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Regional Cooperation towards Green Asia: Trade and Investment

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Abstract

It is logical to argue that growth led by low-carbon goods and services (LCGS) is an imperative for the countries of Asia and the Pacific, and particularly for emerging Asian economies, which are heavily dependent on imported energy and resources. Acknowledging this fact, individual governments in Asia have recently been taking effective actions in the form of voluntary targets and policy commitments to improve the production and use of LCGS. However, the observed effects of these commitments are often challenged by many constraints, such as technological barriers, financial deficiencies, and lack of human capital, some of which are very specific to developing Asia. Different sector policies—such as in trade and environment—and investment policies that aim to facilitate private enterprises, households, and government agencies to contribute to green growth through the use of LCGS are being implemented at the national level. However, fears of competitive disadvantage mean that these policies need to be driven by global and regional frameworks that encompass all countries and sectors. In this context, the objectives of this study are to (i) measure the potential of major emerging Asian economies for exports in LCGS under the "grand coalition," partial coalition, and stand-alone scenarios; (ii) measure the impact of existing "behind the border" constraints on potential exports in emerging Asian economies; (iii) identify the potential, options, and challenges with respect to a grand coalition scenario; and (iv) find ways to improve the contribution of public–private partnerships to LCGS.

JEL Classification: Q56, Q58, R11.

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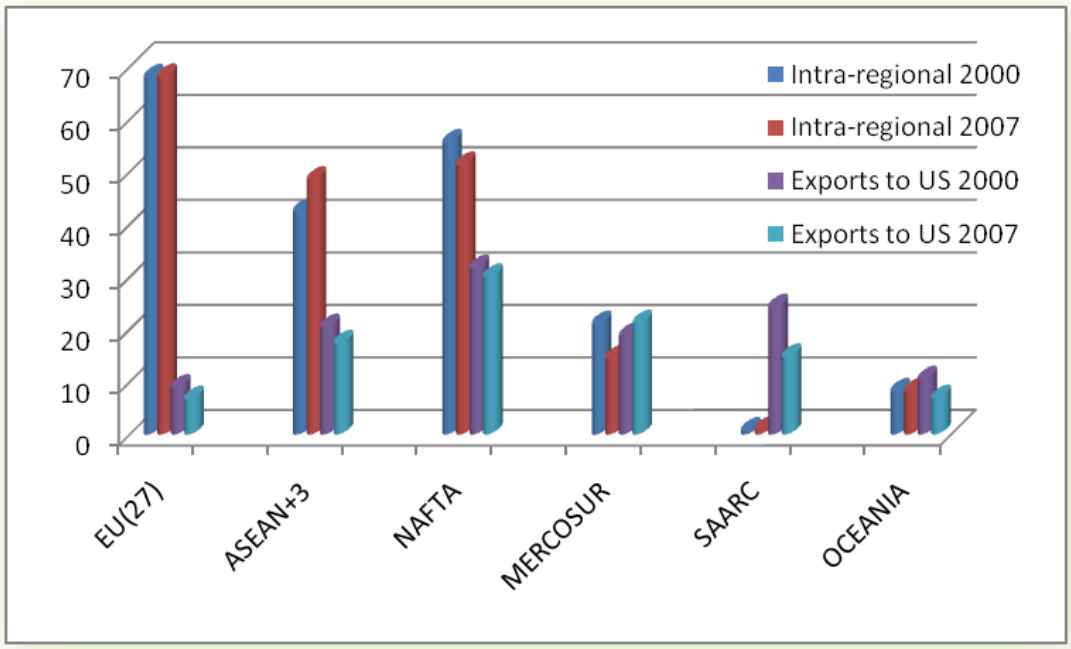
1. INTRODUCTION

Given the trend of increasing trade and investment around the world, countries have increased their integration not only globally but also regionally. Despite having bilateral and multilateral trade agreements, most countries are also linked directly or indirectly as members of regional trade blocs (Figure 1). It is interesting to note from the literature that production networks have spread more extensively in East Asia than in other regions (Gill and Homi 2007). These production networks in East Asia have been dominated particularly by vertical intra-industry trade in which several countries participate in various stages of production chains (Wakasugi 2007). Thus, trade—particularly intra-Asian trade—has been a major contributing factor to East Asian integration, which has also been boosted through foreign direct investment (FDI) (Kuroda, Kawai, and Nangia 2007). Trade and FDI can easily be identified as East Asia's twin growth engines that have contributed to a massive reduction in poverty in the region. It should also be noted that, as regional income increases through trade and investment growth, the demand for clean environmental goods and services (EGS) or low-carbon goods and services (LCGS) will increase. In this context, the interesting question is whether Asian countries can significantly contribute to closing the gap between the demand for and supply of LCGS in Asia. As the production of some environmental goods, such as jute and other textile bast fibers, is labor intensive, drawing on the Heckscher-Ohlin theory, it is customary to argue that developing countries with relatively abundant low-skilled labor should concentrate on the production and export of labor-intensive goods. However, empirical studies have asserted that mere relative abundance of low-skilled labor will not guarantee sustained growth of labor-intensive exports if the countries do not have good logistics, including transportation infrastructure, and telecommunication infrastructure. Thus, labor availability should be complemented with improved physical and institutional infrastructure. In this context, the need for regional cooperation in building and sustaining physical and institutional infrastructure assumes added importance.

Figure 1: Regional Trade Characteristics

(%)



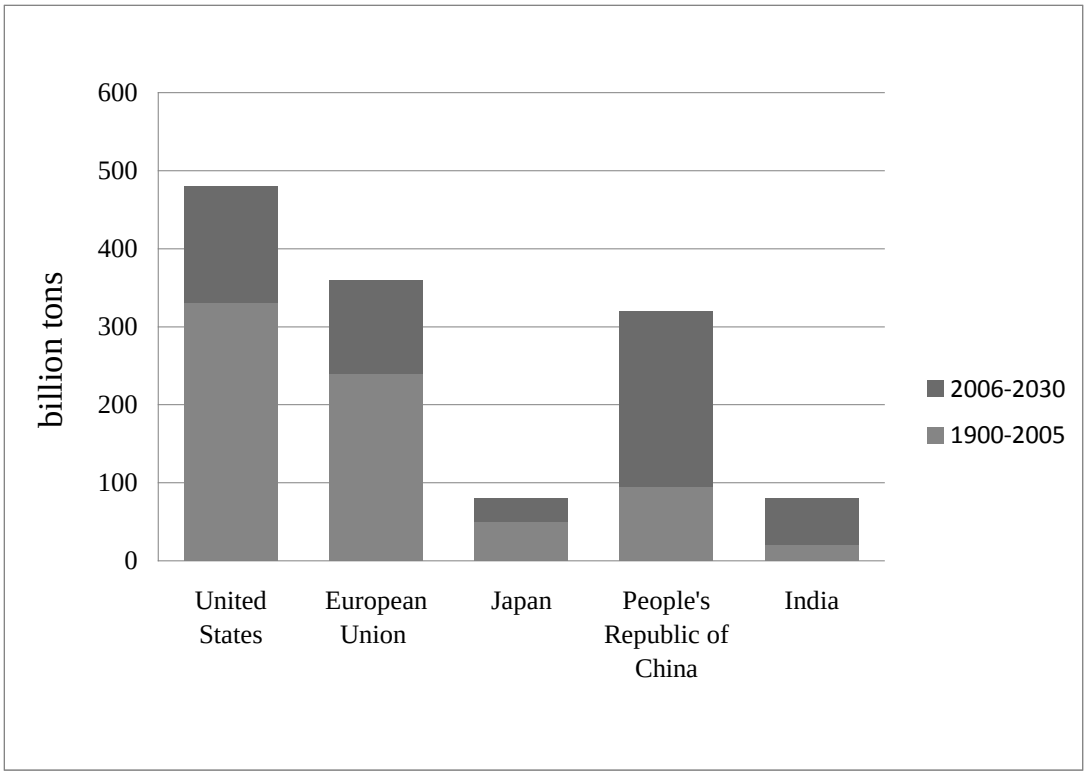
ASEAN+3 = Association of South East Asian Nations + Japan, the People's Republic of China, and the Republic of Korea; EU = European Union; MERCOSUR = Common Southern Market; NAFTA = North America Free Trade Area; SAARC = South Asian Association of Regional Cooperation

Source: Compiled from COMTRADE Data base.

Further, the Garnaut Climate Change Review (Garnaut 2011) among other studies argues that the sustained high growth of developing countries such as the People's Republic of China (PRC) and India, along with developed economies, has been exerting pressure on the demand for energy, which has a bearing on carbon dioxide (CO_2) emissions. Based on the calculations of the International Energy Agency (2007), it may be seen from Figure 2 that the cumulative energy-related CO_2 emission from the PRC from 1990 to 2030 would soon catch up with that of the United States (US) and European Union (EU); there would also be a significant accumulation from India from 2006 to 2030. In the literature there are various scenarios of carbon emissions using different assumptions worked out by individual researchers and institutions involved in climate change research; all scenarios uniformly highlight the danger of increasing greenhouse gas emissions and their impacts on the livelihoods of billions of people on earth. It becomes, therefore, imperative to intensify the use of low-carbon goods and services (LCGS) or environmental goods and services (EGS) in all economic activities.[1]

[1] Low-carbon goods and services (LCGS) and environmental goods and services (EGS) are synonymously used in this study.

Figure 2: Energy-Related Carbon Dioxide Emissions



Source: Adopted from the International Energy Agency (2007)

Also, with increasing awareness of climate change, environmental protection activities such as carbon sequestration and the Clean Development Mechanism create demand for EGS. Some Asian countries—such as the PRC, India, Japan, the Republic of Korea, and Singapore—have good potential to export such professional services, which are in great demand in Asia. For example, recently the United Kingdom Joint Environmental Markets Unit has argued that there will be increasing demand from countries such as Indonesia, Malaysia, Philippines, and Thailand for services concerning solid-waste handling and disposal, and also water filtering and purifying equipment. It is reported that about 50% of total EGS to be used by 2030 are yet to be created, which emphasizes the urgent need for funding and research and development (R&D) to develop and transfer the technologies to countries that need them. This situation provides an opportunity to strengthen regional research capabilities in the area of LCGS through regional cooperation. The huge foreign currency reserve that exists in Asia could be leveraged for green research and investment through regional cooperation (Kalirajan, Anbumozhi, and Singh 2010).

Unfortunately, trade and investment in LCGS is very low compared to trade and investment in pollution-intensive products (Mikic 2010). Though the effective tariffs on LCGS are low, the nontariff barriers, or "behind the border" constraints, are very high (Table 1). How can such trade barriers to LCGS be eliminated?

Table 1: Trade in Low-Carbon Goods and Services: Effective Tariffs in Emerging Asian Economies

(%)

Country	All Industrial Goods Average	Solar PV	Wind Power	Clean Coal	Energy Efficient Lighting
PRC	8.57	4.16	7.65	8.03	8.03
India	9.74	5.41	7.28	7.25	9.39
Indonesia	5.84	5.93	4.81	0.00	7.63
Malaysia	5.91	7.51	4.39	0.00	25.11
Philippines	5.00	4.97	0.84	2.07	9.88
Singapore	0.00	0.00	0.00	0.00	0.00
Thailand	10.97	6.82	6.59	0.89	17.00
Viet Nam	11.68	14.91	11.8	0.00	32.22

PRC = People's Republic of China, PV = photovoltaic.

Source: Adapted from Mikic (2010).

The Garnaut review highlights the importance of regional cooperation in boosting trade in LCGS by arguing

> If binding global agreement remains out of reach for some time and the rules for emissions trading remain uncertain under the UN Framework Convention [United Nations Framework Convention on Climate Change], is it possible that bilateral and regional arrangements could fill a substantial part of the gap left by the absence of a basis for global trade in entitlements?
>
> The short answer is yes—much more clearly and emphatically than regional preferential trade agreements can fill the gap left by the absence of multilateral free trade. If carefully structured, they can become building blocks for a genuinely open global trading system.
>
> Careful structure requires application of internationally acceptable rules for measuring, verifying and reporting emissions. It requires internationally the acceptance of targets for emissions within the member countries of the bilateral or regional arrangements that are built on principles that could be the basis of a comprehensive global agreement. It requires openness to economically and environmentally sound trade by member countries with external countries. (Garnaut 2011: 31)

An exploratory study in this area of how regional cooperation can be achieved in trade and investment in LCGS will be useful for policy makers in Asia and elsewhere.

