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Foreword by Hideyuki Mori and Mark Elder

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Foreword

During the last two decades Asian countries have recognized the potential of regional economic integration. There are now a number of free trade agreements (FTAs) and economic partnership agreements (EPAs) between various countries in the region, and efforts are continuing to further expand the scope of economic integration. Some believe that an East and South East Asian multi-lateral regional trading community could be established by 2020.

To assess the economic and environmental implications of this integration, a project entitled "Promotion of Sustainable Development in the Context of Regional Economic Integration—Strategies for Environmental Sustainability and Poverty Reduction" was initiated by the Institute of Global Environmental Strategies (IGES) in Japan, together with the United Nations Environment Programme—Economics and Trade Branch (UNEP-ETB), McGill University in Canada, the Korea Environment Institute (KEI) in the Republic of Korea, and the National Institute for Environmental Strategies (NIES) in Japan in October 2005. This three year project was funded by the Ministry of the Environment of Japan as one of three sub projects of a larger project called APEIS (Asia Pacific Environmental Innovation Strategy Project). Also, this study was developed as the first project of the United Nations Environment Programme—Network of Institutes for Sustainable Development (UNEP-NISD). IGES was the lead institute coordinating the project.

Other institutions from the region provided input into the project and supported the research with both data and policy information. These institutions included: the Policy Research Centre for Environment and Economy (PRCEE) of the State Environment Protection Administration of China (SEPA) (now the Ministry of Environmental Protection), the Indonesian Institute of Sciences (LIPI), the Thailand Environment Institute (TEI), and the Institute for Environmental Science and Technology of the Hanoi University of Technology in Vietnam (INEST). The project was divided into two components: economy-wide modelling analysis, and sector/issue-specific policy analysis. McGill University's contribution focused on the economy-wide modelling analysis. China, Indonesia, Japan, the Republic of Korea, Thailand and Viet Nam were selected as case studies for analysis because they reflect the diversity of East Asia in terms of economic and social development, priority environmental concerns, and geographical representation of the sub-regions of Northeast and Southeast Asia. It was expected that this set of cases would provide

a spectrum of results in terms of both economic and environmental impacts. This monograph is a partial outcome of this project.

The goal of this monograph is to estimate the economy wide impact of different scenarios of potential future regional economic integration of East and South East Asian economies covering ASEAN, China, Japan and the Republic of Korea. The economic analysis was undertaken with the Global Trade Analysis Project (GTAP) database and modelling software, while the environmental impacts were estimated with a number of air and water pollution indicators. Environmental policy options were applied in order to mitigate the expected pollution effects and to promote sustainable development in the context of regional economic integration. The analysis was dynamic and took into account estimated changes in macroeconomic variables to the year 2020. Results of the analysis indicate that regional integration will enhance economic growth and intra regional trade in the East and South East Asian regions. The overall impact on the environment was not significantly different from baseline estimates; however, distributional effects were observed. This book makes a valuable contribution to the literature on regional economic integration of East and South East Asian economies. The academic community and policy makers, it is hoped, will find the book useful.

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Preface

In recent years the East and South East region of Asia has witnessed a rapid expansion of regional economic cooperation programs through bilateral and plurilateral free trade agreements (FTAs). Slow progress on multilateral negotiations under the WTO and APEC is shifting preferences to regional agreements. Recent developments in individual economies such as China's rapid export-driven growth performance and entry into the WTO, Japan's prolonged recession and desire to regain its leadership role in the region, Republic of Korea's change toward a more liberalized economic system, and Singapore's active role to become a hub of regionalism, can be considered as additional factors behind the strategic change in East and South East Asian regionalism.

Currently, Asian countries are moving towards more free trade agreements (FTAs) and or economic partnership agreements (EPAs) in the region. Each country in East and South East Asia, including China and Japan, is accelerating its move towards concluding such agreements with other countries in the region. The potential of an "East Asian Free Business Zone" is likely to become a reality by 2010. It is expected that an East-Asian multi-lateral regional trading community will be established by 2020. This multi-lateral regional trading community is expected to decrease the current barriers to trade between individual countries, expand the movement of goods and services between countries, and continue economic growth within individual countries, increase welfare and reduce poverty.

Economic growth concerns are often expressed in terms of the potential for environmental degradation from free trade agreements. Climate change, ozone depletion, and deforestation are often cited as examples of environmental problems that have resulted from economic growth. This region has also been plagued with various environmental problems as a result of rapid industrialization and trade openness.

One of the on-going debates in trade discussions is how to protect the environment when multi-lateral regional trade agreements are being negotiated. Many environmental advocates argue that freer trade harms the environment and, by fostering more trade liberalization is environmentally unfriendly. They claim that trade policy reforms produce substantial resource depletion and environmental degradation effects. Others argue that, on the contrary, trade liberalization is beneficial to the environment. It is also argued that increasing one's environmental standards in

the framework of a regional trade agreement results in increased competitiveness of firms in these countries as they become more innovative in their industrial processes. Thus, the impact of trade liberalisation on the environment continues to be debated.

Towards this end, the present study estimates the economic and environmental impacts of trade liberalization in East and South East Asian countries by the year 2020. The book uses a multiregional general equilibrium model. The economy wide impact of economic integration across the regions is estimated for the future of the world economy at 2020. Further, it estimates how the changes in the aggregate level of output, composition of that output, and inputs and technologies used, as a consequence of trade liberalization are likely to impact the environment of countries in the agreement. The study also uses the decomposition analysis to find the factors responsible for changes in pollution. The book suggests several policy options from the analysis. Impact of several environmental policies for specific pollutants is applied in the analysis. Overall the trade liberealisation is not too unfavourable for the environment especially for Japan, the Republic of Korea and some ASEAN countries in 2020. GHG emissions and Industrial waste are likely to be a serious concern in this region.

Thus the study provides an insight in pursuing a concrete multilateral trade liberalization policy (combining ASEAN and other countries in East Asia) and throws more light on the trade environment debate. This book will be a good addition to the field of Regional Economic Integration for East and South East Asian countries. The academic community primarily researchers and policy makers, and world bodies like WTO, ADB, World Bank may find the book useful.

Acknowledgements

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This study would not have been completed without immense cooperation from Centre for Global Trade Analysis, Purdue University, USA in general and, Dr.Terrie Walmsley (Director, Centre for Global Trade Analysis) and Dr. Badri Narayanan (Research Economist) in particular.

The findings of the current study have been presented in various international conferences (The International Input-Output Meeting on Managing the Environment, Seville 9–11 July 2008; 11th Annual Conference on Global Economic Analysis, Marina Congress Centre Helsinki, Finland, June 12–14, 2008 and 16th International Conference on Input-Output technique at Istanbul Technical University, Turkey, 2–6 July, 2007). The authors are thankful to the participants of these conferences for their comments and suggestions which have contributed to the improvement of the book.

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Chapter 1
Introduction

1.1 Globalization and Regionalization

Globalization facilitates economic growth, improvement in resource allocation, and the promotion of technological progress. But it has its costs such as increased income inequality and potential environmental damage. Similarly regionalization has its benefits and costs. For example, the benefits of pooling labor and information sharing resulting from regionalization are also associated with the costs of congestion (Urata, 2003).

The world economy has experienced considerable intensification of economic and financial integration since the late twentieth century. Trade and capital account liberalization, rapid technological improvement in transport and telecommunications, have increased the pace of the international flow of goods and services. The process of 'globalisation' has also been accompanied by the strengthening of economic and financial linkages within and between geographic regions.

Multilateral trade liberalization under the General Agreement on Tariffs and Trade (GATT), succeeded by the World Trade Organization (WTO) has accelerated the speed of postwar globalization. Unilateral liberalization of trade and investment, deregulation and privatization of state-owned enterprises, and the lower cost of foreign transactions due to technological progress in telecommunications and transportation have hastened the process of globalization.

Recent trends show that the world economy is simultaneously becoming more 'regionalized' and more 'globalized'. These trends are reflected in globalization indicators. For example, the ratio of foreign trade to gross domestic product (GDP) increased from 25% in 1960 to 46% in 1999 to 57% in 2006. Foreign direct investment (FDI), has grown more than 90-fold since 1970, and world trade by 18-fold. Thus, both FDI and World Trade have increased faster than GDP.

The General Agreements on Tariffs and Trade (GATT) and the World Trade Organization (WTO) were created to promote international trade and oversee the multilateral trading system. Currently, the WTO has 150 members, and a significant amount of global trade is covered by the WTO agreement. However, recently problems have arisen in the WTO over agreements on agriculture and intellectual property rights. These problems at the WTO have ushered in a gain in popularity in regionalization (Hasmi & Lee, 2008).

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1.2 Basic Issues of Regional Trade Agreements

Regional trade agreements (RTA) are economic trade agreement that reduce tariffs and restrictions on trade between two or more nations within a certain region (WTO, 2007). RTAs are of different types. Some are complex, for example, European Unions, while others are far less intensive, for example, North American Free Trade Agreement (Whalley, 1998). Governments in most countries favour RTAs. However, the WTO argues against these. According to Pascal Lamy, Director-General of the WTO, the proliferation of RTA '. . . is breeding concern—concern about incoherence, confusion, exponential increase of costs for business, unpredictability and even unfairness in trade relations' (Lamy, 2007).

RTAs have become a very prominent feature of the Multilateral Trading System (MTS) in recent years. The surge in RTAs has continued unabated since the early 1990s (WTO, 2009). Initially the WTO encouraged the growth of RTAs because it believed that regional integration initiatives can complement the multilateral trade regime. However, the rapid increase of RTAs in global trade results in increased diversion of trade through this route and this is increasingly becoming a cause for concern for the multilateral trading system under the WTO (Pal, 2007).

There were 421 RTAs that have been notified to the GATT/WTO up to December 2008 and an additional 400 expected by 2010 (WTO, 2009). Of these, 324 RTAs were notified under Article XXIV of the GATT 1947 or GATT 1994; 29 under the Enabling Clause; and 68 under Article V of the GATS (General Agreement on Trade in Services). In addition there were, 230 agreements already in force as of December, 2008. RTAs, free trade agreements (FTAs), and partial scope agreements accounted for over 90% of the agreements, while customs unions accounted for less than 10% (WTO, 2009). Almost every country in the world has become a member of at least one agreement (WTO, 2009).

Regional economic integration is a form of RTA. It can be referred to include any type of arrangement in which countries agree to coordinate their trade, fiscal, and/or monetary policies. Regional economic integration plays an important role in global trade.

According to Balassa (1961) economic integration increases as trade barriers diminish. There are six degrees of economic integration depending upon their level of integration. These are Preferential Trading Areas (PTAs), Free Trade Areas (FTAs), Customs Union (CU), Common Markets, Economic and Monetary Unions, and Complete Economic Integration. A PTA is a union in which member countries impose lower trade barriers on goods produced within the union, with some flexibility for each member country on the extent of the reduction. A Free Trade Agreement (FTA) is a special case of PTA where member countries completely abolish trade barriers; both tariff barriers and non-tariff barriers for goods originating within the member countries. It should be noted that in most cases countries do not abolish trade barriers completely even within Free Trade Area. Most agreements tend to exclude sensitive sectors. A Customs Union (CU) provides deeper integration than an FTA. In FTAs member countries are free to maintain their individual level of tariff barriers for goods imported from non-member countries. In a CU

member countries apply a common external tariff (CET) on goods imported from non-member countries. The CET can vary across goods but not across union partners. PTA, FTA and CU are called 'shallow integration' arrangements in the trade literature (World Development Report, 2008).

Apart from these shallow arrangements there are three types of regional agreements which provide 'deep integration'. The first is Common Markets. In a Common Market member countries attempt to harmonize institutional arrangements, and commercial and financial laws, and regulations among members. Common markets require the free movements of factors of production, i.e. labour and capital. 'Economic and Monetary Union,' is the most advanced type of economic integration. Here countries implement common economic policies and regulations and common currency among member countries. The final stage of deep integration is Complete Economic Integration. In this case, the integrated units have no or negligible control of economic policy, including full monetary union and complete fiscal policy harmonization (World Development Report, 2008). These later two types of Economic Integration are also referred to as regionalism. Burfisher, Robinson, and Thierfelder (2003) argue that there is a major transition from a shallow to a deeper economic integration in most RTAs. The old version of regionalization is based on traditional trade theory that describes trade creation versus trade diversion adopted from Viner (1950) and Meade (1955). While the new regionalism focuses more on broader issues such as the linkages between trade and productivity, the role of FDI, productivity growth and the integration between developed and developing countries.

Among the Regional Trade Agreements, it is found that, a large majority of the agreements are shallow integration agreements, for example, PTAs or FTAs. In contrast, only a handful of Customs Unions, Common Markets, and Economic and Monetary Union are found worldwide. Most of the deep integration arrangements are found in Europe. The Maastricht Treaty and the EU Single Market programme provide examples of deep integration schemes. The ANDEAN Pact[1] and the Central American Common Market (CACM) are examples of Preferential Trade Agreements. The North American Free Trade Agreement (NAFTA) and the ASEAN Free Trade Agreement (AFTA) provide examples of FTAs. MERCOSUR (Mercado Comun Del Cono Sur) is an example of a customs union.

1.3 Proliferation of Regional Trade Agreements

Regional Trade Agreements have increased significantly in recent years. Apart from removing tariffs on intra-bloc trade in goods, the newer agreements aim to have deeper coverage. The following emerging trends have been noted in regional trade integration (Crawford & Fiorentino, 2005).

First, countries are increasingly attempting to make RTAs a central objective of their trade policy and giving priority over multilateral trade objectives. Second, RTAs are becoming more complex, in many cases establishing regulatory regimes

that go beyond multilaterally trade regulations. Third, the emergence of trade agreements between key developing countries may indicate a strengthening of 'South–South' trading cooperation. Fourth, RTAs are expanding and consolidating. The number of cross-regional RTAs is increasing and they account for a large proportion of the total increase in RTAs. In addition, regional trading blocs that span continents are being proposed.

WTO (2003) highlights two broad emerging trends. First, many countries which traditionally relied on multilateral trade regime are increasingly joining regional agreements to promote trade. Second, a number of continent-wide big trade blocs like the Free Trade Area of the Americas (FTAA) or the Euro-Mediterranean FTA are under negotiation. Once these negotiations are finalized, a significant share of global trade flow will be diverted through these mega trade blocs.

Several of the new RTAs, proposed by developed countries, include more regional rules on investment, competition, and standards and provisions for the environment and labour. Most of these new agreements also include preferential regulatory frameworks for mutual services trade.

RTAs are also becoming increasingly less regional since many countries appear to be looking for preferential partners beyond their regional borders. Traditionally, RTA formation took place between 'natural' trading partners, neighbouring countries with already well-established trading patterns. For example, Australia and New Zealand, the NAFTA countries, the EC, the European Free Trade Association (EFTA), and Central European Free Trade Agreement (CEFTA) belong to this category. It should be mention that most countries sign their first RTA with one or several neighbouring or regional partners. South East Asian countries' participation in ASEAN, sub-Saharan African groupings such as the Economic and Monetary Community of Central Africa (CEMAC) or Southern Africa Customs Union (SACU) or the Western Hemisphere groupings of Central America Common Market (CACM), the Caribbean Common Market (CARICOM) and MERCOSUR (Mercado Comun del Sur) provide examples (Fiorentino, Verdeja, Toqueboeuf 2007). These regional groups are making efforts to deepen intra-regional integration.

RTAs differ considerably in terms of their scope and depth. Some are for the exchange of tariff preferences on a limited range of products, others are attempting to remove tariffs on a wide range of products. Other RTAs integrate several regulatory regimes including common currency provisions and fiscal policy.

The diversity and complexity of RTAs is increasing with overlapping RTAs and networks of RTAs spanning within and across continents at the regional and subregional levels. An important aspect of the proliferation of RTAs is that their configurations are changing overtime. There has been a decrease in the number of plurilateral RTAs and a net increase in the number of bilateral and cross-regional RTAs. Bilateral agreements account for 80% of all RTAs notified and in force; 94% of those signed and under negotiation; and 100% of those at a proposal stage (Fiorentino et al., 2007).

Table 1.1 provides Notified RTAs in goods and services by date of entry into force and type of partner as of December 2006. Besides RTAs among transition economies, the major clusters of RTAs are North–South followed by South–South

Table 1.1 Notified RTAs in goods and services by date of entry into force and type of partner as of December 2006

Developed only			Developed developing		Developed transition		Developing Only		Developing transition		Transition only		Total	
	g	s	g	s	g	s	g	s	g	s	g	s	g	s
1958–64	2	1					1						3	1
1965–69							1						1	
1970–74	5		1				2						8	
1975–79			3				1						4	
1980–84	2		1				1						4	
1985–89	1	1	1				2						4	1
1990–94	3	2	3		4		6		1		4		21	2
1995–99	3	1	7	1		2	6	4	2		17		35	8
2000–2		1	11	5	4		11	5	3		6		35	11
2003–6	3	1	18	14		1	12	6	2		19		54	22
Total	19	7	45	20	8	3	43	15	8	0	46	0	169	45

Source: Fiorentino et al., 2007.
g-goods
s-services

RTAs accounting for 27 and 25%, respectively, of the total number of notified RTAs in goods. In terms of Economic Integration Agreements (EIAs), N–S and S–S agreements account for 44 and 33%, respectively**.** Both of these clusters will be expanded given that almost all of the RTAs in the making fall under these two categories (Fiorentino et al., 2007).

1.4 Global Development of RTAs

A closer look at the development of RTAs within the region, and across regions provides additional information on the global development of RTAs.

Europe has the largest number of RTAs. Almost half of the agreements are notified to the WTO and are in force. The main regional groupings are the European Union (EU) and the European Free Trade Association (EFTA). South-Eastern Europe is consolidating into a third trading group under the auspices of the Stability Pact.[2] The EU accession negotiations with Croatia were officially launched in October 2005 (along with Turkey). In the Mediterranean basin, the establishment of a Euro-Mediterranean FTA between the EU and its Mediterranean partners made further progress in June 2005. The EU continues to expand its RTA negotiations beyond its immediate neighbourhood. These include FTAs with MERCOSUR, the Gulf Cooperation Council (GCC) and the six Economic Partnership Agreements (EPAs) with sub groupings of the African Caribbean and Pacific (ACP) countries. The EU has also taken an interest in starting new FTA negotiations with the Republic of Korea, India and the countries belong to the ASEAN, the Central American Common Market (CACM) and the COMUNIDAD ANDINA (CAN) as partners. As for the EFTA States, their FTAs with Tunisia and the Republic of Korea entered into force in June 2005 and September 2006 respectively and an FTA with the SACU countries was signed in June 2006. EFTA States opened FTA negotiations with Thailand in 2005 and with GCC countries in 2006 (Fiorentino et al., 2007).

The United States is also expanding the number and regional locations of its RTAs. It has signed FTAs with Colombia, Peru and with five Central American countries and the Dominican Republic-Central American Free Trade Agreement (DR-CAFTA).[3] It has pursued negotiations with Ecuador and Panama and made deals with some Northern African and Middle Eastern countries, as part of its Middle East Free Trade Initiative. In Asia-Pacific, the United States has opened FTA negotiations with the Republic of Korea and Malaysia in order to strengthen ties with ASEAN countries (Fiorentino et al., 2007).

The other two NAFTA members are also active in RTA negotiation. Canada has opened FTA negotiations with the Republic of Korea and is considering possible FTAs with the Caribbean Community and Common Market (CARICOM), MERCOSUR and the Dominican Republic. Canada has signed an FTA with Japan. It has also started FTA negotiations with Singapore (Fiorentino et al., 2007).

Countries in Central and South America are also negotiating RTAs across a wide range of regions. Panama has concluded an FTA with Singapore and CARICOM has ratified agreements with Cuba and Costa Rica. Chile is increasing its FTA

network under the Trans-Pacific Strategic Economic Partnership (SEP-4) which includes New Zealand, Brunei and Singapore. All of these FTAs were in place as of November 2006. Chile has also signed an FTA with China, and a framework agreement for a possible FTA with India. MERCOSUR has signed a framework agreement for possible FTAs with the GCC, India, Israel, Egypt, Morocco and the SACU (Fiorentino et al., 2007).

Efforts for regionalism have also occurred in the Asia-Pacific region. At a country level, Japan has taken several initiatives to establish RTAs. Developments since 2006 suggest that it has expanded its partnerships focus from Asian countries to cross-regional partners.[4] Japan has an FTA with Mexico and has launched negotiations with Chile and the GCC countries. In early 2007, it started FTAs negotiation with Vietnam and has initiated studies for FTAs with Australia, India and Switzerland. The Republic of Korea, in addition to its FTAs with Chile and the EFTA States, has signed an FTA with Singapore. It has launched negotiations with ASEAN, Canada, the United States, India and Japan, and it is considering FTAs with Australia, MERCOSUR, Mexico and the EU. China, an emerging economy has also adopted this trade strategy. It has signed an FTA with Chile and Pakistan, and started negotiations with the GCC, Singapore, Australia, and New Zealand. China is also considering an agreement with India. The ASEAN group is negotiating with India, Japan, Australia and New Zealand, as well as considering an FTA with the Republic of Korea and the EU. At the same time, some ASEAN countries (Singapore, Thailand and Malaysia) are negotiating individual agreements. Singapore has established FTAs with Jordan, India, the Republic of Korea, and Panama. It is negotiating a FTA with Canada, China, Mexico, Pakistan, Peru. Thailand has also become an active RTA player in recent years. Its FTAs with Australia and New Zealand have started to operate. It has concluded a framework agreement with India and signed an FTA with Bahrain. Thailand is currently negotiating FTAs with the EFTA States, Japan, Peru and the United States and is considering FTAs with Chile and Pakistan. Malaysia has signed an FTA with Japan and a partial scope agreement with Pakistan. It is negotiating FTAs with Australia New Zealand and the United States and is considering an FTA with India. In South Asia, SAARC members are implementing the South Asian Free Trade Area (SAFTA). Beside regional initiatives, India and Pakistan are also very keen to have an RTA. In addition to its FTA with Singapore, India has signed an FTA with Mauritius and has partial scope agreements with Chile, MERCOSUR, SACU and Thailand. In addition, India is in FTA negotiations with ASEAN, the GCC countries and the Republic of Korea. Pakistan has concluded an FTA with Sri Lanka and China, and a partial scope agreement with Malaysia. It is negotiating FTAs with the GCC and Singapore, and is considering an FTA with Indonesia (Fiorentino et al., 2007).

1.5 Economic Integration in East and South East Asia

In the last section, we have mapped various global developments of RTAs and type of regional economic integration already negotiated or being negotiated around the

world. We now turn to East and South East Asia, our territory of study for more in-depth analysis.

East and South East Asian economies have grown rapidly over the last few decades, driven by the expansion of international trade and foreign direct investment. Although not yet having formed a legal economic integration as a whole, as seen in North America and Europe, the growth in intraregional trade has been higher than in these two counterparts. East and the South East Asia's increased trade and investment linkages are due to unilateral reforms, and the fragmentation and relocation of production processes that has arisen since the mid-1980s (Kawai & Wingaraja, 2008a). East and South East Asia's economic development has moved toward regional economic cooperation and integration. Even without the support of formal regional trade agreements, countries in East and South East Asia achieved lowered barriers to intra regional trade, increased trade both within the region and with world markets, diversification of production and trade, increased foreign direct investment and growth and lower average tariff rates than most other regions.

Economic integration in this region has been market-driven, with private activities as the primary and public policies as secondary in the early stages. Recently, however, new efforts in institution-driven integration are being initiated to further accelerate or complement the market-driven integration in East and South East Asia. The region has witnessed a rapid expansion of regional economic cooperation programs through bilateral and plurilateral FTAs. Recent developments in individual economies such as: China's rapid export-driven growth performance and entry into the WTO, Japan's prolonged recession and desire to regain its leadership role in the region, the Republic of Korea's change toward a more liberalized economic system, and Singapore's active role to become a hub of regionalism, can be considered as additional factors behind the strategic change in East and South East Asian regionalism.

1.5.1 FTA in East and South East Asia—A Brief History

The two major East and South East Asian efforts at economic integration and cooperation are the Association of Southeast Asian Nations (ASEAN) and the Asia-Pacific Economic Cooperation forum (APEC).

1.5.1.1 APEC

APEC was established in 1989 to further improve economic growth and prosperity in the region and to strengthen the Asia-Pacific community. It is the premier forum for facilitating economic growth, cooperation, trade and investment in the Asia-Pacific region. APEC is the only inter governmental group operating on the basis of non-binding commitments, open dialogue and equal respect for the views of all participants. Unlike the WTO or other multilateral trade bodies, APEC has no treaty obligations required of its members. Decisions made within APEC are reached by consensus and commitments are undertaken on a voluntary basis. APEC

has 21 members–referred to as 'Member Economies'. These economies account for approximately 40.5% of the world's population, 54.2% of world GDP and approximately 43.7% of world trade (APEC, 2009). Since its inception, APEC has worked to reduce tariffs and other trade barriers across the Asia-Pacific region, to create efficient domestic economies and to substantially increase the volume of exports. APEC's vision is to liberalize trade and investment in the Asia-Pacific by 2010 for industrialized economies and 2020 for developing economies. These goals were adopted by Leaders at their 1994 meeting in Bogor, Indonesia (The Department of Trade and Foreign Affairs, 2008).

Since APEC's inception it has had a favorable impact on trade and GDP growth. APEC′s total trade has grown 395%, significantly more than the rest of the world. In the same period, GDP (in purchasing power parity terms) in the APEC region has tripled, while GDP in the rest of the world has less than doubled. The Asia-Pacific region has thus been one of the most economically dynamic regions in the world (The Department of Trade and Foreign Affairs, 2008).

APEC works in three main areas: Trade and Investment Liberalisation, Business Facilitation, and Economic and Technical Cooperation. These activities have been the drivers of rapid economic growth, job creation, and increase in the standard of living for people of the region.

1.5.1.2 ASEAN

In 1967 the Association of South East Asian Nations or ASEAN was established. The five original member countries were the Philippines, Indonesia, Malaysia, Singapore, and Thailand. ASEAN was extended in 1984 to include Brunei Darussalam, Vietnam in 1995, both Laos PDR and Myanmar in 1997 and Cambodia in 1999. Enhanced integration between the ASEAN countries already commenced early on, starting in 1977 with the *Agreement on ASEAN Preferential Trading Arrangement*, amended in 1995. Since then, the relations between member countries of ASEAN have grown and deepened both in scope and importance. These relations include among others trade, investment, customs, and intellectual property (European Commission, 2008). Table 1.2 presents a historical overview of these relations and agreements between the ASEAN member countries. As of 2006, the ASEAN region had a population of 560 million, an total area of 4.5 million square kilometers, a combined gross domestic product of almost US$ 1,100 billion, and total trade of about US$ 1,400 billion. Tariffs for goods covered by the agreement were lower than the MFN (most favoured nations) tariff, but not necessarily zero (ASEANSEC, 2009).

The aims and purposes of the ASEAN are: (i) to accelerate the economic growth, social progress and cultural development in the region through joint endeavours in the spirit of equality and partnership in order to strengthen the foundation for a prosperous and peaceful community of Southeast Asian nations, and (ii) to promote regional peace and stability through abiding respect for justice and the rule of law in the relationship among countries in the region and adherence to the principles of the United Nations Charter (ASEANSEC, 2009).

Table 1.2 Historical overview of ASEAN relations and agreements

Year	Agreements
1967	ASEAN is formed by the Philippines, Indonesia, Malaysia, Singapore and Thailand
1977	Agreement on ASEAN preferential trading arrangement (implemented in 1977 and further extended in 1987)
1984	Brunei joins ASEAN
1992	Agreement on the ASEAN free trade area
1992	Agreement on the common effective preferential tariff scheme for the ASEAN free trade area
1992	Framework agreements on enhancing ASEAN economic cooperation
1995	Vietnam joins ASEAN
1997	Laos PDR and Myanmar join ASEAN
1999	Cambodia joins ASEAN
2003	Declaration of ASEAN Concord II (Bali Concord II); ASEAN Economic Community

Source: European Commission, 2008.

Economically, steps have been taken to reduce trade barriers between member states. In 1992, ASEAN members agreed to form the ASEAN Free Trade Area (AFTA). In the early and mid-1990s, foreign investment in the region grew rapidly. However, the pace of integration slowed because member states were reluctant to take steps that would lower the tariffs of protected industries and expressed concerns about national sovereignty. Further, the economic crises of 1997 hit these economies severely. AFTA was signed by Brunei, Indonesia, Malaysia, the Philippines, Singapore and Thailand in 1992 and came into force on January 1, 1993. At that time it covered a selection of non-agricultural goods, known as the 'inclusion list'. Trade will eventually be completely liberalized within ASEAN members, with only a few exceptions allowed to remain permanently as stated in the AFTA. During the implementation period the member countries enjoyed some freedom in identifying the products they granted preferences on and in setting their preferential tariffs.

Each country excluded some products temporarily, and a few products were on a 'general exclusion list'. The preferential tariff is called 'Common Effective Preferential Tariff' (CEPT). It included products that were either on a 'fast track'-list or on a 'normal track' list. For fast-track-products, tariffs above 20% had to be reduced to 0–5% by 2003, and other tariffs had to be reduced to this level by 2000. Tariffs below 20% had to be reduced to 0–5% by 2003. For normal-track products, tariffs above 20% had to be reduced to 20% by 2001 and to 0–5% by 2008. Members were free to set tariffs until the end of the implementation periods, but encouraged to use a linear tariff reduction formula (ASEANSEC, 2007).

In 1995, the six members amended the 1992 agreements to include agricultural products and the timeframe for tariff reductions. Tariffs were to decrease to 20% by 1998, instead of 2001, and to 0–5% by 2003, instead of 2008. In 1999, a protocol was signed which defined country-specific sensitive and highly-sensitive agricultural products. Those were implemented into the CEPT scheme until 2001

and 2003, and tariffs for sensitive products have to be reduced to 0–5% until 2010 and 20% for highly-sensitive products (ASEANSEC, 2007).

Economic integration increased with the signing of the 2003 Protocol for Elimination of Import Duties. In 2003, members agreed that tariffs for all products of the inclusion list should be abolished by 2010. By 2003, significant tariff reductions had been made among the members. Tariffs on 99.55% of products mentioned on the Inclusion List of 2003 have been reduced to below 5% or removed altogether. This mostly holds for the original six signatories; Brunei, the Philippines, Singapore, Thailand, Malaysia, and Indonesia. However, the other member countries of ASEAN are not far behind this target. The ASEAN countries have not only agreed on reducing or eliminating tariffs under the CEPT Scheme, they have also agreed upon Rules of Origin. In 2004, sector-specific agreements were concluded. This provided for increased tariff reduction for most products within a list of sectors.

Investment in the region had increased substantially in 2005. However, some countries, such as Singapore and Malaysia, receive significantly more investment than other countries within the organization. In addition, intra-ASEAN trade remains only a small part of ASEAN's total trade. The ASEAN members faced other challenges such as extreme poverty found in many of the countries and the continuation of military regime in Myanmar (ASEANSEC, 2007).

ASEAN Vision 2020

In 1997 the ASEAN countries continued the process of economic integration by establishing a vision and outlook for the year 2020. Their vision is to have a Zone of Peace, Freedom, and Neutrality for the ASEAN countries. The pathway chosen to reach this vision is to expand the economic integration of member countries. It is hoped that by 2020 an ASEAN Economic Region can be established that is a Free Trade Area for member countries.

ASEAN+3

At present, the most important framework for economic integration in East and South East Asia is ASEAN+3 (ASEAN+3).

The ASEAN+3 cooperation began in December 1997 at an informal summit among the leaders of ASEAN and their counterparts from East Asia that is China, Japan and the Republic of Korea. The ASEAN+3 process was institutionalized in 1999 when the Leaders issued a Joint Statement on East Asia Cooperation at their third ASEAN+3 Summit in Manila. In this statement ASEAN+3 leaders expressed determination in strengthening and deepening East Asia cooperation at various levels and in various areas, particularly in economic, social and political areas (ASEANSEC, 2009).

