSG in 2002. This variable may be a reflection of information needs of such trade. All countries should be aware of the domestic regulations, certifications and standards for trade of CSG. As in case of 2008, economic size and distance matters for trade in 2002. Tariffs in 2002 have insignificant impact although they come with right signs. Distance and partner GDP have elasticity greater than one (elastic). Trade of CSG in 2002 show lower import commitment (under preferential trading arrangements, PTA) on the part of the economy using the gravity model in 2002. The maximum percentage change is nearly 5.4% as opposed to more than 45 % in 2008 achieved by top liberalizers under PTA (trading nations) in 2008. It confirms of the greater commitment in terms of import liberalization measures under preferential schemes for CSG by member states in year 2008 as opposed to 2002.

Limitations of the Study

Climate smart goods defined even at the HS6 digit level still are quiet broad categories. There may be products within the group which may be of non environmental use. Tariff liberalization may tend to liberalize goods trade for all subcategories within the broad group which may not be desired by many WTO member states. It is sometimes suggested that tariff liberalization could focus on products with predominantly single environmental use with a view to minimizing problems related to multiple use products. Countries that do not have capacities to produce the entire range of climate smart goods may focus on liberalizing imports of finished products (such as solar PV modules and wind turbines) with clear environmental benefits. Also, some CSG products like pipes may be of dual use. It could be used to carry oil or it can be used

for environmental purpose or services. The present analysis does not take into account input processes of such clean technologies and components as well. For example aluminum pipes can be based on coal generated electricity or the coal based process entirely.

We have used simple and extended Gravity Model in our study. In recent times however, one can distinguish three more types of studies related to Gravity Analysis made distinguishable by considering different independent and dependent variables. The list is given below

1) Baier and Bergstrand(2001) in their gravity formulation explain growth of trade to the following independent factors. These are changes in transport costs, changes in sum of GDPs, changes in relative country size(same as size dispersion index) and changes in prices of each country measured with GDP deflators.
2) Anderson and Van Wincoop (2003) on the left hand side consider bilateral trade to the product of GDPs in the gravity equation. This they relate to distance between regions, followed by other border effects and then the multilateral resistance term (derived from implicit prices indices prevailing in the trading nation). The study define price index as index of multilateral resistance because they depend on the transport costs and income shares. These indexes are unobserved, but Anderson and Wincoop argue that they can be solved by using price index equation in conjunction with the transport cost equation. This approach requires custom programming to perform the constrained minimization exercise (and obtain standard errors). Alternatively exporter and importer dummy can be used as proxies for multilateral resistance terms. It seems that in the model prices and other border effects and distance may be correlated with each other.
3) Use panel data to estimate the gravity equation and interpret the fixed effects as the unobserved price indexes. These multilateral indexes could instead be measured as coefficients of source and destination region fixed effects as well.

We have not considered the above formulations. We can consider both tariffs and transport costs(IMF IFS data base) as border effects as well. However, we do get robust results from our analysis.

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