In this context, the objectives of this study are to examine the following:

- What will be the magnitude of technology and investment flows in LCGS into Asia under a grand regional coalition scenario, limited cooperation scenario, and stand-alone scenario? This is equivalent to examining what the magnitude of export flows in LCGS into Asia will be under each scenario, as production and thereby exports of LCGS are mainly determined by technological innovation and investment.[2]
- What are the impacts of behind the border constraints on potential export flows in LCGS in Asia?
- What are the potentials, options, and challenges associated with a grand coalition scenario?

[2] Using firm data from East Asia, Wignaraja (2008) highlights the importance of FDI and technological innovation in export growth.

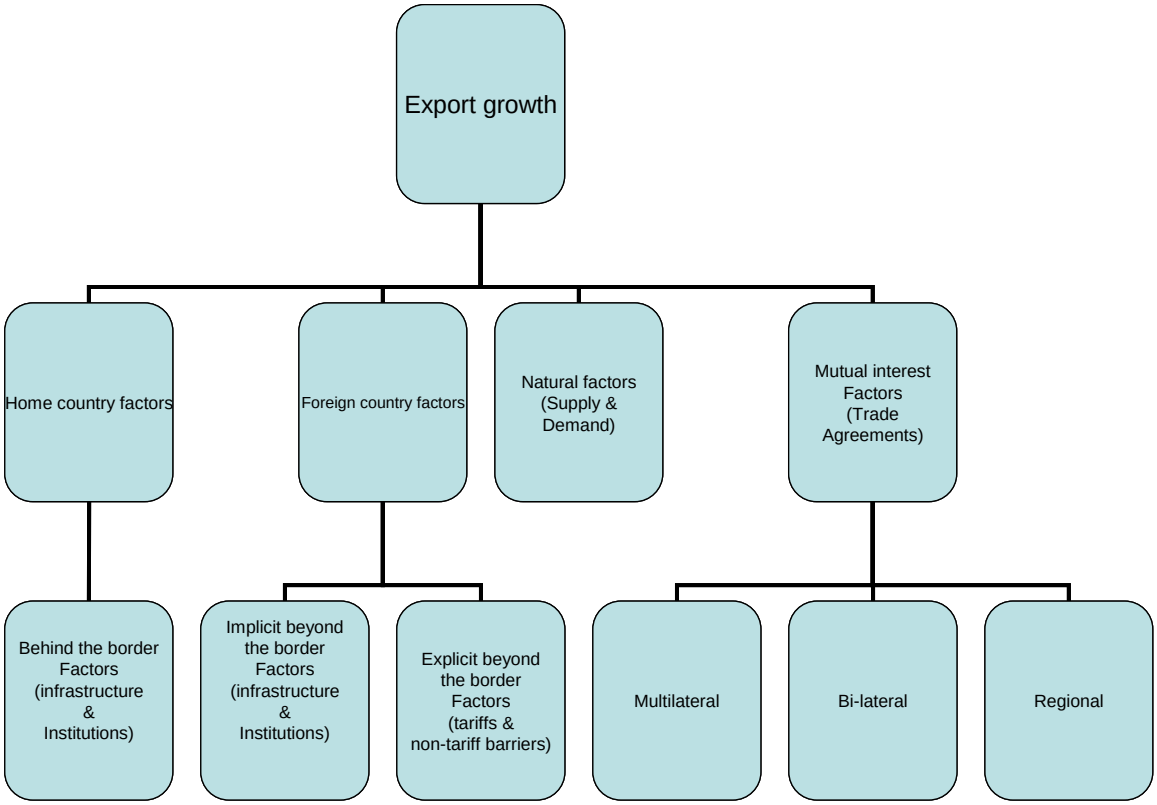
- What pathways are feasible so as to eliminate impediments to successful cooperation among government and private enterprises?

2. METHODOLOGY

The current patterns of trade and investment in LCGS in key emerging economies of Asia, which are identified based on their carbon emission capabilities, are examined. These key emerging economies of Asia are the PRC, India, Indonesia, Malaysia, Philippines, Singapore, Thailand, and Viet Nam. Export flows (EX) in LCGS between two countries (i and j) are determined by the following factors:[3] First, the demand for and supply of goods (which are usually proxied by gross domestic product [GDP]), the population (POP) of the exporting and importing countries, and the geographical distance (D) between countries would influence exports. These factors may be called "natural determinants" of export flows between countries. Second, the relative prices of the imported goods, which are mainly influenced by the tariff (T) structure of the importing country, would also influence export flows, and these may be called changes in "explicit beyond the border determinants." Third, different kinds of institutional and infrastructure rigidities that exist in the exporting country may influence exports negatively, and these factors may be referred to as "behind the border determinants" in the home country, and which are under the control of the exporting country. Fourth, different kinds of institutional and infrastructure rigidities that exist in the importing country would also influence export flows negatively, and these factors may be called "implicit beyond the border determinants," which are beyond the control of the exporting country. Fifth, bilateral and multilateral trade negotiations in the form of improvement in trade promotion and facilitation policies of both home and partner countries would influence export flows positively. A dummy variable (D_1) can be used to represent whether there are such trade agreements between countries, and the influence of these factors on exports may be called "mutually induced determinants (regional cooperation)."

[3] The methodological framework is given in Figure 3.

Figure 3: Methodological Framework



Source: Author..

Another variable—the ratio of FDI from Asia to non-Asia FDI to the home country lagged one period—is used as a proxy for regional integration. Here, it becomes necessary to elaborate briefly on the type of FDI used in this study. “The limited understanding of the role of FDI in promoting green growth objectives is largely due to the lack of an internationally agreed definition of and relevant data on green FDI" (Golub, Kaufmann, and Yeres 2011: 7). Further, there is no uniform data available on FDI in the World Trade Organization (WTO) 153 list of LCGS for the selected emerging economies in Asia over the period of analysis. Most importantly, particularly for FDI, green economic activity is often not associated so much with a particular good or service, but rather with a process or technology, which is very difficult to apprehend statistically. There is an important greening role for FDI in sectors and industries that are not environmental by nature but where the potential for pollution abatement is important. This dimension would not be captured if the definition was limited to investment in EGS (Golub, Kaufmann, and Yeres 2011). Therefore, total FDI is used in the following model explaining the export flow of LCGS.

Thus, the impact of the grand regional coalition scenario is captured by the coefficients of the two variables D1 and FDI. Secondly, the impact of the limited coalition scenario is captured by including only one of the variables in the following model equation 1. Finally, the impact of the stand-alone scenario is captured by deleting both variables D1 and FDI from equation 1. Estimating the contribution of each factor to the overall variations in export flows over time is important for evaluating the effectiveness of trade policy towards promoting exports in the home country.

Loulou, Labriet, and Kanudia (2009) analyzed the possibility of achieving five climate targets in this century under two cooperation regimes of full cooperation and sequential cooperation among countries. They concluded that using the stochastic programming approach to interpret the multiple climate targets would produce results without defects that would be found in the traditional deterministic scenario analysis. Nevertheless, as admitted by them, one of the major problems in their stochastic programming approach concerns not considering the impact of non-modeled factors, which would constrain the adoption of some technologies. Contrary to their study, the impact of non-modeled factors, such as behind the border constraints on which full information is not available, is included in the stochastic model under an error component approach in this study. The approach is explained in the following paragraphs.

Drawing on Kalirajan (2007), a stochastic frontier gravity equation is modeled to explain the variations in total exports of the focus country by incorporating directly the influence of natural determinants, behind the border determinants, mutually induced determinants, and explicit beyond the border determinants for a given level of the existing implicit beyond the border determinants.[4]

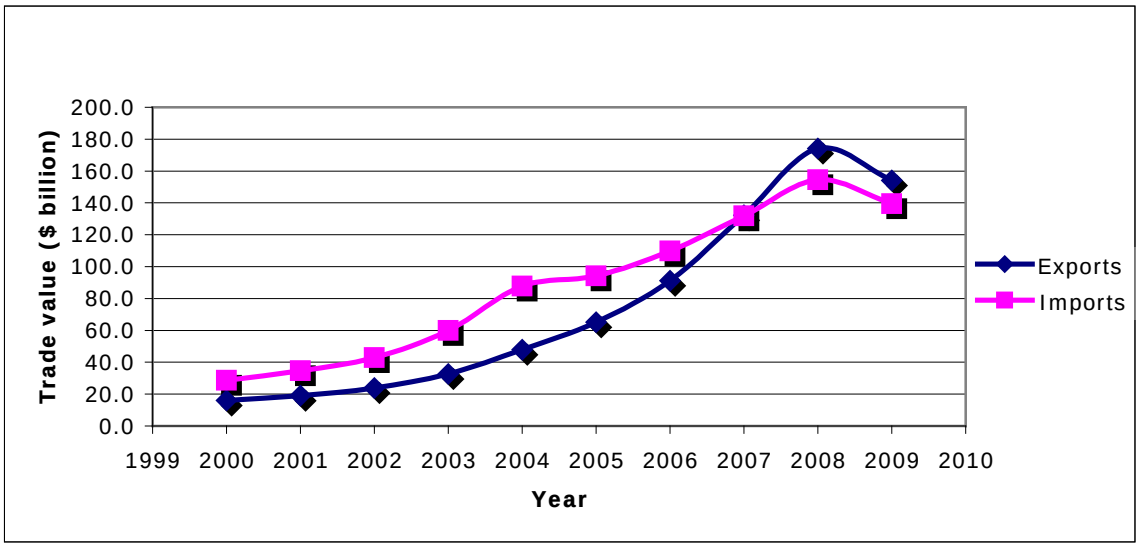
$$\ln EX_{i,j,t} = B_{1,t} + B_{2,t} \ln(PCGDP_{i,t}) + B_{3,t} \ln(PCGDP_{j,t}) + B_{4,t} \ln(DIST_{i,j}) + B_{5,t} \ln (T_{j,i,t}) + B_{6,t} \ln(FDIj_{,t-1}) + B_{7,t} D_1 + B_{8,t} D_2 - u_{ij,t} + v_{ij,t} \quad (1)$$

PCGDP refers to per capita GDP. DIST refers to the geographical distance between two major ports in exporting and importing countries. T is the average tariff rate in the importing country. FDI is the ratio of Asian FDI to total FDI in the exporting country. D_1 takes the value 1, when there are trade agreements between home and partner country; otherwise it takes the value of zero. D_2 is year dummy and is equal to 1 when the relevant period is considered; otherwise is zero. The period considered for the analysis is 2000–2009. $u_{ij,t}$ measures the negative influence of the combined behind the border determinants that exist in the exporting country on which complete information is not known. $v_{ij,t}$ refers to the normal statistical error term. It is assumed that $u_{ij,t}$ takes the value zero if there is no significant negative influence of behind the border determinants, and takes a positive value and thereby reduces the level of exports when there exists significant negative influence of behind the border determinants in the exporting country. The parameter gamma (γ) is the ratio of country-specific variation (σ_u^2) to total variation ($\frac{\sigma_u^2}{\sigma_u^2 + \sigma_v^2}$), which indicates whether behind the border constraints are one of the determinants of total exports of LCGS. When γ is significant, it implies that behind the border constraints are important determinants of LCGS exports.

Thus, drawing on the framework used in the stochastic frontier production function models (Kalirajan 2007), $u_{ij,t}$ may be assumed to follow a truncated normal distribution N (μ, σ_u^2), truncated at zero and $v_{ij,t}$ as N($0, \sigma_v^2$). The above model (1) is estimated through the maximum likelihood estimation method applied in the software FRONTIER 4.1 (Coelli 1996).

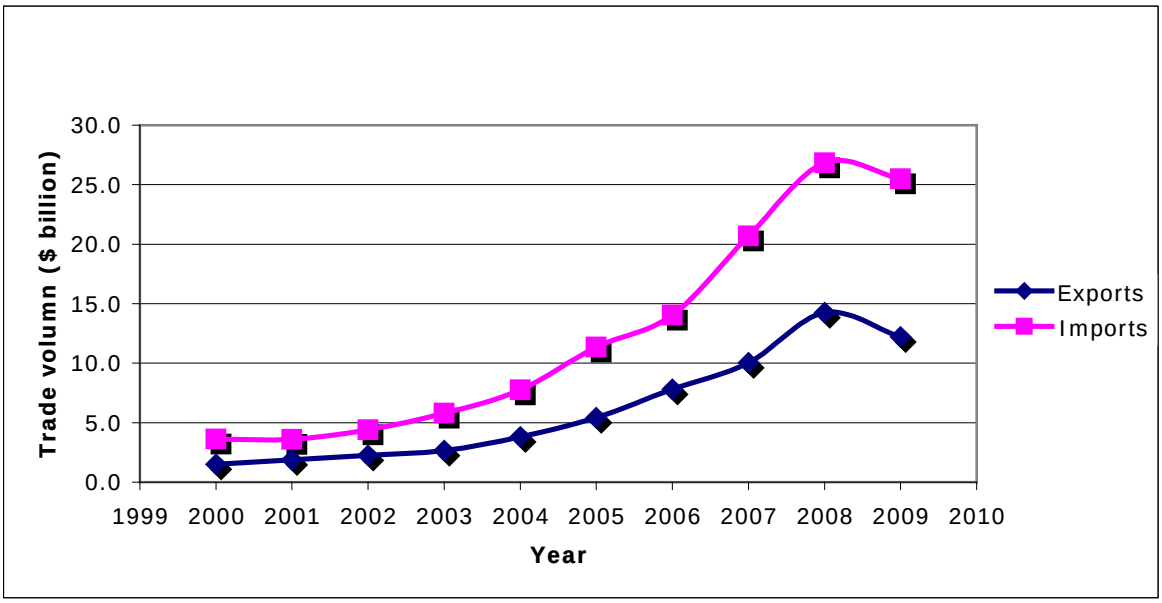
[4] Figures 5–12 show the total trade in LCGS in the selected Asian emerging economies.