Substantial progress has been made in the areas of economic, monetary and financial cooperation. Total trade value between ASEAN and the +3 Countries has been increasing over time reaching US$ 195.6 billion in 2003 compared to US$170.8

billion in 2002 (14.49% growth in trade). Bilateral trading arrangements between ASEAN and China and ASEAN and Japan and ASEAN and the Republic of Korea have been established. These arrangements will serve as the building blocks for the possible establishment of an East Asia Free Trade Area (EAFTA). In terms of financial cooperation, a regional financing arrangement called the 'Chiang Mai Initiative'[5] (CMI) has been in place. The CMI consists of an expanded ASEAN Swap Arrangement (ASA) and a network of bilateral swap arrangements (BSAs) among ASEAN members.

Significant progress has been achieved in developing the Asian Bond Market Initiative (ABMI) for China, Japan and the Republic of Korea. ASEAN+3 countries are taking initiatives to alter existing regulations to help the issuance of and investment in local currency denominated bonds under the ABMI.

1.5.2 Factors Affecting FTA Initiatives in East and South East Asia

Three major factors are responsible for FTA initiatives. These are (i) the deepening of market-driven economic integration; (ii) the progress of European and North American economic integration; and (iii) the Asian financial crisis (ADB, 2007).

First, the expansion of regional economic linkages and interdependence is the most important reason for recent initiatives for institutional cooperation to support economic integration in Asia. East Asia has long enjoyed market-driven integration through trade and foreign direct investment. It has traditionally worked through a multilateral liberalization framework under the GATT/WTO and through APEC. The degree of regional economic integration through trade in East Asia has increased rapidly over the last twenty-five years (Hasmi & Lee, 2008).

Recent economic cooperation has increased the foreign direct investment flow to East Asia. Recently, firms in the Asian newly industrialized economies (NIEs) i.e. the Republic of Korea, Taiwan, Singapore and Hong Kong have been investing in ASEAN and China (ADB, 2007; Hasmi & Lee, 2008).

Second, the success of economic regionalism in Europe (EU) and North America (NAFTA)—has encouraged the East and South East Asian economies to pursue regional trade arrangements. Governments in this region recognise that the two giant blocs—the European Union and the United States—might dominate the global trading system and minimize the role of Asia in global competition and multilateral negotiations. They realised that uniting and consolidating themselves through a process of integration would strengthen their bargaining power and make them a major economic force. They could be a powerful group to voice the region's views on global trade issues (Hasmi & Lee, 2008).

Finally, the 1997–1998 Asian financial crisis had made them aware of the necessity to strengthen monetary and financial cooperation. The region must establish its own 'self-help' mechanism for economic management. This financial crisis encouraged the development of the sense of a 'region' to brave a common set of challenges (Hasmi & Lee, 2008).

Let us discuss the features of East and South East Asia's RTA.

1.5.3 Features of Existing RTAs in East and South East Asia

Diverse geometry: RTA partners range from bilateral to plurilateral. Plurilateral agreements include ASEAN/AFTA, ASEAN+1, ASEAN+3 as well as agreements with other regional groupings such as the EFTA, GCC, SACU and MERCOSUR. Theoretically, these RTAs are discriminatory and have negative trade diversion effects on excluded countries and are thus the second best options to multilateralism (Yue, 2007).

Diverse geographical partners: Geographical proximity traditionally facilitates trade, but due to technological innovation in transport and telecommunications, geographic distance is no longer the trade barrier. RTAs are found to exist not only among ASEAN countries, between ASEAN and northeast Asia, but also between East Asian countries and countries in the Americas, Europe, Middle East, Africa, South Asia and Oceania (Yue, 2007).

Diverse economic partners: RTAs have diverse economic partner. Economic complementarity between north–south economies encourages inter-industry trade, particularly between high tech manufacturers and primary commodity producers, for example, the Japan-ASEAN partnership. The south partners benefit from FDI and technology transfers from the north.

Comprehensive scope and coverage: In some FTAs in East Asia, 100% of the bilateral trade and tariff lines are included for immediate liberalization for market access. Singapore-New Zealand and Singapore-Australia are examples of such cases. In other situation, the percentage coverage is less, and the tariff elimination is phased out over a period, usually 10 years. Agreements also vary in the length of the exclusion lists (Yue, 2007).

ASEAN as hub: AFTA was the first FTA uniting the countries of Southeast Asia. No comparable grouping in the economically advanced Northeast Asia exists. There are agreements and/or proposals for FTAs/EPAs between ASEAN and separately with the three northeast countries—China, Japan and the Republic of Korea. These agreements will make ASEAN a hub in the region (Yue, 2007).

Multiple and overlapping RTAs: As RTAs differ in their rules of origin, however, the rapid increase of multiple and overlapping RTAs creates a 'spaghetti bowl', affecting business transaction costs and potential economies of scale (Yue, 2007).

1.5.4 FTA Initiatives in East and South East Asia

In the formation of an 'East Asia Free Business Area,' Japan, China and the Republic of Korea are pushing forward FTA-based integration, with the ASEAN Free Trade Area acting as a hub (Zhao, 2007). Here we shall discuss briefly these initiatives.

1.5.4.1 China-ASEAN

China-ASEAN trade and economic relations have passed through several stages. During the first stage (from 1967 to 1990) the relations between two has experienced

from mutual suspect to mutual understanding and trust. China and ASEAN began to gradually strengthen mutual understanding through bilateral activities, especially in the late 1970s and early 1980s when China changed its foreign policy. China established diplomatic relations with all ASEAN members by 1991 for future cooperation.

The second stage covers the period from 1991 to 2001. During this period, political and economic relations between China and ASEAN increased very quickly. In 1997, both sides issued a joint declaration on building a good-neighborly partnership oriented to the 21st century (Zhao, 2007).

The third stage is from 2002 to the present. In 2002, the both sides signed the Framework Agreement on China-ASEAN Comprehensive Cooperation, with the purpose of forming the China-ASEAN Free Trade Area by 2010. In 2003, China joined the Treaty of Amity and Cooperation in Southeast Asia, becoming the first non-ASEAN signatory to the treaty. In 2004, all ASEAN members unanimously recognized China's full market economy status and signed the Agreement on Trade in Goods of the Framework Agreement on Comprehensive Economic Cooperation with China. In July 2005, the 'early harvest trade in goods' programme came into effect. Early Harvest Package, which includes market access and economic cooperation activities particularly in the five priority areas identified i.e. agriculture, investment, information and communications technology, human resource development and the Mekong Basin development (Greenwald, 2006). In 2007, both sides signed the Agreement on Trade in Services. These agreements have resulted in China and ASEAN developing a close economic relationship.

CAFTA brings direct benefits to both China and ASEAN. It decreases the transaction cost between the two. These reductions bring direct benefits to the producers and consumers from both sides. The first ASEAN+China summit was held in 1997. The framework agreement on China-ASEAN comprehensive cooperation was signed in 2002. In addition the agreement on trade in goods and dispute settlement mechanism was signed in 2004. Finally, an agreement on trade of services was signed in 2007 (Zhao, 2007).

The development of the China-ASEAN trade and economic relationship has important implications for the whole region. It alters the economic pattern in the region, enlarges the regional internal market, and develops the construction of the regional institution, which helps expand the regional economic scale and improve the regional integration.

1.5.4.2 Japan-ASEAN

A comprehensive free-trade agreement between Japan and the 10-member ASEAN came into force on December, 2008. The FTA includes goods, services and investment. It enables Japanese companies that are expanding their markets in Southeast Asia to reduce their trade costs. For example, the tariffs on Japanese exports from one ASEAN country to another will be removed. In particular, electronics and automobile manufacturers will benefit from this agreement as parts from various countries in the region can be assembled without tariffs being levied. Japan will

repeal tariffs on 93% of the imports from ASEAN by value within 10 years of the deal. Meanwhile, six major ASEAN members—Brunei, Indonesia, Malaysia, the Philippines, Singapore and Thailand—will eliminate tariffs on 90% of imports from Japan, including automobiles, within 10 years. A more gradual tariff elimination table has been set for the remaining four ASEAN members with smaller economies—Cambodia, Myanmar, Laos and Vietnam. The deal with ASEAN, signed in April 2008, is Japan's eighth FTA, following bilateral agreements with Singapore, Mexico, Malaysia, Chile, Thailand, Indonesia and Brunei (Kyodo News, 2008).

1.5.4.3 Republic of Korea-ASEAN

The Republic of Korea free trade agreement covering goods with nine of the ten members of Association of Southeast Asian Nations took effect on June 1, 2007. Thailand, the world's top rice exporter, refused to join the agreement to protest Seoul's insistence on excluding rice (Oryza, 2007). According to the final tariff concession schedule for goods, the Republic of Korea and ASEAN will eliminate tariffs on products constituting 90% of their respective imports by 2010. The products making up the other 7% of imports are to have their tariffs lowered to 0–5% by 2016. Taking into consideration the sensitive nature of the products making up the remaining 3%, items under this group are eligible for receiving protection through various measures, such as exemption from concessions, long-term tariff reduction schemes, and tariff rate quotas (TRQ). In particular, with the elimination or reduction of ASEAN member countries' tariffs on major Korean exports such as automobiles and steel products, Korean corporations are expected to secure a more advantageous position in the export market to ASEAN compared to their major competitors such as China and Japan (Oryza, 2007).

The Republic of Korea has included rice and other sensitive agricultural and marine products within the 3% category of highly sensitive products. These can receive protection through measures such as exemption from concessions and long-term tariff reduction schemes (KOREANET, 2006).

1.5.4.4 ASEAN Countries FTA in East and South East Asia

There are a number of bilateral FTA already signed by ASEAN countries individually with Japan, China and Republic of Korea or within themselves. A summary of the FTAs in East and South East Asia is presented in Table 1.3.

At the bilateral level, Thailand has made progress in her bilateral consultations and arrangements with a number of countries including Japan with a view to fostering long-term economic partnership and multilateral trade liberalization with the ASEAN countries since 1993. Thailand was one of the main countries that played an important role in the Free Trade Area development in ASEAN. The tariff reduction program has been implemented in Thailand since January 1993. The AFTA was endorsed at the Fourth ASEAN Summit in Singapore in 1992. Regarding the CEPT, Thailand reduced its average tariff rate from 10.6% in 1998 to 4.64% in 2003

Table 1.3 Growth of FTAs in East Asia, 1976–2008 (cumulative number of FTAs)

Status of FTAs				
Year	No. of FTAs	Concluded[a]	Under negotiation	Proposed
1976	1	1	0	0
1986	1	1	0	0
1996	4	3	0	1
2000	7	3	1	3
2001	10	5	2	3
2002	14	6	4	4
2003	23	9	5	9
2004	42	14	16	12
2005	67	21	30	16
2006	96	31	42	23
2007	103	37	40	26
2008[b]	108	41	38	29

Source: Compiled from Asian Development Bank Free Trade Agreement Database, Asia Regional Integration Center, www.aric.adb.org.
Notes: a. Concluded FTAs are those signed and/or under implementation; FTAs under negotiation cover those with or without a signed framework agreement; and proposed FTAs include official pronouncements of parties to negotiate an FTA, joint study groups established, and feasibility studies conducted to determine the desirability of establishing an FTA. b. Data as of 30 June 2008.

(Ministry of Commerce, 2003). This also reduced its product tariff rates to 0% on 5,337 product items at the end of 2003 (Ministry of Commerce, 2003).

AFTA is expected to influence the necessary reforms of Vietnam's trade policies. Full participation in AFTA creates opportunities for Vietnam. The possibility of expanding labor intensive exports to ASEAN markets on a preferential basis will assist the Vietnamese producers (Thanh, 2001). In July 2003, the government of Vietnam announced a revised CEPT schedule resulting in industrial adjustments as regional free trade begins to improve.

Indonesia is a founding member of the ASEAN and participates in the AFTA. With few exceptions, AFTA tariffs on intraregional trade were reduced to between 0 and 5% in 2002. Initially, 20% of Indonesia's tariff lines were excluded from AFTA reductions. Now, only 1% is excluded. Tariff reductions for certain sensitive items, such as rice and sugar, were also finalised after 2002. Reductions in Indonesia's AFTA tariff rates have closely followed reductions in MFN rates. As a result, the margin of preference for Indonesia's ASEAN trading partners has remained fairly small at about 2.5%. The margin is probably even smaller for agricultural commodities because of the sharp reduction in tariffs required by Indonesia's Letter of Intent (LOI) with the IMF (FAO, 2003).

The Philippines is firmly committed to the multilateral trading system of the WTO. However, the country is also seeking to further expand trade in the region. Following the Japan-Philippine Summit in May 2002, the Philippines is currently exploring the feasibility of establishing an economic partnership agreement with

Japan. Singapore is strongly committed to free trade and the multilateral trading system (WTO, 2008).

A free trade agreement was negotiated and implemented between Japan and Malaysia in 2006. This agreement will scrap tariffs on essentially all industrial goods and most agricultural, forestry and fishery products within 10 years. The FTA will contribute toward enhancing the cross-border flow of goods, services and capital between Japan and Malaysia. For example, Malaysia will remove tariffs on finished passenger cars with engine displacements by 2010 and smaller vehicles by 2015. It will also immediately abolish tariffs for completely knocked down auto parts for Japanese carmakers assembling vehicles in Malaysia. For farm products, Japan will eliminate tariffs on Malaysian imports of tropical fruits. The accord will cover trade in goods and services, intellectual property right protection, investment rules, competition policies, business facilitation and cooperation projects for personnel training in Malaysia. As a result both sides will gain (FTA Malaysia, 2006). Malaysia completed the legal procedures necessary for entry into the Agreement on Comprehensive Economic Partnership among Japan and Member States of the Association of Southeast Asian Nations (Japan-ASEAN Comprehensive Economic Partnership Agreement). They became a part of the agreement is of February 1, 2009. Other countries who have already entered into the agreement include Japan, Singapore, Laos, Vietnam, Myanmar and Brunei (Bernama, 2009).

1.5.5 Efforts and Time Frame for Economic Integration

The time frame for implementation of EAFTA will take into account existing benchmarks. This indicates that the developed countries of EAFTA, Japan, Republic of Korea and possibly Singapore, should move at a faster pace than the APEC. As a consequence these countries must achieve their objectives by 2010, while the remaining countries not later than 2020. For the ASEAN-6 countries, this should not be much a problem, because ASEAN-6 have targeted CEPT zero tariff by 2010 under the AFTA. The pace of liberalization of EAFTA should not take longer the pace of liberalization to which ASEAN members have already agreed under AFTA i.e. elimination of tariff by 2010 for ASEAN-6 and 2015 for the new members. CLMV (Cambodia-Laos-Myanmar-Vietnam) need more time to adjust to the required liberalization policies. Hence, some amount of flexibility and differential deadlines in their liberalization commitments should be given to these countries (Kawai & Wingaraja, 2007).

The Asian movement towards regionalization[6]—known as ASEAN 10+3, +4 or +6—is relatively new, but it may assume importance, as it includes China, Japan and the Republic of Korea. The move in the region is now towards the conclusion of free trade agreements and economic partnership agreements. All countries in East Asia, including China and Japan, are moving towards the conclusion of such agreements with other countries in the region. The potential of an East Asian free trade area may be realized by 2010. It is also expected that an East Asian multilateral regional trading community will be established by 2020 (Hew, 2006).[7]

Table 1.4 Liberalization timeframe for major economic groups in East Asia

For developing countries			
Group/FTA (Year of full negotiation completed)	For developed or partner countries	For advanced six ASEAN members	For other four ASEAN members[a]
APEC (voluntary and unilateral)	2010	2020	2020
ASEAN (1992)	–	2003 (0% tariff by 2010) ASEAN economic launched by 2015	2006–10 (0% tariff by 2015) Community to be
ASEAN+China (2010)	2007 (China)	2007	2010
ASEAN+Korea (2008)	2008 (Korea)	2010 (excl. Thailand)	2015 (flexibility allowed)
ASEAN+Japan (2007)	2010 (Japan)	2012	2018
ASEAN+India (2011)	2011 (India)	2011 (excl. Philippines)	2016 (incl. Philippines)
ASEAN+CER (Australia and New Zealand) (2009)	2010 (CER)	2017	2017

Source: Kawai & Wingaraja, 2008a.
Note: a. Cambodia, Laos, Myanmar and Vietnam.

The ASEAN Economic Community (AEC) is one of the three pillars of the ASEAN Community. It is considered the goal of economic integration as outlined in the ASEAN Vision 2020. ASEAN is expected to become a single market and production base by 2020. Free flow of goods, services, capital, equitable economic development, and reduction of poverty and socio-economic disparities are expected to be achieved (Kawai & Wingaraja, 2008a). Table1.4 presents the time frame for the major economic integration agreements in East Asia.

1.6 Environmental Degradation

Globalization triggered by free and open trade has had a considerable impact on the Asia-Pacific region. This region has emerged as an integrated economic player in the world economy. It is expected that an East and South East Asian multi-lateral regional trading community will be established by 2020. This multi-lateral regional trading community is expected to decrease the current barriers to trade between individual countries, expand the movement of goods and services between countries, and continue the economic growth within individual countries.

Economic growth has often also been accompanied by environmental degradation of both national and international environments. Climate change, ozone depletion, and deforestation are often sited as examples of environmental problems that have resulted from economic growth. This region has also been plagued

with various environmental problems as a result of rapid industrialization and trade openness.

One of the on-going debates in trade discussions is how to protect the environment when multi-lateral regional trade agreements are being negotiated. Many environmental advocates argue that freer trade harms the environment and, by fostering more trade, liberalization is environmentally unfriendly. They claim that trade policy reforms produce substantial resource depletion and environmental degradation effects. Others argue that, on the contrary, trade liberalization is beneficial to the environment. By reducing market distortions, which protect dirty industries and encourage excessive intensification of production, trade liberalization would improve environmental quality. Further, it will increase the amount of environmental-friendly technology that is adopted. This occurs because capital and technology can flow more freely under a regional trade agreement. It is also argued that increasing environmental standards in the framework of a regional trade agreement results in increased competitiveness of firms in these countries as they become more innovative in their industrial processes. Thus, the impact of trade liberalization on the environment continues to be debated (Mukhopadhyay, 2007).

The East and South East Asian region has a major stake in the global response to the challenges of environmental degradation, climate change, and clean development. At the APEC meeting in Sydney 2007, leaders agree to work through bilateral, regional and global partnerships to foster clean development and adopt the APEC action agenda. This agenda includes an APEC wide reduction in energy consumption intensity of at least 25% by 2030 and an increase in forest coverage in the region by at least 20 million hectares by 2020 (Griffin, 2007).

Rapid urbanization, industrialization, growth of sectors such as tourism, pressures exerted by agricultural land use and fish cultivation on natural land, in combination with governance issues and illegal trade are putting tremendous pressures on ASEAN natural resources and environment. Although the gravity of the situation is recognized by authorities and various initiatives and laws are in place or being developed, the capacity of authorities in many countries for environmental management is limited. More resources are needed to fight the current environmental problems. Widespread urbanization and the creation of ‘mega cities’ has directly caused mass migration, increased automobile traffic and, consequently, severe air pollution. City infrastructure is not developed adequately to address the problem of solid waste and wastewater pollution (European Commission, 2008). Deforestation has also affecting the growing economies in the region. To achieve stable and sustainable economic growth is a major concern for individual economies of the region. Increasing attention is needed to search out new approaches for “clean and sustainable” development. To address environmental issue such as climate change requires region wide or world wide cooperation.

Towards this end, the present study makes a modest effort in this area. The book estimates the economic and environmental impacts of trade liberalization in East and South East Asian countries by the year 2020.

1.7 Objective

The overall objective of the book is to provide policymakers with strategic environmental policy options for promoting sustainable development in the context of regional economic integration, identifying strategies for environmental sustainability, and poverty reduction. This research has focused on regional economic integration in Asia through the process of creating an East and South East Asian trading community.

More specifically, the objective of the study was to estimate the economic, social and environmental impacts of the development of an East Asia multi-lateral trading community. This includes estimating the economic impact of this trading community on individual country industrial output, exports and imports, and the resulting impact on poverty and the environment. The environmental impacts are estimated with a number of selective environmental indicators In addition, the impact of alternative environmental policy packages are estimated on the economic growth, industrial development, welfare, and environment of the countries under study.

1.8 Structure of the Book

The literature review is presented in Chapter 2. It analyzes studies related to the economic effects of RTAs and its sectoral and regional implications, environmental as well as poverty implications. To address these impacts the empirical research identifies different methods to evaluate these. One relies on a simulation approach based on global general equilibrium models to analyze the economic effects of policy changes due to the formation of a RTA. The other method applies econometric techniques to historical trade data and assesses the impacts of the formation of a RTA on bilateral trade flows. The review critically addresses all of the literature. The chapter continues by evaluating free trade agreement impacts on the environment, particularly addressed by those studies that use a general equilibrium framework. This would provide a picture of the gap in the trade and environment literature using different methods in East and South East Asian countries.

The features of the East and South East Asian Economies are described in Chapter 3. This chapter will present the performance of the ASEAN economy along with China, Japan, and the Republic of Korea since the 1990s. It also covers the status of environmental pollution in each country. This chapter will provide the background material for the model building and the subsequent empirical experiments to trace the direction of the future development of these economies to achieve both their economic and environmental goals.

The economic and environmental framework used in the book along with database and scenario development is described in Chapter 4. The GTAP database is augmented with an environmental database to produce a model that is used to evaluate the impact of economic integration in the region. The study uses a CGE global model which includes households, industry, government and global sectors across countries. Countries and regions in the world economy are linked together

through trade. Prices and quantities are determined through factor and commodity markets.

Apart from the theoretical framework, the chapter also includes detailed data description of GTAP, data for macro projections, and environmental data, sourced for East and South East Asian countries. The detailed regional aggregation scheme of GTAP data will also be presented. Further, the chapter provides various scenarios for the regional trade agreement. The scenarios developed are based on regional scope; for example: Within ASEAN or ASEAN-CJK or ASEAN+3, timing of tariff reductions; for example: the reduction implemented at 2010 or 2015, degree of tariff reduction; for example: 80% or 100% import tariff reduction and export subsidies, and the nature of the commodities-agricultural versus non-agricultural.

Chapter 5 discusses the economy wide impact of economic integration across the regions. It estimates the future world economy to 2020. Further, it shows the impact on output growth of each economy along with sectoral analyses; detailed sectoral export and import performance; effects on factor returns; welfare and poverty implications for the regions under different trade liberalization scenarios.

The environmental impact of economic integration is analysed in Chapter 6. It examines how the changes in the aggregate level of output, composition of that output, and inputs and technologies used, as a consequence of trade liberalization are likely to impact the environment of countries in the agreement. The analyses focus on air pollution (CO_2, N_2O, and CH_4), water pollution (BOD, COD, and Suspended Solids), and industrial waste for these countries. This chapter also uses the decomposition analysis to find the factors responsible for changes in pollution.

The study is designed to integrate both trade and environmental policies in a coherent manner so that trade related environmental policies (TREMS) and environment related trade measures (ERTM) could be coordinated so that the objectives of obtaining the gains from trade while protecting the environment could be achieved. In this context, the book suggests several policy options from the analysis which is included in Chapter 7.

Chapter 8 summarizes the major discussion in each chapter of the book and concludes. It also compares the findings of the current study with those of other Regional Trade Agreement studies.

Chapter 2
Review of Literature

2.1 Introduction

The process of globalization including trade liberalization generated a number of agreements all over the world, varying from bilateral preferential trade agreements to world-scale integrations like the European Union. Bhagwati (1993) recognizes two waves of creation of RTAs. The first one took place in the1960s and 1970s and did not spread beyond Western Europe. The second one started in the 1980s when US changed its trade policy from multilateral approach to regional liberalization of trade within RTAs. There are large number of RTAs already notified to the GATT/WTO till December 2008 and the more is expected by 2010 (detail in Chapter 1).

Free trade agreements among developing countries can facilitate and solidify regional cooperation. But trade treaties between developed and developing countries can lead to various problems for different stake holders such as consumers and producers. Further the impact on the environment due to the RTA/FTA cannot be ignored, especially for the North–South RTA or South–South RTA. The present effort thus attempts to provide a comprehensive survey in this area.

The discussion of the present chapter begins with a brief review of the existing literature on FTAs/RTAs around the world. Then the following section captures the studies on FTAs and RTAs in East and South East Asia. Finally, the survey presents the literature on the impact of trade liberalization (RTAs/FTAs) on the environment.

There are numerous studies on the impact of trade liberalization including the WTO impact, economic effects of RTAs—sectoral, regional, welfare and poverty, as well as environmental. To address all those impacts the empirical studies have used various approaches. The estimates of these impacts have been generated using primarily three approaches. First, simulation approach is based on global general equilibrium model. The second applies other quantitative methods, mainly using gravity model. The third one uses descriptive approach based on historical trade data and relationships. Other recent approaches like CEPII Mirage model and Nuno Limao type are also used by various scholars. The review of literature covers these various approaches as far as possible.

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2.2 FTAs/RTAs Around the World

The world trading system in the 1960s reflected a bipolar world with Europe and the US. These two formed blocs with some of their close neighbors, former colonies, and/or cold-war partners and with hub-and-spoke links to the rest (World Bank, 2005). Europe and the US dominate their blocs—the other countries belong to these blocs. In the 1970s, a realignment of world trade began. The major changes in world trading patterns occurred. The earlier European and US-centered blocs ended. Diversification of trade by countries formerly closely linked to either Europe or the US took place. Both the European and North American blocs concentrated more on their core countries and immediate peripheries. The East and Southeast Asia emerged as a new trade bloc—a major force in world markets. This bloc has a bigger share of total world trade than North America. In the 1980s, the realignment of world trade continued and the various trade blocs formed. In addition to the EU and North America, the new East and Southeast Asian bloc expanded and solidified, with increasing links to the US. The trade shares for Europe and North America within bloc rose, while the European bloc expanded by one region to include Mediterranean countries in North Africa ('rest of MENA'). The North American bloc did not change composition. Researchers were involved in assessing the implications of these developments (World Bank, 2005).

A number of variants of the gravity model have been used in several studies to assess the effects of RTAs. Braga, Safadi, and Yeats (1994) using gravity model showed that if the Americas were to employ EU level of trade integration, shares of intra-member trade is expected to increase from 41.1 to 62.5%. Zahniser et al. (2002) analyzed the impact of NAFTA and MERCOSEUR on US agricultural exports to the region. They concluded that NAFTA did not have a significant impact on US trade with Canada while MERCOSEUR had a trade diversion impact on US agricultural export to Brazil, especially on wheat. Dee and Gali (2003) examined large number of RTAs and found that many of them have negative net trade effects where trade diversion from non-members are greater than trade creation among members. In addition, more liberal RTAs such as the EU and NAFTA did not have significant positive impact on members' trade when compared to other less liberal agreements.

Some of the studies used a computable general equilibrium model to explore the magnitude of the potential gains from economic integration. Hoekman and Konan (1999) find that a free trade agreement between the European Union and Egypt limited to goods could raise welfare by around 4% while an agreement that reduced barriers to services in Egypt could raise economic welfare by over 13%. Similarly, Brenton, Tourdyeva, and Whalley (2002) find that an EU-Russia FTA limited to tariff removal would increase welfare marginally while a comprehensive agreement removing technical barriers to trade in goods and services would raise welfare significantly.

For over three decades Sub-Saharan African (SSA) countries have had an interest in regional integration initiatives to accelerate their industrialization and growth. Yeats (1998) shows that Preferences for African intra-trade do not appear to have

the potential to make an important impact on these countries' trade due to high non-complementarity of the region's exports and imports, and the lack of appropriate infra-structure. The study suggested that trade reforms, implemented on a general most-favored nation basis, are a better strategy for African development.

Yeboah et al. (2007) develop gravity models to estimate and predict the potential bilateral trade flows between US and CAFTA countries using the panel data. All the six CAFTA countries except Costa Rica are trade creators. The study has also revealed the importance and positive effects of differences between resource endowment, relative size of the economies, and exchange rates on trade flows. Results concluded that Free Trade Agreement will lead to an expansion of trade between the United States and the DR-CAFTA countries. But it will benefit the US producers from the agreement, given the already low duties on agricultural imports from these countries to the US and the relatively high duties placed on the US agricultural exports.

Rivera and Ramagosa (2007) use a top-down macro–micro approach to estimate the effects on poverty and income inequality of two major trade agreements in Central America: DR-CAFTA and EU-CAAA (European Union–Central American Association Agreement). They assess the main changes in factor and goods prices associated with each trade agreement, and then combine this information with household surveys for Costa Rica and Nicaragua. Headcount poverty is reduced in both countries, although DR-CAFTA provides the largest decreases. Inequality in Costa Rica remains unchanged with both agreements, although it increases slightly in Nicaragua under the EU-CAAA

Drogué, Pyykkönen, and Virolainen (2008) assess the impacts of different levels of a trade agreement between Russia and the European Union using GTAP. The scenarios consider three levels of agreement between the two: a 'minimum' agreement, a total liberalisation except for sensitive products and the creation of a free trade area with the abolition of all protection between the two blocs. They have drawn several conclusions. A free trade agreement between the EU and Russia leads to welfare loss for Russia even if combined with multilateral trade liberalisation because of adverse terms of trade. As the industrial sector is the most important in the composition of trade of these two economies, it is also the sector which gains most. In agro-food, gains are more modest in absolute terms. Increases in trade in relative terms are significant for dairies, meats, cereals, fisheries and food for Russia; meats, dairies and other crops for the EU.

Kinnman and Lodefalk's (2008) study analyses the potential effects from unilateral trade liberalisation, using a CGE-model with monopolistic competition. They address the tariffs, subsidies, services barriers and trade facilitation, and non-tariff-measures (NTM) in a simulation. The effect of a 'Global Baltic' would be a substantial boost to national income and trade of the region (1 and 0.9% increase in regional income, in the main and the NTM-scenario, respectively). Particularly strong results are found for the group of emerging economies. The largest income gains stem from a country's own liberalisation. With respect to the different simulation elements, trade facilitation and reductions in NTMs bring the major sources of gains.

Jensen, Baltzer, Babula, and Frandsen (2007) estimate the economic effects on the world and Danish economies of the Non-Agricultural Market Access (NAMA) negotiations. They used the GTAP model and database to simulate trade shock scenarios that mimic WTO's 'August 2004 NAMA Framework'. They use the economic impacts of the proposed NAMA tariff reductions, with and without the developing country flexibility rule. Results suggest that modest NAMA-induced effects—relatively small average tariff reductions increase global trade by about 1% and global welfare by just over 9 billion US$. Trade would expand for most observed sectors, but vary across the sectors. Large gains would be realized for the textile and clothing sectors. A number of Asian countries would benefit from the NAMA tariff reductions. The NAMA tariff reductions with flexibility would generate modest increases in Danish trade and produce a slight improvement in the trade balance. It would also shift Danish trade patterns from the EU and EFTA markets towards other world markets. The removal of the developing country flexibility rule would increase global welfare by 26%, with the largest gains occurring in the Asian countries. The removal of the flexibility rule has virtually no impact on the Danish welfare.

There are couple of studies dealing with the East–West trade agreements. Plummer (2002) looks at economic integration between the EU and ASEAN and also at trade integration within these regions. He used an econometric gravity model to show that the EU-ASEAN relationship is stronger than one would predict based on economic factors. He also showed that the EU trade policy has not been particularly conducive to building the partnership.

An attempt has been made by Antimiani, Mitaritonna, Salvatici, and Santuccio (2008) to estimate a set of trade restrictiveness indices for six major agricultural trading countries, such as Brazil, China, and India among developing countries, and the EU, Japan and the US among developed countries. The overall level of protection of these six markets is assessed through the uniform tariff equivalent of different trade policy instruments that would generate the prevailing level of trade (MTRI). A GTAP model is used with imperfect competition as well as the bilateral tariffs. Results show that developing countries appear to be substantially restricted in their trade with the EU, Japan, and the US.

Jugurnatha, Stewarta, and Brooks (2007) examine the effect of trade creation and trade diversion using a gravity model. Annual data from 26 countries covering five RTAs in the Asia and Pacific region for the years 1980–2000 were used. The results show that the effects of the different RTAs varied significantly. The ASEAN and the Australian and New Zealand Closer Economic Relations (CER) promoted larger trade with trading partners and with the rest of the world. While the APEC, MERCOSUR and the NAFTA tended to be trade diverting.