Figure 5: Total Trade in Low-Carbon Goods and Services: the People's Republic of China, 2000–2009



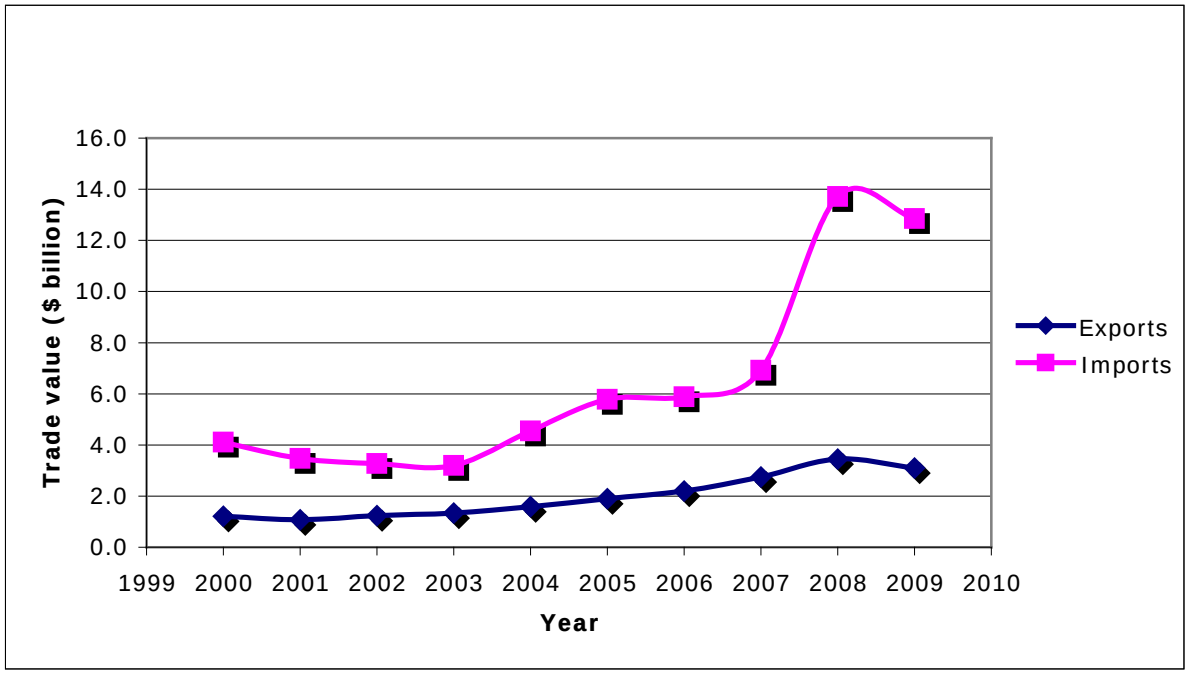
Source: Compiled from COMTRADE Database.

Figure 6: Total Trade in Low-Carbon Goods and Services: India, 2000–2009



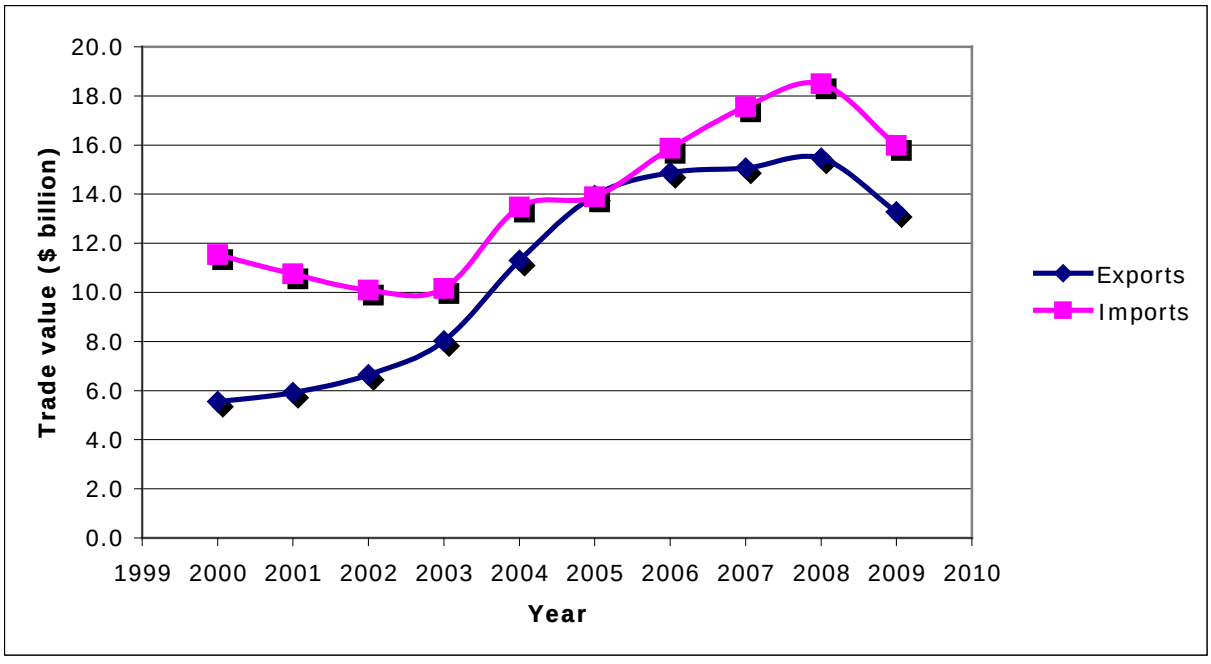
Source: Compiled from COMTRADE Database.

Figure 7: Total Trade in Low-Carbon Goods and Services: Indonesia, 2000–2009



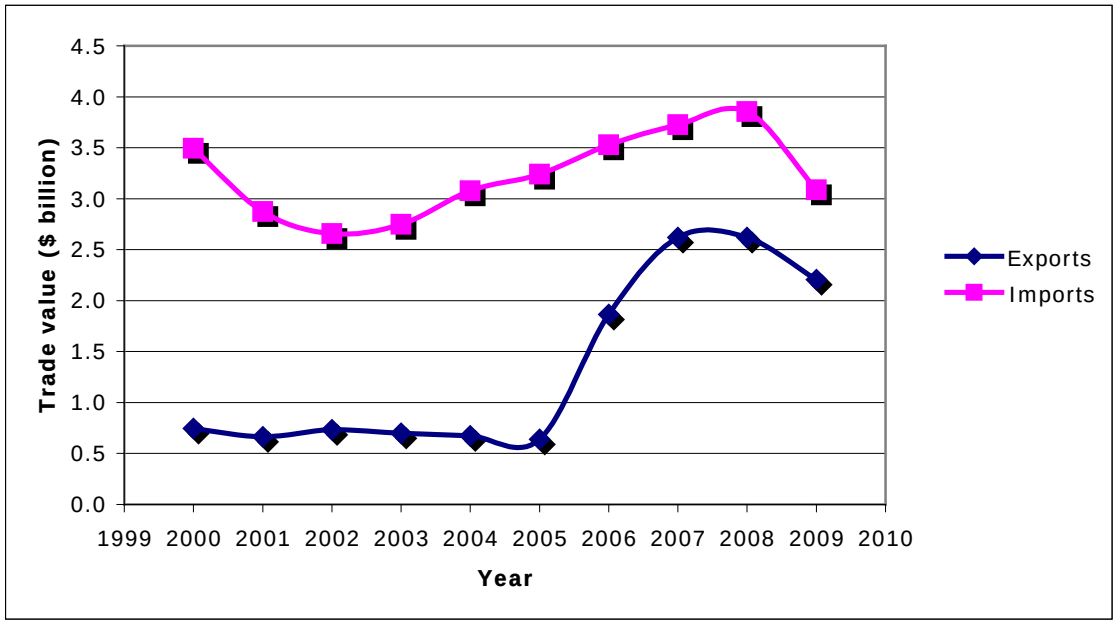
Source: Compiled from COMTRADE Database.

Figure 8: Total Trade in Low-Carbon Goods and Services: Malaysia, 2000–2009



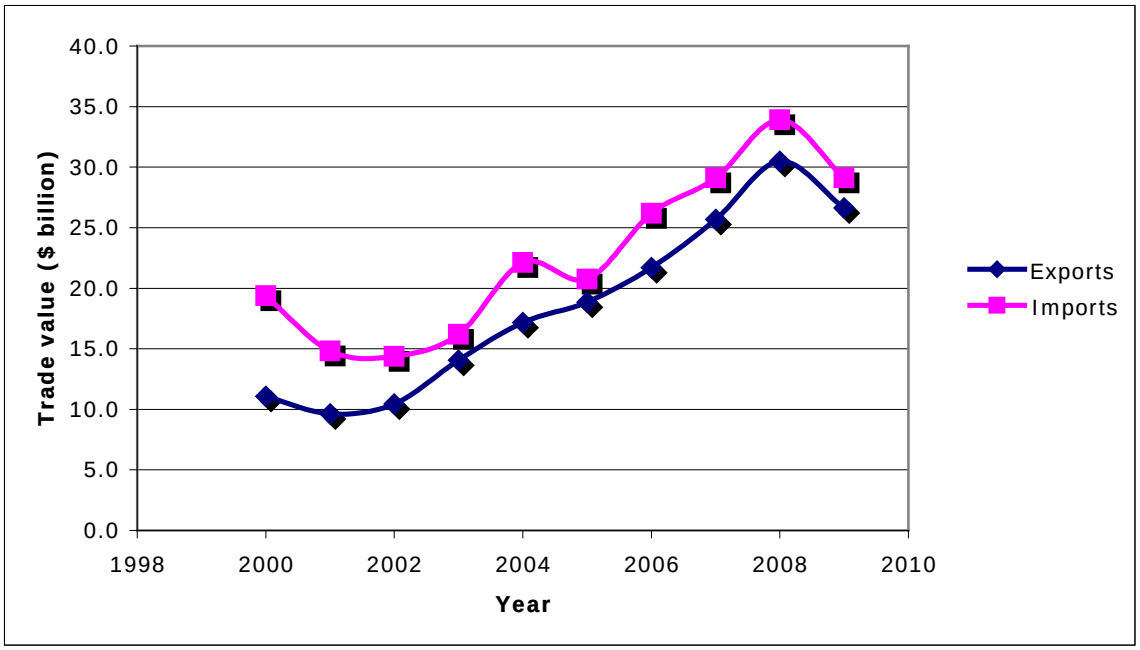
Source: Compiled from COMTRADE Database.

Figure 9: Total Trade in Low-Carbon Goods and Services: Philippines, 2000–2009



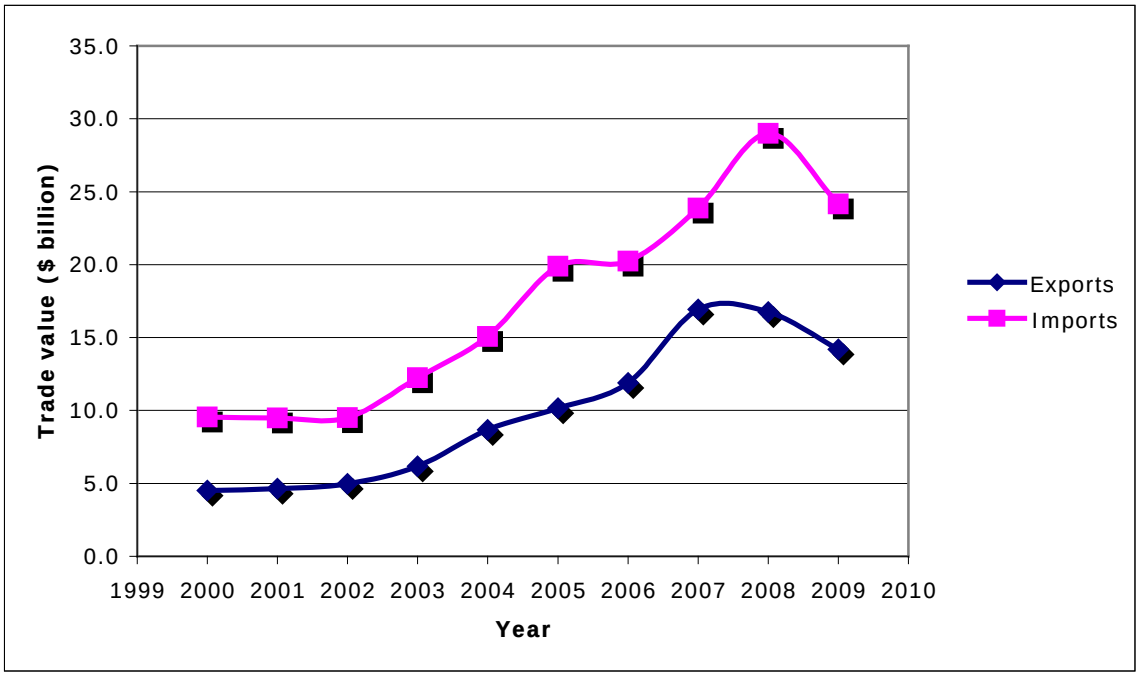
Source: Compiled from COMTRADE Database.

Figure 10: Total Trade in Low-Carbon Goods and Services: Singapore, 2000–2009



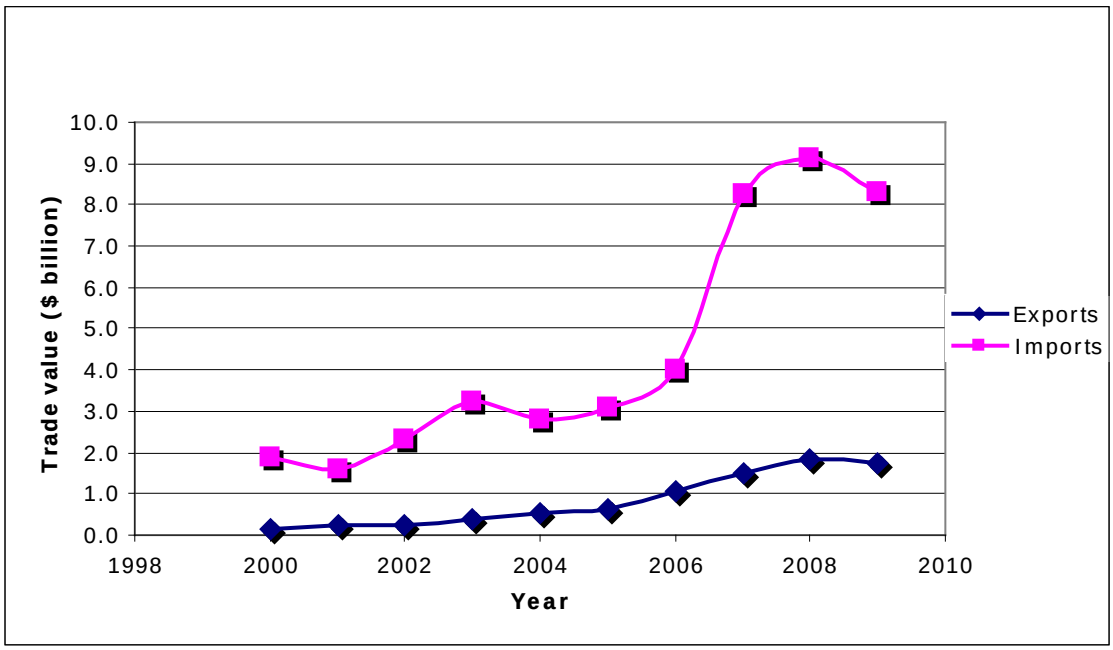
Source: Compiled from COMTRADE Database.

Figure 11: Total Trade in Low-Carbon Goods and Services: Thailand, 2000–2009



Source: Compiled from COMTRADE Database.

Figure 12: Total Trade in Low-Carbon Goods and Services: Viet Nam, 2000–2009



Source: Compiled from COMTRADE Database.

To answer the first objective question of what will be the magnitude of export flow in LCGS of the selected emerging economies in Asia to their partner countries under a grand regional coalition scenario, limited cooperation scenario, and stand-alone scenario, the following simulations can be made using the estimated results from equation 1:

1. The potential exports of home country to the relevant partner countries when there are no significant behind the border constraints and there is grand regional cooperation, which is proxied by coefficients B_6 (associated with variable FDI) and B_7 (associated with variable D_1), which are calculated from the estimates of equation 1 with the assumption that $u_{ij,t} = 0$.
2. The potential exports of the home country to the relevant partner countries when there are no significant behind the border constraints and there is limited regional cooperation are calculated from the estimates of equation 1 with the assumption that $u_{ij,t} = 0$ and either $B_6 = 0$ or $B_7 = 0$.
3. The potential exports of the home country to the relevant partner countries when there are no significant behind the border constraints and there is a stand-alone attitude in the home country are calculated from the estimates of equation 1 with the assumption that $u_{ij,t} = 0$, $B_6 = 0$, and $B_7 = 0$.

To answer the second objective question of what are the impacts of behind the border constraints on potential export flows in LCGS in Asia, the ratio of actual export flows to potential exports flows under the stand-alone scenario (EX^a/EX^p) is calculated across the selected countries, which provides a measure of how much potential is achieved by the relevant country. A measure of $[1 - (EX^a/EX^p)] \times 100$ shows the relevant country's inefficiency due to its behind the border constraints in achieving its potential exports to its trading partners. Drawing on the evidence-based approach, the other objective questions of options and challenges associated with grand coalition are discussed along with the identification of pathways to eliminate constraints on effective collaboration between governments and the private sector.

3. DATA

The main data sources for this study are the United Nations Commodity Trade (COMTRADE) database, World Integrated Trade Solutions, and United Nations Conference on Trade and Development (UNCTAD) World Investment Reports covering 2000–2009. The Asian emerging economies covered in this study are the PRC, India, Indonesia, Malaysia, Philippines, Singapore, Thailand, and Viet Nam. LCGS covered in this study are the WTO 153 list grouped into 12 categories for analytical purposes: air pollution control, clean up or remediation of soil and waste, cleaner or more resource-efficient technology, environmental monitoring and analysis, environmentally preferable products, heat and energy management, management of solid and hazardous waste, natural resources protection, natural risk management, noise and vibration abatement, renewable energy plant, and waste water management and potable water.

3.1 Current Patterns of Trade and Investment in Low-Carbon Goods and Services

Tables 2.1–2.12 show the current patterns of exports and imports of LCGS by major Asian emerging economies. It is interesting to note that the PRC dominates in the LCGS trade in all categories except management of solid and hazardous waste, in which India dominates during 2000–2009. Among the Association of Southeast Asian Nations (ASEAN) emerging economies,

Singapore dominates and is followed by Thailand. Given the difficulties in identifying FDI that is directly connected with the production of the WTO 153 list of LCGS, estimates from different sources are discussed to examine the overall pattern of investment in LCGS. Using FDI data in greenfield projects and cross-border mergers and acquisitions data, UNCTAD has recently estimated that three LCGS—renewables, recycling, and low-carbon technology manufacturing—have attracted FDI flows of $90 billion in 2009 (UNCTAD 2010). The pattern of FDI in LCGS is diversified geographically and in terms of types of LCGS. For example, FDI in alternative or renewable power generation is concentrated in developed economies, though about 25% of investments is in developing countries including Asian emerging economies—the PRC, India, Indonesia, Philippines, and Viet Nam. In terms of venture investments in clean technology, North America, Europe, the PRC, and India attracted about $8.4 billion from venture capital firms NTEC, Cleantech Ventures, and Foundation Capital. The pattern of clean technology venture investments clearly shows an increasing trend, from $0.5 billion in 2001 to $2.1 billion in 2005 and $8.4 billion in 2008. The PRC and India seem to be major growth markets for clean technology investments, particularly in renewable energy technologies. In 2008 solar accounted for about 40% of total clean technology investment and investment in biofuels accounted for 11%.

Table 2.1: World Trade Organization 153 List of Environmental Goods and Services, Air Pollution Control, 2003–2009

(%)

	2003		2005		2007		2009	
Country	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
PRC	56.8	35.4	56.6	45.3	51.1	56.0	53.4	60.5
India	5.3	4.4	7.0	4.7	12.2	6.8	9.5	6.6
Indonesia	4.5	4.0	4.1	3.7	4.2	2.8	7.6	2.2
Malaysia	7.9	13.0	8.2	12.8	7.5	8.5	5.3	6.4
Philippines	2.1	0.8	1.1	0.4	1.0	0.2	0.9	0.2
Singapore	9.4	23.8	7.7	16.5	8.9	13.0	10.8	12.1
Thailand	12.3	17.8	13.7	16.0	11.3	12.3	9.2	11.2
Viet Nam	1.7	0.8	1.5	0.5	3.9	0.4	3.3	0.9
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

PRC = People's Republic of China

Source: Compiled from COMTRADE Database.

Table 2.2: World Trade Organization 153 List of Environmental Goods and Services, Clean Up or Remediation of Soil and Waste, 2003–2009

(%)

	2003		2005		2007		2009	
Country	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
PRC	56.7	26.9	59.1	36.6	58.2	45.4	54.8	57.9
India	2.9	6.6	4.6	8.3	6.3	6.7	11.0	5.2
Indonesia	1.6	3.5	2.0	2.7	1.9	2.2	3.6	1.8
Malaysia	10.0	15.2	8.9	13.4	7.2	10.5	6.5	8.6
Philippines	5.0	3.9	4.5	1.9	3.8	2.8	2.7	1.9
Singapore	13.3	39.7	12.1	32.3	14.0	26.8	12.5	20.8
Thailand	8.3	3.7	6.7	4.4	5.2	4.3	5.6	3.7
Viet Nam	2.2	0.4	2.1	0.3	3.3	1.2	3.2	0.3
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

PRC = People's Republic of China

Source: Compiled from COMTRADE Database.

Table 2.3: World Trade Organization 153 List of Environmental Goods and Services, Cleaner or More Resource Efficient Technology, 2003–2009

(%)

	2003		2005		2007		2009	
Country	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
PRC	54.3	87.4	61.4	89.7	51.5	83.7	55.1	81.9
India	3.8	2.3	8.8	2.3	10.9	4.4	9.4	5.7
Indonesia	5.1	0.2	5.1	0.5	5.4	2.6	5.1	0.6
Malaysia	3.3	2.3	4.1	1.1	6.5	0.9	9.2	4.3
Philippines	0.3	0.0	0.6	0.0	0.6	0.0	0.6	0.0
Singapore	9.3	5.7	7.9	3.3	14.2	5.4	10.7	4.4
Thailand	20.3	2.0	10.4	2.9	6.5	2.9	6.8	3.0
Viet Nam	3.5	0.1	1.8	0.2	4.4	0.1	3.1	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

PRC = People's Republic of China

Source: Compiled from COMTRADE Database.

Table 2.4: World Trade Organization 153 List of Environmental Goods and Services, Environmental Monitoring and Analysis, 2003–2009

(%)

	2003		2005		2007		2009	
Country	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
PRC	57.4	52.0	61.6	59.3	62.5	66.1	61.0	74.8
India	4.6	2.0	5.9	3.2	7.5	4.3	8.3	4.9
Indonesia	1.9	1.4	2.5	0.7	1.9	0.6	4.3	1.0
Malaysia	8.2	16.8	6.9	16.8	6.1	7.7	5.6	5.5
Philippines	1.8	1.0	1.3	0.3	0.8	2.6	0.9	1.8
Singapore	13.3	14.2	9.2	9.9	8.3	8.5	8.2	6.9
Thailand	7.7	12.3	10.9	9.3	8.9	9.4	8.0	4.3
Viet Nam	5.0	0.3	1.7	0.5	4.0	0.7	3.7	0.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

PRC = People's Republic of China

Source: Compiled from COMTRADE Database.