2.3 FTAs/RTAs in East and South East Asian Region

A number of studies attempted to address Regional Trade Agreements (RTAs) focusing primarily on the East and South East Asian Region.

Implications of accession to the WTO are addressed by scholars [Lejour (2000), Ianchovichina and Walmsley (2003) on China and Abbott et al. (2007) on Vietnam]. Lejour (2000) focuses on the impact of China's accession to the WTO. Worldscan[8], a general equilibrium model, has been used. The study concentrates on the sectoral production within China and its main trading partners. The result shows that China benefits much more from trade liberalization if other countries also reduce their trade barriers. A Chinese unilateral action would mainly benefit other countries in East and South–East Asia. Within China, the sectors Wearing Apparel and Electronic Equipment would expand. Similar issue using a dynamic GTAP model is attempted by Ianchovichina and Walmsley (2003). China will be the biggest beneficiary of accession, followed by the industrialized and newly industrializing economies (NIEs) in East Asia. By contrast, developing countries in East Asia are expected to incur small declines in real GDP and welfare as a result of China's accession. This will occur because with the elimination of quotas on Chinese textile and apparel exports to developed countries China will become a formidable competitor in areas in which these countries have comparative advantage. With the WTO accession China will increase its demand for petrochemicals, electronics, machinery, and equipment from Japan and the NIEs, and farm, timber, energy products, and other manufactures from the developing East Asian countries.

Abbott, Bentzen, and Tarp (2007) examine Vietnam's past experience with economic integration as a basis for predicting the economic impact of WTO accession, and whether this accession will accelerate economic growth and poverty reduction. It explores Vietnam's experience with bilateral trade agreements and compares the results with predictions from the other computable general equilibrium models. Those assessments have greatly underestimated the impact of past agreements. They suggest that a distinctly different analytical path to the evaluation of trade agreement impacts has to be pursued at both national and international level. It must be better to address institutional reforms and services trade issues.

Some trade agreements are of bilateral type. An analysis of the economic effects of Japan–Republic of Korea FTA has been attempted by Nakajima (2002). They applied a GTAP model to see the short run as well as long run impacts. The Republic of Korea's real GDP increased in the long run case. On the other hand, gains for Japan were limited in terms of real GDP. However, both countries benefited from equivalent variation. With regard to sectoral effects, it is found that removal of tariff decreases the costs of electronic sector in the Republic of Korea. This implies that an increase in intra-industry trade will enlarge the static effects of the FTA. The elasticity of substitution of imports played a crucial role in terms of export sales of Japanese motor vehicle and other transport equipment. Cheong (2002) provides an overview of the Republic of Korea's bilateral FTA policy and progress with Chile and Japan using GTAP. The author shows that despite many obstacles, a Republic of Korea–Japan FTA is strategically significant and offers various economic benefits, by strengthening the alliances among the firms of the two countries. He also concluded that Chile is a suitable partner for Republic of Korea's first FTA since the effects of structural adjustment would be moderate due to Chile's distance from Republic of Korea while the effects of increasing exports would be great. The

Republic of Korea's export to Chile will double once the FTA is in place. Another study on Korea by McKibbin, Lee, and Cheong (2004) estimated that gains for Korea and Japan from a bilateral FTA would amount to 0.1–0.2% of GDP per year for both countries. A study focusing on Indonesia by Hartono, Priyarsono, Nguyen, and Ezaki (2007) analyzed how different FTAs scenarios may affect Indonesia's GDP, welfare, investment, trade and income distribution. Overall, they found that most of FTAs have positive impacts on these factors. For example, an Indonesia–China FTA will lead to a 0.20 and 0.65% increase in GDP and welfare, respectively, while it will cause real investment, exports and imports to increase by 2.28, 0.85 and 2.66%, respectively. Their analysis of an Indonesia–Japan FTA (IJFTA) also yielded similar results, with GDP, real investment and welfare increasing by 0.04, 1.81 and 0.38%, respectively, while increasing income equity. Hence, this indicates that it may be beneficial for Indonesia to pursue a FTA with Japan.

Preferential Trade Agreement is a trading bloc which gives preferential access to certain products from several countries. Various researchers have attempted to study the impact of this. Dee and Gali (2003) quantify the impact of traditional and 'new age' provisions of preferential trading arrangements (PTAs) on merchandise trade and investment using the gravity model. They found adverse effects on investment flows, negative impact of FTA on its members' trade and a positive effect on AFTA members' trade with non-members. Lochindaratn (2008) performs the impact analysis of certain bilateral preferential trading agreements Thailand has reached with Japan, China, India, Australia, and New Zealand. He emphasized the degree of commodity market competition by sector and labour market by skill level with a view to better reflect economic reality using GTAP model. Among Thai bilateral FTAs in place, in terms of equivalent variation, Japan–Thailand Economic Partnership Agreement (EPA) is the most beneficial while Thailand–New Zealand–China EPA turns out to be the least beneficial FTA for Thailand. Real gains from bilateral FTAs are poor compared to the benefits from the groupings that include ASEAN. On the whole, trade diversion is offset by trade creation and improving welfare gains. Strutt and Rae (2007) argue that multilateral trade negotiations have faced many hurdles and frustrations in recent years, giving increased impetus for some countries to negotiate regional and bilateral trade agreements. In this paper, they focus on some of the agreements that China is currently negotiating. Agreements with countries that include New Zealand and Australia and a framework agreement between China and ASEAN were signed in 2002. They explore how such preferential trade agreements might impact on one another. They use the dynamic GTAP model to assess the anticipated impact of possible liberalization scenarios. Results reveal that China–New Zealand agreement is unlikely to have a large economic impact on China. Significant gains may accrue to New Zealand, if the sensitive agricultural sector is liberalised. However, if China also enters into preferential agreements with other countries, this is likely to have adverse impact on the gains accruing to New Zealand. If the spokes emanating from the China hub can be joined in a regional free trade area, rather than bilateral hub-and-spoke agreements, the overall gains can be much greater. Manchin and Pelkmans-Balaoing (2008) examine the current state of intra-ASEAN trade under the preferential regime of the AFTA. It assesses

the impact of the utilisation of AFTA preferential tariffs. The results show that at very high differential margins, the significance of AFTA preferences might not be favourable.

There are numerous studies which evaluate the economy wide impacts of regional trade agreements. The primary goal of most of these studies is to evaluate the impact of ASEAN integration with other Asian and Pacific countries. Studies are also attempted to verify the ASEAN simulation with +1 +2 +3 or +6 using different type of model.

Studies using econometric analysis by Clarete Edmonds, and Wallack (2002); Frankel and Wei (1996); Soloaga and Winters (1999 a,b); Gosh and Yamarik (2004); Lee and Park (2005) are worth mentioning.

Frankel and Wei's (1996) work is one of the first empirical studies assessing the impact of ASEAN trade integration using gravity framework. The authors found the intra-ASEAN bias to be significant for every year of the period under study (1970–1992). Moreover, the intra-ASEAN orientation is only slightly reduced when the openness of ASEAN, which is significantly more than what is predicted by the model, is accounted for. The ASEAN effect, however, disappears when the East Asian bloc is tested simultaneously. This is consistent with the finding of Lee and Park (2005), who found ASEAN regionalism to have a significantly positive effect on intra and extra-regional trade. The significance of the AFTA bloc also looses when estimated with the ASEAN+3 grouping (China, Japan and the Republic of Korea). Similar studies are also produced by Soloaga and Winters (1999 a,b). Investigating nine major blocs over the period of 1980–1996, they found a highly significant increase in the extra-bloc coefficient, together with a fall in intra-ASEAN trade. Asian Development Bank study by Clarete et al. (2002) showed that the AFTA might have reduced extra-ASEAN trade, and found no evidence of an effect on the pattern of intra-regional exports and imports. The inclusion of the new ASEAN members, namely, Cambodia, Myanmar, Laos and Vietnam in the 1990s, may have diluted the impact of regionalism. These countries are being less outward oriented and less developed relative to the rest of ASEAN. Gosh and Yamarik (2004) use extreme bound analysis to look at trade creating and diverting effects of regional trade agreements. Using least squares estimators they found trade creating effects for ASEAN, while at the extreme bounds, negative effects for ASEAN regional integration. Lee and Park (2005) estimated the economic impact of possible East Asian free trade areas based on a bilateral gravity model. The paper explored the effects of possible RTAs in East Asia; such as: a China-Republic of Korea free trade area (FTA), a Japan-Republic of Korea FTA, a China-Japan-Republic of Korea FTA, and an ASEAN+3 (China, Japan, Republic of Korea) FTA. They compare the economic effects of the existing RTAs, and the proposed East Asian FTAs. They proposed strategic policy measures that would enable East Asian RTAs to further promote free trade and economic integration at the global level. Overall, they concluded that an East Asian FTA would be a building bloc for a global FTA if it takes the form of deeper integration. The trade creation effect expected from the proposed East Asian FTAs would be significant enough to dampen the trade diversion effect. Therefore, the proposed East Asian FTAs were likely to be non-discriminatory trade

blocs without incurring any significant impact on interregional trade. Furthermore, if the three major East Asian countries successfully implement their own FTA and expand it into an ASEAN+3 arrangement that lead to the East Asian FTA, then the study anticipated a tripolar system of international trade consisting of the American FTA, the European FTA, and the East Asian FTA. Such a tripolar system could prove to be a vital impetus for expanding free trade around the globe. Lee and Park (2007) quantitatively analyzed the trade effects of enhanced trade facilitation with extended gravity equations. Their findings confirm that RTAs comprising countries equipped with better trade facilitation were more trade-creating, less trade-diverting, and would thus lead the world economy toward global free trade. The gains from a combined trade liberalisation strategy through tariff reductions and enhanced trade facilitation will be greater for North-South RTAs in East Asia such as a China-Republic of Korea and an ASEAN+3 RTA.

Studies that used a general equilibrium approach to analyze the impact of the RTAs in ASEAN and neighboring Asia Pacific region are reviewed. Some studies were based on individual country computable general equilibrium (CGE) models, while others used a multi regional general equilibrium approach. Among them Urata and Kiyota (2003), Cheong (2005), Chawin (2006), Park (2006), Ando and Urata 2005, 2006) deserve to be mentioned.

Urata and Kiyota (2003) examine the effect of an East Asian FTA on trade in the region using GTAP. Their results indicate that an East Asian FTA would have a positive impact on members' GDP and welfare. Moreover, the positive impacts on ASEAN countries are sizeable with Thailand's GDP increasing by 16% as a result of the FTA. Further sectoral analysis revealed that sectors with comparative advantage gained from trade liberalization. It indicates that many East Asian economies have a comparative advantage in the electronic equipment sector that arises from labour-intensive assembling part of the production process. Unfortunately, the FTA leads to a decline in non-members countries' GDP and welfare, indicating the presence of trade diversion. However, their result indicated that an East Asian FTA does not have a great impact on export and import composition. GTAP simulations by Zhang et al. (2006) confirm these findings—an ASEAN+3 FTA is estimated to increase the overall GDP of East Asian countries by 1.2% and economic welfare by $105 billion and raise every member's GDP in excess of 1.7%, with the exception of Japan. In a similar tune and based on a GTAP exercise, Mohanty, Pohit and Roy (2004) find that an ASEAN+3 and India FTA will bring gains to members.

Another strand of literature compares alternative FTA scenarios in East Asia and provide additional insights on the costs and benefits of possible FTAs. Using GTAP, Gilbert, Scollay, and Bora (2004) found that an ASEAN+3 FTA will produce higher welfare gains for members than a narrower China–Japan–Republic of Korea FTA indicating that broadening FTAs in East Asia brings more benefits. Based on a GTAP model which includes capital accumulation, Cheong (2005) reports that all members reap larger gains from an ASEAN+3 FTA compared to a series of bilateral arrangements between East Asian economies and ASEAN and Japan.

Park (2006) evaluated the effects on East Asia of Regional Trade Agreements -expansionary, duplicate, and overlapping RTAs, applying a computable general

equilibrium model analysis. The study found that the static effect of existing, proposed, and negotiating East Asian RTAs on world and members' welfare was sufficiently positive. From the scenario analysis, it was found that expansionary RTAs, such as an ASEAN+3 (or +6) or a Global Asia RTA, were the optimum strategy for East Asian members and the world economy in terms of net trade creation, welfare improvement, and output growth. Duplicating a separate RTA, such as an ASEAN-China versus Japan–Republic of Korea RTA, may not be desirable for both members and the world economy. The hub-and-spoke type of overlapping RTAs, such as ASEAN+1 RTAs (ASEAN-China, ASEAN-Republic of Korea, and ASEAN-Japan RTA), China Hub RTAs, or Japan Hub RTAs were the worst strategy for both member countries and the world economy. Moreover, it was found that RTAs, driven by the hub-and-spoke type of overlapping RTA or duplicating bilateral RTA, were proliferating in East Asia because of the higher positive welfare and output gains and positive trade creation effects to original members of existing RTAs. However, the increasing trend of RTAs in East Asia was found to be stumbling blocs, working against global free trade. The study also confirmed that the static effect of the proposed East Asian RTAs on world and members' welfare was sufficiently positive, and would lead to non-discriminatory global free trade. Park's finding satisfies the Bhagwati (1993) conditions for RTA to be long lasting. His conclusions strongly suggested that East Asian policy-makers take an expansionary path of RTAs, such as the proposed ASEAN+3 or the East Asian RTAs, including Hong Kong and Taiwan as members.

Chawin (2006) assessed the economic effects of East Asian regionalism under ASEAN+3 using the GTAP model. He simulated several hypothetical FTAs covering ASEAN and China, Japan, and the Republic of Korea. The economic scenario of an FTA was assumed to decrease tariffs to zero for all goods and services. The simulation impact of a FTA among North East Asia showed that the welfare gains were concentrated in either Japan or Republic of Korea. For China welfare or GDP gains only in the case of a CJK agreement with small positive margin. The East Asia FTAs and ASEAN-China FTA do not bring any gains to China. In contrast, ASEAN was the large gainer in this FTA with China among the three North East partners. Japan and Republic of Korea did not earn any economic or welfare gain in ASEAN-CJK compared with the CJK case, while ASEAN gained in terms of welfare. On the other hand, ASEAN–China, ASEAN-Republic of Korea, and China-Republic of Korea FTA scenarios could have a negative impact on the future of ASEAN. If East Asia regionalism under ASEAN+3 was achieved, benefits would occur. However, ASEAN would be worse off, if Japan, Republic of Korea, and China formed a FTA among themselves.

Ando and Urata (2006) estimated the impacts of an East Asian FTA involving ASEAN members and non members using CGE. A variety of groupings were considered for the study. These included: AFTA, ASEAN–China, ASEAN–Japan, ASEAN–Republic of Korea, China–Japan–Republic of Korea, ASEAN+3 and APEC. They found that the ASEAN+3 FTA was the most desirable among the all FTAs. Results demonstrated that capital accumulation and various facilitation and coordination programs had significant impacts on the member economies. At

the sectoral level, many sectors gained in terms of output and trade. Some sectors in some countries had dipped in industrial output as a result of ASEAN+3, but most of them experienced increases in both exports and imports even if output declined. On the whole, the greatest benefits accrued to member countries.

Kawai and Wignaraja (2008a, b) capture the possibility of various East Asian FTA and its economic impacts. They used a computable general equilibrium model to examine the economic impact of various types of FTAs in East Asia (among ASEAN+1, ASEAN+3, and ASEAN+6). They found that consolidation at the ASEAN+6 level would yield the largest gains to East Asia among plausible regional trade arrangements—while the losses to non-members are relatively small. For such consolidation, ASEAN must act as the regional hub by further deepening ASEAN economic integration, including three countries (China, Japan, and Republic of Korea) and India needs to pursue further structural reforms. Furthermore, substantial international support is required to strengthen the supply-side capacity of poorer ASEAN countries—including the building of trade-supporting infrastructure (transport, energy, and telecommunications). This would help them take advantage of integrated regional markets and reduce development gaps within ASEAN.

Ezaki and Nguyen (2007) studied the impact of regional economic integration on growth, income distribution, and poverty in East Asia (Vietnam, Thailand and China) using GTAP. The results indicated that East Asian FTA's generally have positive effects on growth, improved income distribution, and poverty reduction. Though, impacts on China were found to be of an exception.

Mukhopadhyay, Thomassin, and Chakraborty (2008) estimate the economic impacts of proposed ASEAN+3 trade agreements on the South Asian economy based on GTAP. The findings reveal that South Asia will be affected adversely in terms of GDP growth, export and also welfare.

Francois and Wignaraja (2008) used both GTAP and gravity model to explore the implications of broad-based regional trade initiatives in Asia, highlighting the bridging of the East and South Asian economies. They examine regionally narrow and broad agreements-ASEAN and northeast Asian economies (China, Japan, Korea) and also the South Asian economies. The inclusion of the South Asian economies in a broader regional agreement sees gains for the East Asian and South Asian economies. Most of the East and South Asian gains follow directly from the Indian participation.

The descriptive approach uses historical data and trade relationships to draw conclusions on the potential impact of changes in ASEAN trade relationships. JETRO (2003) studied the FTAs trends in East Asia and the current state of trade within the region. This analysis included a number of different countries and regions, namely ASEAN as a whole, the so-called ASEAN 6 (Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam), China, Hong Kong, Republic of Korea, Taiwan, and India. They also studied the approaches to FTAs being taken in other parts of the world, particularly the United States, the European Union, and Australia. The study looks at the impact of FTAs on domestic industries and the prospects for the period to come. Their findings show that (1) a Japan-ASEAN Closer Economic Partnership (JACEP) between 1997 and 2020 would augment exports by 27.5%

in Japan to ASEAN and 44.2% in ASEAN to Japan, while it would boost gross domestic product by 1.99% in ASEAN and 0.07% in Japan; (2) if tariffs were reduced to zero in an ASEAN-China Free Trade Area (ACFTA), it was predicted that exports would expand by US$13 billion per year (48.0%) from the ASEAN 6 to China and US$10.6 billion (55.1%) from China to ASEAN 6, while GDP would grow by 0.86% in the ASEAN 6 and 0.27% in China; (3) a Thai-Japan FTA accompanying JACEP would boost Thai exports to Japan by 19.7% and Japanese exports to Thailand by 33.3%. This would increase Thai GDP by 6.4%, providing greater benefits than could be expected from ACFTA. Among the FTA proposals under negotiation, social welfare in Thailand would be best served by a bilateral trade agreement with Japan. Igawa and Kim (2005) discussed the optimum FTA map of the world and FTA players in East Asia. An East Asia FTA would give China a greater opportunity of maintaining a high growth rate with higher productivity growth. They examined the costs and benefits of forming a bilateral FTA between the three countries; China, Japan, and Republic of Korea. With a China- ASEAN FTA, China was relatively larger than ASEAN and static gains of trade creation would go to the smaller members of ASEAN. Dynamic gains of concentration and scale/space economies would not be large with the unification of the two markets, although potential gains in the future would be large. The FDI that flows into China might be diverted into ASEAN. ASEAN might get larger benefits by specializing in relatively more capital-intensive products and inviting FDI, which might have gone to China without an ASEAN-China FTA. On the other hand, ASEAN might have to pay greater costs in adjusting from labour-intensive products into more capital-intensive products. Thus, a FTA between the two parties may be possible, however, it may not be an effective FTA. For Japan and Republic of Korea, both ASEAN and China were important partners for trade and investment. ASEAN was interested in attracting FDI and in obtaining technology from Japan and Republic of Korea. However, Japan and Republic of Korea, in the economic environment of global competition, were more interested in directing FDI into China. Competition between Japanese and Republic of Korean firms with regard to FDI into China would reduce the benefits for firms in both countries and give China an advantageous position. However, the benefits would increase if Japan and Republic of Korea cooperated to devise a negotiation strategy against China. Through a J–K FTA, Japan and Republic of Korea could strengthen their bargaining power against outsiders. Competition in a free and large market with a J–K FTA might help both countries in their economic restructuring. They suggested various strategies for promoting an East Asian FTA. They concluded that it would be better for all East Asian players to have a large economic concentration in East Asia. An East Asia FTA would enable the region to generate its large economic potential.

Apart from the major three approaches, Lendle (2007) used the recent Limão (2005, 2006) approach to investigate empirically whether the ASEAN Free Trade Agreement had a building bloc or stumbling bloc effect on subsequent changes in MFN tariffs of four major ASEAN members. The study uses tariff data to test whether MFN tariffs were changed differently for preferential products compared to otherwise similar products without a preference. He finds a significant building

bloc effect for Indonesia, the Philippines and Thailand. MFN tariffs of preferential products were reduced by more than for non-preferential products and obtain ambiguous effects for Malaysia. This suggests that overall the ASEAN Free Trade Agreement has rather helped than hindered nondiscriminatory trade liberalization.

Bchir and Fouquin (2006) use the CEPII Mirage Model to create several scenarios of economic integration based on a hub and spoke approach (ASEAN+1) and an ASEAN+4 (including India) regional approach. They find that ASEAN would be better off with a series of bilateral agreements than with an ASEAN+4 approach as this would allow them better to exploit their comparative advantage in agriculture, having much higher levels of protection in the region than manufactures. Drawing on GEMAT simulations for an FTA involving goods only, Plummer and Wignaraja (2006) report that the current wave of bilateral FTAs is inferior to any of the major FTA proposals in East Asia (including an ASEAN+3, an ASEAN+6, or an APEC FTA). They find that an ASEAN+6 FTA will bring larger global welfare gains than an ASEAN+3 FTA. Their study provides a preliminary assessment of the economic effects of an ASEAN+3 and ASEAN+6 FTA even though services trade, trade facilitation, and other aspects of FTAs are excluded from the exercise.

Some attempts (Cheong, 2003; Ballard & Cheong, 1997) have focused on North East Asia and Pacific region using multiregional CGE. Ballard and Cheong (1997), carry out simulations of different RTA scenarios involving different countries in the Pacific Rim region (including East Asian countries) using a CGE model. Their main conclusions are that these countries would have welfare gains by participating in the RTA and that these gains enhanced with increasing RTA size. In addition, their comparison of perfectly-competitive and imperfectly-competitive model indicates that the former results in smaller welfare gain. Cheong (2003) reviews the status of economic integration in Northeast Asia and future prospects for economic integration in the region. The study also discusses the issues on regional trade and investment relations, financial cooperation, environmental cooperation, science and technology cooperation and industrial cooperation. The simulation model used in this exercise is a GTAP model with Baldwin-type capital accumulation. It is highly possible that China is likely to become more actively involved in economic integration in Northeast Asia in near future. The Republic of Korea, which is aiming to become a Northeast Asia economic hub, would set up conditions for the free movement of goods and resources in Northeast Asia as well as improve the internal business environment. As for improving external conditions, the China–Japan–Republic of Korea FTA could be an effective method of doing so. Considering China and Japan's competitive relationship, Republic of Korea's role as mediator is crucial in the Northeast Asian economic integration.

Individual country assessment of regional economic integration has been studied by Fukase and Martin (1999) for Vietnam and Kawasaki (2005) for Japan.

Vietnam's accession to ASEAN Free Trade Area has been an important step in its integration into the world economy. Fukase and Martin (1999) use a multiregional, multisector computable general equilibrium model to evaluate how different trade liberalization policies by Vietnam and its main trading partners affect Vietnam's welfare. They considered the simultaneous impacts on trade, output, and industrial

structure in their framework. The result implies that economy wide effects of AFTA liberalization to which Vietnam is currently committed are small. On the import side, the exclusion of a series of products from the AFTA commitments would limit the scope of trade creation, and the discriminatory nature of AFTA liberalization would divert Vietnam's trade from non-ASEAN members. Vietnam's small initial exports to ASEAN result modest gains from improved access to partner markets. Since Singapore dominates Vietnam's ASEAN exports and initial protection in Singapore is close to zero, gains from preferred status in this market are small. When Vietnam extends its AFTA commitments to all of its trading partners on a most favored-nation (MFN) basis, its welfare increases substantially. This is partly because of the greater extent of liberalization which reduces the trade diversion created by the initial discriminatory liberalization, and because of the more efficient allocation of resources among Vietnam's industries. AFTA benefits Vietnam's agriculture by giving it better access to ASEAN market. Broader unilateral liberalization beyond AFTA is likely to shift labor from agriculture and certain import competing activities toward relatively labor-intensive manufacturing. These sectors conform to Vietnam's current comparative advantage. By contrast, more intense import competition may lead some import substitution industries to contract. This suggests that AFTA should be treated as the important initial step towards broader liberalization for Vietnam. This will help upgrading of existing firms and investment in efficient and dynamic firms. Kawasaki (2005) looked at the sectoral and regional implications of trade liberalization on the Japanese economy by using simulation of a CGE model of global trade based on the GTAP database. In model simulations, the dynamic impacts of trade liberalization through capital formation mechanisms and productivity improvements were taken into account in addition to standard static efficiency gains. Trade liberalization will benefit all of Japan's trading partners. However, within Japan the ratio of agricultural production, which is estimated to shrink with trade liberalization, was higher in lower- income prefectures. In contrast, the ratio of transport equipment production, which is estimated to expand with trade liberalization, was higher in higher-income prefectures. Regional differences in income levels would increase given the current structure of industries by region. Structural reforms of the economy would be required in implementing trade liberalization measures.

Several studies (Thierfelder et al., 2007; Dimaranan, Ianchovichina, & Martin, 2007) attempted to evaluate the impact of East Asia integration on the global economy. Thierfelder et al. (2007) using a global general equilibrium trade model, study the impact of the dramatic expansion of trade by India, China, and an integrated East and SouthEast Asia trade bloc on the global economy, especially developing countries. The analysis considers the importance of their different degrees of integration into regional and global economies, focusing on potential complementarities and competition with other developing countries. The result indicates that the integration of East and South East Asia with the creation of free trade area would increase welfare in the region and generate small losses for countries outside the bloc. This would also lead to significant changes in the structure of production and trade. Dimaranan et al. (2007) using the GTAP framework analysed the impact

of rapid growth in China and India on the world economy. They argue that both China and India were labor abundant and dependent on manufacturing. However, their export mix was very different. The findings revealed that accelerated growth through efficiency improvements in China and India, especially in their high-tech industries, would intensify competition in global markets resulting in the contraction of the manufacturing sectors in many other countries.

The analysis on the different free trade scenarios in East and South East Asia studies discussed so far have clearly concluded that East and South Asian countries stand to benefit from adopting FTAs/RTAs. However, many of them employ a 100% tariff reduction to capture policy shocks in their FTA analysis which is unfortunately both unrealistic and unlikely to be adopted by countries in their free trade negotiations. The relatively recent nature of FTAs negotiations in East and South East Asia may have prevented them from using actual tariff shocks that was ultimately adopted. However, these studies provide a good indication of the range of gains that can be achieved. The conclusions of several FTAs in the region in the past few years provide new opportunities to analyze the impacts of these trade agreements using the actual tariff reduction schedules.

2.4 Impact of FTAs and RTAs on the Environment

The above discussed literature mainly focused on the RTA impacts on the economy and welfare. The literature on energy-economy-environment-trade linkage, an important objective in applied economic policy analysis, is growing. Environmental issues began to appear in trade studies in the 1970s. This section reviews these studies.

The survey by Dean (1992) highlights the various areas of discussions in the trade and environment literature: (i) environmental regulation and comparative advantage; (ii) trans-boundary pollution and trade; (iii) non-tariff barriers in term of standards; (iv) trade of hazardous substances and (v) impact of trade liberalization on the environmental degradation. Among these, (i) and (v) are more important and often discussed issues. A study by Robinson (1988) using a general equilibrium investigated the effect of changes in pollution abatement cost on US trade. Results concluded that environmental abatement costs have changed US comparative advantage with the country importing more high-abatement goods and exporting more low-abatement goods. The ratio of import to export abatement content rose from 1.17 to 1.39 during 1977 to 1982, an indication that import composition is getting more pollution intensive. In addition, 1% increase in US sectoral price due to environmental abatement costs results in a 0.67% decrease in US trade in 1977. This facts shows that marginal changes in abatement cost will only lead to marginal changes to trade flow. Utilizing the Trade and Environment Equilibrium Analysis (TEQUILA) CGE model on Mexico and NAFTA, Beghin, Roland-Holst, and van der Mensbrugghe (1995) run a 20-year simulation where advalorem tariffs are reduced gradually over the period. One of their main conclusions was that

although increased trade liberalization resulted in a 3.2% rise in real GDP and a corresponding 2.5–4.8% increase in pollutants, there was no evidence of the PHH. Despite the expansion of a few dirty activities in certain sectors, composition of industries in Mexico had actually become cleaner. However, it must be noted that Mexico did increase its imports of 'dirty' products to replace domestic production and this may constitute in itself a pollution export to other nations but just not to its free trade partners. Similarly, authors (Ederington, Levinson, and Minier, 2004) concluded that there is little link between tariff reductions and dirty industries migration across borders. They found that tariff reduction in the US from 1974 to 1994 did not have a significantly different impact on imports from clean and polluting industries.

There are a few studies using GTAP-E that dealt with energy and environmental implications only, in particular, the Kyoto Protocol. Burniaux and Truong (2002) used an extended version of the GTAP model called GTAP-E, which includes the standard GTAP model as a special case. GTAP-E incorporates carbon emissions from the combustion of fossil fuels and provides a mechanism to trade these emissions internationally. Implications for policy analysis were demonstrated via a simple simulation experiment in which global carbon emissions were reduced via a carbon tax. Results showed that incorporating energy substitution into GTAP model was essential for analyzing this problem. The policy relevance of GTAP-E in the context of the existing debate about climate change was illustrated by some simulations of the implementation of the Kyoto Protocol.

Studies on international capital mobility related to the reallocation of investment and the resulting effects on growth and emissions were undertaken by McKibbin, Ross, Shackleton, and Wilcoxen (1999) and Babiker (2001). With a fairly elaborate description of international capital markets, the G-Cubed model reported that capital reallocation in the context of the Kyoto Protocol had little impact on leakages, as most of this reallocation took place among Annex 1 countries rather than non-Annex 1 countries (McKibbin et al., 1999). They examined and compared four potential implementations of the Protocol involving various degrees of international permit trading, focusing particularly on short term dynamics and on the effects of the policies on output, exchange rates, and international flows of goods and financial capital. They presented calculations of some of the gains from allowing international permit trading, and examined the sensitivity of the results. The results suggested that regions that did not participate in permit trading systems, or that can reduce carbon emissions at relatively low cost, would benefit from significant inflows of international financial capital under any Annex 1 policy, with or without trading. Their results indicated that the United States was likely to experience capital inflows, exchange rate appreciation and decreased exports. In contrast, the Rest of OECD region, as the highest cost region, saw capital outflows, exchange rate depreciation, increased exports of durables and greater GDP losses. Similarly, Babiker (2001) showed that assuming perfect capital mobility did not affect the carbon leakage significantly. Burniaux (2001) analyzed the influence of international investment reallocation in the context of unilateral reductions of GHG emissions undertaken by industrialized countries. The analysis was based on the simulation results obtained by using a recursive dynamic AGE model (GDYN-E). This model was designed to

simulate the economic consequences of the Kyoto Protocol. Results showed that the existence of investment reallocation may become much more influential under certain circumstances related to different types of investor's expectations, different levels of inter-fuel substitution, a longer time horizon and the possibility of alternative carbon-free energy sources (called 'backstops' energies).

Dagoumas, Papagiannis, and Dokopoulos (2006) investigate scenarios concerning the economic implications of the Kyoto Protocol. The general equilibrium model, GTAP-E was used to examine the cases of the USA participation and on the role of Russia as a major emission credits seller. A significant issue in the Kyoto Protocol negotiations is the introduction of sinks in the Marrakech Accords. This seems to weaken the initial targets by replacing CO_2 emissions reduction with afforestation activities and reduces the cost of the Protocol compliance. It is also shown that the absence of the USA may reduce the costs for the other developed countries and may influence the total costs more than the CDMs. A new scenario is studied by introducing a guaranteed minimum of 60% in the emission credits sold by Russia. Results show that the profits of Russia are not significantly affected by the guaranteed minimum.