Table 2.5: World Trade Organization 153 List of Environmental Goods and Services, Environmentally Preferable Products, 2003–2009

(%)

	2003		2005		2007		2009	
Country	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
PRC	50.4	62.3	51.6	65.6	48.0	68.7	47.6	60.9
India	7.6	4.5	8.3	5.5	9.7	6.1	8.6	13.5
Indonesia	3.5	6.1	6.2	6.0	5.0	3.9	7.8	4.0
Malaysia	8.9	8.9	7.3	6.4	7.7	6.7	6.9	5.6
Philippines	3.3	1.4	2.3	0.7	2.0	0.3	1.7	0.3
Singapore	14.3	12.9	10.4	11.6	12.4	8.6	11.2	9.6
Thailand	8.1	3.4	10.7	3.5	10.0	5.2	12.7	5.7
Viet Nam	3.9	0.4	3.1	0.6	5.3	0.6	3.5	0.4
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

PRC = People's Republic of China

Source: Compiled from COMTRADE Database.

Table 2.6: World Trade Organization 153 List of Environmental Goods and Services, Heat and Energy Management, 2003–2009

(%)

	2003		2005		2007		2009	
Country	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
PRC	43.0	64.3	46.7	66.5	45.4	74.1	46.6	72.2
India	6.3	4.6	7.8	4.5	9.6	4.1	9.7	5.0
Indonesia	3.6	1.9	4.0	1.2	3.8	1.0	5.9	0.9
Malaysia	7.7	3.9	7.1	4.7	6.8	3.5	5.7	3.2
Philippines	1.7	0.7	1.1	0.5	1.0	0.3	0.8	0.2
Singapore	17.4	15.2	13.9	13.5	13.4	9.2	12.9	9.7
Thailand	17.4	8.5	17.3	8.4	16.2	7.2	15.1	7.8
Viet Nam	2.9	0.8	2.1	0.7	3.8	0.7	3.3	0.9
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

PRC = People's Republic of China

Source: Compiled from COMTRADE Database.

Table 2.7: World Trade Organization 153 List of Environmental Goods and Services, Management of Solid and Hazardous Waste, 2003–2009

(%)

	2003		2005		2007		2009	
Country	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
PRC	30.2	6.0	49.9	6.4	31.4	4.6	25.8	11.6
India	42.6	77.7	34.9	88.6	47.7	87.4	48.1	81.0
Indonesia	6.8	1.3	7.8	0.2	10.3	0.6	8.4	1.4
Malaysia	0.9	0.2	0.7	0.6	1.0	0.7	0.9	2.3
Philippines	0.9	0.0	0.4	0.0	0.6	0.0	0.5	0.1
Singapore	1.9	0.7	0.8	0.5	1.2	1.6	0.6	1.2
Thailand	9.5	3.6	2.1	2.7	4.7	1.1	14.4	1.0
Viet Nam	7.2	10.4	3.4	1.0	3.1	4.1	1.2	1.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

PRC = People's Republic of China

Source: Compiled from COMTRADE Database.

Table 2.8: World Trade Organization 153 List of Environmental Goods and Services, Natural Resources Protection, 2003–2009

(%)

	2003		2005		2007		2009	
Country	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
PRC	26.9	74.1	19.3	80.4	14.8	88.0	5.9	86.0
India	10.2	3.7	8.9	0.9	14.0	0.3	58.3	0.8
Indonesia	3.8	1.3	4.0	6.5	7.0	3.6	9.0	3.3
Malaysia	24.5	5.6	38.0	3.2	25.3	2.4	7.5	4.0
Philippines	6.2	0.0	4.3	0.0	4.6	0.0	1.7	0.0
Singapore	14.9	13.1	12.3	7.2	15.6	3.6	7.4	2.5
Thailand	8.1	1.8	8.4	1.2	9.7	1.5	4.6	2.8
Viet Nam	5.4	0.4	4.9	0.6	8.9	0.6	5.7	0.5
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

PRC = People's Republic of China

Source: Compiled from COMTRADE Database.

Table 2.9: World Trade Organization 153 List of Environmental Goods and Services, Natural Risk Management, 2003–2009

(%)

	2003		2005		2007		2009	
Country	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
PRC	50.8	33.4	49.8	49.4	43.7	53.3	50.2	48.8
India	3.5	2.4	7.5	4.9	12.2	5.3	8.5	10.6
Indonesia	6.1	2.3	5.3	1.9	5.5	1.9	7.5	3.5
Malaysia	10.7	18.5	10.2	12.9	7.0	4.6	8.3	4.1
Philippines	1.0	0.4	0.3	0.4	0.2	0.0	0.4	0.1
Singapore	25.9	40.4	24.0	27.1	27.6	34.0	21.5	31.4
Thailand	1.3	0.9	2.2	3.4	1.0	0.3	2.5	1.0
Viet Nam	0.8	1.7	0.7	0.0	2.9	0.6	1.2	0.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

PRC = People's Republic of China

Source: Compiled from COMTRADE Database.

Table 2.10: World Trade Organization 153 List of Environmental Goods and Services, Noise and Vibration Abatement, 2003–2009

(%)

	2003		2005		2007		2009	
Country	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
PRC	21.7	50.7	19.4	50.4	15.9	57.0	17.7	59.5
India	3.2	3.8	2.9	5.3	4.4	2.5	3.5	4.4
Indonesia	2.8	4.6	2.8	5.0	5.8	4.3	8.6	3.7
Malaysia	13.3	2.3	11.7	2.4	12.7	2.4	12.8	2.5
Philippines	8.2	3.1	5.4	3.8	4.5	3.9	4.1	3.6
Singapore	26.2	7.0	30.2	6.6	28.2	6.0	19.1	3.2
Thailand	15.2	24.0	18.0	22.6	14.6	20.3	14.1	17.9
Viet Nam	9.3	4.6	9.7	3.8	13.9	3.6	20.1	5.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

PRC = People's Republic of China

Source: Compiled from COMTRADE Database.

Table 2.11: World Trade Organization 153 List of Environmental Goods and Services, Renewable Energy Plant, 2003–2009

(%)

	2003		2005		2007		2009	
Country	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
PRC	45.9	25.5	39.0	32.7	43.3	42.5	43.1	46.4
India	5.4	14.6	6.0	15.6	7.9	14.1	9.1	11.2
Indonesia	11.0	5.1	16.8	4.9	10.8	4.1	12.3	3.7
Malaysia	3.0	2.4	4.7	1.6	5.4	2.3	5.0	1.3
Philippines	1.3	0.1	1.3	0.1	1.0	0.0	0.9	0.0
Singapore	14.3	36.7	10.5	23.7	10.6	16.4	10.8	20.2
Thailand	17.2	15.4	19.3	20.6	18.5	19.5	15.5	16.4
Viet Nam	2.1	0.3	2.3	0.8	2.5	1.0	3.4	0.8
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

PRC = People's Republic of China

Source: Compiled from COMTRADE Database.

Table 2.12: World Trade Organization 153 List of Environmental Goods and Services, Waste Water Management and Potable Water, 2003–2009

(%)

	2003		2005		2007		2009	
Country	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**	**Import**	**Export**
PRC	52.8	26.7	51.6	33.7	53.5	42.4	57.5	43.3
India	7.1	1.5	8.4	1.8	9.8	2.0	10.2	3.6
Indonesia	0.8	0.3	0.9	0.4	0.9	0.4	1.6	0.6
Malaysia	12.7	24.3	10.9	26.7	10.7	22.3	8.6	16.9
Philippines	0.9	0.4	0.9	0.5	0.8	0.1	0.5	0.1
Singapore	16.1	43.3	17.7	33.0	15.8	28.0	13.5	30.0
Thailand	8.5	3.1	8.6	3.7	7.1	4.3	6.4	4.8
Viet Nam	1.0	0.3	0.9	0.2	1.3	0.3	1.7	0.7
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

PRC = The People's Republic of China

Source: Compiled from COMTRADE Database.

During 2006–2010, the PRC invested CNY200 billion in energy saving and emission reduction projects, generating investment worth about CNY2 trillion (China Daily 2010). Also during 2006–2010, US firms invested a total of $6.5 billion in India, so that India now stands as one of the largest markets for US clean energy technologies. In 2011–2012, two of the three US financing agencies approved 173 transactions in India, totaling $1.4 billion, in solar energy. It is estimated that between 2010 and 2030 India will need investments of over $1 trillion to improve health care, transportation infrastructure, energy production, and others. In May 2011 the World Bank approved a $15.36 million credit and $8.14 million grant for the Biodiversity Conservation and Rural Livelihood Improvement Project to support the Government of India in its efforts to conserve high-value forest areas with the objective of improving the livelihoods of forest-dependent communities. The project, which will run for 6 years, will conserve biodiversity while improving rural livelihoods by applying culturally appropriate and tested participatory approaches from the communities to support opportunities for improving rural livelihoods.

3.2 Potential Exports of Low-Carbon Goods and Services under Different Scenarios

Using unbalanced panel data for the selected Asian emerging economies during 2000–2009, model 1 was estimated using the FRONTIER 4.1 software for total exports of LCGS (Table 3), and also for each of the 12 categories of LCGS exports for individual countries of the Asian emerging economies. All the coefficients for individual countries are statistically significant at least at the 5% level, which indicates the selected model has clearly explained the variations in exports flows in LCGS through the selected determining variables.[5] The statistical significance of γ implies that behind the border constraints are important determinants of export flows in LCGS from the selected Asian emerging economies. This result also confirms that the selected model 1 is appropriate to examine the determinants of export flows in LCGS from the selected

[5] The author has the panel estimation results for each of the 12 categories for individual countries and interested readers may contact the author.

countries. Other interesting results are the magnitude and significance of (i) the variable FDI, which is the ratio of FDI from Asian countries to FDI from non-Asian countries to the relevant Asian emerging economy; and (ii) D_1, which shows the existence of trade agreements between the exporting Asian emerging economy and its trading partner countries. Taken together, these two coefficients indicate the influence of the grand coalition scenario on the potential export of LCGS from the concerned Asian emerging economy. On the other hand, taking either of the coefficients individually indicates the influence of the limited coalition scenario on exports. Though these coefficients are all positive for all the Asian emerging economies, they vary in magnitudes across countries. The impact of Asian FDI on export of LCGS is the largest for Singapore (0.92) and the lowest for the Philippines (0.46). This means that Singapore's LCGS exports will increase by 9% for every 10% increase in FDI from Asian countries. This clearly supports the view that Asian money could be leveraged for green research and investment through regional cooperation.

Table 3: Estimates of Determinants of Total Exports of Low-Carbon Goods and Services across Countries

Coeffts. of	PRC	India	Indonesia	Malaysia	Philippines	Singapore	Thailand	Viet Nam
Constant	10.532	9.441	8.560	9.862	7.655	9.753	7.662	7.453
$PCGDP^e$	0.672	0.543	0.572	0.618	0.438	0.712	0.453	0.426
$PCGDP^m$	0.815	0.675	0.642	0.788	0.525	0.844	0.616	0.589
Dist	(0.435)	(0.680)	(0.580)	(0.553)	(0.643)	(0.507)	(0.620)	(0.614)
Tariff (%)	(0.765)	(0.720)	(0.680)	(0.725)	(0.831)	(0.654)	(0.710)	(0.730)
FDI ratio	0.892	0.675	0.558	0.618	0.457	0.915	0.584	0.595
D1(PTA)	1.056	0.768	0.825	0.856	0.845	0.918	0.822	0.851
D2 (Years)	0.876	0.612	0.556	0.612	0.338	0.698	0.589	0.572
Gamma - γ	0.815	0.786	0.882	0.867	0.797	0.693	0.802	0.903

( ) = negative.

Notes: All coefficients are statistically significant at least at the 5% level.

The estimated model is as follows:

$$\ln EX_{i,j,t} = B_{1,t} + B_{2,t} \ln(PCGDP_{i,t}) + B_{3,t} \ln(PCGDP_{j,t}) + B_{4,t} \ln(DIST_{i,j}) + B_{5,t} \ln (T_{j,i,t}) + B_{6,t} \ln(FDIj_{,t-1}) + B_{7,t} D_1 + B_{8,t} D_2 - u_{ij,t} + v_{ij,t}$$

All the variables are defined in the text. Gamma – γ is the ratio of country-specific variation (σ_u^2) to total variation ($\frac{\sigma_u^2}{\sigma_u^2 + \sigma_v^2}$), which indicates whether "behind the border" constraints are one of the determinants of total exports of low-carbon goods and services (LCGS). When γ is significant, which is the case in this study, it implies that behind the border constraints are important determinants of LCGS exports.

Source: Author's estimation.

Another important result that conveys the significance of regional cooperation on improving LCGS exports in Asian emerging economies concerns the positive and significant coefficient of the variable D_1. The coefficient varies from 1.06 for the PRC to 0.82 for Thailand. The implication is that the PRC's existing trade agreements with other countries have facilitated it to export more LCGS than other Asian emerging economies, which also have trade agreements with their partner countries.

Tables 4.1–4.8 show how much increase in potential export of LCGS (by category) each Asian emerging economy will achieve under grand coalition, limited coalition, and stand-alone scenarios. These scenarios are simulated with the assumption that there are no behind the

border constraints on export in the Asian emerging economies. It is clear that all Asian emerging economies will enjoy a greater increase in export potential in the case of the grand coalition than in the case of a limited coalition. However, the percentage increase varies across countries; the PRC and Singapore appear to enjoy more increase in their potential exports in the majority of the categories. The implication from these results is that regional cooperation in the form of a grand coalition can certainly increase the export potential in LCGS in Asian emerging economies, and this can increase the pace of transforming Asia into "Green Asia."

Table 4.1: Potential Exports of Low-Carbon Goods and Services under Different Scenarios: the People's Republic of China

Category	Stand alone (% increase)		Limited coalition (% increase)		Grand coalition (% increase)	
	2005	2009	2005	2009	2005	2009
Air pollution control	20	22	26	28	32	33
Clean or remediation of soil and waste	30	28	32	33	35	36
Cleaner and more efficient technology	28	30	31	32	33	34
Environmental monitoring	40	35	42	38	44	41
Environmentally preferred products	35	33	37	35	38	36
Heat and energy management	38	35	39	36	40	37
Management of waste and hazardous waste	42	43	45	45	47	48
Natural resources protection	38	35	40	37	41	38
Natural risk management	44	42	45	43	46	44
Noise and vibration abatement	45	47	47	48	49	49
Renewable energy plant	28	27	30	28	32	30
Waste water management and potable water	36	38	39	40	41	42

Source: Author's calculation

Table 4.2: Potential Exports of LCGS under Different Scenarios: India

Category	Stand alone (% increase)		Limited coalition (% increase)		Grand coalition (% increase)	
	2005	2009	2005	2009	2005	2009
Air pollution control	30	32	31	33	32	34
Clean or remediation of soil and waste	31	32	32	33	34	35
Cleaner and more efficient technology	32	33	34	35	35	36
Environmental monitoring	40	42	42	43	44	44
Environmentally preferred products	37	38	39	40	40	42
Heat and energy management	38	37	39	38	40	40
Management of waste and hazardous waste	28	26	30	28	32	30
Natural resources protection	40	42	42	43	44	45
Natural risk management	37	35	39	37	40	38
Noise and vibration abatement	46	47	47	48	49	50
Renewable energy plant	30	32	32	33	34	35
Waste water management and potable water	40	38	41	40	41	42

Source: Author's calculation.

Table 4.3: Potential Exports of LCGS under Different Scenarios: Indonesia

Category	**Stand alone** (% increase)		**Limited coalition** (% increase)		**Grand coalition** (% increase)	
	2005	2009	2005	2009	2005	2009
Air pollution control	44	42	45	43	46	44
Clean or remediation of soil and waste	33	30	34	32	35	34
Cleaner and more efficient technology	35	36	37	38	38	39
Environmental monitoring	40	40	42	42	43	43
Environmentally preferred products	35	33	37	35	38	36
Heat and energy management	38	35	39	36	40	37
Management of waste and hazardous waste	45	42	46	44	47	46
Natural resources protection	38	35	40	37	41	39
Natural risk management	34	35	36	37	38	39
Noise and vibration abatement	46	47	48	49	49	50
Renewable energy plant	32	33	33	34	34	35
Waste water management and potable water	40	41	42	43	44	45

Source: Author's calculation.

Table 4.4: Potential Exports of LCGS under Different Scenarios: Malaysia

Category	**Stand alone** (% increase)		**Limited coalition** (% increase)		**Grand coalition** (% increase)	
	2005	2009	2005	2009	2005	2009
Air pollution control	34	35	36	36	38	38
Clean or remediation of soil and waste	35	36	36	37	38	38
Cleaner and more efficient technology	35	36	37	38	38	39
Environmental monitoring	33	34	35	36	37	38
Environmentally preferred products	40	41	42	43	44	45
Heat and energy management	30	32	33	36	35	37
Management of waste and hazardous waste	38	42	40	44	43	46
Natural resources protection	32	35	34	37	36	39
Natural risk management	30	32	33	34	35	36
Noise and vibration abatement	38	40	39	41	41	43
Renewable energy plant	35	36	37	38	39	40
Waste water management and potable water	42	43	44	45	45	46

Source: Author's calculation.

Table 4.5: Potential Exports of LCGS under Different Scenarios: Philippines

Category	**Stand alone** (% increase)		**Limited coalition** (% increase)		**Grand coalition** (% increase)	
	2005	2009	2005	2009	2005	2009
Air pollution control	36	37	38	39	39	40
Clean or remediation of soil and waste	37	38	39	40	41	42
Cleaner and more efficient technology	40	41	42	43	43	45
Environmental monitoring	41	42	43	44	44	46
Environmentally preferred products	45	47	47	48	49	50
Heat and energy management	35	36	36	37	38	38
Management of waste and hazardous waste	38	40	40	42	43	45
Natural resources protection	40	42	43	44	45	45
Natural risk management	38	40	41	42	43	44
Noise and vibration abatement	38	40	39	41	40	42
Renewable energy plant	37	39	39	40	41	41
Waste water management and potable water	45	46	48	48	50	51

Source: Author's calculation.

Table 4.6: Potential Exports of LCGS under Different Scenarios: Singapore

Category	**Stand alone** (% increase)		**Limited coalition** (% increase)		**Grand coalition** (% increase)	
	2005	2009	2005	2009	2005	2009
Air pollution control	23	24	25	26	27	29
Clean or remediation of soil and waste	30	31	32	33	34	35
Cleaner and more efficient technology	28	29	30	31	33	34
Environmental monitoring	27	29	29	30	31	32
Environmentally preferred products	28	29	30	31	32	33
Heat and energy management	31	32	33	34	36	35
Management of waste and hazardous waste	32	33	34	35	35	36
Natural resources protection	28	30	30	32	32	34
Natural risk management	25	27	26	28	27	30
Noise and vibration abatement	23	25	25	27	28	28
Renewable energy plant	22	23	24	25	27	26
Waste water management and potable water	28	29	32	33	33	34

Source: Author's calculation.

Table 4.7: Potential Exports of LCGS under Different Scenarios: Thailand

Category	**Stand alone** (% increase)		**Limited coalition** (% increase)		**Grand coalition** (% increase)	
	2005	2009	2005	2009	2005	2009
Air pollution control	45	46	47	48	49	50
Clean or remediation of soil and waste	40	42	41	43	42	44
Cleaner and more efficient technology	40	42	43	44	45	45
Environmental monitoring	41	43	43	44	44	45
Environmentally preferred products	45	47	47	49	49	50
Heat and energy management	40	42	42	44	44	45
Management of waste and hazardous waste	38	39	40	41	43	44
Natural resources protection	45	47	46	48	48	50
Natural risk management	40	40	41	41	43	44
Noise and vibration abatement	40	42	42	44	43	45
Renewable energy plant	39	41	41	43	43	45
Waste water management and potable water	44	46	47	48	50	51

Source: Author's calculation.

Table 4.8: Potential Exports of LCGS under Different Scenarios: Viet Nam

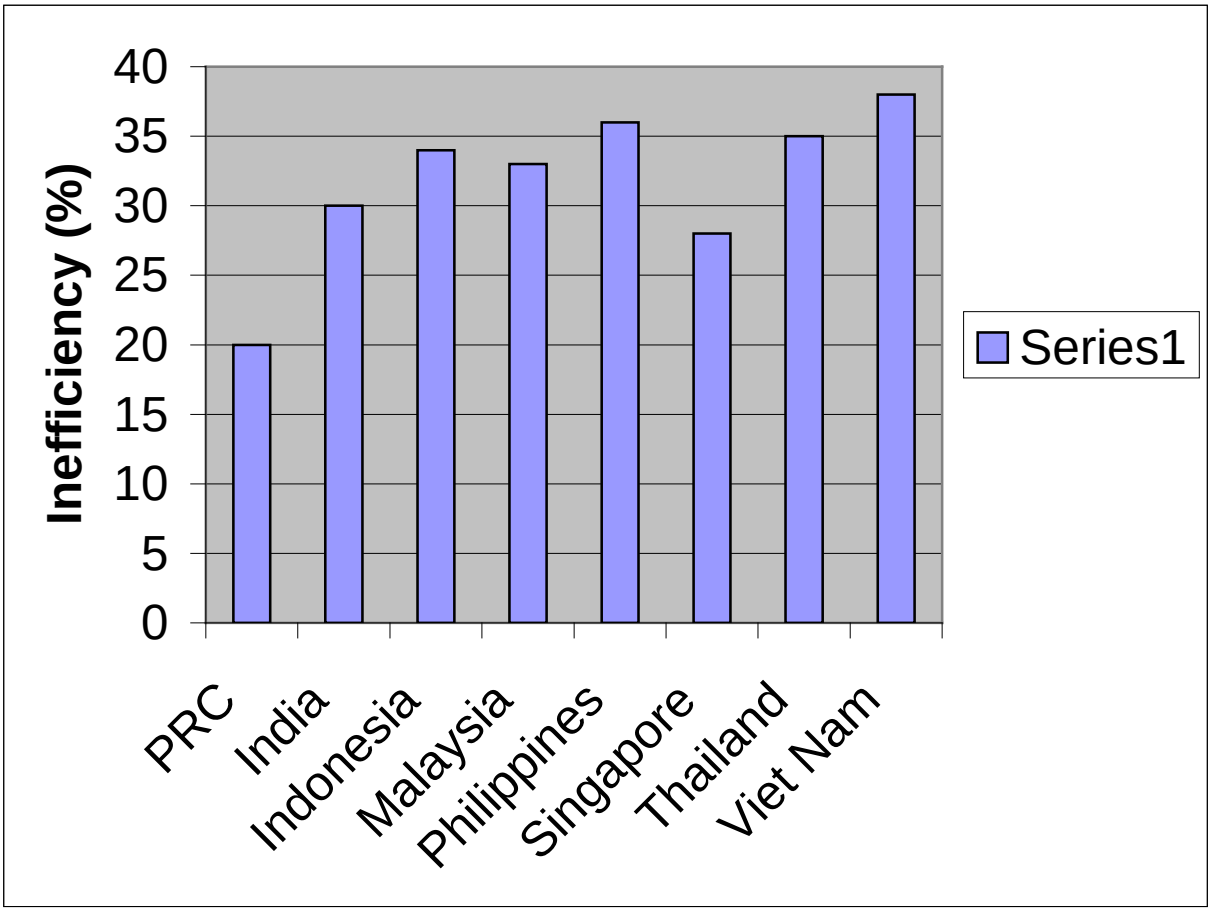
Category	**Stand alone** (% increase)		**Limited coalition** (% increase)		**Grand coalition** (% increase)	
	2005	2009	2005	2009	2005	2009
Air pollution control	46	47	48	49	49	50
Clean or remediation of soil and waste	38	40	40	42	42	44
Cleaner and more efficient technology	40	42	41	44	43	45
Environmental monitoring	42	43	44	45	46	48
Environmentally preferred products	40	41	42	43	44	45
Heat and energy management	38	39	39	40	40	41
Management of waste and hazardous waste	47	48	49	50	51	52
Natural resources protection	36	37	38	40	41	42
Natural risk management	38	40	40	41	43	42
Noise and vibration abatement	45	48	48	49	49	50
Renewable energy plant	34	35	37	37	39	40
Waste water management and potable water	42	44	45	46	48	50

Source: Author's calculation.

Nevertheless, such a transformation will not come without careful tailoring of existing policies and agreements relating to matters such as preferential or free-trade agreements that remove barriers to trade in goods and services.

What is equally important is the elimination of behind the border constraints, such as poor infrastructure and inefficient institutions, which exist within the exporting country and which create the gap between actually realized and potentially possible exports. The gaps between actual and potential exports are calculated for each year during 2000–2009 and the average gap for the eight selected Asian emerging economies is presented in Figure 4. The results indicate that the PRC's gap between its actual and potential exports is the least, which means that, on average, the PRC is able to realize 80% of its potential exports, Singapore is able to realize 73%, while the figure for India is 70%. Viet Nam appears to be realizing only about 62% of its export potential in LCGS. It would be interesting to examine what are the specific behind the border constraints that contribute to such gaps between actual and potential exports in these countries. However, due to lack of appropriate data across the countries over the period of analysis, identification of specific constraints could not be done in this study.

Figure 4: Mean Inefficiency in Export Flows in Low-Carbon Goods and Services across Emerging Asian Economies



PRC = People's Republic of China.