There are few GTAP studies focusing on trade liberalization and its impact on the environment. Kuik and Gerlag (2003) examine the effect of trade liberalization on carbon leakage using GTAP. They estimate the carbon leakage under the Kyoto Protocol with and without freer trade by means of import tariff reductions agreed to in the Uruguay Round of multilateral trade negotiations. The study finds that under a plausible range of assumptions, the implementation of these import tariff reductions increases the overall rate of leakage. But they also found that the costs of abating the trade-induced leakage are modest relative to the welfare gains of freer trade. Analysis of the trade-induced carbon leakage shows large differences between leakage caused by reductions of import tariffs on energy goods and by reductions of import tariffs on non-energy goods. It also shows large differences in emission responses among developing country regions. Tsigas, Gray, and Hertel (2004) investigated the impact of a trade policy on the environment using the GTAP modelling framework. It involved trade liberalization in the Western Hemisphere a topic which has received considerable discussion in the past decade, and its environmental consequences. They found that trade liberalization in the Western Hemisphere was likely to benefit all participating countries. However, it guarantees neither improved environment nor more degradation. Authors noted that existing global models failed to provide a coherent view of the magnitude and regional distribution of the carbon leakages that could emerge following the implementation of emission abatement by a group of industrialized countries. Similarly, Kang and Joon (2004) analyzed the air pollution impact in Republic of Korea induced by trade liberalization between Republic of Korea and Japan using a standard multi-region CGE model based on the GTAP database Version 5.0. The simulation results showed that the aggregated environmental effect depends on the change in specialization structure between pre and post trade liberalization. The inter-industrial difference of emission coefficients and of disposal cost by air pollutants plays a major role in determining the scale of the aggregated environmental effect. A free trade agreement between

Republic of Korea and Japan reduced the overall air pollution emission by 0.36% but increased the pollution disposal cost slightly by 0.06%. This analysis provides useful environmental policy guidelines for pursuing a 'win-win strategy' in trade.

Beghin et al. (1995) has found that trade liberalization under NAFTA led to a 2.5–4.8% increase in pollutants level in Mexico while Dessus and Bussolo (1998) estimated that trade liberalization will lead to a 15–20% higher emissions level among pollutants in Costa Rica when compared to the benchmark scenario in the year 2010. A study by Lee and Roland-Holst (1997) on the impact of trade liberalization between Indonesia and Japan has also arrived at the same conclusion. The analysis involves creating a two-country, 19-sector CGE framework based on the 1985 SAM of both nations and CGE model specifications. Data for pollution emissions are obtained from Industrial Pollution Projection System of the World Bank. Effluent intensities of Indonesian and Japanese industries are derived from that of the US industries. This, however, means that the Indonesian effluent level is likely to be understated while it is the reverse for Japan. Their results indicated that in the absence of technological improvements, a unilateral tariff reductions adopted by Indonesia will lead to an increase in emissions of all pollutants in Indonesia, ranging from 0.51% for BOD to 3.73% for lead. For Japan, emission level decreased for these pollutants but only by a marginal amount, ranging from – 0.02 to –0.09%. Between the two countries, emission level increases for the majority of pollutants. These studies suggest that trade liberalization leads to an increase in pollution level.

On the contrary, Strutt and Anderson (2000) found the positive impact of major multilateral and regional trade liberalizations on the Indonesian economy and environment. They used GTAP to project the world economy to 2010 and 2020 without and with trade reforms. They estimated the effects of changes in economic activity due to trade liberalisation on air and water pollution in Indonesia. A base case projection without trade reform was compared with alternative scenarios involving full global implementation of Uruguay Round commitments by 2010, and the additional move to MFN free trade by APEC countries by 2020. The study concluded that trade policy reforms would improve the environment and reduce the depletion of natural resources for most of the scenario cases and in the worst cases would add only slightly to environmental degradation. This occurred even without toughening the enforcement of existing environmental regulations or adding new ones, and even if the reforms stimulated a faster rate of economic growth.

Eickhout, van Meij, Tabeau, and van Zeijts (2004) quantified the impact of trade liberalization on poverty and environment for developing countries. A framework based on two models, GTAP and IMAGE, was used to obtain the economic and environmental impact of the scenarios. IMAGE is a dynamic integrated assessment modeling framework for global environmental changes. IMAGE used the GTAP outcomes to calculate land use changes and environmental consequences. With regard to the current Doha round they found that liberalization generated economic benefits. The benefits were modest in terms of GDP and unequally distributed among countries. Developing countries gained relatively the most. However, a large part of the benefits for developing countries were the result of their own reform policies in agriculture. South–South trade liberalization was key to the 'development'

part of this round. Trade liberalization had environmental consequences that could be positive or negative for a region. Liberalization can be helpful in gaining welfare. Economic growth in developing regions was necessary to alleviate poverty. However, uncoordinated liberalization can lead to pressures on the environment. Moreover, the continuation of trade-blocs throughout the world can also have negative effect. For example, the Transatlantic Market (EU-USA FTA) scenario had negative impact with low economic growth in developing countries and large pressures on the natural system. Overall they suggested that environmental and trade agreements and policies must be sufficiently integrated or coordinated to improve the environment and attain the benefits of free trade.

Though some studies address the environmental implications, but none of them have undertaken an integrated assessment of the economic, social and environmental implications of Regional Trade Agreements covering ASEAN and China, Japan and the Republic of Korea using a GTAP framework. The current study deals with that.

Chapter 3
Features of the East and South East Asian Economies

3.1 Introduction

The East and Southeast Asia has occupied an important position in the wider Asian economy, linking China and the Far East with India and the Middle East, and has also played a major role in the world-economy during last few decades (Dixon, 1991).

East and Southeast Asian nations are extremely heterogeneous, much more than are European, including East European countries.

Economic development in East and South East Asia has followed a notable pattern, compared to any other developing regions in the world. During the last half century, the economic performance of the East and Southeast Asian countries has been far from uniform rather with remarkable diversities. The several countries of this region have made good progress while others did not. The following features have been commonly observed in East and SouthEast Asia. Some of these features are unique to this region (Ohno, 2002).

1. Wide diversity in ecosystem, population, ethnicity, religion, social structure, and political regime.
2. Equally wide diversity in GDP, per capita income, and economic performance.
3. High growth maintained over a long period almost throughout the region.
4. High savings and investment rates are associated with this high growth rate, openness of the economies, export orientation, industrialization, and general improvements in social indicators.

In spite of these diversities these countries have common interest in cooperation for peace and prosperity.

One of the most significant events in the history of East and Southeast Asia was the formation of the Association of Southeast Asian Nations (ASEAN) in 1967.

Bilateral or trilateral, and multilateral negotiations with other developed Asian countries and ASEAN bloc are implemented already and some are in the offing. ASEAN already negotiated with China, Japan, the Republic of Korea, New-Zealand and Australia. The details of the regional economic integration in this region have been discussed in Chapter 1.

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The appropriate approach for analyzing this region seems to be to look into each country separately in order to find its diversities, similarities, and uniqueness. The subsequent sections will present the salient features of the different countries of the East and SouthEast Asia.

3.2 Population

The ASEAN region as a whole has a population of about 560 million as of 2006. The fourth highest populated region in the world and first rank in ASEAN region is Indonesia with 220 million plus population according to 2005 census. The second rank in the region is the Philippines with 84 million followed by Vietnam (83 million) and Thailand (62.4 million). The lowest population in the region is Singapore (4.24 million). But density of population is highest in Singapore with 6366 per sq. km and lowest in the region is Lao-PDR (24.54 per sq. km.). Other countries in the region are in the range of 70–270 per sq. km. The other major countries in East Asia are China, Japan and Republic of Korea. Though China is the world's largest and most populous country with 1.3 billion people but density is 139.85 sq. km far behind than Japan (350.44 sq. km). The population size, growth and density are presented in Table 3.1

Table 3.1 Size, growth, and density of population in East and SouthEast Asian countries

	Population (millions)			Population growth		Density of population per sq km
	1990	2000	2007	1990–2000	2000–07	2005
Brunei Darussalam	0.25	0.33	0.38	29.75	16.72	70.93
Cambodia	9.69	12.78	14.44	31.78	13.04	79.05
China	1135.18	1262.64	1319.98	11.22	4.54	139.85
Indonesia	178.23	206.26	225.63	15.72	9.38	121.74
Japan	123.53	126.87	127.77	2.69	0.71	350.44
Republic of Korea	20.14	22.94	23.78	13.91	3.64	196.12
Malaysia	18.10	23.27	26.55	28.56	14.07	78.07
Myanmar	40.14	45.88	48.78	14.29	6.31	72.94
Philippines	61.22	76.21	87.89	24.47	15.32	283.61
Singapore	3.04	4.02	4.58	32.19	13.92	6366.86
Thailand	54.29	60.66	63.83	11.74	5.22	123.31
Vietnam	66.20	77.63	85.14	17.27	9.66	268.01
Lao-PDR	4.07	5.22	5.86	28.15	12.17	24.54

Source: WDI, 2007 (prepared by the author from the WDI online data base of population and land area).

The issue of population and economic growth is as old as economics itself (Malthus, 1798). Population growth increases labour force and thus facilitates economic growth while unregulated population growth could push into many economic problems. Over the past two decades, the remarkable growth of the East and Southeast Asia has established the region as one of the major pillars of the world economy. The region is vigorously pursuing a long term multilateral and liberalization of trade. The region's integration into world economy has been a powerful vehicle to promote rapid economic growth and poverty reduction. However, this impressive economic performance of the region has over shadowed many other challenges and have raised questions about the sustainability of this achievement. Thus it is of high interest to look at the determinants of the economic success.

A brief sketch of the country related development strategy and important growth factors are described in the following section.

3.3 Economic Growth of the East and SouthEast Asian Economies

Most of the countries in East and Southeast Asia have enjoyed the highest annual GDP growth rates in the world for the past two decades, averaging well over 6% (GSI, 2008). Steady trade liberalization has contributed to this regional growth. Over the past three decades, tariffs have fallen by an average 8% while in the last fifteen years trade as a percentage of GDP has risen from 45 to 81% (GSI, 2008). In the 1960s Singapore and the Republic of Korea started their industrialization effort and moved upwards with rapid strides since the 1980s. China with its sweeping economic and structural reforms has been able to expand its economy with annual growth rates averaging over 9%. If China continues its path of reform—in different fields like financial sector, monetary policy, WTO-mandated trade policy, and the political sphere—the country will likely move to the top surpassing the United States in total size of economy by 2041, according to Goldman Sachs projections (GSI, 2008). Reforms in other Asian economies are also changing the scenario. Republic of Korea, Vietnam, the Philippines, and Indonesia are among Goldman Sachs' N-11 countries—a set of the 'Next Eleven' developing countries that could reach a level of global influence similar to the BRIC (Brazil, Russia, India, and China) economies (GSI, 2008).

3.3.1 GDP Growth

Table 3.2 records the annual growth of GDP of different East and Southeast Asian economies. Table 3.3 reports GDP per capita of these economies for selected years.

Table 3.2 Annual growth rate of GDP

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Brunei Darussalam	2.7	4	−1.1	0.5	1.8	3	1.1	3.6	−4	2.6
Cambodia						6.5	5.3	5.7	5	12.6
China	3.8	9.2	14.2	14	13.1	10.9	10	9.3	7.8	7.6
Indonesia	9	8.9	7.2	7.3	7.5	8.4	7.6	4.7	−13.1	0.8
Japan	5.2	3.4	1	0.3	1.1	1.9	2.6	1.4	−1.8	−0.2
Republic of Korea	9.2	9.4	5.9	6.1	8.5	9.2	7	4.7	−6.8	9.5
Malaysia	9	9.6	8.9	9.9	9.2	9.8	10	7.3	−7.4	6.1
Myanmar	2.8	−0.7	9.7	6	7.5	7	6.4	5.7	5.9	10.9
Philippines	3	−0.6	0.3	2.1	4.4	4.7	5.8	5.2	−0.6	3.4
Singapore	9.2	6.5	6.3	11.7	11.6	8.2	7.8	8.3	−1.4	7.2
Thailand	11.2	8.6	8.1	8.3	9	9.2	5.9	−1.4	−10.5	4.5
Vietnam	5.1	6	8.7	8.1	8.8	9.5	9.3	8.2	5.8	4.8
Lao PDR	6.7	4.1	6.8	5.9	8.2	7	6.9	6.9	4	7.3
	2000	2001	2002	2003	2004	2005	2006	2007		
Brunei Darussalam	2.8	3	2.8	3.8	1.7	–	–	3		
Cambodia	8.4	7.7	6.2	8.6	10	13.4	10.5	–		
China	8.4	8.3	9.1	10	10.1	10.2	10.7	10		
Indonesia	4.9	3.6	4.5	4.8	5	5.7	5.5	6		
Japan	2.9	0.4	0.1	1.8	2.3	2.6	2.2	2		
Republic of Korea	8.5	3.8	7	3.1	4.7	4.2	5	4		
Malaysia	8.9	0.3	4.2	5.7	7.2	5.2	5.9	6		
Myanmar	9.8	11.3	12	13.8	3	5	–	6		
Philippines	6	1.8	4.5	4.9	6.2	5	5.4	6		
Singapore	10.1	−2.4	4.2	3.1	8.8	6.6	7.9	6		
Thailand	4.8	2.2	5.3	7.1	6.3	4.5	5	4		
Vietnam	6.8	6.9	7.1	7.3	7.8	8.4	8.2	8		
LaoPDR	5.8	5.8	5.9	6.1	6.4	7.1	7.6	–		

Source: WDI, 2007.

Table 3.3 GDP per capita (at constant 2000 US$)

	1990	1995	2000	2006	2007
Brunei Darussalam	18713	19043	17996	18304	–
Cambodia	–	225	286	445	482
China	392	658	949	1611	1791
Indonesia	612	827	800	983	1034
Japan	33369	35439	36789	39824	40656
Republic of Korea	6615	9159	10884	13884	14540
Malaysia	2511	3471	3881	4535	4715
Myanmar	–	–	–	243*	334*
Philippines	918	913	996	1154	1216
Singapore	14658	19359	23019	28033	28964
Thailand	1462	2086	2023	2605	2713
Vietnam	227	305	402	576	617
Lao PDR	231	274	332	438	462

Source: WDI, 2007.
*calculated by the authors from EIU (2009a).

The growth experience of all the economies of East and South East Asia is not similar as it is seen from Table 3.2.

The first group of economies are those which had very low per capita income and have experienced very modest growth rates since the 1960s. Cambodia, Lao-PDR and Vietnam fall into this category. However, GDP growth has accelerated in Vietnam and Laos since the early 1990s. There are several factors behind the growth of Vietnam. Since Doi Moi (Economic Reform) Vietnam becomes more and more open to regional and world market. Overall, significant economic reforms taking place over nearly two decades of Doi Moi have yielded encouraging results. Vietnam has created a competitive and dynamic economic environment. The multi-sector economy has been encouraged to develop, thus mobilizing effectively all social resources for economic growth (MOFA, 2007). Three large economic programs, namely food production program, consumer goods production program and export commodities program had been initiated. This led to rapid economic performance in Vietnam with GDP growth at 6.7% compared with the rate of 4.8% in 1999. Since then the GDP growth is increasing enormously, the average growth of approximately 7.1% per year from 2000 to 2004 increased to approximately 8% in 2007 (Table 3.2), the second largest growth in this region, trailing only China. The shift away from a centrally planned economy to a more market-oriented economic model improved the quality of life for many Vietnamese. Per capita income rose from $227 in 1990 to $617 in 2007 (Table 3.3).

A second group of low achievers include Brunei and the Philippines. These economies had relatively high per capita GDP in 1960s but have grown very slowly since then (Brunei-3% and Phillipines-6% in 2007, Table 3.2). During the 1990s, the Philippines government introduced a broad range of economic reforms to business growth and foreign investment. As a result, the Philippines experienced a period of higher growth, although the Asian financial crisis in 1997 slowed the economic development of the country (ADB, 2005).

A third group includes those economies which had low per capita GDP in 1960 but which have grown rapidly (4% per annum in per capita terms or more) since then. This group comprises Indonesia, the Republic of Korea and Thailand. The growth was 9% for Republic of Korea and Indonesia and 11% for Thailand in the 1990s. But this rate sharply dropped to 4% for Republic of Korea and Thailand and 6% for Indonesia in 2007 (Table 3.2).

The steady growth of GDP is observed for the *Republic of Korea* since the 1990s. Sustained increase in fixed investment and exports led this steady growth. There was also increase in private consumption expenditure and notable rise in equipment investment, reflecting a sharp rise in domestic capital formation in machinery and transportation equipment.

Indonesia is the largest national economy in East and Southeast Asia and a major emerging market. The country is currently classified as low income economy by the World Bank, with $1,925 GDP per capita (Trading Economics, 2009). A declining growth rate has been observed from the 1990s with an average of 5% in the current decade.

On the other hand, *Thai* economy grew well with reasonable stability for over three decades. During the decade from 1990 to 1996, Thailand was one of the fastest growing economies in the world, with an average annual rate of 8.6%. The Thai economy experienced negative GDP for two consecutive years, i.e. −1.4% in 1997 and 10.5% in 1998. It regained its growth rate slowly and reached 7.1% in 2003 (Table 3.2).

Another group of high growth performers include Malaysia and Singapore which have grown rapidly since the 1960s. *Singapore* had the highest per capita income in the region in 1960 and has grown very rapidly since then and by the mid-1990s its per capita GDP was higher than the West European average (World Bank, 1997). In the five years 1993–1997, GDP growth averaged 8.84% but it dropped to 1.4% in 1998(Table 3.2) because of residential property prices fell 40%. Due to the world-wide boom in IT demand and in impressive recoveries in domestic consumption and investment, GDP growth soared to 10.1% in 2000 but again it fail to 6% in 2007 (Table 3.2).

Malaysia had maintained a steady GDP growth with average of 9% until 1997. In the decade of 2000, the average growth declined to 7% (Table 3.2). In 2007, Malaysia was the 29th largest economy in the world by PPP with gross domestic product was at $357.9 billion (The Edge, 2008).

China recorded the highest GDP growth in this region (3.8% in the 1990s to 10% in 2007, Table 3.2). The economy has its high domestic savings rate, high rate of investment in human capital, large domestic market and unlimited supply of surplus labor (Spence, 2007).

Japan is the lowest performer in this region in the 1990s which came to 2% in 2007(Table 3.2). Between 1950s and 1980s, the *Japanese economy* grew extremely well with just a short slowdown in the middle of the period. Starting from 1991, the growth has been very weak experiencing a long period of economic underperformance. There are numerous explanations of the observed behavior of the Japanese economy: 'inadequate fiscal policy, the liquidity trap, depressed investment …, problems with financial intermediation', and 'low productivity growth' (Hayashi & Prescott, 2002). However, one can not deny the fact that Japan's economy is highly efficient, highly diversified, and very competitive, being ranked 19th among 111 countries on productivity. Japan has a high level of savings and investment rates (Hayashi & Prescott, 2002).

As we know that most of the Asian countries are agriculture based, we are trying here to present the status of agricultural sector.

3.3.2 Agricultural Sector in East and South East Asia

The major contribution of GDP from agriculture is especially for the countries like Cambodia, Lao-PDR, Myanmar, and Vietnam. For China, the Philippines, and Thailand, the share which was in the range of 12–27% in the 1990s declined to 11–14% in 2006 (Table 3.4).

Table 3.4 Agriculture, value added (% of GDP)

	1990	1995	1997	2000	2005	2006
Brunei Darussalam	1	1	1	1	1	1
Cambodia	45	48	44	36	31	30
China	27	20	18	15	13	12
Indonesia	19	17	16	16	13	13
Japan	3	2	2	2	2	–
Republic of Korea	9	6	5	5	3	3
Malaysia	15	13	11	9	8	9
Myanmar	57	60	59	57	–	–
Philippines	22	22	19	16	14	14
Singapore	0	0	0	0	0	0
Thailand	12	10	9	9	10	11
Vietnam	39	27	26	25	21	20
LaoPDR	61	56	53	53	44	42

Source: WDI, 2007.

Economic structural change has been observed in *Vietnam*. The share of primary sector (Agriculture) in GDP has decreased from 39% in 1990 to 25% in 2000 and further declined to 20% in 2006 (Table 3.4). This sector accounted for about two thirds of domestic employment. The marginal slowdown in the agricultural sector output to 3.5% in 2004 from 3.6% in 2003 is due to the effects of a drought brought on by a weak monsoon, an unusually severe winter, and avian influenza (UNESCAP, 2005). Fisheries output increased sharply in 2004 as a result of the vigorous expansion of aquaculture and a greater number of harvests. However, the fisheries sector in Vietnam is affected by antidumping duties imposed by the United States on shrimp and catfish exports (UNESCAP, 2005).

Agriculture is not too important in Japan and the Republic of Korea. The contribution from this sector to GDP is as low as 2% for *Japan* since the 1990s (Table 3.4). Only 12% of Japan's land is suitable for cultivation. Due to this lack of arable land, a system of terraces is used to farm in small areas. This results in one of the world's highest levels of crop yields per unit area, with an overall agricultural self-sufficiency rate of about 50% on fewer than 56,000 km^2 (14 million acres) cultivated (Japan, 2009). Japan's small agricultural sector, however, is also highly subsidized and protected, with government regulations that favor small-scale cultivation instead of large-scale agriculture as practiced in North America (Japan, 2009). Japan ranked second in the world behind China in tonnage of fish caught—11.9 million tons in 1989. After the 1973 energy crisis, deep-sea fishing in Japan declined, with the annual catch in the 1980s averaging 2 million tons. Japan maintains one of the world's largest fishing fleets and accounts for nearly 15% of the global catch.

For the *Republic of Korea*, the agricultural contribution to GDP was more than 10% in 1990s, declined to 4% in 2005 (Table 3.4). The country grew from a predominantly rural agricultural economy to an urban industrialized developed country and the agricultural workforce shrunk to only 21% in 1989. The number of agricultural

workers reduced further to well under 10% in the current decade. As regards the sectoral sources of growth, value added in agriculture, forestry and fishery has made a negligible contribution in the current decade. This was attributable, in part, to the poor performance of inshore fisheries and marine aquaculture which more than offset the ongoing growth in the livestock industry (UNESCAP, 2008).

Agriculture and fishing contribute marginally to *Singapore's* GDP. Just 0.9% of Singapore's total area is farmland. Vegetables, pigs, and poultry are raised for domestic consumption, although the vast majority of food is imported.

Though the scope of agriculture in *Indonesia* was enormous, however, it's not tapped properly. The contribution to GDP which was almost 20% in the 1990s declined to 13% in 2006 (Table 3.4). Agriculture improved its performance in 2000, helped by an import ban on rice, and in November 2004 the Ministry of Agriculture announced that Indonesia had regained self-sufficiency in rice production after nearly 10 years, taking a major step towards food security. Since the late 20th century there has been a shift from rice toward less-demanding subsistence crops, such as cassava. The government intervenes in the marketing of rice to maintain production at an economically viable level. Various 'mass guidance' schemes to broaden the availability of credit and to promote the use of fertilizers and high-yielding varieties have increased rice output. In spite of good performance of rice production, there has been a persistent tendency since the late 1990s to import additional rice (Indonesia, 2009).

Agriculture, forestry, and fishing once formed the basis of the *Malaysian* economy, but between 1970 and the early 21st century their contribution to the country's GDP declined from roughly 29% to 9%. Similarly, the proportion of the labour force engaged in agriculture decreased from about one-half to less than one-eighth over the same time span, and the trend has continued. But rubber production remains important and closely tied to domestic manufacturing. By the early 21st century, Malaysia had become one of the world's top producers of palm oil. Malaysia remains the world's fourth-largest producer of cocoa. Other common cash crops include pepper, coffee, tea, various fruits, and coconuts (Malaysia, 2009a).

As a newly industrializing nation, the *Philippines* is still an economy with a large agricultural sector. Agriculture accounted for one fifth of GDP and growth of this sector slowed from 1999 onwards largely because of political unrest in the important crop-producing area. Still agriculture benefited from extraordinarily productive harvests of the two food staples, rice and maize during 2000, although cash crops such as coconut, pineapple and forestry also performed well (UNESCAP, 2005). The average annual growth was 2% in 2007–8.

Thailand's share of agriculture in GDP has declined from more than 30% in the 1970s to 11% in 2006 (Table 3.4). This long-term decline reflects in part the slow growth of demand for farm products compared to the faster growth in demand for manufactured goods and services due to rising income. It also reflects supply side factors, especially capital accumulation, which resulted in resources moving out of labor intensive agricultural industries and into more capital- and skill-intensive manufacturing and services industries (Mukhopadhyay, 2006). Several factors are

responsible for this decline. Trade policies have encouraged the development of capital intensive manufacturing, giving that sector an edge when competing for domestic resources. Although expenditures by the government are high by regional standards, public investment in agricultural research and investment has been modest. Private capital investment in agriculture, especially in crop production, is also rather limited. As a result, yield improvements in Thai agriculture are among the lowest in the region. Apart from that, agricultural production declined due to the renewed outbreaks of avian influenza took their toll on poultry farming and shrimp production fell due to the imposition of preliminary anti-dumping tariffs by the United States. In addition, a prolonged drought aggravated by deceleration in agricultural growth and weak monsoon affected the output of rice and other grains in the current decade (Mukhopadhyay, 2006).

The two most important sectors of the *Chinese economy* have traditionally been agriculture and industry, which together employ more than 70% of the labor force and produce more than 60% of GDP. According to the United Nations World Food Program, in 2003, China fed 20% of the world's population with only 7% of the world's arable land. China ranks high worldwide in farm output, and, as a result of topographic and climatic factors, only about 10–15% of the total land area is suitable for cultivation. (China, 2009). China is the world's largest producer of rice and is among the principal sources of wheat, corn (maize), tobacco, soybeans, peanuts (groundnuts), and cotton. The major agricultural products can be broadly grouped into foods, fibers, fuels, raw materials, pharmaceuticals and drugs, and an assortment of ornamental or exotic products. In the 2000s, plants have been used to grow biofuels, biopharmaceuticals, bioplastics, and pharmaceuticals. Biofuels include methane from biomass, ethanol, and biodiesel. Like Thailand, the importance of agriculture has also slowed down in China from 27% in the 1990s to 12% in 2006 (Table 3.4). The relative significance of farming has dropped steadily since the beginning of industrialization (China, 2009).

Agriculture in *Cambodia* is important. The severe flooding in September 2000 had an adverse impact on total agricultural production. The country slowly adjusts its growth—agriculture and forestry expanded by 2.6% in 2000. The situation is tackled after two years. In particular, improved weather conditions helped lift agricultural output by nearly 8% (UNESCAP, 2005). The contribution of agriculture declined by 15% within a span of 16 years (Table 3.4).

Lao People's Democratic Republic is primarily agriculture based. Its contribution to GDP was 61% in 1990 and declined to 42% in 2006 (Table 3.4).

Another agriculture based economy is *Myanmar*. Agriculture accounts for almost 59% of GDP in 1997 (Table 3.4). A stable growth is maintained as a result of extensive farming, and incentives to private investors since 1998 to bring unused land into production (UNESCAP, 2003). Myanmar is devoted to rice, and to increase production the government has promoted multiple, easily supported by the country's climate. As a whole, the sector accounts for nearly one-half of the country's gross domestic product (GDP) and employs about two-thirds of the labour force

(Myanmar, 2009). Nevertheless, agriculture remained constrained by shortages of key inputs such as fertilizers, seeds and diesel for irrigation pumps. There were also limited irrigation facilities and inadequate logistics, transport and marketing services (UNESCAP, 2003).

3.3.3 Industrial Sector in East and South East Asia

As we have seen from the previous section that agricultural contribution to GDP is declining in this region, particularly for Thailand, Vietnam and China. Let us now look at the share of the industrial sector to GDP for different countries. Table 3.5 presents this share.

For *Japan*, the industrial growth started before the Second World War. The mid-1960s ushered in a new type of industrial development as the economy opened itself to international competition in some industries and developed heavy and chemical manufactures. Whereas textiles and light manufactures maintained their profitability internationally, other products, such as automobiles, ships, and machine tools, assumed new importance. In the current decade, the key industries dominating in Japan's economy are petrochemicals, pharmaceuticals, bio-industry, shipbuilding, aerospace, textiles, and processed foods. But the contribution of industry to GDP has declined from 40% in 1990 to 30% in 2005 (Table 3.5). Crude oil, natural gas and coal production has increased from mid-1990s, the economy had construction boom associated with huge inflows of foreign capital and a boost in tourism since the early 1990s (Japan, 2009).

To achieve higher economic growth, the *Republic of Korea* has adopted a policy of industrialization. The industrialization programme was sustained by export demand. After a slump in 2003, the economy began to recover in 2004. Sustained

Table 3.5 Industry, value added (% of GDP)

	1990	1995	1997	2000	2005	2006
Brunei Darussalam	62	54	56	64	72	73
Cambodia		14	16	22	25	26
China	42	47	48	46	48	48
Indonesia	39	42	44	46	47	47
Japan	40	34	34	32	30	30
Republic of Korea	42	42	41	41	40	40
Malaysia	42	41	45	51	50	50
Myanmar	11	10	10	10	–	–
Philippines	34	32	32	32	32	32
Singapore	35	35	35	36	33	33
Thailand	37	41	40	42	44	45
Vietnam	23	29	32	37	41	42
LaoPDR	15	19	21	23	30	32

Source: WDI, 2007.

by export demand, industry recovered from the slowdown of 2003 and expanded at a rate of 9.0% in 2004. In 1990 South Korean manufacturers planned a significant shift in future production plans toward high-technology industries-as new materials, mechatronics—including industrial robotics, bioengineering, microelectronics, fine chemistry, and aerospace. As a result of structural reforms in the economy, Republic of Korea was able to build a strong industrial foundation, especially in the areas of electronics, automobiles, shipbuilding, and petrochemicals. For example, Korea's shipbuilding industry is second only to Japan's and holds 32% of the world market share. In the semiconductor industry, three Korean firms supply more than 40% of the global demand for DRAMs. Automobiles and petrochemicals rank fifth in the world in terms of production. Since November 1997, financial meltdown has impacted economic growth of the country. The economic situation has improved with considerable restructuring and rebuilding phase. Industries which are highly dependent on domestic market sales have suffered the most due to the sluggish demand. Industries like construction, steel, petrochemical, machinery, textiles, and most services suffered (Korea, 2009a).

Industry is responsible for about 48% of *China's* GDP in 2006 (Table 3.5). Industry (including mining, manufacturing, construction, and power) contributed 52.9% to GDP in 2004 and occupied 22.5% of the workforce. China ranks third in globally in industrial output. Major industries comprise mining and ore processing, iron and steel, aluminum, coal, machinery, armaments, textiles and apparel, petroleum, cement, chemical, fertilizers, food processing, automobiles and other transportation equipment including rail cars and locomotives, ships, and aircraft, consumer products including footwear, toys, and electronics, telecommunications and information technology. Overall industrial output has grown at an average rate of more than 10% per year. Since the founding of the People's Republic, industrial development has been given considerable attention. Among the various industrial branches the machine-building and metallurgical industries have received the highest priority. These two areas alone now account for about 20–30% of the total gross value of industrial output. The automobile industry and petrochemical industry have grown rapidly since 2000. China is the world's leading manufacturer of chemical fertilizers, cement, and steel. By 2002 the share in gross industrial output by state-owned and state-holding industries had decreased to 41%, and the state-owned companies themselves contributed only 16% of China's industrial output. China's construction sector has grown substantially since the early 1980s. China is one of the largest producer of steel in the world and the steel industry has been rapidly increasing its steel production. Iron ore production kept pace with steel production in the early 1990s but was soon outpaced by imported iron ore and other metals in the early 2000s. Steel production, an estimated 140 million tons in 2000, increased to 419 million tons in 2006. Much of the country's steel output comes from a large number of small-scale producing centers (EIU, 2005a, 2003a).

By the early 1980s, *Singapore* had built a much stronger and diversified economy, which gave it an economic importance in East and SouthEast Asia. The government emphasizes during the first half of the 1980s on industrial activities

from traditional labor-intensive, low-wage activities to capital-intensive, high-wage and high-technology activities, notably the electronic industries and oil refining. By the late 1980s, Singapore further diversified its economy, provided manufacturing, financial, and communications facilities to multinational firms (Lee, 2000). The contribution to GDP is maintained at 33–35% since 1990s (Table 3.5).