Source: Author's estimation.

3.3 Potential, Options, and Challenges for Cooperation

Though regional integration is not a new concept in Asia, it is restricted to different pockets involving smaller areas. There is no doubt that Asia has a large market and financial resources to support and sustain regional growth as well as global growth (Research and Information System for Developing Countries 2007). Despite the differences in governance structure and inequalities across countries in terms of GDP and physical and human infrastructure, emerging Asian economies show similarities in terms of social values and culture. Historically too, emerging and other Asian economies have been well connected through the so called "silk routes" in terms of trade and investment. Gradually, due to the tensions and conflicts that arose among Asian countries from time to time, such trade and investment eroded slowly. However, in the modern globalization era, the emergence of a production network across East Asian countries has slowly been involving other Asian countries, either directly or indirectly, and the prospect for regional cooperation within Asia is bright. Thus, trade in goods and services and investment appear to act as one of the important drivers of regional cooperation in Asia. Improving physical connectivity in terms of better transportation links across Asian countries would facilitate stronger regional coalition in other areas such as capacity building and technology research, development, and dissemination across not only Asia but also globally. The Asian Development Bank (ADB) has been facilitating both regional and subregional transportation infrastructure through the financing of a number of projects. As net importers of hydrocarbons, many Asian countries are very keen to address the question of energy security, and this provides huge potential for regional coalition. However, the effectiveness of regional cooperation initiatives in Asia will depend on the special characteristics of the Asian economies.

> The primary reasons for the success or failure of some initiatives over others include economic dynamism, too large memberships, diverse interests, conflicts and political differences, geopolitical factors such as competition toward dominance, lack of leadership and vision, weak institutional arrangements and resource constraints. (Das, Vasudev, and Gupta 2011: 379)

A brief review of some of the national and sector policy measures implemented by major transition economies in the region—including the PRC, India, and Indonesia—towards promoting the use of LCGS in different sectors is discussed in the following pages. Such a review is necessary to understand the existing potential and options for regional cooperation.

In the case of environmental goods and services, mainly technological disparities between countries encourage FDI. Provision of environmental infrastructure services, notably potable water delivery, requires complex organizational capabilities, knowledge, and capital typically possessed by multinational enterprises. However, in the absence of proper environmental policy in the host country, the foreign country investment may not bring environmentally friendly technologies. Depending on the level of environmental regulations, multinationals transfer the technologies to the host country just to meet those regulatory measures. Thus, the attitude of multinationals in transferring better pollution control technologies depends on the strength of the host country's environmental policy. Nevertheless, it is recognized by governments that technological upgrading ultimately is the responsibility of firms, whose operations need to be supported by governments with appropriate industrial and institutional frameworks. However, the possibility of multinationals "crowding out" domestic firms in the production and distribution of LCGS in emerging Asian economies may not be ruled out. Thus, it is imperative for the countries promoting FDI in LCGS to implement proper policies to minimize the potential negative effects of FDI. Without instituting business laws formally, the governments of Malaysia and Singapore, for example, helped small and medium-sized firms in many ways to link up with multinationals (Huff 1999; Rasiah 1995). Also, in order to attract multinational enterprises,

emerging Asian economies have been instituting different laws concerning LCGS. As the PRC has been the leader among emerging Asian countries in trade and investment in LCGS involving the WTO 153 list, it is worthwhile here to briefly discuss some of the important laws that the PRC has recently initiated with respect to LCGS.

The PRC released its first national climate change plan in June 2007. It covered a range of policies concerning mitigation, adaptation, and science and technology. In addition to national policies, there are several policies at the provincial, municipal, and local levels. Learning from the experiences of developed countries, the PRC passed three important laws concerning renewable energy development: (i) the Law of Environment Protection was passed in 1979; (ii) the Environmental Impact Assessment Law was passed on 28 October 2002; and (iii) the crucial one, the Law of Renewable Energy, was passed on 28 February 2005.

The Law of Renewable Energy was enacted to (i) promote the development of renewable energies, (ii) increase the supply of energy, (iii) change the consumption mix of energy, (iv) solve the energy shortage, and (v) protect the environment for sustainable economic and social development. According to this law, renewable energies refers to non-fossil energies, such as wind, solar, hydropower, bio-energy, geothermal, and ocean energy. The law does not apply to the utilization of old biomass energy such as straw or stalks. The law emphasizes that the development of renewable energy should have the first priority among all kinds of energies. The government must make every effort to facilitate the development of the renewable energy market by attracting all kinds of investors including private enterprises. Since research on and investigation into renewable energy reserves in the PRC will entail a huge cost, the government must play the leading role in this regard. This law also mandates that the PRC should have a national plan on renewable energy development for both the short and medium term.

The Environmental Impact Assessment Law is a method and system for (i) analyzing, forecasting, and assessing the potential impact on the environment after implementation of plans and construction projects; (ii) putting forward strategies and measures to prevent or alleviate adverse impacts on the environment; and (iii) carrying out follow-up and monitoring. According to this law, an environmental assessment must be done before a development project starts, and regular reviews are required after the project is completed.

The Law of Environment Protection was enacted to (i) protect and improve the ecological environment, (ii) prevent and control pollution and other public hazards, (iii) safeguard people's health, and (iv) facilitate modernization. The law emphasizes that the plans for environmental protection formulated by the government must be incorporated into national economic and social development plans. The government shall adopt economic and technological policies and measures favorable for environmental protection so as to coordinate the work of environmental protection with economic and social development. Since renewable energy is more environmentally friendly than fossil-fuel energy, the laws related to the environment will increase the cost of fossil-fuel consumption and strengthen incentives for consumers to use more renewable energy.

The PRC uses both regulatory measures and incentive structures to promote the use of LCGS at the plant and industry levels. The main objective of the stimulus packages adopted in late 2008 and early 2009 in the PRC was to increase the use of technologies involving LCGS in the energy and transport sectors. These measures boosted the application of low-emission technologies such as wind power, solar, bio-mass, hydropower, and nuclear, along with the replacement of environmentally damaging and inefficient small coal-fired generators with large and environmentally friendly plants.

In the transport sector, the PRC introduced fuel economy standards in 2005. The fuel consumption regulation for passenger cars aims to improve the fuel efficiency of new passenger

vehicles to 7 liters per 100 kilometers. In 2008, the PRC implemented a tax structure on new vehicles, which doubled taxes on large vehicles but reduced those on small vehicles.[6] In the agriculture sector, the PRC introduced abatement measures in rice production to promote low-emission seed varieties and disseminated new technologies to improve irrigation techniques (National Development and Reforms Commission 2009). With respect to trade policy, the Government of the PRC started to use a preference tariff policy on wind power equipment in January 2008 (General Administration of Customs of [the People's Republic of] China 2007). The tariff is collected at the border and the collected money is given back to the importing domestic firms as an investment from the state. This part of the equity is state owned and will be used only for R&D on wind energy technology in this firm.

India's National Action Plan on Climate Change comprises eight national missions with the objective of achieving key goals in the context of climate change with special emphasis on energy efficiency, solar energy, and forestry (Government of India 2009). In the transport sector, to reduce emissions it is mandatory for public transport vehicles in some major cities such as Delhi and Mumbai to use liquefied petroleum gas (LPG). Further, mandatory vehicle fuel efficiency standards under the Energy Conservation Act 2001 are planned from 2012.

In the agriculture sector different technological innovations are being initiated to use water efficiently and reduce emissions. Such research is taking place mostly in local agriculture universities across states. India imposed a Clean Energy Tax of Rs50 (approximately US$1 in December 2011) per ton on both imported and domestically produced coal from July 2010, with the aim of raising funds for research and projects in clean energy technologies under a National Clean Energy Fund (NCEF).[7] It is worth noting that the PRC also plans to impose a new tax on coal, oil, and gas extraction in its western provinces (Garnaut 2011). The Government of India has implemented a number of policies since the beginning of 1990 to improve energy use efficiency in the economy, particularly in industries. These policies include reforms in the industry sector, such as relaxing price and output regulations on certain energy-intensive industries, and imposing energy efficiency labeling requirements for appliances. Nevertheless, based on the best-practice method of production in industries with respect to energy efficiency, Indian industries on average still need to improve their energy efficiency practices by 20%–30% (Bhattacharya and Cropper 2010). The Government of India is preparing a national bio-energy mission to boost power generation from biomass, a renewable energy source abundantly available in India. The mission, to be launched during the 12th Five-Year Plan, 2012–2017, will offer a policy and regulatory environment to facilitate large-scale capital investments in biomass-fired power stations. It will also encourage development of rural enterprises.

Indonesia is committed to cutting emissions by 26%–41% relative to business as usual by 2020. Indonesia has implemented the program of reducing emissions from deforestation and forest degradation (REDD+). The Government of Indonesia has produced several policies and strategies to guide its development and implementation, including the introduction of a moratorium on new permits to convert forests and peatlands to other land uses.

> A moratorium on issuing new licences for land conversion was agreed as part of a US$1 billion agreement with Norway, and initiatives to improve institutions, incentives and monitoring in the forestry sector are underway, including with Australian support through the Indonesia-Australia Forest Carbon partnership. (Garnaut 2011, 27)

[6] International Council of Clean Transportation. http://www.theicct.org/2010/04/ghg-fe-standards-update/

[7] India Budget 2010–2011 (Government of India 2010). Speech by Pranab Mukherjee, minister of finance. 26 February. Notification No. 01 /2010-Clean Energy Cess. 22 June 2010. Available at http://indiabudget.nic.in/ub2010-11/bs/speecha.htm

However, this does not seem to be sufficient. Dealing with deforestation involves different sectors and layers of governments. These entities are known to have competing interests over land use. Without the provision of clear incentives, it is difficult to persuade these actors to change the patterns of land use in Indonesia. A special window of funding for REDD+ at a regional and global level would certainly provide more than a moral boost for tropical-forest nations such as Indonesia and Malaysia to advance their REDD+ development nationally and on the ground.

> Indonesia is also preparing major expansion of geothermal power production as a zero-emissions alternative to new coal-fired electricity generation. The Indonesian Government provides financial incentives for investment in low-carbon power supply, and the possibility of a carbon tax was mooted in a 2009 Ministry of Finance climate policy strategy paper. (Garnaut 2011: 27)

With respect to the industry sector

> the Indonesian Government has identified the following as potential options to increase energy efficiency in the industrial sector: development of more efficient conversion processes and combustion systems; use of variable speed electric motors; more efficient material conversion processes; recycled materials and the introduction of co-processing or co-firing technology. As yet no specific program has been announced to implement these options. (Government of Indonesia 2009: 25)

The diffusion of technologies using LCGS is generally a slow process in any country, and the pace can be slowed due to different factors. A fundamental constraint is government policies that influence prices of LCGS. In this context, a country's trade policy plays a crucial role with respect to achieving its specific environmental goals such as emission reduction through the use of efficient technologies and LCGS. This is because the use of LCGS and efficient technologies depends on the accessibility of industries and households, which in turn is determined by the cost of production of LCGS. Only when there are no restrictions on the movements of inputs entering into the production of LCGS across countries will the cost of production be low. For example, tariffs on biofuel imports are higher in many developed countries. The EU and the US have instituted mandatory requirements to use biofuels in transport. In these countries, domestic producers tend to dominate the national biofuel market at the expense of environmentally and economically more efficient imports from developing countries, where biofuels can be produced at lower costs. Thus, restrictions on imports of biofuels need to be eliminated.

The importance of infrastructure in attracting FDI in LCGS is highlighted with the case of India. At the South India Infrastructure Investment Summit 2011 organized by the Confederation of Indian Industries, Hidenobu Teramura [8] said that infrastructure development and private participation should go hand in hand. He argued that

Many Japanese companies are willing to invest in India, but the infrastructure bottlenecks are the deterrent. India spends only one-eighth of the investment the PRC makes in infrastructure development. Japan has national and international experience in developing infrastructure facilities and India could make use of that in several sectors like environment and energy conservation. The Japanese companies with expertise in power generation and conservation, solar and wind power, water treatment, including desalination plants, and waste management are willing to interact with Indian counterparts for possible collaboration and investments. (*The Hindu Business Line* 2011)

[8] Hidenobu Teramura is the director of the Financial Co-operation Division; Trade and Economic Co-operation Bureau; Ministry of Economy, Trade and Industry; Government of Japan,

As multinational enterprises have the technical know-how to produce LCGS, developing countries tend to rely more on them to meet their demand for LCGS. This aspect may lead to another constraint concerning the negative impact of multinationals in crowding out domestic firms. This negative impact can be eliminated by instituting proper FDI and R&D policies for domestic firms. The PRC provides a good case study. In 2007, the Ministry of Finance set up the Fund for the Development of Renewable Energy with the aim of supporting the R&D activities of those domestic firms working in the field of renewable energy. This fund can be attractive to those firms involved in the production of renewable energy.