Malaysia is the world's largest producer of palm oil, accounting for almost half of the world's production. The industrial output is ranked 32nd in the world. The industrial sector is regulated and promoted by Malaysia Industrial Development Authority (Malaysia 2009b). In the past, the country also was the world's largest producer of rubber, but in the early 1990s it was overtaken by Thailand and Indonesia. Mining sector, which once played a very important role in Malaysian exports, is losing its importance. However, there is great potential for development of this sector, since Malaysia has various relatively under-exploited mineral resources, including bauxite, iron ore, copper, limonite, and gold. For a long time, Malaysia was the world′s largest producer of tin, but in the early 1990s was overtaken by Brazil and neighboring Indonesia. Additionally, there are large offshore reserves of high-quality oil and gas. During recent decades, Malaysia has increased production of crude petroleum and natural gas. Malaysia was ranked thirteenth in the world in terms of gas reserves and twenty-second in oil reserves in 1999. The production of gas increased steadily in the 1990s to meet the rising demand in the domestic and international markets (Malaysia, 2009b). In Malaysia industrial sector is performing well since 1990s. Its contribution to GDP is around 50% in the current decade (Table 3.5).

Industrial production in *Indonesia* has increased by 7% during the 1990s. Its contribution to GDP has also grown from 39% in 1990s to 47% in 2006 (Table 3.5). The growth of industrial sector was generally broad-based, with all sectors except mining expanding. The lack of investment in the mining sector has affected oil production negatively (ADB, 2003). The pace of recovery in Indonesia picked up significantly in 2000, due to the rise in oil prices, strong private consumption, and a revival in investment. Due the destruction caused by the tsunami of 26 December 2004, there has been a substantial loss of human and physical capital. Other key economic assets in some province, such as coal and copper mines and oil and gas operations, were not affected (ADB, 2003).

Industrial production in the *Phillipines* expanded modestly from 3.6% in 2000 to 5% in 2008 (EIU, 2009a) while its contribution to GDP is varying between 30–34% during 1990 to 2006 (Table 3.5). Food processing displayed an improved performance, but other industries such as chemicals, basic metals, textiles, electrical machinery, wood products and beverages, recorded low growth in the current decade. The Phillipines is rich with mineral and thermal energy resources. Gold, nickel, copper and chromite deposits are among the largest in the world. Other important minerals include silver, coal, gypsum, sulfur, clay, limestone, marble, silica, and phosphate. About 60% of total mining production are accounted for by non-metallic minerals, which contributed substantially to the industry's steady output growth between 1993 and 1998, with the value of production growing by 58% (EIU, 2002).

Industrial sector in *Brunei Darussalam* grew strongly due to higher oil revenues. Growth in the domestic non-energy sectors did not gain much momentum as these remained dependent on government spending. The promotion of SMEs in the private sector and the further development of public ICT systems and facilities were moving upwards (UNESCAP, 2005). Industrial contribution to GDP varies between 60 and 70% since 1990s (Table 3.5). Oil and gas sector output accounts for around 35% of GDP.

Cambodia experienced considerable growth in garment production, tourism, non-forestry agriculture and construction which pushed GDP growth since mid-1990s and their contribution to GDP increased to 26% (Table 3.5).

Industry provided about 32% of total GDP during 2006 in **Laos** (Table 3.5). It performed well in process timber and garments. *Myanmar* experienced expansion in energy production. Industrial output rose by over 13% in 1999 from about 6% in 1998. The production of cotton yarn and fabrics and cement has increased in the currrent decade. Since the economy is agriculture based the industrial contribution is only 10% of GDP (Table 3.5) during 2000. Industrial production expanded rapidly in 2003–4 (20.8–21.5%), but dropped sharply in 2007 (9%) (EIU, 2008a).

3.3.4 Manufacturing Sector in East and SouthEast Asia

Though manufacturing and industrial sectors are partly overlapping, still we are trying to capture the status of manufacturing sector for the countries in East and South East Asia.

Japanese manufacturing is very diversified, with a variety of advanced industries that are highly successful. The fields in which Japan enjoys relatively high technological development include consumer electronics, automobile manufacturing, semiconductor manufacturing, optical fibers, optoelectronics, optical media, facsimile and copy machines, and fermentation processes in food and biochemistry. Manufacturing contributed 21% of GDP in 2006 (Table 3.6), while employing 10.2% of the workforce (Japan, 2009).

The share of manufacturing industries in the *Republic of Korea* increased from 21.5% in 1970 to 30% in 1990 but dipped to 28.74% in 2005. Electric and electronics equipment played a pivotal role (especially computers, semiconductors, and telecommunications equipment).

China's manufacturing sector produced about 8.74 trillion Yuan in goods according to the World Bank for the year 2005. In 2006, China surpassed Japan as the world's No. 2 auto market, with total sales of 7.2 million vehicles and production of 7.3 million. In 2007, China also became one of the world's top producer of merchant ships (Tkacik, 2007). The contribution of the manufacturing sector to GDP varies between 33 and 35% since 1990s till 2005 (Table 3.6).

A major vehicle of growth in *Singapore* continued to be the manufacturing sector, although trade and tourism activities are no less important. The contribution to GDP is around 28% in the current decade (Table 3.6). The electronics industry

Table 3.6 Manufacturing, value added (% of GDP)

	1990	1995	1997	2000	2005	2006
Brunei Darussalam	11	13	15	15	12	10
Cambodia		9	12	16	18	19
China	33	34	33	32	33	35
Indonesia	21	24	27	28	28	28
Japan	–	–	23	22	22	21
Republic of Korea	27	28	26	29	28	28
Malaysia	24	26	28	33	30	30
Myanmar	8	7	7	7	–	–
Philippines	25	23	22	22	23	23
Singapore	27	27	24	28	27	28
Thailand	27	30	30	34	35	35
Vietnam	12	15	16	19	21	21
LaoPDR	10	14	16	17	21	21

Source: WDI, 2007.

accounted for the largest share of value-added in manufacturing. Manufacturing was dominated by the production of computer peripherals and oil processing. Singapore produces a diversity of manufacturing goods, including electronic items, chemicals, transportation equipment and machinery, petroleum products, rubber and plastic products, and fabricated metal products. Electronic goods—notably computer disk drives, communications equipment, and televisions—account for about half of the country's manufacturing output. Singapore is developing as a global hub of information and communications technology, and telecommunications is a vital aspect of the economy. The government has placed high priority on upgrading and expanding the country's already well-developed telecommunications infrastructure (Singapore, 2009a). Even within manufacturing, further branching off from electronics to other areas like chemicals and biomedical manufacturing (especially pharmaceuticals) has been taking place over the decade after the Asian Financial Crisis. In 2006 electronics accounted for 29% of manufacturing value added compared to more than 50% in 1995. With the emergence of chemicals and biomedical manufacturing also as key players with 14 and 25% of value added shares, respectively, in 2006, the manufacturing sector has become more broad based (Abeysinghe, 2007).

Malaysia has developed a diversified manufacturing sector that plays an increasing role in the Malaysian economy. Manufacturing contributes about 30% of GDP (Table 3.6), providing employment 27% of the workforce during the present decade (Malaysia, 2009b). Manufacturing sector received incentive in the 1970s and 1980s by the extensive growth of the electric assembly and electronics sectors. The country became an important producer of radios, television sets, stereo equipment, and other related products. In the 1980s, the Malaysian government started its national automobile project, the locally produced Proton car (in cooperation with Mitsubishi of Japan). In the late 1980s, it started exporting the Proton to the international market. In the 1990s Malaysia saw further growth in the manufacturing sector, especially

in export-oriented electronics production, including semiconductors, silicon wafers, and other items. Malaysia has become the world's third-largest producer, and one of the world's largest exporters of semiconductors. The country was adversely affected by the 1997 Asian financial melt down, its manufacturing sector contracted. However, in 1999 and 2000, Malaysia could overcome the impact of recession in manufacturing, and this sector made an impressive growth of 12% per annum in recent times (Malaysia, 2009b).

Manufacturing is the second most dynamic economic sector in the *Philippines* after services. It employs 9.8% of the labor force and contributes 22% to the GDP in 1998 and maintained till 2006 (Table 3.6). Modern manufacturing production is concentrated on processing and assembly operations of the following: food, beverages, tobacco, rubber products, textiles, clothing and footwear, pharmaceuticals, paints, plywood and veneer, paper and paper products, small appliances, and electronics. In the 1990s the electronics industry was the fastest growing sector not only in manufacturing but also in the Philippines economy as a whole and employs huge labor in this sector (EIU, 2008b).

From an agriculture based economy *Thailand* moved towards an industrialized economy. Manufacturing sector increased by 12.6% annually in the late 1980s and the early 1990s (before the crisis of 1997). Its contribution to GDP has increased from 27% in 1990 to 35% in 2006. Among all manufacturing industry transport sector, electronics and food products dominate. Manufacturing sector showed a growth rate of 5.4% in 2002. It enjoyed the benefit of growing domestic and external demand. In 2003 it grew by 10.3% and contributes to the economic growth (Mukhopadhyay, 2007).

Vietnam emerges as a major actor in five key manufacturing sectors: textiles, footwear and garments, agro-processing, electric and electronic industries, and automobile and motorcycle assembly. The contribution to GDP has increased from 12% in the 1990s to 21% in 2006 (Table 3.6) while employing 10.2% of the workforce. The top manufacturing sectors—food processing, cigarettes and tobacco, textiles, chemicals, and electrical goods—experienced rapid growth in the current decade. There are a total of 14 joint ventures in the emerging Vietnamese automobile industry. There is a huge domestic market for motorcycles. Vietnam's electronics assembly is also growing rapidly since 1990s (Vietnam, 2009).

3.3.5 Service Sector in East and SouthEast Asia

Table 3.7 provides contribution of the services sector to total GDP of East and South East Asian economies

The service sector performs fairly well through out 1990s and the current decade its share to GDP is 69% (Table 3.7). Banking, insurance, real estate, retailing, transportation, telecommunications and tourism are major industries under the service sector.

In the late 1980s one of the fastest growing sectors of *Singapore's* economy was international banking and finance. This sector accounts for about 25% of GDP.

Table 3.7 Services, value added (% of GDP)

	1990	1995	1997	2000	2005	2006
Brunei Darussalam	37	45	43	35	27	26
Cambodia	–	38	39	42	44	44
China	31	33	34	39	40	40
Indonesia	41	41	40	38	40	40
Japan	58	64	64	66	69	68
Republic of Korea	49	52	53	54	56	57
Malaysia	43	46	44	40	42	41
Myanmar	32	30	30	33	–	–
Philippines	44	46	49	52	54	54
Singapore	65	65	65	64	67	67
Thailand	50	50	50	49	46	45
Vietnam	39	44	42	39	38	38
Lao-PDR	24	25	26	25	26	26

Source: WDI, 2007.

It ranked behind Tokyo and Hong Kong amongst financial service centers in the East and Southeast Asian region (Singapore, 2003). Services comprise 65% of the GDP throughout 1990s and further high to 67% in 2006 (Table 3.7). In this sector, financial and business services are the most important, followed by wholesale and retail trade, transportation and communications, and tourism. Singapore has become East and Southeast Asia's banking and finance hub. It houses international banks, wealth management firms and other financial institutions. A sound economy, robust infrastructure, pro-business environment, talented international workforce and strong regulatory framework have made Singapore one of the major International Finance Centres of the world. Electronic commerce (e-commerce), an increasingly important component of the service sector, is supported by Singapore's well-developed telecommunications infrastructure. Tourism is an important source of foreign exchange fuelling the nation's economic growth (Singapore, 2009b).

Service sector is not so important in *Brunei*, still the restaurant and hotel sector was doing well in the 1990s, however, contracted quite sharply recently. The contribution to GDP declined from 37% in 1990s to 26% in 2006 (Table 3.7).

The service sector in *Indonesia* has always maintained a steady share of 40% (Table 3.7) of GDP since the 1990s. Tourism along with fairly high private domestic demand, hotel and restaurant sector, and financial services are working together to maintain the growth.

The share of the service industries in GDP was 51.5% in 1997 increased to 64.3 in 2005, in the *Republic of Korea* (Table 3.7). The service industry expanded largely by higher output, in the transportation, storage, and communication sectors.

In *Malaysia*, service sector expanded steadily over the last two decades, becoming the second-largest sector of the Malaysian economy. Value added in the service sector as a whole rose by 5.9% in 2000, compared with 3.6% in 1999. The contribution to GDP varies between 40 to 46% during 1990–2006 (Table 3.7). The good performance contributed much to the solvency of the financial sector and facilitated

efforts in restructuring the corporate sector. Progress in banking reforms and corporate restructuring and the improved employment prospects strengthened domestic demand. Private investment expenditure also contributed to the growth.

The *Philippines*' services sector had a significant contribution to the economic growth. The sector's growth experiences 4.1 and 4.6%, respectively, for 1999 and 2000. The growth further accelerates to 7.3% in 2004 from an average 5.6% in 2002–2003. The contribution to GDP has always maintained above 50% in the current decade (Table 3.7). This can be attributed largely to the telecommunications sector, where investment related to call centre activity and other business process outsourcing, as well as software development, mushroomed (EIU, 2006).

China's services output ranks seventh worldwide, it has remained on a high-growth path (China, 2009). In 2006 the services sector produced 40% of China's annual GDP (Table 3.7), second only to manufacturing. China's tourism industry is one of the fastest-growing industries in the national economy and is also one of the industries with a very distinct global competitive edge (China, 2009).

The service sector is performing well in *Cambodia*. Its contribution to GDP has increased from 38% in 1995 to 44% in 2006 (Table 3.7).

The service sector is responsible for 26% of GDP in 2006, in **Laos** and it has been steady since the 1990s (Table 3.7). This performance is caused by tourism-related activities, such as transport, hotels and restaurants, and commerce, which are being promoted under the campaign 'Visit Laos Year' in 1999–2000 (UNESCAP, 2003).

Financial, construction, telecommunication and transportation and tourism sectors have expanded rapidly in *Thailand* (NESDB, 2005). Thailand remained an interesting and attractive destination for tourists. In the services sector, tourism industries continued to expand markedly as a result of public–private cooperation in promotional activities coupled with the strong yen and European currencies. The service sector's contribution to GDP was 50% till 2000. In the current decade, it declined to 45% in 2006 (Table 3.7).

3.4 Poverty and Unemployment

The performance of the broad sectors of ASEAN is expanding rapidly including China, Japan and the Republic of Korea. But, recent reports of the UNDP and the ILO tell us that East and South East Asia has been experiencing deeper inequality and rising unemployment under economic liberalization and globalization. Some countries are even experiencing jobless growth. The 2006 Asia-Pacific Human Development Report said '. . .the region has embraced free trade, but has free trade embraced the poor?' (Tañada, 2008).

This development is vividly illustrated by the present food crisis being experienced by the Filipino poor, urban and rural, due to policy of deregulating and liberalizing agriculture, during the last 25 years or so. Today, the Philippines, from a net rice exporter in the late l970s, has become one of the global importer of rice (Tañada, 2008).

Likewise, the Philippines has been experiencing a pattern of jobless growth, as it has become dependent on a few growth industries such as IT/ICT and electronics while losing all other industries, from shoe and textile production to tire and steel manufacturing (Tañada, 2008).

Since 1988, unemployment rate kept decreasing due to the economic boom in Malaysia and amounted to 2.6% in 1997. And it remained moderate at approximately 3.5% from 1998 to 2004 (Furuoka, 2007).

Unemployment problem has been serious in China between 1997 and 2007. This is because massive layoffs in the urban areas and the peak in surplus labor in the countryside happened simultaneously in this period. It is said that China has surplus workforce of 120 to 150 million (Jianjun, 2002). When they lose their jobs, farmer still have means of production but urban workers are left with no means of production. Tsinghua University's Center for China Study estimates that urban jobless rate is 8.3% in nationwide average. As the regional financial and economic crisis persists in the ASEAN region, social problems have loomed larger as many workers face unemployment and vulnerable and disadvantaged communities experience greater hardship and poverty. Since much of the region is affected, the combined potential of social problems from desperate unemployed workers and the new poor pose a threat to national, as well as regional stability (ASEANSEC, 2009).

The Poverty headcount ratio at national poverty line (% of population) is highest in Cambodia (35 in 2004), Lao-PDR (33 in 2003), Vietnam (29 in 2002) and Indonesia (17, 2004) (WDI, 2007). But other developing countries in the region are relatively better off in that respect. With economic reforms in China initiated in the late 1970s, the growth results in significant increase in per capita income and also a decline in the poverty rate from 64% at the beginning of reform to 10% in 2004 (Kniivilä, 2007). At the same time, however, different kinds of disparities have increased. Income inequality has risen, the difference between rural-urban income has enhanced and disparity between highly educated urban professionals and the urban working class has been sharpening. There have also been increases in inequality of health and education outcomes. In Thailand there is a problem of the huge difference in income between the upper 30% and the rest of the population. Thailand's impressive economic growth in the 1980s and 1990s has improved overall living conditions, but the benefits of this national affluence have not been distributed equitably. Those belonging to the lower 30% of the population are merely surviving (United Nations, 2000). Though the poverty rate in Vietnam has reduced from about 58% in 1993 to 16% in 2006, or about 34 million people have escaped poverty, the Gini coefficient (measure of income inequality), has increased from 0.34 in 1993 to 0.36 in 2006 (VietnamNet, 2008).

Japan is a highly developed country with high living standards. It is found that the rate of poverty (i.e. the headcount ratio) is high among advanced countries. The degree of inequality of outcome in terms of income distribution has also been increasing (Tachibanaki, 2006).

The Republic of Korea has been one of the world's fastest growing economies for over four decades. The GINI index for Japan and the Republic of Korea is 0.37 and

0.35, respectively, while for Thailand, Philippines and Malaysia it is at the range of 0.46–0.52. Among the least developed countries in ASEAN are Cambodia and Laos at 0.39–0.40 according to the World Bank estimate in 2006 (WDI, 2007).

The economic advances in the region have allowed the East and South East Asian countries to enjoy improvements in poverty reduction. They are expected to achieve the UN Millennium Development Goals well before the 2015 target date.

There are various measures taken by the national as well as international level to eradicate poverty by countries in ASEAN+3. Social safety net programmes can become more successful coupled with socioeconomic development programmes. While efforts to promote economic growth are emphasized both at the national and regional levels through trade reforms, intra-regional trade and investment are equally important to address the social impacts of the financial and economic crisis, and to reduce the impact on the incidence of poverty and social well-being, particularly of the rural areas in the ASEAN region. (ASEAN, 1999)

3.5 The Structure of Foreign Trade and FDI

In this section we are going to discuss the pattern of trade and investment. Few basic issues will be addressed in this section. What are the major exports and imports of these countries and the primary destination of trade and interregional trade? Also the sources of FDI are touched upon.

Table 3.8 shows the growth of exports of goods and services and its contribution to GDP over the period 1990–2006 in ASEAN countries and China, Japan and Republic of Korea. Export as a percentage of GDP during 1990–2006 is highest for Singapore followed by Malaysia, Brunei and Thailand. The impressive export growth rate during the period has also been found for Vietnam and Thailand.

Table 3.9 presents the imports of good and services by ASEAN countries and China, Japan and Republic of Korea since the 1990s. Import growth shows, however, a fluctuating pattern for most of the countries. Cambodia and Myanmar show a steady import growth throughout while for Thailand and Malaysia it declined considerably after 2000.

Now we are discussing in detail the factors behind the export and import growth and also the major destinations of each country's trade along with the principal items of trade.

3.5.1 Japan

For the Japanese economy, East and Southeast Asia is the most important region. For East Asia, too, Japan is a particularly important country in trade and investment. The major exported goods are capital goods and parts, motor vehicles and related goods, and IT-related goods which accounted for approximately 70% of total exports.

Table 3.8 Export growth and contribution to GDP

		1990	1995	2000	2006
Brunei	Exports of goods and services (% of GDP)	62	60	67	71
	Exports of goods and services (annual % growth)	1	17	12	4
Cambodia	Exports of goods and services (% of GDP)	6	31	50	69
	Exports of goods and services (annual % growth)	–	44	30	19
China	Exports of goods and services (% of GDP)	19	23	23	40
	Exports of goods and services (annual % growth)	5	6	31	23
Indonesia	Exports of goods and services (% of GDP)	25	26	41	31
	Exports of goods and services (annual % growth)	3	8	26	9
Japan	Exports of goods and services (% of GDP)	10	9	11	16
	Exports of goods and services (annual % growth)	7	4	13	10
Republic of Korea	Exports of goods and services (% of GDP)	28	29	41	43
	Exports of goods and services (annual % growth)	4	24	19	12
Lao PDR	Exports of goods and services (% of GDP)	11	23	30	36
	Exports of goods and services (annual % growth)	–	–	6**	29
Malaysia	Exports of goods and services (% of GDP)	75	94	124	117
	Exports of goods and services (annual % growth)	18	19	16	7
Myanmar	Exports of goods and services (% of GDP)	3	1	0	–
	Exports of goods and services (annual % growth)	14	−22	44	–
Philippines	Exports of goods and services (% of GDP)	28	36	55	46
	Exports of goods and services (annual % growth)	2	12	17	11
Singapore	Exports of goods and services (% of GDP)	–	–	192	246
	Exports of goods and services (annual % growth)	–	–	20*	18*
Thailand	Exports of goods and services (% of GDP)	34	42	67	74
	Exports of goods and services (annual % growth)	13	15	17	9
Vietnam	Exports of goods and services (% of GDP)	36	33	55	73
	Exports of goods and services (annual % growth)	13	25	25	23

Source: WDI, 2007.
*WTO 2001, 2007.
** 2002 data.

This remained the main pillars of Japan's exports throughout the 1990s. There was a sharp increase during 1999–2000 in particular, and then dip in 2001 with the bursting of the so-called 'IT bubble' (Bank of Japan, 2002). Exports of motor vehicles and related goods declined to about 20% of total exports in 2000 from

Table 3.9 Imports of goods and services (annual % growth)

	1990	1995	2000	2006
Brunei	18	16	−6	4
Cambodia	–	36	24	15
China	18	7	24	14
Indonesiag	23	21	26	9
Japan	8	13	9	4
Republic of Korea	14	23	20	11
Lao PDR	–	–	–	4
Malaysia	26	24	24	9
Myanmar	48	20	−8	–
Philippines	10	16	4	2
Singapore	–	13*	21*	19*
Thailand	24	20	27	2
Vietnam	−4	34	40	21

Source: WDI, 2007.
*EIU, 1995, WTO, 2001, 2007.

approximately 30% in the early 1990s. Furthermore, the percentage of semiconductor fabrication machines and equipment within the capital goods and parts category rose.

As for exports by region, the US consistently maintained of 30% of Japanese exports, and is Japan's largest export market. However, the percentage of exports to NIEs (the Republic of Korea, Taiwan, Hong Kong, and Singapore) and ASEAN 4 (Thailand, Indonesia, Malaysia, and the Philippines) and China, then comes to approximately 40% of all Japanese exports in the current decade. Japan's main exports in the 1990s were motor vehicles and related goods to the US and the EU, and capital goods and parts to the US and NIEs. From 2000 onwards, the percentage of motor vehicles and related goods exports has been down to about 20% while the percentage of IT-related goods, which are mostly shipped to the US and East Asia, has increased more than 20%. The percentage of capital goods and parts exports remained consistent at around 30% from 1990 (Bank of Japan, 2002).

Raw materials including crude oil and other mineral fuels were the major imports, but these are recently starting to be overtaken by IT-related goods. The value of consumer goods imports, is increasing, and explains 10% of total imports. Office machinery is the largest, accounting for nearly half of total IT-related goods imports, followed by semiconductors and other electronic parts, which account for about 30% (Bank of Japan, 2002).

US remains the largest supplier of Japanese imports as a single country. But imports from the East Asia, particularly China, expanded rapidly from the latter 1990s and now has share of about 40% of the total, which is around twice the US figure. The value of imports from other regions, which includes sources of crude oil, has not changed significantly. The importance of IT-related goods imports, mostly from the East Asia, especially NIEs, and from the US has been growing, and the

percentage of consumer goods imports from East Asia, especially China, is also expanding (Bank of Japan, 2002).

3.5.2 Thailand

Thailand has changed markedly over the last four decades. In the sixties, agricultural products accounted for the bulk of the country's exports. Since the seventies, manufactured exports account for more than 80% of the nation's total export value.

In the late eighties, Japan and some newly industrialized economies relocated a number of their industries to Thailand. There were large FDI inflows in export-oriented and machinery-related industries during this period. The average export-output ratio in the manufacturing sector has risen over time. Industries with high export-output ratio are canned food, milled rice and tapioca, sugar and other food products, textiles, wearing apparel, footwear, wood products and furniture, rubber products, electronic products, and electrical appliances (UNIDO, 2002). Since 1998 exports of motor vehicles and parts have become the nation's principal export items (Mukhopadhyay, 2006).

The United States, the European Union and Japan were the three most important markets for Thailand until the early nineties when sales to ASEAN markets surpassed the EU and Japan. In ASEAN, Thailand's single largest market is Singapore. The United Kingdom, the Netherlands, and Germany are the principal EU markets. Other important destinations for Thai products include China and the newly industrializing economies of Asia (Hong Kong, Taiwan and Republic of Korea), as well as Australia, Nigeria, Saudi Arabia and the United Arab Emirates.

Thai manufactures rely heavily on imported materials. Products serving primarily the domestic market such as breweries and dairy products, animal and vegetable oil, animal feed, tobacco, pharmaceuticals, iron, steel and metal products rely much on imported materials. Some exports depend even more on imported components. Computer parts, integrated circuits, electrical and electronic products, and transport equipment are among the leading export items with high import content (UNIDO, 2002).

3.5.3 Vietnam

The policy of openness and industrialization has opened up new opportunities for Vietnam to make full use of its inherent comparative advantages. Over the years of the Doi Moi process, Vietnam's export growth has averaged 20% (MOFA, 2007).

The structure of exports has seen a change. During the 1991–1995 period, major exports of Vietnam were crude oil, fishery products, rice, textiles, coffee, forestry products, rubber, peanut and cashew nuts. By 2005, Vietnam was mainly exporting namely crude oil, garment and textile, footwear, seafood, woodwork, electronics

appliances, and rice. This structure reflects the rise in processing and manufactured products and decline in unprocessed products, including agricultural, fishery, forestry products and minerals. Despite this shift, unprocessed export products still make up a large proportion (MOFA, 2007).

The main destinations of Vietnam's exports in 2004 were the United States (18.8%), Japan (13.2%), China (10.3%), Australia (6.9%), Singapore (5.2%), Germany (4.0%), and the United Kingdom (3.8%). Vietnam is facing trade deficit since 2007 (EIU, 2008a). Vietnam's merchandise imports were valued at US$31.5 billion in 2004 and growing rapidly. The main origins of Vietnam's imports were China (13.9%), Taiwan (11.6%), Singapore (11.3%), Japan (11.1%), Republic of Korea (10.4%), Thailand (5.8%), and Malaysia (3.8%) (EIU, 2008c).

3.5.4 Singapore

Singapore generally maintains a positive balance of trade. Singapore's port is one of the busiest in the world in terms of shipping tonnage. The chief imports, in order of value, are machinery and transport equipment; basic manufactures, such as textile yarn, fabric, iron and steel; miscellaneous manufactured articles; petroleum and petroleum products; and food and live animals. The country's major exports are electronics products, machinery and transportation equipment, and refined petroleum products. Leading purchasers of Singapore's exports are Malaysia, the United States, the European Union (EU), Hong Kong, and Japan. Imports come mainly from Japan, Malaysia, the United States, the EU, and China. Singapore has no energy resources, so it relies on imported fuels. Crude oil is imported and refined in the country. Singapore also imports natural gas to meet its energy needs. Some of the petroleum imports are used to fuel electricity-generating plants (Singapore, 2009b).

3.5.5 Republic of Korea

The principal export commodities of Republic of Korea are machinery and equipment including electronics, telecommunications equipment, semiconductors, LCD panel, mobile phone, computers related, television, motor vehicle—passenger cars, steel, ships, and petrochemicals, and metal goods. The Republic of Korea's export earnings fared well from 2000 onwards. One of the main factors in the export boom was the demand from China, which is now the Republic of Korea's most important export market. In addition to heavy reliance on a few major markets, the Republic of Korea's exports are relatively narrowly based on a limited range of products such as wireless communication equipment, automobiles and steel. Korean exports to the United States were sluggish because imports from Japan proved more price competitive that from Korea's as a result of the weakened yen (EIU, 2005a). The major imports to the Republic of Korea are machinery, industrial materials, electronics

and electronic equipment, fuels-oil, steel, transport equipment, organic chemicals and plastics and capital goods, most of which were stimulated by export demand (EIU, 2005a).

3.5.6 Malaysia

Malaysia's international trade experienced considerable growth throughout the last three decades. Even during the Asian financial crises of 1997 and 1998, the country had a large trade surplus of US$4.0 billion in 1997 and US$17.7 billion in 1998. The Malaysian government encouraged export-oriented industries, created favorable investment environment in the country, and promoted close relations between the government and private businesses. In the mid-1990s Malaysia faced growing competition from neighboring Indonesia, the Philippines, and Thailand, which could offer cheaper labor and larger and growing domestic markets. However, political stability in Malaysia has been advantage compared to these countries (Malaysia, 2009a).

The important export products were electrical and electronics products, chemicals and chemical products, manufactured metal products, and textiles, clothing, and footwear, petroleum and liquefied natural gas, chemicals, palm oil, wood and wood products, rubber. Most of Malaysia's electrical and electronic products are produced for export (56% during 2000) to the United States, Europe, and other markets. Imports are machinery and equipment, chemicals, food, fuel, lubricants. Historically, the United States has long been one of Malaysia's largest trading partners. Trade between these two countries consisted mainly of assembled electrical goods and manufactured electronic products. Singapore is traditionally the second-largest export market. The proportion of goods exported to Singapore is around 16.5%. The major exports are electrical and electronic equipment, machinery, metals, and mineral fuels. Malaysia exports 11.6% of total to Japan and exports comprise electrical and electronic equipment, machinery and mineral fuels. Other export destinations are the Netherlands, Taiwan, and Hong Kong. Malaysia is one of ASEAN's leading exporters of furniture. Access to cheap local wood makes Malaysian furniture manufactures very competitive in the international market. The United States was the largest single market for Malaysian wooden furniture (37%), followed by Japan (14%), Singapore (9%), and the United Kingdom (9%). Malaysian imports originate from Japan, and consisting mainly of electrical and electronic equipment and machinery. The United States is the second major source of imports and consists mainly of electrical and electronic equipment and transportation equipment (Malaysia, 2009a).

3.5.7 Philippines

Since the mid-1980s, nontraditional manufactured exports are becoming important in the Philippines export basket. The principal export items of the country are electronic products (29.6%), semiconductor (22.3%), agriculture based product (1.6%),

minerals (2.1%) and garments (2.6%) in 2006. The major items in the import basket are electronic products (24.4%), mineral fuels (8.2%), transport equipment (2.0%), industrial machinery (2.0%) and textile fabrics (1.1%) in 2006 (EIU, 2007). The leading markets of Philippines are China (39.6%), USA (17.7%), Japan (15.6%), Singapore (10.5%), Hong Kong (10.4%) and others (6.8%) in 2007. The leading suppliers of imports are Japan (17.1%), USA (14.7%), China (13.5%), Singapore (11.7%), the Republic of Korea (6.7%) and others including Taiwan and Hong-Kong (36.3%) in 2007(EIU, 2008b, 2009a).

3.5.8 Myanmar

The principal export of Myanmar was basically rice and rice products, Pulses and beans, Teak and Rubber during the1990s. From 2000 onwards the major items in export list were gas, fish and fish products, pulses and teak. The principal imports throughout the 1990s were raw materials, transport equipment, foodstuffs, machinery and equipment, construction materials. During 2000, crude-oil and edible oil were also added to the import list as a major item. The main destinations of exports were Singapore, Thailand, India, Hong Kong, China, Japan and USA during the 1990s. From 2000 onwards Thailand became a major destination with 34% share. The main origins of imports are Japan, China, Thailand, Singapore, Malaysia, the EU and Indonesia. During 2000, Singapore, China and Thailand became major importers with 52% share (EIU, 2003b).

Myanmar recorded a merchandise trade surplus (US$730 million at the official rate) in 2002, owing to considerable growth in exports and a decline in imports and this trend continued into the first half of 2003. However, exports for the year as a whole were impacted by the US sanctions in 2003, banning all imports from Myanmar, most of which are manufactured goods, primarily garments (EIU, 2003b). Exports fell by 12.3% during 2007–8. Much of the fall was the result of a contraction in natural-gas exports due to sluggish demand in Thailand (the main market for Myanmar's gas exports) (EIU, 2009b). Exports were disrupted by Cyclone Nargis, which caused severe damage to the area around Yangon, which is an important base for Myanmar's agricultural-processing and export-oriented manufacturing sectors. On the other hand, imports increased by 24.2% during the year 2007–8 (EIU, 2009b).

3.5.9 China

China's international trade has experienced a steady expansion since the opening of the economy in 1979. China has become an important actor in world trade during the last thirty years. Its overall share of exports to industrial economies has increased and become more diversified (China, 2009).

Apart from Asia, China's leading export destination is USA, the EU and Japan.

China's export base has diversified from an initial heavy reliance on textiles and other light manufacturing. In the early 1990s, light manufacturing had a share of more than 40% of China's exports. These products largely consisted of footwear, clothing, toys, and other miscellaneous manufactured articles. A large part of the remaining exports was accounted for by manufactured goods, machinery and transport. In recent years, China is exporting more sophisticated electronics, furniture, travel goods, and industrial products. For example, the proportion of China's exports by machinery and transport increased from 17% in 1993 to 41% in 2003, while the share of miscellaneous manufacturing declined from 42 to 28%. The composition of imports reflects the high degree of vertical specialization of production within the Asian region. A high share of imports for processing is embodied in China's exports. This ratio increased from about 35% of all imports in the early 1990s to about 50% by 1997 and has remained at about that level since then (EIU, 2004).

3.5.10 Indonesia

In the early 1990s, Indonesia was considered as one of the most promising developing country. From 1990 to 2006 Indonesia's export values have been about 20–30% of its GDP) (Table 3.8). The country experienced a slight dip in exports and much bigger drop in imports due to the financial crisis in 1997. Indonesia has a few important trading partners such as China, Japan, Singapore, the Republic of Korea and the USA. In 2006, these five countries contributed to 57.5 and 47.7% of Indonesia's export and import, respectively. The major export item in the list of Indonesia are mineral fuels, oil distillation products, wood and wood products, electrical and electronic equipment, apparel accessories, rubber and footwear. The imports are intermediates and final goods dominated by nuclear reactors, boilers, machinery, vehicles, electrical and electronic equipment, organic chemicals, iron and steel product. The major chunk of exports is destined to the USA and the EU countries in the 1980s and the 1990s, but after the mid-1990s, the share has gone up to the rest of ASEAN countries and Japan, the Republic of Korea and China.

3.5.11 Trend of Intra Regional Trade

Over the past two decades, the region's trade and FDI have expanded rapidly. East and South East Asia's exports rose from 14% of world total exports in 1980 to 27% in 2006, while its imports expanded from 15 to 24% during 1980–2006 (Kawai & Wingaraja, 2007). After discussing the performance of the individual countries in ASEAN, it is worth to see the share of intra regional trade. Table 3.10 summarizes changes in the share of intra-regional trade for various groupings in Asia over the period 1980–2006. Table 3.10 demonstrates that intra-regional trade as a share of ASEAN+3 has risen from 30.2% in 1980 to 38.3% in 2006. Within ASEAN the trade share has increased from 17.9 to 27.2%.

Table 3.10 Trend of the intra regional trade share from 1980 to 2006 (%)

Region	1980	1990	1995	2000	2002	2004	2006
ASEAN(10)	17.9	18.8	24	24.7	24.4	26.7	27.2
ASEAN+China, Japan and Republic of Korea (13)	30.2	29.4	37.6	37.3	37.9	39.2	38.3

Source: IMF Direction of Trade Statistics CD-ROM (June, 2007) and Kawai & Wingaraja, 2008a.

3.5.12 Status of FDI in East and South East Asia

East and Southeast Asia has long enjoyed a market-driven expansion of trade and FDI. FDI inflows into East Asia (including Japan) more than tripled from 5% of world total FDI inflows in 1980 to 16% in 2005, while East Asian FDI outflows increased from 5 to 11% of world total outflows over the same period (Kawai & Wingaraja, 2008a).

FDI inflows into East and Southeast Asia have facilitated regional economic integration. Table 3.11 summarizes the source regions/countries of emerging East Asian economies' FDI inflows (cumulative figures) for the period 1995–2005. It shows that major industrialized countries as well as emerging East Asia are the main investors in East and SouthEast Asia. Multinational corporations from the European Union (EU), the United States (US) and Japan account for 15, 14 and 11%, respectively, of emerging East Asia's cumulative FDI inflows over the period 1995–2005. More specifically, the largest investors in the Asian newly industrializing economies (NIEs), particularly in Singapore and Taipei, China, come from

Table 3.11 Emerging East and SouthEast Asia's FDI inflows, 1995–2005

	Source regions/countries of FDI inflows to emerging East and Southeast Asia (%)						
FDI inflows to	USA	EU	Japan	Asian NIEs	ASEAN9	Other countries	Total
Asian NIEs	16.8	15.8	8.1	5.2	3.9	50.2	100
Hong Kong	5.1	7.4	5.7	5.3	1.8	74.7	100
Republic of Korea	22.4	40.1	13.3	4.1	7.4	12.7	100
Singapore	31.7	19.3	8.5	4.0	5.8	30.7	100
Taipei, China	19.9	13.1	15.5	14.2	2.5	34.8	100
ASEAN 9	18.4	29.1	19.1	29.2	4.2	0	100
Indonesia	5.7	50.9	3.3	15.0	9.3	15.8	100
Malaysia	27.4	23.4	13.6	22.0	2.1	11.5	100
Philippines	23.4	10.3	23.1	16.9	1.1	25.2	100
Thailand	10.5	10.5	25.1	27.6	0.9	25.4	100
Vietnam	4.8	19.1	14.4	39.2	6.6	15.9	100
China	8.1	8.1	8.6	54.0	1.6	19.6	100
Total	13.9	14.7	10.5	34.9	3.1	100	

Source: ADB, 2007.

the US. In contrast, the EU is the largest developed region investor in ASEAN-9 (which excludes Singapore), particularly in Indonesia and Vietnam. Japan is the principal investor in Thailand and Philippines. However, in Thailand and Vietnam, the Asian NIEs' firms are the most dominant investors. In the case of China, Hong Kong is by far the largest investor. The rising importance of FDI by the Asian NIEs' firms, account for 29.2% of total FDI inflows to ASEAN 9 and 54% of total inflows to China. More recently firms from the middle-income ASEAN countries, such as Malaysia and Thailand, have also begun to invest in other ASEAN countries and in China.

In this connection, the direct investment among ASEAN is also worth checking. Table 3.12 explains the intra-ASEAN direct investment flows. Among ASEAN, Thailand and Indonesia are the highest investors in this region.

In 1998 the ASEAN member countries signed the *Framework Agreement on the ASEAN Investment Area*. This agreement enables the establishment of an investment area by 2010, recognizing that the inflow of FDI is very important for overall development. Under this agreement member countries of ASEAN will be granted immediate national treatment by 2010, and all investors will be granted this benefit by 2020 (ASEANSEC, 2007).

Initially the objective of this agreement was to promote free flow of investment, technology and skilled professionals. The agreement has been extended to cover the agriculture, fishing and forestry sectors, mining, manufacturing and services.

Several factors are responsible for the expansion of trade and FDI. First, East and South East Asian economies have pursued trade and investment liberalization as part of their outward-oriented trade and FDI policies within the multilateral framework under the General Agreement on Tariffs and Trade/World Trade Organization and open regionalism through Asia-Pacific Economic Cooperation. Second, through FDI, global MNCs and later other East Asian firms have formed production networks and supply chains throughout East and Southeast Asia. They have divided their production processes into multiple sub-processes and located

Table 3.12 Intra ASEAN direct investment flows (millions of US$)

Host country	2002	2003	2004	2005	2006	Total 2002–06
Brunei Darussalam	21.23	36.79	19.66	19.43	9.71	106.82
Cambodia	8.52	19.88	31.92	129.18	155.54	345.04
Indonesia	1296.62	383.46	204.25	883.32	1524.53	4292.18
Lao-PDR	2.92	2.98	7.75	6.68	10.56	30.9
Malaysia	0.02	251.12	980.17	572.91	467.82	2272.05
Myanmar	25.11	24.28	9.31	38.35	27.79	124.84
Philippines	87.44	175.37	71.11	12.69	−95.56	251.06
Singapore	762.3	699.2	548	1175.6	1137.7	4322.8
Thailand	1408.29	1060.42	688.71	762.22	2822.12	6741.76
Vietnam	200.43	100.4	242.87	164.72	181.89	890.31
Total ASEAN	3812.89	2753.9	2803.75	3765.11	6242.09	19377.75

Source: ASEAN Secretariat-ASEAN FDI Database, 2007, BOP Basis.

these sub-processes in different countries based on comparative advantage—i.e., relative factor proportions and technological capabilities. As a result intra-regional of division of labor has evolved and rising vertical intra industry trade in manufactured products have been possible. Third, improved infrastructural facilities and ICT progress have reduced trade costs of conducting cross-border business. This encourages trade and investment activities. Fourth, rapid growth of China, has also helped to closer economic linkages among the East and SouthEast Asian economies. The country has thus become a manufacturing assembly for the East and SouthEast Asian economies, particularly for Japan and the Asian NIEs. All these factors have created regional concentration of trade and FDI activities in East and Southeast Asia (Kawai & Wingaraja, 2007).

Rapid economic expansion in East and South East Asia's economies are likely to have environmental implications. What is the current state of the art is to be looked into.

3.6 Environmental Profile: An Overview

A short profile of the environmental situation in ASEAN countries and China, Japan and the Republic of Korea is presented in this section.

3.6.1 Vietnam

The rapid economic growth and substantial investments in infrastructure may significantly threaten the environmental sustainability of the country's development. Five key components of the environment are forest, biodiversity, land, water (both inland and sea water), the air, and hazardous and toxic waste (State of the environment, 2002).

The industries like oil and gas, electricity, and cement have poor environmental records due to old equipment, lack of adequate controls, and inadequate treatment of wastewater and air emissions. The major sources of air and noise pollution in urban areas are from the transport vehicles and the industrial establishments scattered in residential areas. The total number of transportation vehicles has also increased very rapidly, in particular motorcycles and automobiles. Automobiles and motorbikes still use leaded petrol (World Bank, 2007a).

Table 3.13 shows the trend of the major GHG emissions and PM10 in Vietnam during 1990–2005. The trend shows that the local pollutants like PM10 is declining due to several measures but the GHG emissions especially CO_2 and NO_x are rising at a rapid rate at 166 and 169% during 15 years. Sulfur dioxide levels near some factories occasionally exceed national standards by several times. Many industrial pollutants have a high environmental health cost. Health damages from particulate emissions (PM10) have been estimated to account for 0.4% of GNI.

Table 3.13 Status of the environment, Vietnam

	1990	1995	2000	2005
CO_2 emissions (kt)	21385	29813	53809	57000*
Combustible renewable and waste (metric tones of oil equivalent)	18900	20967	22631	23955
Methane emissions (kt of CO_2 equivalent)	52990	59130	71560	75080
Nitrous oxide emissions (thousand metric tons of CO_2 equivalent)	13920	20500	27110	37470
PM10, country level (micrograms per cubic meter)	124	78	70	61

Source: WDI, 2007.
*Data for the year 2004.

Rapid urbanization and industrialization in coastal areas, expansion in coastal tourism, and an increase in the number of oil spills are all contributing to the deterioration of coastal water quality. The Government of Vietnam has implemented fees on wastewater pollution and introduced a Prime Ministerial Decision to reallocate, close down or adapt cleaner technologies, but these policies need to be enforced effectively (World Bank, 2007a).

Vietnam uses Ozone Depleting Substances (ODS) and Halons in industrial facilities. Therefore, Vietnam is eligible for financing under the Montreal Protocol for ODS phase-out. Implementation of the National CFC and Halon Phase out Plan in Vietnam is currently under way (World Bank, 2007a).

Vietnam is one of the first countries in the East and Southeast Asia region to ratify the Stockholm Convention on Persistent Organic Pollutants (POPs). To address its environmental challenges, Vietnam has raised the profile of environmental sustainability in its national and international dialogue. In 2003, the Government established the Ministry of Natural Resources (MoNRE), initiated separation of regulation of some natural resources from that of users, and approved the National Strategy for Environmental Protection (NSEP). MoNRE is also taking initiatives of Law on Environmental Protection to enable new policy tools and remedies for pollution prevention and cleanup and adjustments to cover environmental management in the private sector. In 2004, the Environmental Impact Assessment (EIA) requirements for project approvals were increased and the Strategy for Sustainable Development (Agenda 21) was adopted (CAI, 2006a).

Despite these measures, the progress has been slow due to weak commitment by sectoral agencies, low awareness in local departments and officials. There is a lack of environmental integration at planning and programmatic levels, especially in the public investment planning process and in regional plans for land and resource use (World Bank, 2007a).

3.6.2 Philippines

The Philippines was one of the first countries to adopt the Agenda 21 process, initiated at the Rio Earth Summit in 1992, by formulating its own National

Agenda 21, through a highly participatory process, in 1996. However, despite its government's good intentions, rapid population growth, urbanization and industrialization have far outstripped urban environment services caused by poor natural resource management system (World Bank, 2007b).

Air pollution levels in Metro Manila and other cities exceed national air quality standards and impose a serious economic burden on society. Increasing water pollution is degrading the country's groundwater, rivers, lakes, and coastal areas (World Bank, 2007b).

The major sources of air pollution are from mobile sources-20% (primarily, motor vehicles) stationary-54% (mainly, power plants and boilers in various industrial processes) and the remaining 26% from area sources. Of the pollutants inventoried, CO has the biggest contribution (39%). The contribution of other pollutants is the following: NO_x—35%, SO_x—8%, PM—8%, TOG—7%, and VOC—2% (World Bank, 2007b).The emissions inventory also shows SO_2 as the main pollutant emitted by stationary sources, CO for the mobile sources and PM for area sources.

The transport sector's contribution ranges from 50 to 90%. In 2005, TSP concentrations in Metro Manila exceeded the 90 $\mu g/m^3$ Philippines annual mean TSP guideline value (24-h sampling) (CAI, 2006a).

The trend of GHG emission is shown in Table 3.14. CO_2 increased heavily followed by methane, while PM10 is declining during the period 1990–2005.

The World Bank Philippines Environment Monitor 2004 computed that the annual estimate for urban heath cost can amount to over $1.5 billion or 1.8% of the 2004 GDP (World Bank, 2007b).

In the last few years the government has employed economic instruments such as pollution fines and environmental taxes to address the problem. Community and civil society-led recycling programs have become popular, but hazardous and toxic waste disposal has emerged as a major environmental challenge. Over the past decade, the Government of Philippines has tried to address environmental degradation by introducing institutional and legal reforms. In addition, in recent years, World Bank, has supported efforts to improve overall environmental governance in the country by building the capacity of the Department of Environment and Natural Resources (DENR). In spite of all these efforts, capacity in environmental and natural resources governance still requires significant improvement, particularly in local government units (World Bank, 2007b).

Table 3.14 Status of the environment, Philippines

	1990	1995	2000	2005
CO_2 emissions (kt)	43897	62776	77923	80512
Methane emissions (kt of CO_2 equivalent)	38830	44490	44630	44860
Nitrous oxide emissions (thousand metric tons of CO_2 equivalent)	17990	18520	16890	18940
Combustible renewable and waste (metric tones of oil equivalent)	7642	8814	9541	10892
PM10, country level (micrograms per cubic meter)	55	58	48	26

Source: WDI, 2007.

3.6.3 Cambodia

Cambodia is facing the growth of unplanned settlements, higher quantities of untreated urban domestic sewage, industrial effluent and solid waste polluting surface, and ground water in many of Cambodia's cities and towns. There are no special landfills or other treatment facilities for toxic, hazardous or medical waste, which is often burned at open dumpsites, together with solid waste.

Cambodia is facing a growing air pollution challenge. Ambient concentrations of PM is increasing resulting in severe impacts on the health of residents of Phnom Penh and, of other urban centers. The pollution trend shows that methane and CO_2 is increasing, while PM10 and nitrous oxide declining gradually (Table 3.15).

Between 1993 and 1996, the Government of Cambodia enacted several key pieces of environmental legislation to establish the legal framework to control, use and manage its natural resources and urban environment. The World Bank is helping to increase environmental capacity and information with a range of analytical and advisory services.

3.6.4 Indonesia

Indonesia is one of the world's largest greenhouse gas emitter, generating 80% of greenhouse gases from changed land use following logging and forest/swamp fires (World Bank, 2007c). Transportation is the main source of ambient air pollution in Jakarta, with 15,000 people per square kilometer.

According to the Statistic Central Agency, oil fuel consumption increased. In 2003, oil fuel use was 68% of total energy consumption. In 2004–2005, the demand for gasoline in Jakarta rose, resulting in increased air pollution (World Bank, 2007c). Industry was estimated to emit about 40% of NO_x and more than 80% of Sulfur dioxide (SO_2) in Indonesia. Other sources of Nitrogen oxide (NO_x) were transport and domestic sources. Domestic sources also emitted a large proportion of particulates. PM10 and SO_2 averages in Jakarta and Surabaya from 2000 to 2004 exceeded the WHO air quality guideline (AQG) (World Bank, 2007c).

Table 3.15 Status of the environment, Cambodia

	1990	1995	2000	2004	2005
CO_2 emissions (kt)	451	549	531	535	–
Methane emissions (kt of CO_2 equivalent)		12800	13350	–	14890
Nitrous oxide emissions (thousand metric tons of CO_2 equivalent)		4350	3490	–	3820
PM10, country level (micrograms per cubic meter)	116	66	70	66	62

Source: WDI, 2007.

Table 3.16 Status of the environment, Indonesia

	1990	1995	2000	2005
CO_2 emissions (kt)	213773	302754	365304	532847
Combustible renewables and waste (metric tones of oil equivalent)	45002	48747	49927	51094
Methane emissions (kt of CO_2 equivalent)	180250	214710	223140	224330
Nitrous oxide emissions (thousand metric tons of CO_2 equivalent)	60220	66640	69130	69910
Organic water pollutant (BOD) emissions (kg per day)	495594	749872	752834	–
Other greenhouse gas emissions, HFC, PFC and SF6 (thousand metric tons of CO_2 equivalent)	1380	960	900	900
PM10, country level (micrograms per cubic meter)	138	115	120	96

Source: WDI, 2007.

The GHG emission as evident from Table 3.16 shows an increasing trend. CO_2 has increased by 150%, methane and NO_x have increased by 24 and 15%, respectively, during the 15-year period.

Health care costs increase by US$3.8 million per year. On average, people have only 18 'good air' days in a year. In 2004, 46% of all illness cases in Jakarta were respiratory related. One of the major threats to Indonesians, especially to children is TSP and lead concentration (World Bank, 2007c).

National energy policies emphasize reliance on renewable energy sources, including biomass, geothermal, and hydropower. The government plans to increase the use of coal to reduce Indonesia's dependence on oil imports. However, this would lead to adverse environmental impacts (World Bank, 2007c).

3.6.5 China

China's rapid growth is damaging the natural resource base and generating major environmental pressure. China is a second-largest source of greenhouse gas (GHG) emissions in world. Almost 68% of its energy comes from coal, much of which is burned in thermal power plants or in industrial boilers.

Table 3.17 shows 109% increase of CO_2 emission from 1990 to 2005. Methane and nitrous oxide is also on rise during the period, while BOD shows a deciling trend. In 2006, the total of China's CO_2 emissions from fossil fuels increased by 9% thus surpassing those of the USA. China has a large share in global cement production (about 44% in 2006) and nationally their share in CO_2 emissions is almost 9% (550 megatonne out of a total of about 6200 megatonne of CO_2). China is one of the largest source of SO_2 emissions in the world (http://www.pbl.nl/en/news/pressreleases/2007).

Table 3.17 Status of the environment, China

	1990	1995	2000	2005
CO_2 emissions (kt)	2398203	3196726	3336334	5005687
CO_2 emissions from solid fuel consumption (% of total)	80	78	72	72
Combustible renewables and waste (metric tones of oil equivalent)	200407	205648	214322	223561
Methane emissions (kt of CO_2 equivalent)	895350	958940	973730	995760
Nitrous oxide emissions (thousand metric tons of CO_2 equivalent)	455150	544230	556620	566680
Organic water pollutant (BOD) emissions (kg per day)	7038131	7558406	6229906	–
Other greenhouse gas emissions, HFC, PFC and SF6 (thousand metric tons of CO_2 equivalent)	8640	19890	82590	119720
PM10, country level (micrograms per cubic meter)	114	92	85	75

Source: WDI, 2007.

Suspended particulate levels are higher in northern cities, due to industrial activity (SEPA, 2007). Since 2003, NO_x and particularly SO_2 concentrations have increased. The annual average of PM10 levels in excess of 100 $\mu g/m^3$, which is twice the US annual average standard. Twenty-one percent of cities reported annual average levels in excess of 150 $\mu g/m^3$. A direct consequence of air pollution from SO_2 and NO_x is acid rain, which remains a serious problem in China. However, recent data suggest that sulfur dioxide emissions are increasing due to the high demand for coal in a rapidly growing economy. Emissions in 2005 were over 25 million tons, 28% higher than in 2000, and 42% higher than the 2005 target (SEPA, 2007).

China is an active participant in the climate change talks and other multilateral environmental negotiations. It is a signatory to the Basel Convention governing the transport and disposal of hazardous waste and the Montreal Protocol for the Protection of the Ozone Layer, as well as the Convention on International Trade in Endangered Species and the Kyoto Protocol, although China is not required to reduce its carbon emissions under the terms of the present agreement. On June 19, 2007, the Netherlands Environmental Assessment Agency announced, on the basis of an analysis of fossil fuel consumption (including especially the coal power plants) and cement production data, that China surpassed the United States as the world's largest emitter of carbon dioxide, putting out 6,200 million tons, in comparison with America's 5,800 million (China, 2009).

Water pollution is also a cause for serious concern. During the period 2001–2005, on average about 54% of the seven main rivers in China contained water deemed unsafe for human consumption. This represents a nearly 12% increase since the early 1990s. The trends in surface water quality from 2000 to 2005 suggest that quality is deteriorating which caused substantial increase in COD loads.

Government measures to address pollution, including industrial water and air pollution (mainly from state-owned enterprises), have achieved significant results. However, problems remain with the implementation and enforcement of environmental regulations, and the balance between reducing emissions and increasing production has not yet been satisfactorily achieved.

3.6.6 Republic of Korea

Republic of Korea ranked tenth in the world in terms of CO_2 emissions (as of 2004, IEA statistics). Heavy chemical industry is major cause of air pollution degradation. Methane emissions have shown an annual decrease of 4.2% due to a decline in farm lands and the implementation of waste reduction measures. Table 3.18 presents the GHG emissions of the country.

The other primary air pollutants such as TSP and SO_2 are decreasing in Seoul area, but a sharp increase in fuel consumption and traffic has produced the secondary pollution problems such as visibility impairment and ozone episodes. Upon the persistent efforts on the air quality improvement, SO_2, CO, and Pb have been improving. PM10 has declined since 2000. This phenomenon has been due to Ministry's comprehensive policy for air quality improvement. However, NO_2 are getting slightly worse since 2000.

The Republic of Korea's smaller population is the ninth largest consumer of ozone-depleting chlorofluorocarbons. The status of ozone exceedance events during a short term (0.1 ppm/h), shows that exceedance events have been on the rise, from 343 exceedances at 49 stations nationwide in 1996 to 1,090 at 220 stations in 2006. This has been due to an increase in the number of automobiles in Seoul and urban cities.

The Energy Economics Institute and the Korean Environment Institute assume that if emissions are cut 10% against the expected CO_2 emissions of 2020, KRW 3.4 trillion, or 0.29% of GDP, could be lost. On the other hand, a reduction of CO_2 emissions by 10% against 2010 levels could generate environmental co-benefits of

Table 3.18 Status of the environment, Republic of Korea

	1990	1995	2000	2005
CO_2 emissions (kt)	241568	372358	433044	452218
Methane emissions (kt of CO_2 equivalent)	27430	27290	29880	31280
Nitrous oxide emissions (thousand metric tons of CO_2 equivalent)	9480	13100	16170	22020
Organic water pollutant (BOD) emissions (kg per day)	366912	353077	309064	316969
PM10, country level (micrograms per cubic meter)	51	51	47	37

Source: WDI, 2007.

US$ 5.16 billion, because of the reduction in air pollutants, disease occurrence, death rates, and agricultural damage.

Transboundary pollution concerns encouraged the creation of a joint commission among Republic of Korea, Japan, and China to address environmental problems (Korea, 2009b).

To cope with the environmental problems, the Korean government has improved the environment-related organizations and laws and increased the government budget for the environment protection (ESRI, 2004). The country has specified areas with the high pollution rates as Special Atmospheric Preservation Measure Areas and Atmospheric Environment Regulation Areas. The government has also reinforced stronger emission standards compared to general standards. The government has given effort to cope with this problem by specifying Seoul and the metropolitan area as the Seoul Metropolitan Environment Regulation Area, and also by establishing the Special Act on Seoul Metropolitan Air Quality Improvement in 2003 (Kim, 2006).

According to the Ministry of Knowledge and Economy, the country intends to spend 194.4 billion won ($193 million) on technologies and projects, including solar, wind and biofuel in 2008 to overcome the pollution problem (Korea, 2009b).

Pollutants originating from non-point sources have also increased. The discharge of nonpoint pollutants has been rising due to growing economic activities and land use, which have had a negative effect on water quality.

To prevent non-point source pollution, the Ministry of Environment formulated and implemented the 'Comprehensive Measures for Water Management in Four Major Rivers' from 1998 to 2000, aiming to designate riparian zones, create buffer zones and urban reservoirs, restrict the use of agricultural fertilizers and pesticides, and convert livestock waste into energy resources (European Commission, 2008).

Total waste generation has shown an average annual increase of 8.6% over the past five years (1999–2004). Waste generated is composed of municipal waste (16.2%), industrial waste (37.6%), and construction waste (43.3%) which has the largest portion of waste produced. This ratio indicates that there was a substantial rise in construction waste from an increase in construction and reconstruction. In case of municipal waste, the implementation of the 'Volume-based Waste Fee System' has promoted waste separation and rapidly increased recycling in 2005. Policies for controlling waste generation (e.g., regulations on disposable goods and a Volume-Based Waste Fee System) have led to a gradual reduction in the amount of waste (European Commission, 2008).

3.6.7 Malaysia

Emissions from mobile sources have been the major source of air pollution, contributing to at least 70–75% of the total air pollution. Emissions from stationary sources generally contribute 20–25%, while open burning and forest fires have contributed approximately 3–5%. Recent estimates of emissions in Malaysia show that the transport sector contributed to the majority of Nitrogen oxide (NO_x) emissions

and about 35% of the total particulate matter (PM) emissions in the country. The power sector accounted for about 60% of the total SO_2 emissions and almost 50% of the total PM emissions, while the industries accounted for about 20% of the total SO_2 and PM emissions. The major industries in the country affecting air quality are the iron and steel industry, nonferrous metal industry, nonmetallic (mineral) industry, oil and gas industry, petrochemical industry, pulp and paper, power plants, and waste incineration sector (CAI, 2006b).

The annual average concentration levels of ambient PM10 from 1998 to 2004 were generally within the Malaysian Ambient Air Quality Guideline (RMG) for PM10. The annual average ambient concentration levels of SO_2 in Malaysia between 1996 and 2004 were well below the World Health Organization (WHO) annual average guideline. The annual averages of 24-h ambient concentrations of NO_2 are relatively low and generally stable. Similar to the other air pollutants, the annual 8-hourly average concentrations of CO from 1996 to 2004 were consistently higher in urban areas where the main sources of emissions are motor vehicles. Table 3.19 shows that GHG emissions (CO_2 and CH_4) are rising since 1990s. BOD is also rising during the period 1990–2005 (CAI, 2006b).

The Environmental Quality Act (EQA), the basic framework for environmental management in Malaysia, was enacted in 1974. The Act was officially endorsed by the Government of Malaysia in its Third Malaysia Plan (1981–1985). The main environmental regulatory agency in Malaysia is currently a part of the Ministry of Natural Resources and the Environment. It was established to administer and enforce EQA of 1974 (Heng, 2002). Regulations have since been in place for both petrol and diesel vehicles under Acts that came into force: the Environmental Quality (Control of Emission from Diesel Engines) Regulation on 1 September 1996 and the Environmental Quality (Control of Emission from Petrol Engines) Regulation on 1 November 1996 (Heng, 2002). Though the Government has actively pursued stricter vehicle emissions standards, the move toward the use of higher quality fuels has not been similarly aggressive. The growth in the number of private vehicles has resulted in increased emissions. However, the Ninth Malaysia

Table 3.19 Status of the environment, Malaysia

	1990	1995	2000	2005
CO_2 emissions (kt)	55264	119417	126359	177425*
Combustible renewable and waste (metric tones of oil equivalent)	2124	2349	2529	2787
Methane emissions (kt of CO_2 equivalent)	21300	24360	25320	25510
Nitrous oxide emissions (thousand metric tons of CO_2 equivalent)	11600	12410	9350	9920
Organic water pollutant (BOD) emissions (kg per day)	104728	158535	186108	–
PM10, country level (micrograms per cubic meter)	37	32	27	25

Source: WDI, 2007.
*Data for the year 2004.

Plan (2006–10) has recognized the importance of public transportation and the need to reduce private motorized travel and to encourage a shift toward public transportation.

3.6.8 Thailand

The major sources of air pollution in Thailand are industries, power plants, transport (primarily automobiles), and area sources that include agricultural wastes and biomass burning. Key air pollutants include particulate matter (PM)10 with diameter not more than 10 microns (PM10) and with diameter not more than 2.5 microns (PM2.5), Sulfur dioxide (SO_2), lead (Pb), Carbon monoxide (CO), Nitrogen oxides (NO_x), hydrocarbons (HCs), and ground-level ozone (O_3). The main pollutant of concern is PM10 (CAI, 2006a).

Mobile Sources

Cars are major sources of CO, HC, and NO_x. Two-stroke motorcycles are a dominant source of HC and contribute significantly to PM and CO emissions but are decreasing in number. Diesel trucks—both heavy and light duty—are responsible for high emissions of PM, NO_x, HC, and CO. Aging bus fleets in urban areas, including Bangkok, are large emitters of PM. An estimated 10,000 tons per year of PM can be attributed to light-duty trucks (31%), city buses (30%), city trucks (23%), motorcycles (10%), long-haul trucks and buses (5%), and passenger cars (1%) (CAI, 2006a).

Stationary Sources

As large sources such as power plants and refineries have been controlled over the last decade, small and medium industries have increased in importance as major sources of PM and NO_x pollution. The central region—the most industrialized area—accounts from 60 to 70% of all industrial emissions. The World Bank (World Bank, 2002) identified the key sources of PM, SO_2, and NO_2 within the central region as cement, lime and plaster manufacturing, iron and steel making, and other medium to heavy industries. Within the region, BMR accounts for more than 50% of SO_2, volcanic organic compounds (VOCs), and CO and over 30% of the total NO_2 from industries. Latest data from PCD reports that out of the 20,119 factories in BMR, one fourth are causing air pollution (PCD, 2006).

Area Sources

The forest fires in Thailand in 2000 were estimated to have generated approximately 40,000 tons of total suspended particulates (TSP)—equivalent to the total emissions for Bangkok from all sources. The burning of agricultural residues generated 319 tons of TSP each year, causing widespread subregional haze. Other pollution

sources that are usually overlooked are residential and commercial open cooking and refuse burning (CAI, 2006a).