The important question is whether the different sector policies followed in the PRC, India, and Indonesia have been contributing positively to environmental protection. The answer is "yes." For example, “Until about 2007 or 2008, the PRC sat comfortably as one of the developing countries that faced no strong requirements to reduce emissions below business as usual." (Garnaut 2011: 25). Thus, the PRC, India, and Indonesia can help other emerging Asian economies in terms of capacity building with the purpose of instituting possible options for different sector policies that proved successful in controlling emissions and improving people’s lives in the PRC, India, and Indonesia. Such regional cooperation has the potential to promote the effective use of LCGS towards protecting the environment across Asia and globally. Thus, the possibility that nationally appropriate mitigation actions, which were submitted by certain emerging economies at the 2009 Copenhagen summit, could effectively contribute to green growth is very high under the grand regional coalition, regardless of individual country development preferences.

3.4 Feasible Pathways to Enhance Cooperation between Government and Private Firms

It has been acknowledged that public–private partnership (PPP) is an effective way of producing and distributing national and global public goods such as LCGS. For example, the ASEAN Infrastructure Fund, which is an initiative to boost the supply of infrastructure financing, can be increased by including many private firms across the regions. The Approach Paper to the 12th Five Year Plan, 2012–2017 of India highlights some of the conditions necessary to strengthen the cooperation between government and private enterprises.

> PPPs are best implemented through standardized arrangements that constitute a stable policy and regulatory regime where private capital derives greater comfort and seeks the least possible risk premium. Model Concession Agreements (MCAs) would be used for providing a stable regulatory and policy framework. (Government of India 2011)

Viability gap funding is a one-time grant used by the Government of India to boost cooperation between government and private enterprises. Though infrastructure projects are often economically justifiable, they may initially not be viable commercially for a few years due to gestation periods and externalities. Commercial viability is hard to achieve in the initial stages of big infrastructure projects, which necessitates the need for some upfront assistance. It is in this context that India’s viability gap funding provides support to such PPP projects. State governments are also taking steps to boost private investment in various sectors, particularly in infrastructure including LCGS. For example, Karnataka state, which has envisaged an investment requirement of $6 billion every year, is proposing an infrastructure development and regulatory bill to facilitate, regulate, and mitigate risk in infrastructure investments.

At the South India Infrastructure Investment Summit 2011, Samy Vellu[9] argued that about $30 billion could be sourced by creating an infrastructure investment-based fund (it could be listed on the Malaysian stock exchange) by both Indian and Malaysian companies and institutions. This cooperation between Indian and Malaysian PPPs would contribute to infrastructure development in India.

A successful PPP towards climate change improvement is the partnership between the World Renewal Spiritual Trust (WRST), which is a registered charity trust with headquarters in Mumbai and branches all over India, and the Government of India under the One India program. The WRST's major objective is to promote the use of alternative energies through carrying out research into and demonstrating renewable energy systems. To pursue its aims the WRST works in close association with the Prajapita Brahma Kumaris Ishwariya Vishwa Vidyalaya, a premier spiritual university in India.

> After detailed evaluation of various solar technologies, WRST selected to make use of the in-house developed 60m^2 Scheffler parabolic dish in order to set up a solar thermal power plant near its Shantivan Campus in Abu Road, Rajasthan. For this project, WRST has teamed up with Fraunhofer Institute (ISE) and enjoys the support of Wolfgang Scheffler. WRST is in close liaison with various solar R&D institutions and manufacturers and has initiated all necessary steps for completion of this project. The thermal solar power plant will be the first of its kind in the world in dish technology in direct steam generation mode, with full thermal storage for 16 hours continuous operations for base load. The budget for the project is Rupees 66 crores [Rs660 million] excluding the cost of land. The WRST request for funding with the Indian Central Ministry of New and Renewable Energy Sources (MNRE) has been approved. The German Ministry for Environment, Nature Conservation and Nuclear Safety (BMU) has also agreed to support this project. (http://www.wrst.in/)

This is a good example of how the private sector could be engaged in a strategic way in a grand coalition scenario involving private, national, and international government organizations. Similar examples involving national and foreign governments can be found in other emerging Asian economies. For example, the Government of Indonesia is committed to reining in deforestation and improving land management with help from Australia under the Indonesia–Australia Forest Carbon Partnership.

Another example of PPP in power generation in India involving a state government concerns the involvement of the country's largest private power company, Tata Power. In October 2010 Tata Power signed a financing agreement for its 25 megawatt solar photovoltaic power project at Mithapur in Gujarat, which is one of the fastest-growing states in India.

> Tata Power Renewable Energy Limited, a subsidiary of Tata Power, has successfully tied up the entire debt requirement through a consortium of domestic lenders, namely State Bank of India and Export Import Bank of India with SBI Capital Markets Limited acting as the sole financial advisor and arranger. The project costing Rs365 crore [Rs3.65 billion] is being funded through a debt–equity mix of 70:30. The project financing comprises of [sic] equity of Rs110 crore [Rs1.10 billion] and rupee term loans of Rs255 crore [Rs2.55 billion]. Crystalline silicon photovoltaic technology, which is modular, proven, and widely deployed, is the choice of technology for this project. The company has signed a power purchase agreement (PPA) for the project with Gujarat Urja Vikas Nigam. This plant is likely to be one of the largest of its kind in the country and will be ready to inject power into the system by end-December 2011. (*Business Line* 2011: 3)

[9] Samy Vellu is special envoy to India and South Asia on infrastructure, Prime Minister's Department, Government of Malaysia.

4. CONCLUSIONS

Trade and FDI have been the two main sources of growth for East Asia, and they have been nurtured over the years through the creation of a production network. Such regional cooperation has increased the pace of poverty reduction in East Asia. The experiences of East Asian countries encouraged other Asian countries to connect with East Asia, either directly or indirectly; thus, Asian countries appear to be moving steadily towards greater Asian integration. With the increasing awareness of climate change and its impact on people's lives, each country is keen to reduce pollution. One approach to reducing pollution is encouraging the use of low-carbon goods and services (LCGS); unfortunately production, trade, and investment in LCGS are very low globally. The result is a large gap between demand for and supply of LCGS. It is acknowledged that about 50% of LCGS that are to be used by 2030 are not yet available. This supply crisis provides an opportunity for emerging Asian economies, which have the potential to contribute to the creation of LCGS, individually and collectively pooling their physical and human capital. How the existing opportunities for creating and using LCGS across Asia and globally are utilized will depend on country-specific and region-specific factors. Thus, the volume of trade and investment in LCGS will be determined by whether the emerging Asian economies work together (i) fully under a grand coalition, (ii) partially under a limited cooperation coalition, or (iii) under a stand-alone scenario.

Specifically, this study examined the following objectives:

- What will be the magnitude of export flows in LCGS into Asia under a grand regional coalition scenario, limited cooperation scenario, and stand-alone scenario?
- How much influence do behind the border constraints exert on potential export flows in LCGS in Asia?
- Under a grand coalition scenario, what are the potentials, options, and challenges?
- What are the feasible pathways to promote public–private partnership effectively with respect to LCGS?

COMTRADE, WITS, and UNCTAD's World Investment reports provide data for empirical analyses covering 2000–2009. The emerging Asian economies considered in this study are the PRC, India, Indonesia, Malaysia, Philippines, Singapore, Thailand, and Viet Nam. This study used the WTO 153 list of LCGS, which were grouped into 12 categories for analytical purposes. The categories are air pollution control, clean up or remediation of soil and waste, cleaner or more resource-efficient technology, environmental monitoring and analysis, environmentally preferable products, heat and energy management, management of solid and hazardous waste, natural resources protection, natural risk management, noise and vibration abatement, renewable energy plant, and waste water management and potable water.

The PRC is the only emerging Asian economy which had significant trade figures with respect to LCGS during 2000–2009. The PRC ranks number one in trade in all categories of LCGS among the emerging economies, except in management of solid and hazardous waste, in which India dominated in 2000–2009. However, during 2008 and 2009, the PRC enjoyed a trade surplus in LCGS, while all other Asian emerging economies had a trade deficit in LCGS. This is a clear indication that the PRC's policy environment is conducive to trade and investment in LCGS. After the PRC, Singapore and Thailand were the next most active participants in trade in LCGS over the period of analysis. The Philippines had a large trade deficit in LCGS during 1999–2005; although the figure has reduced in recent years, the levels of trade were very low compared to those in other emerging Asian economies.

There are difficulties in defining FDI that goes directly into the production of LCGS. Official development assistance that is directed towards mitigation and adaptation may not involve LCGS directly. For example, rain water harvesting through either repairing or constructing tanks in rural areas may receive official development assistance as an adaptation technique, but does not fall under LCGS. Among the categories of LCGS, renewables, recycling, and low-carbon technology manufacturing attracted large amounts of FDI globally during 2009. Among the emerging Asian economies, the PRC and India attracted significant amounts of FDI, particularly in renewable energy technologies.

Regional cooperation was examined under three scenarios—grand coalition, limited coalition, and stand alone. These scenarios are simulated with the assumption that there are no behind the border constraints on export LCGS in emerging Asian economies. As expected, the analysis indicates that emerging Asian economies will increase their export potential in LCGS more under the grand coalition scenario than under the partial coalition scenario, though both scenarios show more potential than the stand-alone scenario. Thus, regional cooperation—either full or partial—has the potential to improve the export performance of emerging Asian economies in LCGS. Economies that are more open to trade and FDI appear to enjoy more increase in their potential exports in LCGS and, naturally, the PRC and Singapore fall into this category. Nevertheless, such a transformation will require cooperation, such as preferential or free-trade agreements entailing the removal of barriers to trade in goods and services (Kawai and Wignaraja 2008).

Earlier analysis of the impact of different scenarios on LCGS exports assumed that there were no behind the border constraints in emerging Asian economies. In reality, such an assumption may not be valid in many countries; there are infrastructure bottlenecks and institutional rigidities that contribute to the gap between potential and actual exports. Therefore, it is imperative to examine whether the impact of such behind the border constraints on exports is significant; if so, how much potential export is reduced. The results are alarming in the sense that none of the emerging Asian economies are able to fully realize their LCGS export potential. While the PRC was able to achieve about 80% on average of its export potential during the period of analysis, Viet Nam could achieve only about 62%. Lack of appropriate data across countries and over the period of analysis constrained examination of the causes for such variation.

There is a large market and huge foreign reserves within Asia. However, benefits from these characteristics could not be reaped fully to further develop the region in terms of technological advancement mainly due to preconceived false ideologies and misunderstandings between countries in the region. Nevertheless, East Asia has demonstrated that it is possible to grow together with each other's help despite differences among governments on certain issues of national pride. It is high time the rest of Asia, particularly the rest of emerging Asian economies, took the lead from East Asia and formed a grand Asian coalition for the benefit of the entire region and the global economy. The East Asian experience emphasizes that trade and investment in goods and services are two important instruments for regional and multinational cooperation. One of the crucial factors for such a grand cooperation is maintaining easy flow of goods and services, which very much depends on good transport and communication networks and institutional infrastructure. It is worth noting that not only multinational financial institutions but also regional institutions such as the Asian Development Bank (ADB) have been facilitating both regional and subregional transportation infrastructure through financing a number of projects.

Further, the involvement of multinationals in trade and investment in LCGS in Asia through FDI also has the potential to increase the regional cooperation into a bigger multinational cooperation. One of the important pathways to increase and strengthen such grand regional and

international cooperation is drawing on public–private partnerships (PPPs), and this has been promoted effectively by ADB and other international organizations such as the World Bank. The recently expressed collaborative ideas from Japan and Malaysia involving government agencies and private enterprises in those countries towards contributing to infrastructure projects in India, including investments in LCGS, are good examples of PPP under a grand regional coalition scenario. The trade and investment policies that have the potential to promote regional cooperation are (i) establishing clean-investment promotion strategies, (ii) enabling the dissemination of clean technology, (iii) harmonizing corporate green gas emissions disclosure, (iv) setting up a regional low-carbon technical assistance center, and (v) eliminating tariff and nontariff barriers to LCGS. Special attention is warranted to eliminate behind the border constraints on trade, which include bottlenecks in transportation and telecommunication infrastructure, so as to boost national and global market access. Emerging Asian economies, through their experiences in promoting LCGS, can share with other Asian economies the knowledge of policies and practices which have worked for them. This can be done through grand regional cooperation in terms of capacity building and institutional strengthening with the help of regional development organizations such as ADB.

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