Thailand's air quality is still centered on the problem of PM10, which is generally exceeded in several areas. Ambient PM10 level in 2005 is within the standard of 50 micrograms per cubic meter ($\mu g/m^3$), while roadside ambient PM10 concentrations exceeded the standard. PCD has identified power plants as the major source of SO_2. Thus, measurements are made near power stations around the country.

Concentrations of biological oxygen demand (BOD) were almost consistently worse (higher) than the standard. In one study of 15 waste disposal sites, 11 were found to have heavy metal (nickel, lead and mercury) contamination exceeding standard values. It is estimated that more than 200,000 tons of waste (BOD) is discharged into the Gulf of Thailand annually. Industrial pollution discharges to coastal waters, the heavy metal count, especially mercury, has exceeded Thai water quality guidelines at times. Solid waste has steadily increased from about 30,000 tons/day in 1992 to close to 40,000 tons/day in 1997. This totals about 13 million tons/year, of which about 25% came from Bangkok, 35% from other urban areas, and the remaining 40% from rural areas (Mukhopadhyay, 2007).

A number of recent studies show that air pollutants have increased mortality and morbidity rates, most notably in BMR. A study reports that Bangkok's population has been affected adversely by increases in PM—with an estimated 5,000 premature deaths annually. The Mae Moh valley has recorded an unusual number of deaths from heart failure and a high incidence of chronic respiratory problems (CAI, 2006a).

As pollution prevention creates additional costs, manufacturers, including transnational corporations investing in Thailand, did not pay much attention to the environmental effects of their production. To cope with this problem the Thai government took initiatives like other countries by enacting several laws and regulations.

The natural resource management laws have existed over a century in Thailand. The first environmental protection legislation was passed in 1975 before any other Asian countries. Thailand's policies and planning for natural resources and the environment was first specified in the Sixth National Economic and Social Development Plan (NESDP, 1987–1991). By 1997, there were at least three pieces of legislation in Thailand relating to industrial pollution, discharge of industrial wastes, and hazardous substances. These are the 1992 National Environment Quality Enhancement and Protection Act (NEQA), the 1992 factory Act, and the 1992 Hazardous Substances Act. In addition, the 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes is the first global Convention designed to control international trade in hazardous substances. The Thai government has set up the Policy and Prospective Plan for Enhancement and Conservation of National Environmental Quality (1997–2016) and the Environmental Quality Master Plan (1999–2006). At present, several government agencies across many industries are responsible for environmental protection. However, they seem to have limited power to work independently and public institutions in Thailand are highly segmented with limited co-ordination among them. In general, the implementation

of regulations on the environment has suffered from lack of monitoring activities and weak enforcement (Mukhopadhyay, 2007).

3.6.9 Japan

Japan produces approximately 5% of the total world CO_2 emissions, which is the fourth largest in the world in 2006. Japan emitted 1,355 million tonnes of greenhouse gases (CO_2 equivalent) in FY2004, which was 8.0% higher than the total emissions of the base year (1,255 million tonnes) as stipulated in the Kyoto Protocol. Table 3.20 shows that CO_2 emission increased by 16.8% in 15 years period, while methane and nitrous oxide shows declining trend.

Compared to the base year level 1990, a breakdown by sectors shows that the emissions of greenhouse gases for the industrial sector had decreased by 3.4%, while that of the transport sector had increased by 20.3%, the commercial and other sectors had increased by 37.9%, and the residential sector had increased by 31.5% in 2004 (Quality of the Environment in Japan, 2006).

Japan formulated ambitious climate protection targets in the early 1990s and continued to give attention to combating global warming throughout the decade. Japan has a detailed climate protection policy whose implementation is well coordinated and regularly reviewed. The country has consistently supported international climate protection efforts under the UN Framework Convention on Climate Change (UNFCCC). The CO_2 intensity of the economy (kg CO_2/unit GDP) decreased by 1.8% during the 1990s to rank eighth among OECD countries. Japan has pursued fuel switching away from oil and towards gas and nuclear power. Voluntary initiatives by Japanese industry have contributed to reductions of greenhouse gas (GHG) emissions from transport sector. Still Japan is away from its overall goal reducing GHG emissions by 6% between 1990 and 2008–2012 (OECD, 2005).

Table 3.20 Status of the environment, Japan

	1990	1995	2000	2005
CO_2 emissions (kt)	1070406	1137072	1211336	1256838
CO_2 emissions from solid fuel consumption (% of total)	28	29	33	38
Combustible renewables and waste (metric tones of oil equivalent)	4974	5179	5845	6295
Methane emissions (kt of CO_2 equivalent)	57690	60650	59490	53480
Nitrous oxide emissions (thousand metric tons of CO_2 equivalent)	31970	31710	26240	23590
Organic water pollutant (BOD) emissions (kg per day)	1556648	1452191	1332525	–
PM10, country level (micrograms per cubic meter)	43	37	34	31

Source: WDI, 2007.

The performance of the other pollutants are not same as CO_2, photochemical oxidants still exceed the environmental quality standard (EQS) (a one-hour value of 0.06 ppm or less). As one of the measures to combat photochemical oxidants, the Air Pollution Control Law was revised in May 2004 to control VOC emissions from factories. By combining VOC emission regulations and voluntary measures by business operators, the revised law provides an effective solution for curbing VOC emissions. The achievement rates for the NO_2-related EQSs were slightly improved in FY2004.

The government has attempted to control emission of various chemical substances, in accordance with the Air Pollution Control Law. The government also encourages the private sector to take voluntary actions to curb emissions. As a result total emissions of hazardous air pollutants have significantly reduced from 2001 to 2003.

According to the FY2005 Monitoring Survey of Groundwater Quality, 6.3% of the wells monitored exceeded the EQS (of one or more substances). Specifically, 4.2% of the total did not meet the EQS for nitrate-nitrogen or nitrite-nitrogen. Most of the wells are polluted by farmland fertilization, livestock excreta, or domestic wastewater. Appropriate measures to prevent the pollution are necessary for the conservation of groundwater (MOE, 2007).

The 'Inter-Ministry/Agency Coordination Committee for Building Sound Water Cycle' is serving as a coordinator of policy actions. In FY 2003, of all municipal solid waste, direct incineration accounted for 78.1%, while recycling accounted for 18.3%. The government implements the Waste Management and Public Cleansing Law as well as other recycling-related legislation. In spite of the tough policy, in FY2004 there were 673 cases of illegal dumping of industrial waste in Japan (MOE, 2007).

To solve the acute waste problems Japan has pushed through major reforms in the field of waste and recycling policies over the past 10–20 years. To create a sound material-cycle society ('SMS'), Japan formulates a SMS involving the central government, local authorities, businesses, the general public, and all other stakeholders of society through the use of the so-called 3R activities (Reduce, Reuse, and Recycle waste). Some excellent technologies have been introduced following reforms in the field of waste and recycling policies. Japan, a country with meager natural resources, has also acquired abundant experience of effectively using resources through the application of recycling technology (MOE, 2007).

The Ministry of the Environment was established in 2001, 30 years after the Japan Environment Agency (which it replaced), with more environmental responsibilities such as waste management, international environmental co-operation. A comprehensive greening of government programme implemented in the late 1990s has reduced the environmental footprint of the public sector. The procurement of eco-friendly goods (2000), a new programme for greening of government was launched in April 2001. Integration of environmental concerns and fiscal policies has begun with the ongoing greening of the automobile tax and automobile acquisition tax (OECD, 2005).

Despite improved policies, strategic environmental assessment is not yet systematically applied to environmentally relevant sectoral policies, plans and programmes. Concerning market-based integration, little use is made of economic instruments such as fees, charges, taxes, tradable permits or deposit-refund programmes. However, through its environmental policy the country has made an effort to balance between economic growth and environmental protection.

3.6.10 Singapore

The main sources of air pollution in Singapore are from the burning of fossils fuels for energy generation in industries, power stations, and in the transportation sector. Other sources include open burning of waste materials and transboundary smoke haze (CAI, 2006c). Over the past 20 years Singapore has maintained an impressive environmental record, despite an increase in industrialization and urbanization. The success in maintaining a clean and safe environment has largely been due to regular monitoring and assessment of the quality of ambient air. Ambient AQ monitoring in Singapore was initiated in 1972 and it is routinely undertaken by NEA Pollution Control Department (PCD) (CAI, 2006c).

Particulate matter (PM) is the most important air pollutant for Singapore. Comparing the ambient concentrations of pollutants in Singapore with US EPA guidelines indicates that PM with diameter less than or equal to 2.5 micrometers (PM2.5) is the major pollutant of concern. The average annual PM2.5 in Singapore of 21 $\mu g/m^3$ for 2004 exceeded the US EPA standard of 15 $\mu g/m^3$ and the 2005 WHO updated guideline of 10 $\mu g/m^3$. All other pollutants have relatively very low concentrations (CAI, 2006a). Table 3.21 shows a marginal increase (15.5%) of CO_2 emission during 1990–2005 while nitrous oxide emission increased at a higher pace (288% p.a.).

In 2005, the average level of SO_2 was 14 $\mu g/m^3$, considerably lower than the US EPA standard of 80 $\mu g/m^3$. The average level of NO_2 in 2005 was 25 $\mu g/m^3$, lower than the WHO guideline of 40 $\mu g/m^3$ and much lower than the US EPA guideline of 100 $\mu g/m^3$ O, which was emitted mainly from mobile sources, had an ambient

Table 3.21 Status of the environment, Singapore

	1990	1995	2000	2005
CO_2 emissions (kt)	45055	46798	56465	52205
Methane emissions (kt of CO_2 equivalent)	740	1120	1260	1260
Nitrous oxide emissions (thousand metric tons of CO_2 equivalent)	180	1140	5880	7970
Organic water pollutant (BOD) emissions (kg per day)	32364	33873	31524	–
PM10, country level (micrograms per cubic meter)	106	53	44	40

Source: WDI, 2007.

air 8-hourly average level of 0.5 mg/m^3 in 2005 which is well below the WHO guideline and US EPA standard. In January 1991, unleaded petrol was introduced in Singapore and leaded petrol was phased out on 1 July 1998 (ADB, 2006). The WHO guideline for annual average Pb levels is 0.5 μg/m^3 and Singapore currently complies with this value. O_3 levels are not problematic in Singapore. The annual average was well below the WHO guideline and US EPA standard (CAI, 2006c).

In 2004, Singapore achieved (Pollutant Standards Index) PSI readings of AQ in the 'Good' range for 88% of the year (MEWR, 2005). Although ambient air concentrations in Singapore have always met the international standards set by the US EPA and WHO, the economic cost of air pollution on human health in Singapore can still be considered significant (Quah & Boon, 2003).

3.6.11 Lao-PDR

The economy of the Lao PDR is still highly agriculture based. Industrialization, rapid urbanization, and motorization with associated emissions are in the early stages, but are expected to grow (ADB, 2006).

Air quality (AQ) monitoring is still not a routine practice in the country. The most recent monitoring conducted was in March to April 2004 in three sites in Vientianne. Total suspended particulates (TSP) monitoring data for all locations indicate concentration levels ranging from 82 to 296 μg/m^3. This suggests that TSP is a problem in Vientiane. PM10 monitoring results in Vientiane showed a range of concentrations between 40 and 179 μg/m^3 and an average of all 30 measurements at 87 μg/m^3. It is exceeding the WHO 24-h guideline updates (50 μg/m^3). SO_2 measurements in Vientiane show varying levels depending on the location. The range of measurements is from 3 to 276 μg/m^3. Only 8 of 29 measurements or (27.6%) comply with the WHO 24-h guideline of 20 μg/m^3 (ADB, 2006).

The results of limited monitoring conducted in Vientiane suggest that the city has excessive ambient concentrations of PM. There is a need to start AQ management through AQ monitoring and compilation of an emissions inventory to provide the basis for decision making (ADB, 2006).

This chapter provides a broad overview of the East and South East Asian countries. We have seen that remarkable economic developments have occurred in this region during last two decades. Most significant reason for this achievement has been their export-oriented growth strategy using low labor costs and opening their economies to the world market. They have attracted large volume of foreign investment, brought technology and skills beside the pure capital. The intense economic and large industrial development, significant changes in trade pattern and the production technology have important implications for the environment and also serious consequences for the future of the East and South East Asian economies. The next few chapters will be focusing on the future of these economies using an analytical framework.

Chapter 4
Theoretical Framework, Database and Scenario Development

4.1 The Theoretical Framework of the GTAP Model

The most widely recognized method to undertake a global trade analysis is with a Multiregional Computable General Equilibrium (CGE) model. The Multiregional CGE modeling framework that has been used to undertake the analysis of the current study is produced by the Center for Global Trade Analysis at Purdue University, USA. The database and model is called the Global Trade Analysis Project (GTAP) (Hertel, 1997). The GTAP model is essentially a multi-country multi-commodity model. The theory of the GTAP model resembles that underlying the standard multi-regional CGE models.

The origin of GTAP can be traced to the ORANI model, a single country general equilibrium model[9] first developed for the Australian economy (see Dixon, Parmenter, Sutton, and Vincent, 1997). The modelling of each region in GTAP is based on the ORANI model. The theory of the ORANI model has been extended to allow international trade to take place between the different countries in the global economy through introduction of a global transport sector and savings institution. Essentially, the underlying theory of GTAP is captured in two types of equations. The key drivers of the model are the behavioural equations, which are based on microeconomic theory. These equations represent the behaviour of agents in the economy. Accordingly there are behavioural equations for the consumers, and also for the international trade (exports and imports). The behavioural equations reflect the behaviour of the optimising agents such as the consumers that allows the derivation of the demand functions. The second type of the equations is the accounting relationships. These are essential in order to ensure that the behavioural equations solution occurs within a consistent macroeconomic framework. Thus, the accounting relationships ensure that the receipts and the expenditures of all the agents (consumers, producers, government, and rest-of-the-world) are balanced.

So the basic structure of the Global Trade Analysis Project (GTAP) model includes: industrial sectors, households, governments, and global sectors across countries. Countries and regions in the world economy are linked together through trade. Prices and quantities are simultaneously determined in both factor markets and commodity markets.

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The GTAP model allows international mobility of capital, multiple trading regions, multiple goods and primary factors, empirically based differences in production technology and consumer preferences across regions (Siriwardana, 2001). In each region there are five types of factors of production. First, the model uses two types of labour (skilled and unskilled) and a single, homogenous capital good. Land, and other natural resources are also in the set of factors of production. In the model, total supplies of labour and land are fixed for each region, but capital can cross regional borders to equalise changes in rates of return. Labour and land cannot be traded while capital and intermediated inputs can be traded. In other words, there is clear distinction between those factors that are perfectly mobile and those that are sluggish to adjust.

In the model, firms minimize input costs given their level of output and fixed technology. The production functions used in the model are of a Leontief structure. Firms are assumed to combine a bundle of intermediate inputs in fixed proportion with a bundle of primary factors. Similarly, the relationship between the amount of intermediate inputs and outputs is also fixed. Firms purchase intermediate inputs, some of which are produced domestically, and some of which are imported.

In the derivation of factor inputs demands, the model structure uses constant returns to scale technology and nested constant elasticity of substitution (CES) production functions with three levels. Two categories of inputs in production are recognised, the intermediate inputs and the primary factors. The technology is assumed to be weakly separable between the primary and intermediate factors of production. There are two advantages of the separability assumption. First, profit maximising firms are able to select their optimal mix of primary factors independently of the prices of intermediate inputs and vice-versa. Second, it also implies that the elasticity of substitution between primary factors and intermediate inputs is equal. In each region, each sector chooses the mix of inputs to minimise total cost for a given level of output. At the highest (top) nest level, intermediate input bundles and primary factor bundles are used in fixed proportions. At the middle nest, intermediate input bundles are formed through combinations of similar imported and domestic intermediate goods. Similarly, primary factors bundles are formed through combinations of labour, capital and land at this middle nest. In both cases the aggregator function has a CES form. At the lowest level, imported bundles are formed through CES combinations of imported goods from each region (TRID, 2003).

Each region or composite region in GTAP has a single representative household that collects all the regional income. This representative household aggregate income is exhausted through constant shares[10] to private household consumption, government expenditures and national savings. Household behaviour in the model is determined with an aggregate utility function. The private household buys bundles of commodities to maximise utility subject to its expenditure constraint. The constrained optimising behaviour of the private household is represented by Constant Difference Elasticity (CDE) demand system. The CDE function is not as general as the commonly used CES and Linear Expenditure System (LES) but is more flexible and easy to calibrate with different price and income elasticities of consumption by region. The consumption bundles are CES combinations of domestic goods and

import bundles. Then the import bundles are grouped by a CES aggregation of imports from different region.

Demand equals supply in all markets, which are, considered competitive. This implies equality between the price received by the producer and the producer's marginal cost. Regional governments intervene in their own markets by imposing taxes and subsidies on commodities and primary factors, thus driving wedges between prices paid by purchasers and prices received by producers (TRID, 2003). These policy interventions are modeled as ad valorem taxes, tariffs and subsidies, or quantitative restrictions in case of trade. These policies have a direct impact on the production and consumption sectors in the model.

The Armington elasticity is an essential component of trade policy analysis. Partial and general equilibrium models that rely on the Armington structure are universally sensitive to these elasticities. International trade is linked through Armington substitution among goods differentiated by country of origin. Therefore, in markets for traded commodities, buyers differentiate between domestically produced products and imported products with the same name. Product differentiation between imports by region of origin allows for two-way trade across regions in each tradable product. Armington elasticities specify the degrees of substitution in demand between similar products produced in different countries. They are critical parameters which, along with model structure, data and other parameters, determine the results of policy experiments. Especially when many tariffs are small, trade liberalisation simulations can produce positive or negative welfare outcomes depending on the values assumed for Armington elasticities (Zhang, 2006).

There are two global sectors in the model: transportation and banking. The transportation sector takes into account the difference in the price of a commodity as a result of the transportation of the good between countries. The global banking sector brings into equilibrium the savings and investment in the model.

Other general features of the model are its explicit recognition of savings by regional economies. These savings are completely exhausted on investments that are savings-driven in the model. The demand for investments, however, affects economic activity through its effect on patterns of production in the capital goods producing sector in each region to service investment (TRID, 2003).

Investment in each region is financed from a global pool of savings. Each region contributes a fixed proportion of its income to the savings pool. Two alternative ways can be used to allocate the savings pool. The first way is where each region's share increases by the proportion in which aggregate pool increases. The second way is where the investment allocation is done according to the relative rates of return. Regions, which experience increases in their rate of return relative to the global average, will receive increased shares of the investment budget, whereas regions experiencing reductions in their rate of return relative to the global average will receive reduced shares (TRID, 2003).

In equilibrium, all firms have zero real profit, all households are on their budget constraint, and global investment is equal to global savings. Changing the model's parameters allows one to estimate the impact from a country's/region original equilibrium position to a new equilibrium position.

Closure plays a very important role in GTAP modeling. Closure is the classification of the variables in the model as either endogenous or exogenous variables. Endogenous variables are determined (solved for) by the model and exogenous variables are predetermined outside the model. Therefore, these variables may be shocked. Closure can be used to capture policy regimes and structural rigidities. The closure elements of GTAP can include: population growth, capital accumulation including foreign direct investment (FDI), industrial capacity, technical change, and policy variables (tax, subsidies).

The number of endogenous variables has to equal the number of equations. This is a necessary but not a sufficient condition for a solution. It may be General Equilibrium (GE) or Partial Equilibrium (PE) depending on the choice of the exogenous variables. The standard GTAP closure is characterized by: all markets being in equilibrium, all firms earn zero profits, and the regional household is on its budget constraint.

GTAP is primarily a tool for global trade analysis and seems to be very well suited to studying the consequences of RTA issues. This is because GTAP has global coverage, distinguishes bilateral trade flows, admits intra-industry trade and has sufficient coverage of agricultural and non-agricultural commodities. Further, reduction in tariff and quotas impact on the respective country and also other regions of the world can be captured.

The models specify the economic structures and behaviour of agents in detail and, using the framework, simulate the economic effects of existing or proposed RTAs. The interdependence of the world economy and the comprehensiveness of the GTAP framework suits the purpose of the study.

4.2 Aggregation Scheme

Version 6 of the GTAP model and database is used to undertake the analysis.[11] This version of the model includes 57 commodities (sectors) and 87 countries (regions). The 57 industrial sectors in the model provide a broad disaggregation of the industrial sectors in each country and region. Annex 1 provides a description of the 57 industrial sectors and Annex 2 presents the name of the 87 countries (regions) included in the model.

The 87 countries were aggregated into 14 regions with an emphasis on the countries in the East and South East Asian region. Annex 2 provides the details of the aggregation scheme used in the study. Given the regional emphasis of the study, the greatest level of disaggregation occurs with the countries in East and South East Asia, while other countries not part of the economic integration were aggregated into larger regional areas. This aggregation includes nine individual countries in East and South East Asia and five other regions. The nine individual countries are: Japan, the Republic of Korea, China, Indonesia, Thailand, Vietnam, Malaysia, the Philippines, and Singapore. The other regions that have been aggregated and included in the model are: Rest of South East Asia as 'other ASEAN', NAFTA, Rest of OECD,

ROW1 (which includes South Asian countries and Hong Kong), and ROW2 (combines the rest of the countries in the world). All 14 regions by 57 industrial sectors are included in the model that will be used to address the study objective.

4.3 Environmental Indicators and Coefficients

The environmental indicators that have been considered for the present study are CO_2 (Gg), CH_4 (Gg) and N_2O (Gg), BOD (tons), COD (tons), SS—Suspended Solid (tons) and Industrial Waste (thousand tons). These seven environmental indicators have been considered due to the importance of these indicators in the countries under consideration.

CO_2 data is available for ten countries under study. CH_4 and N_2O are available for eight countries except Malaysia and Other ASEAN. Water pollution and Industrial waste data are available for six countries-Japan, China, the Republic of Korea, Vietnam, Indonesia, and Thailand.

All these countries like China, Vietnam, Thailand and Indonesia are facing environmental hazards as the economies are accelerating their growth process.[12] The GHG emissions (CO_2, CH_4 and N_2O) are collected from GTAP environmental database Version 6.2 (Lee, 2006a) for the ASEAN countries and China, Japan and the Republic of Korea. These databases are for CO_2 emissions and non-CO_2 GHG emissions (CH_4, N_2O) by 57 sectors and 87 regions (Lee, 2006b). BOD (except China[13]), COD, SS and industrial waste (except Indonesia[14]) data are collected from individual country data sources [BAPEDAL BPS statistics of Indonesia; MOEJ Water Pollution Survey (Point-source emissions only), various lake watershed management studies for unit emission per ha, and MAFF Crop Statistics (2001) for cultivation acreage (Non Point pollution emission) and MOEJ Industrial waste statistics and Industrial sales data from 3EID, Base Year 2001 (sales data: 2000) for Japan; Pollution Control Department and DIW (Department of Industrial Works) for Thailand; NIER (National Institute for Environmental Research, the Republic of Korea) and re-adjusted by KEI (Korea Environment Institute) and Waste generation and treatment in Republic of Korea, Ministry of Environment, Republic of Korea; BOD and Industrial Waste data prepared from the project results based on Water pollution of Vietnam sponsored by Land Ocean-Coastal Zone Office of Vietnam; and the COD,SS and industrial waste data (2001) for China from China Statistical Yearbook, 2002].

Environmental coefficients for the year 2001 were estimated in the model by dividing in the environmental output of a sector by its total industrial output, as reported in the GTAP model. This approach for estimating the environmental coefficients allows for consistency in the denominator.

It should be noted that the environmental coefficients are likely to change over time with technological improvement. Keeping this in mind, we have updated the environmental coefficients for the years 2010, 2015 and 2020. These updated coefficients are used to estimate the volume of emission in each scenario during the year.

For example, we use the 2015 environmental coefficient to estimate the volume of pollution under different trade scenarios for the year 2015 and so on.

4.4 Updated Environmental Coefficients Across the Countries

Environmental coefficients for GHG emissions and others were up-dated based on past behaviour of the sectoral emissions. Emission coefficients were estimated for 1995 and 2001 to calculate the growth of the emission coefficients. Data on both industrial output and GHG emissions (CO_2, CH_4 and N_2O) and other pollutants have been obtained to estimate the emission coefficients (57 sectors) for the year 1995 and 2001. The change in growth of these emission coefficients over this period was used to estimate 2010, 2015, and 2020 emission coefficients.

Data on both industrial output and GHG emissions are obtained to estimate the GHG emission coefficients for the year 1995. Coefficients are estimated for the 57 sectors. GTAP data is used to estimate the industrial output and GHG emission.

The CO_2 emission data for the year 1997 is used as a proxy for the 1995 data. The data was prepared by Lee (GTAP V5.4). This emission data covers 57 sectors and 78 regions (Lee, 2002, 2003). GTAP sector-specific CH_4 and N_2O emissions (Gg) were available for 1995. The CH_4 and N_2O emissions were prepared by Lee (2002, 2003). This data covered 57 sectors and 66 regions.

The industrial output data was taken from GTAP V4 (1995) dataset. The industrial sector output data represented 50 industrial sectors and 45 regions. The 50 industrial sectors were converted to 57 industrial sectors on the basis of the 2001 industrial sector output ratios for the disaggregated sectors. Disaggregation of these sectors were based on the definition of the industrial sectors for the GTAP V4 and GTAP V6 datasets.

For the year 2001–2010, it is assumed the emission coefficient growth rate of period, 1995–2001 across the countries, while the half of these growth rate has been considered for 2010–2015. For the period 2015–2020, we considered one fourth of the emission growth of 2010–2015. This moderate adjustment for coefficient growth has been considered by assuming a fair degree of technological improvement during this period.

When the percentage change in the GHG coefficient from 1995 to 2001 fell within a ‘reasonable’ range, then these percentage changes were kept. When the percentage change in the coefficient was ‘extreme’, a number of different options were used to modify these estimates. The modification used depended on the country, the 1995 and 2001 emission levels, and other information.

The method used to update the BOD, COD, SS coefficients was different from that of GHG emission coefficients. The coefficient reduction of 10 and 15% for the period 2001–2010 has been considered for Japan and the Republic of Korea in agricultural and non-agricultural sector, respectively. While for other four developing countries—China, Indonesia, Vietnam and Thailand, the considered reductions are 2.5 and 5% for agricultural and non agricultural sector, respectively. The same linear

reduction for coefficient growth of BOD, COD and SS is taken for consideration for the 2010–2015 and 2015–2020. The difference between the countries is set for the technological advancement.

We used the historical data to update industrial waste like GHG emission. The difference was that the average coefficient growth changes were applied for all sectors instead of having individual sector growth rates due to the non availability of the data at sectoral level. Here also it is assumed that the coefficient growth of agricultural sector will be half than that of non agricultural sector.

4.5 Scenario Development

The GTAP database provides a framework of the economies in the year 2001. New economies can be generated for the years 2010, 2015, and 2020 using macroeconomic shocks of key variables.

Three scenarios have been attempted: (a) Business as Usual, (b) Medium Economic Integration and (c) Deep Economic Integration.

(a) Business as usual
We are taking the 2001 model and using the macroeconomic shocks to generate a new economy for 2010, 2015, and 2020. In this analysis the tariff structure for all regions and countries remains as they are in 2001. This Business As Usual (BAU) remains the same throughout the analysis and is the base from which the other scenarios will be compared.

This BAU scenario projection was developed to provide a picture of how the global economy and world trade might look with the current tariff barriers. It provides a baseline to compare the implementation of the trade agreements. It also facilitates comparison of how the trade agreements may impact economies overtime, relative to what would have been the case without implementing these agreements.

(b) Medium economic integration
The Medium Economic Integration scenario describes a situation where the timing of the tariffs reductions, both import tariffs and export subsidies, is delayed. This delay in tariff reductions has been implemented for within ASEAN (W-ASEAN), and ASEAN with a bilateral agreement with China, Japan, and the Republic of Korea (ASEAN-CJK) together. Tariff reductions are delayed to 2015 and 2020.

(c) Deep economic integration
The Deep Economic Integration scenario describes a situation where economic integration, reductions in both import tariffs and export subsidies, occurs in a rapid timeframe. This rapid reduction in tariffs is applied to both within ASEAN (W-ASEAN) and ASEAN with a bilateral agreement with China, Japan, and Republic of Korea (ASEAN-CJK) together. In this simulation, tariff barriers

were reduced by 80 and 100% for agricultural and non-agricultural commodities, respectively, for the ASEAN plus Japan, China, and Republic of Korea. These reductions occur in 2010 and 2015, respectively. The final simulation run in the Deep Economic Integration scenario is one where ASEAN and Japan, Republic of Korea, and China form regional trade agreement where all tariffs, both import tariffs and export subsidies, are reduced between all countries. This simulation differed from all of the other simulations because in this case the tariff barriers between Japan, China, and Republic of Korea are also reduced to defined levels. This is the simulation that treats ASEAN plus, Japan, China, and Republic of Korea as a fully integrated trading block where tariffs are reduced for all countries and between all countries. This simulation is labelled as ASEAN+3. The economic integrated region in this case includes: Japan, Republic of Korea, China, Indonesia, Thailand, Vietnam, Malaysia, Philippines, Singapore, and other ASEAN.

Table 4.1 Business as usual, medium, and deep scenarios description

Business as usual (BAU)				
Regional scope	Commodity scope	By 2010	By 2015	By 2020
ASEAN, Whole study region (ASEAN+3), other regions	All commodities	Current tariffs	Current tariffs	Current tariffs
Tariff reductions under medium economic integration (MEI)				
Regional scope	Commodity scope	By 2010	By 2015	By 2020
Within ASEAN, ASEAN with each of Japan, China, and Republic of Korea	Agricultural Commodities		40%	80%
	Non-Agricultural Commodities		50%	100%
Whole study region (ASEAN+3)	Agricultural Commodities			
	Non-Agricultural Commodities			
Tariff reductions under deep economic integration (DEI)				
Regional scope	Commodity scope	By 2010	By 2015	By 2020
Within ASEAN, ASEAN with each of Japan, China, and Republic of Korea	Agricultural Commodities	40%	80%	
	Non-Agricultural Commodities	50%	100%	
Whole study region (ASEAN+3)	Agricultural Commodities			80%
	Non-Agricultural Commodities			100%

The above scenario description required a change in the development of the GTAP model to undertake the analysis. In this case, the up-dating of the model to 2020 require a number of discrete steps. These steps and the models that were estimated are described in Table 4.1.

The GTAP model simulates the impact of the tariff reductions under several scenarios. It estimates how trade flows will change while reducing import tariff restrictions. As the trade flow between countries changes, as a result of the import tariff reductions, the growth of the economies will be impacted, so also will industrial sector output, trade, and the environment.

4.6 Modifications of the GTAP Model to 2020

In order to undertake the scenario analysis, it is decided that the static GTAP model with a base year of 2001 would be inappropriate. This is because the scenario development requires the removal of tariff barriers over time. As a result, the base year, 2001 of the GTAP model had to be up-dated to the year 2020. There are two general approaches to up-dating the model; a recursive process and the use of dynamic GTAP. The recursive updating process is used to up-date the model in this study. This approach to up-dating the model uses projections of macroeconomic variables to simulate what the various economies would look like in the future. Confidence in the simulated model increases when it can predict the variables that it is based on and when it falls within an acceptable range of other independent estimates of the projected macroeconomic variables.

The recursive up-dating process is based on forecasting the countries and regions economies by exogenously shocking the baseline model with projections of selected macroeconomic variables. These projections of the macroeconomic variables are taken from reliable sources that try to predict the future direction and strength of an economy. The literature suggests that the number of macroeconomic variables to be used in the forecasting should be kept to a reasonable number. In addition, most previous attempts of the recursive up-dating process have been for small models i.e. with fewer industrial sectors and fewer regions. As a model increases in size in either industrial sectors or regions or both it increases the data requirements but also the complexities in the modeling and computing tasks.

4.7 Macroeconomic Variable Estimates and Underlying Assumptions

Five primary factors of production are used in the production system: land is used only by the primary sector that requires natural resources, unskilled labour and skilled labour, and physical capital. The first step in the process is to develop a BAU projection to 2010 from the benchmark 2001 GTAP6 database. The projection

of the global economy to 2010 is made with assumptions concerning economic and factor growth rates. Exogenous projections of each region's GDP growth (World Bank, World Development Indicators) are estimated in addition to estimates of factor endowments such as population, skilled and unskilled labour, and capital stock (Mukhopadhyay & Thomassin, 2008; Dimaranan, Ianchovichina, & Martin, 2007; UN 2006). Total factor productivity is endogenously determined to accommodate the combination of these exogenous shocks. This approach allowed for a prediction of the level and growth of GDP as well as trade flows, input use, welfare and a wide range of other variables. The resulting forecast provided a projection of the global economy in 2010 that is in equilibrium. This forecasted economy to 2010

Table 4.2 Factor inputs, GDP, population projections (2001–2010): cumulative percentage changes

2001–2010	Population	GDP	Unskilled	Skilled	Capital
China	6.42	113.11	8.04	32.30	93.89
Japan	0.57	18.48	1.84	−4.94	25.55
Republic of Korea	4.05	53.79	−2.71	39.51	45.60
Indonesia	13.18	57.98	28.48	74.00	51.63
Malaysia	19.96	55.78	18.69	54.16	58.92
Philippines	22.03	46.70	18.66	50.43	42.16
Singapore	14.31	46.21	6.07	11.24	67.65
Thailand	7.35	56.70	1.00	32.98	65.13
Vietnam	14.86	85.98	14.40	19.74	37.54
Other ASEAN	12.44	48.36	12.67	24.60	43.21
Rest of OECD	5.62	21.50	7.02	5.10	31.97
NAFTA	10.46	30.77	14.55	21.49	33.21
ROW1	17.35	61.64	19.01	38.10	50.33
ROW2	17.22	50.49	22.48	32.40	36.01

Table 4.3 Factor inputs, GDP, population projections (2010–2015): cumulative percentage changes

2010–2015	Population	GDP	Unskilled	Skilled	Capital
China	2.74	46.93	3.67	22.82	41.20
Japan	−0.90	10.41	1.63	−4.81	12.27
Republic of Korea	0.91	26.42	10.30	32.88	24.62
Indonesia	4.99	31.94	14.24	37.00	25.82
Malaysia	7.62	29.46	8.96	26.21	29.46
Philippines	8.70	23.43	9.33	25.22	21.08
Singapore	4.73	20.93	3.04	5.62	33.82
Thailand	2.52	28.24	0.50	16.49	32.56
Vietnam	6.19	39.68	7.20	9.87	18.77
Other ASEAN	5.69	25.14	6.54	13.52	22.12
Rest of OECD	1.08	11.83	4.45	0.28	16.74
NAFTA	4.63	15.94	9.52	11.41	17.36
ROW1	7.10	31.78	8.81	19.04	26.69
ROW2	8.04	25.04	11.54	16.67	18.01

Table 4.4 Factor inputs, GDP, population projections (2015–2020): cumulative percentage changes

2015–2020	Population	GDP	Unskilled	Skilled	Capital
China	2.35	46.93	3.74	16.44	37.39
Japan	−1.67	10.41	−0.44	−2.59	11.07
Republic of Korea	0.21	26.42	12.88	26.18	24.13
Indonesia	4.09	31.94	14.24	37.00	25.82
Malaysia	6.57	29.46	10.13	19.51	29.46
Philippines	7.58	23.43	9.33	25.22	21.08
Singapore	3.24	20.04	3.04	5.62	33.82
Thailand	1.84	28.24	0.50	16.49	32.56
Vietnam	5.38	37.54	7.20	9.87	18.77
Other ASEAN	5.24	24.47	6.96	10.42	21.73
Rest of OECD	1.24	13.16	4.72	−0.42	16.22
NAFTA	4.11	14.61	10.41	7.98	16.99
ROW1	6.26	27.64	9.10	14.91	25.78
ROW2	7.51	24.36	11.92	13.80	18.01

provides the starting point for subsequent simulation exercise. Projections for the fundamental drivers of global economic change over the period 2010 are presented in Table 4.2.

These forecasts are generated using several sources. Population projections are based on the United Nations publication; 2006 Revised Population Database, United Nation, Population Division. The projected GDP is estimated from Real Historical and Projected Gross Domestic Product (GDP) and Growth Rates of GDP for Baseline Countries/Regions (in billions of 2000 dollars) 2000–2017 from World Development Indicators adjusted to 2001 base and estimated and projected values developed by the Economic Research Service (World Bank, 2007d). Projections of skilled and unskilled labour and physical capital stock were from Dimaranan et al. (2007) and Mukhopadhyay et al. (2008). This forecasting procedure is also used for the year 2015 (Table 4.3) and 2020 (Table 4.4).

Capital accumulation and FDI are difficult issues to address in a recursive updating approach. Capital in the economic integration scenarios is modified by incorporating the investment in time '*t*', i.e. It, resulting from the trade liberalization shocks along with the baseline capital forecast for *t*+1.

Chapter 5
Economic Impact of Economic Integration

5.1 Introduction

We have discussed in Chapter 4 about the GTAP model which is implemented to estimate the economic impact of the regional integration. The recursive updating procedure is used to update the GTAP data of version 6. The model has been run to analyze the economic impacts of several simulated regional trade agreement scenarios. The regional trade agreements decreased import tariff restrictions and export subsidy between the ASEAN countries as well as Japan, China and the Republic of Korea in the model. The experiments undertaken in the study are briefly described in the previous chapter as Business As Usual, Medium Economic Integration, and Deep Economic Integration.

We begin by comparing the impact of these three integration scenarios. It is expected that the trade agreements would affect the country's growth in industrial output along with its share of exports and imports. The present study is primarily focused on these results along with sectoral analysis. However, the welfare implications and poverty status are also dealt with each phase of the agreements.

5.2 Output Growth

First, we look at changes in real output growth in business as usual scenarios. Then we will discuss the same for different trade scenarios. The real value of output in Business-as-Usual period 2001–2020 divided in three sub periods (2001–2010, 2010–2015 and 2015–2020) is presented in Table 5.1 and percentage change in real value of output for the same period in Table 5.2.

The results indicate that output growth rate is expected to be highest in China through out the period till 2020 followed by Vietnam, Thailand, and Indonesia and the lowest industrial output growth rate in Japan in the BAU periods (Table 5.2). The output growth of ROW1 is also expected to be higher compared to Rest of OECD and NAFTA.

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Table 5.1 Real value of total output in business as usual (BAU) scenario (million US$)

	BAU 2001	BAU 2010	BAU 2015	BAU 2020
China	3135854	7453181	11419955	17630701.8
Japan	7331684	8900080	9892768	10985990.9
Republic of Korea	969486.6	1551934	1992793	2578268.97
Indonesia	289797.9	489425.2	666948.4	918949.024
Malaysia	220174.8	365577.1	487698.5	653837.859
Philippines	152181.9	235113.7	296780.6	377363.729
Singapore	228148.4	362481.2	457405.3	575280.753
Thailand	254791.6	432079	575514.9	774737.716
Vietnam	66231.02	130762.7	185340.3	259580.877
Other ASEAN	138331	212075	267848.4	338226.163
Rest of OECD	15795776	19649798	22187311	25398594.3
NAFTA	20245256	27201363	31779867	36738746.7
ROW1	2217786	3799719	5137321	6768636.79
ROW2	7528336	11565535	14463002	18038318
Total	58573836	82349125	99810554	122037234

Source: Results from the study.

Table 5.2 Percentage change in the real value of output (BAU) during 2001–2020

	2001–2010	2010–2015	2015–2020
China	137.68	53.22	54.39
Japan	21.39	11.15	11.05
Republic of Korea	60.08	28.41	29.38
Indonesia	68.88	36.27	37.78
Malaysia	66.04	33.41	34.07
Philippines	54.50	26.23	27.15
Singapore	58.88	26.19	25.77
Thailand	69.58	33.20	34.62
Vietnam	97.43	41.74	40.06
Other ASEAN	53.31	26.30	26.28
Rest of OECD	24.40	12.91	14.47
NAFTA	34.36	16.83	15.60
ROW1	71.33	35.20	31.75
ROW2	53.63	25.05	24.72
Total	40.59	21.20	22.27

Source: Results from the study

The output growth rate is responding positively across the W-ASEAN (Within ASEAN countries) and ASEAN-CJK (ASEAN countries with China, Japan and the Republic of Korea) regional trade scenarios (detail discussion in Chapter 4).

Table 5.3 presents the percentage change in output growth of each trade agreement phase compared to the BAU period (2020). The table estimates the percentage change in the real value of output of the various countries and regions as a result of the regional trade agreements and the timing of tariff reductions.

Table 5.3 Percentage change in the real value of output for each trade scenario relative to the BAU 2020

	MEI 2020	DEI 2020	ASEAN+3 (2020)
China	0.23	0.22	0.25
Japan	0.04	−0.05	0.01
Republic of Korea	−0.21	0.15	0.31
Indonesia	1.30	1.97	2.30
Malaysia	2.06	2.34	3.30
Philippines	2.00	2.71	2.31
Singapore	3.06	3.30	2.07
Thailand	5.31	7.81	6.88
Vietnam	6.52	8.41	13.59
Other ASEAN	0.04	0.25	0.14
Rest of OECD	−0.27	−0.15	−0.61
NAFTA	−0.26	−0.27	−0.69
ROW1	−0.71	−0.75	−0.77
ROW2	−0.16	−0.23	−0.61

Source: Results from the study

As expected, countries and regions that are not part of the regional agreement have negative real output growth when compared to the BAU scenario (Table 5.3).

Among all the scenarios experimented, the ASEAN+3 at DEI 2020 scenario is projected to generate the largest real growth in output for most of the regions which are part of the agreement.

The largest output growth is achieved by ASEAN member countries particularly Vietnam followed by Thailand, Singapore, Malaysia, and Indonesia in all regional trade agreement scenarios. Real output growth appears to fluctuate in each phase of the various regional trade agreements for the countries involved in the agreement. Timing of tariff and regional integration both plays a very important role in this respect. It is reflected from the DEI 2020 and MEI 2020 scenario results. The early tariff reduction (DEI 2020) is favourable for Philippine, Thailand, Singapore compared to delay in tariff reduction (MEI 2020). So a minor reduction in output growth is observed for these countries in ASEAN+3 at DEI scenario 2020 compared to DEI 2020. Moreover, the regional cluster (ASEAN+3 at 2020)—tariff reduction agreement within China, Japan and the Republic of Korea is not beneficial for some ASEAN member countries.

China's real output growth is not significant; however, it is positive with the various regional trade agreements. It reflects that earlier or late tariff reduction or regional integration like ASEAN-CJK and W-ASEAN will have minor impact on output growth. Japan and the Republic of Korea have mixed results depending on the regional trade agreement that is implemented. Both of these countries have positive real output growth with the ASEAN+3 at 2020. Regional trade agreement shows that regional integration—within CJK is favourable for them. The Republic of Korea has negative real output growth with the MEI 2020 regional trade scenario, however, has positive real output growth with the DEI 2020 regional trade

agreement. It shows that the Republic of Korea's output growth is sensitive to timing of tariff reduction while early reduction benefits. On the contrary, Japan will have a completely opposite experience, with positive real output growth in MEI 2020 and marginal negative real output growth for the DEI 2020. The early tariff reduction in DEI 2020 benefits most of the countries in the region because the reduction strategy applies on 2010 and the countries will have a scope of 10 years to roll on the advantage of tariff reduction. The benefits incurred more for most of the agreement countries when deep integration applies in ASEAN+3 2020 (part of DEI scenario).

5.3 Export and Import Performance

The real output growth for the period 2001–2020 can be further analyzed by investigating the export and import growth and their shares of each country within and outside the study region for each of the different regional trade agreements.

Before proceeding to discuss the export import scenario, let us see the trade openness index of the ASEAN region and CJK in BAU 2001 and BAU 2020 along with different trade liberalisation scenarios.

Table 5.4 shows that highest openness index is achieved by Singapore, followed by Malaysia and Thailand in BAU 2001 and it will increase during the course of the period till 2020. The openness index will gradually increase in different tariff reduction scenarios for most of the countries under agreement. This is an issue whether trade liberalization is necessarily associated with trade openness.

Despite the relatively recent development experiences of a number of Asian countries which adopted various interventionist policies to promote trade, liberal trade policies and trade openness are still assumed to be strongly linked, and

Table 5.4 Trade openness index in different trade scenarios

	BAU 2001	BAU 2020	MEI 2020	DEI 2020	ASEAN+3 2020
China	0.578	0.556	0.602	0.602	0.676
Japan	0.213	0.282	0.285	0.282	0.301
Republic of Korea	0.829	0.939	0.945	0.945	1.022
Indonesia	0.788	0.855	0.950	0.955	0.982
Malaysia	2.326	2.411	2.513	2.513	2.530
Philippines	1.156	1.265	1.356	1.372	1.381
Singapore	2.845	3.678	3.750	3.775	3.679
Thailand	1.265	1.614	1.933	2.026	2.060
Vietnam	1.250	1.195	1.441	1.460	1.601
Other ASEAN	0.195	0.190	0.230	0.231	0.250

Source: Results from the study
Trade openness index can be defined as Index $= (\sum \text{export} + \sum \text{import})/\text{GDP}$.

many authors use these terms interchangeably. Trade liberalization is considered as ultimate vehicle to promote international trade. Several arguments are put forward why trade liberalization promotes economic growth. For example, these are increasing specialization and efficient resource allocation, greater competition, an increase in the flow of knowledge and investment, technological progress, a faster rate of capital accumulation, and reduction in transaction costs. Even if the above arguments are assumed to be valid, such benefits are unlikely to materialize if trade liberalization does not lead to higher trade openness. Therefore, even if trade openness leads to better economic performance, whether trade liberalization leads to better trade performance still needs to be proven (Dean, Desai, & Riedel, 1994; Pritchett, 1996).

In the current study, lowest index is attained by Other ASEAN, Japan and the Republic of Korea. According to Lloyd and MacLaren (2002) the trade openness index around the world also reveals the same picture. Hong Kong and Singapore, retain top ranking, followed by Malaysia (160.9%), Vietnam (112.4%) and the Philippines (102.8%). Our results are also in the same tune.

Recently Subasat (2008) reveals a diversity of experiences. Trade openness is not uniformly, universally linked to trade liberalization. Some countries have liberalized their trade and experienced a higher level of trade openness, and some other countries experienced a reduction in their trade openness. This signifies that if countries liberalize their trade prematurely they may lead to a lower level of trade openness and potentially poor economic performance. Under certain circumstances trade liberalization may indeed lead to trade expansion. This, however, cannot be generalized (Subasat, 2008).

But trade liberalisation will have a definite impact on export and import growth. We are now discussing the export and import growth (Tables 5.5 and 5.6) under the business-as-usual and different trade scenarios.

The main emphasis of the discussion is to capture the behaviour of export and import due to different level of tariff reduction and regional integration in different economic integration scenario compared to the Business as usual scenario.

The highest export growth rate is expected for China at BAU 2020 followed by Indonesia, Vietnam, Thailand and Malaysia, while Japan achieves the lowest. Among non agreement countries, the export growth of ROW1 and ROW 2 is encouraging during BAU 2020.

In different trade scenarios at 2020, countries under agreement show a positive export growth while non agreement countries negative. The highest export growth is expected for most of the agreement countries at ASEAN+3, 2020. Vietnam and Thailand's export growth is highest in all trade liberalisation scenarios at 2020. Japan's export growth is not significant in any trade scenarios, rather negative in DEI 2020.

Like export growth, import growth is also high for Thailand and Vietnam in all trade scenarios at 2020. For Japan, import growth is positive than export growth at DEI 2020 and ASEAN+3 2020 (Table 5.6). The export import growth above explains the broader view of world trade in BAU 2020 and also at the trade liberalisation scenarios.

Table 5.5 Export growth rate for BAU and trade scenarios

Export	BAU 2001–2020	BAU 2020-MEI 2020	BAU 2020-DEI 2020	BAU 2020-ASEAN+3 2020
China	282.57	6.98	7.13	18.01
Japan	50.59	0.88	−1.63	5.37
Republic of Korea	103.57	0.33	0.51	11.31
Indonesia	166.78	11.70	12.75	16.19
Malaysia	121.09	7.82	8.81	9.79
Philippines	105.37	10.18	13.28	13.88
Singapore	113.98	8.17	9.13	7.52
Thailand	151.88	24.54	33.36	42.55
Vietnam	163.31	40.26	40.50	75.47
Other ASEAN	72.23	19.26	20.30	31.62
Rest of OECD	39.55	−0.50	−0.58	−1.03
NAFTA	44.44	−0.60	−0.63	−1.12
ROW1	135.94	−1.89	−1.90	−4.25
ROW2	90.71	−0.02	−0.06	−0.29
Total	74.77	1.65	1.74	3.67

Source: Results from the study

From the above export, import and output growth it is revealed that the trade scenarios benefit the agreement countries under RTAs in East and South East Asia by boosting output, exports and imports.

Table 5.6 Import growth rate for BAU and trade scenarios

Import	BAU 2001–2020	BAU 2020-MEI 2020	BAU 2020-DEI 2020	BAU 2020-ASEAN+3 2020
China	259.90	10.73	10.69	27.54
Japan	50.46	0.53	1.56	10.90
Republic of Korea	128.76	0.34	0.41	12.44
Indonesia	177.07	17.35	17.70	22.62
Malaysia	125.47	11.29	9.27	11.14
Philippines	101.65	10.94	11.81	12.96
Singapore	110.23	8.90	9.16	7.75
Thailand	152.20	33.72	36.07	48.12
Vietnam	171.45	30.21	30.52	57.51
Other ASEAN	146.00	18.57	19.36	28.92
Rest of OECD	30.89	−0.54	−0.48	−1.14
NAFTA	56.74	−0.66	−0.66	−1.43
ROW1	150.53	−1.99	−2.02	−4.46
ROW2	122.54	−0.21	−0.19	−0.74
Total	74.77	1.65	1.74	3.67

Source: Results from the study.

What about the other countries in the world? The present study assigned the other countries of the world as NAFTA, Rest of OECD, ROW1 and ROW2. We have seen the negative output growth of these four regions in different integration scenarios. Similarly, negative export growth is also derived for these four regions, which are not under agreement. The magnitude of the negative export growth for ROW1 will be the highest. ROW 1 in the current study covers South Asian countries and Hong Kong. It is expected that due to integration among the ASEAN countries with China, Japan and the Republic of Korea at 2020 not favourable for the neighboring South Asian countries because ASEAN, China and south Asian countries have similar factor endowment and similar comparative advantage. So the agreement among ASEAN and CJK, is thus affecting negatively the South Asian countries. We have also seen in our other study that the economic impacts of proposed ASEAN+3 trade agreements (if materializes at 2020) on the South Asian economy will be affected adversely in terms of GDP growth, export and also welfare-wise (Mukhopadhyay et al., 2008). But the export growth of the world economy will be enhanced due to economic integration in ASEAN countries and China, Japan and the Republic of Korea.

Similar arguments can be put forward for the import growth. The four regions not under agreement will have negative import growth due to this ASEAN integration with China, Japan and the Republic of Korea. But import growth of the world economy is likely to increase due to integration.

But non RTA countries in the world would be affected negatively. Now the question is why non agreement countries trade turn negative? A part of this answer is due to trade diversion. How far the integration helped to create trade within the region (ASEAN and CJK) and divert it away from the other four regions of the world is also an empirical question.

The concepts of trade creation and trade diversion as a result of discriminatory trade liberalization can be mentioned here. Trade creation measures the gains from expanding trade in the products being liberalized. Trade diversion, by contrast, measures the reductions in the trade of products that are disadvantaged by preferential liberalization.

The original Viner's (l950) distinction between trade creation, under which countries lowering their tariffs shifted away from dependence on high-cost domestic industry to imports from the lower-cost partner countries, and trade diversion where low-cost production in the rest of the world is displaced by higher-cost production in the partner country has been amended and modified in a number of ways. Despite these analytical advances, no definite conclusions yet derived. The current study is also investigating this.

Table 5.7 shows the one to one correspondence of export growth in different trade liberalisation scenarios. It basically captures how far the tariff reduction is responsible for export growth among the countries under agreement. We have focused major three countries—China, Japan and the Republic of Korea and ASEAN as a combined region's export growth to the agreement region and rest of the world. China's export growth to ASEAN and other countries of the world in different trade scenarios relative to BAU is positive (except China to the

Table 5.7 Percentage change in the export growth for each trade scenario relative to the BAU, 2020

MEI-BAU	ASEAN	Japan	Republic of Korea	China	Rest of OECD	NAFTA	ROW1	ROW2
China	63.26	1.54	−1.14	–	2.32	3.14	2.27	1.81
Japan	47.57	–	−4.47	−22.07	−1.51	−1.94	−2.09	−1.17
Republic of Korea	58.46	−0.05	–	−23.38	−0.31	−0.31	−1.56	0.16
ASEAN	10.94	−1.60	25.24	151.98	−18.49	−20.16	−18.04	−20.36
DEI-BAU	ASEAN	Japan	Republic of Korea	China	Rest of OECD	NAFTA	ROW1	ROW2
China	63.17	2.66	−1.37	–	2.51	3.14	2.22	1.97
Japan	43.24	–	−6.89	−24.10	−4.42	−4.97	−3.49	−3.46
Republic of Korea	59.98	−0.02	–	−23.24	−0.12	−0.37	−2.13	0.37
ASEAN	13.71	3.42	27.50	152.68	−15.12	−16.72	−16.72	−17.59
ASEAN+3-BAU	ASEAN	Japan	Republic of Korea	China	Rest of OECD	NAFTA	ROW1	ROW2
China	96.19	25.60	57.49	–	7.18	8.07	6.60	7.09
Japan	37.91	–	28.31	54.06	−20.00	−20.24	−23.98	−18.17
Republic of Korea	67.38	1.98	–	58.51	−19.23	−18.52	−20.16	−18.61
ASEAN	9.77	20.67	23.04	207.37	−22.72	−24.49	−23.85	−24.51

Source: Results from the study.

Republic of Korea in DEI and MEI). China's export growth has increased by 96% to ASEAN in ASEAN+3 integration at 2020 compared to BAU 2020. While, ASEAN's export growth to China augmented by 207% in ASEAN+3 integration at 2020.

From ASEAN to other countries of the world (Rest OECD, NAFTA, ROW1 and ROW2) export growth shows a decline relative to BAU in trade reform scenarios. For Japan and the Republic of Korea, it shows a marginal decline in MEI and DEI and significantly in ASEAN+3 for the same. Overall, the economic integration will have significant influence on country's export growth. The percentage change in the export growth is negative from the integrated region to other countries of the world (Rest OECD, NAFTA, ROW1 and ROW2), those who are not under the agreement. Overall, trade creation is reflected in the agreement region including ASEAN and China, Japan and the Republic of Korea with a detrimental effect for rest of the world at various trade liberalisation scenarios. As trade creation and diversion are two sides of the same coin, the above explanation of trade creation to some extent predicts the trade diversion effect.

To get more insight in this context, we discuss the export and import share within the ten regions under the agreement during Business-as-Usual and different tariff reduction scenarios.

Let us discuss about China, world's second largest economy. China's export and import shares within the ten regions declined in the BAU scenario over the period 2001–2020 (Table 5.8, Figure 5.1). China has the lowest export shares of the ten regions in the regional trade agreements. It is expected to drop from 22.44% in BAU 2010 to 20.21% in BAU 2020, while the share is encouraging in different scenarios—5% higher in the medium and deep economic integration scenarios at 2020 and 8% higher in ASEAN+3 at 2020 compared to BAU 2020. It reflects that China is likely to export more within ten regions if high tariff reduction occurs in ASEAN+3 blocs.

Table 5.8 Export share among the ten regions in BAU scenario and trade scenarios

Export	BAU 2001	BAU 2010	BAU 2015	BAU 2020	MEI 2020	DEI 2020	ASEAN+3 2020
China	24.40	22.44	21.84	20.21	25.12	25.18	28.93
Japan	29.54	34.43	37.07	39.97	41.57	41.53	54.79
Republic of Korea	34.66	38.38	40.10	41.93	42.24	42.36	57.88
Indonesia	43.85	45.03	45.31	45.72	60.25	60.05	63.82
Malaysia	41.75	44.37	45.94	47.93	62.17	61.91	64.36
Philippines	38.01	38.85	39.68	40.89	52.68	52.60	56.82
Singapore	39.48	43.16	45.51	48.24	63.93	63.67	65.97
Thailand	38.17	39.70	40.69	41.83	61.50	60.25	67.23
Viet Nam	37.57	40.77	44.17	48.78	67.29	67.49	81.53
Other ASEAN	41.98	49.09	55.64	64.36	64.68	65.07	69.88

Source: Results from the study.

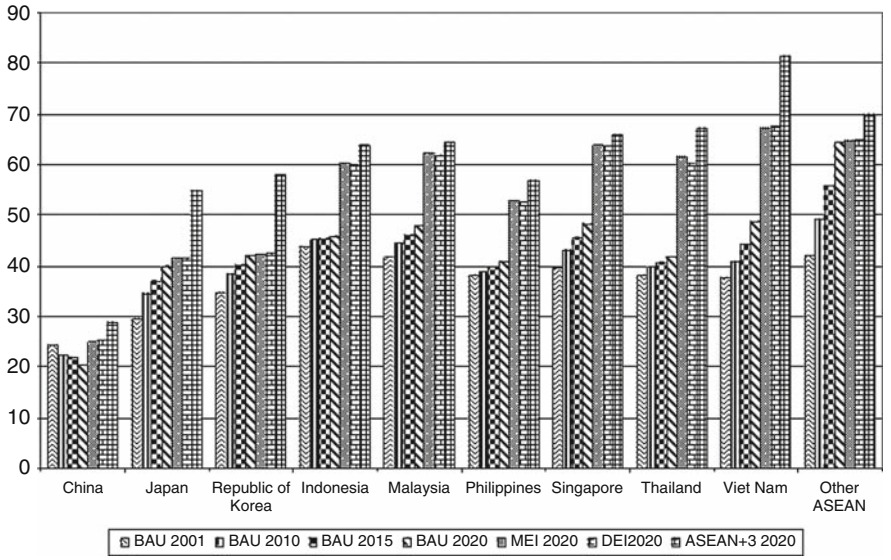

Fig. 5.1 Export share of selected countries among the ten regions in BAU and trade scenarios (%)

Japan is the highly developed country in this group. The export share of Japan within the region has increased by 5% from 2010 to 2020. Further the export share is likely to be high in different integration scenarios particularly for ASEAN+3 at DEI 2020 (15% higher than BAU 2020). Similar performance has also been observed for the Republic of Korea. The share of export increases gradually during the BAU periods. With the agreement in ASEAN+3 at DEI 2020, the share increases approximately by 16% higher compared to BAU 2020.

The export behaviour of the ASEAN region is quite encouraging. The share of export is increasing at a moderate pace during 2010–2020 BAU. The highest share of export is expected for Vietnam and Thailand, almost 20% increase from BAU 2020 compared to different tariff reduction scenarios, while 15% increase is expected for Indonesia, Malaysia, the Philippines and Singapore at DEI and MEI 2020. A significant export share increase is observed in case of Vietnam (33% more) and Thailand (26% more) in ASEAN+3 integration at 2020 compared to the BAU 2020. It reveals that the highest benefit is likely to be achieved by Vietnam in this region, if ASEAN+3 integration occurs at 2020.

These shares indicate that the trade agreement in ASEAN countries with China, Japan, and the Republic of Korea will accentuate the growth of the individual economies in the agreement. Though Other ASEAN's share of export has increased during BAU 2010–2020, a minor increase is observed in ASEAN+3 at 2020.

The import share (Table 5.9, Figure 5.2) among the ten regions reflects almost a similar picture like export in different integration scenarios. Vietnam's import share is highest followed by Thailand at ASEAN+3 integration at 2020.

Table 5.9 Import share among the ten regions (BAU scenario) and trade scenarios

Import	BAU 2001	BAU 2010	BAU 2015	BAU 2020	MEI 2020	DEI 2020	ASEAN+3 2020
China	24.97	22.71	22.07	21.72	24.59	24.47	27.58
Japan	30.58	35.60	38.32	41.28	42.35	42.31	55.11
Republic of Korea	35.54	39.39	41.13	42.95	42.84	42.95	57.96
Indonesia	43.15	44.11	44.22	44.50	58.56	58.37	61.81
Malaysia	41.76	44.24	45.70	47.60	61.11	60.89	62.40
Philippines	37.97	38.83	39.70	40.96	52.53	52.59	56.79
Singapore	40.30	44.05	46.42	49.15	64.23	63.96	66.16
Thailand	39.08	40.34	41.26	42.24	61.37	61.99	69.48
Viet Nam	38.01	41.23	44.58	49.05	62.57	68.45	83.27
Other ASEAN	41.24	48.12	54.65	63.36	62.94	64.08	68.51

Source: Results from the study.

Overall, the net trade share is positive for Indonesia, Malaysia, Other ASEAN and China but rest of the countries show negative in ASEAN+3 integration at 2020.

Thus the analysis shows that the export and import shares increased for the ASEAN and China, Japan and the Republic of Korea for all regional trade agreement scenarios (MEI, DEI and ASEAN+3 at 2020).

The overall export and import shares again indicate that a considerable trade creation occurs within the region under agreement in the different tariff reduction scenarios. In all cases, the agreements lead to an increase in trade amongst the

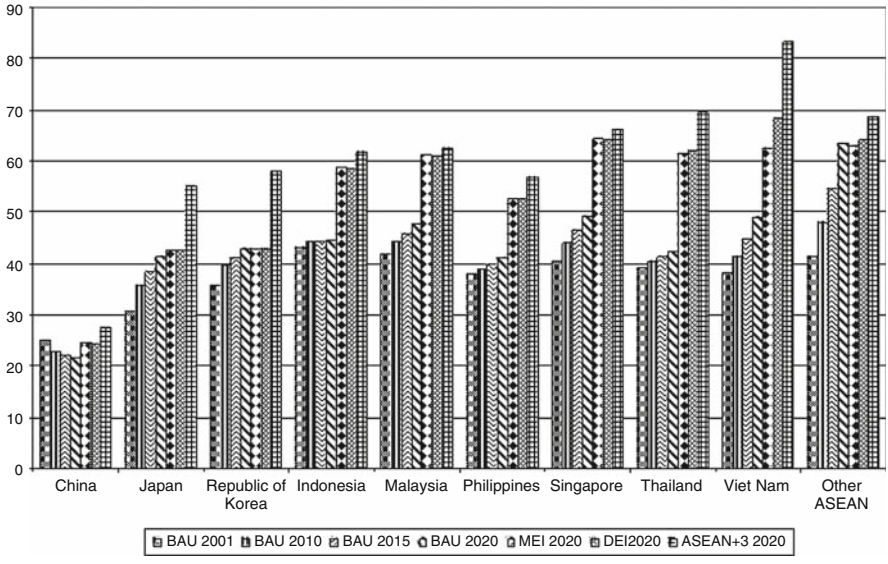

Fig. 5.2 Import share of selected countries among the ten regions in BAU and trade scenarios (%)

Table 5.10 Export share of ASEAN-CJK within region and rest of the world in BAU 2020 and different trade scenarios

BAU 2020 From	To ASEANCJK	Rest of the world
China	21.86	78.14
Japan	40.07	59.93
Republic of Korea	41.93	58.07
ASEAN	46.06	53.94
MEI 2020		
China	24.96	74.41
Japan	41.57	58.43
Republic of Korea	42.24	57.76
ASEAN	61.67	38.33
DEI 2020		
China	25.18	74.82
Japan	41.53	58.47
Republic of Korea	42.36	57.64
ASEAN	61.23	38.77
ASEAN+3		
China	28.93	71.07
Japan	54.79	45.21
Republic of Korea	57.88	42.12
ASEAN	65.81	34.19

Source: Results from the study.

countries included in the agreement. Thus, the regional trade agreements increase the intra regional trade amongst countries in the agreements and divert trade from non-member countries. The ASEAN+3 agreement in 2020 provide the greatest increase in export and import shares in the region.

To get more insight on trade diversion due to trade liberalisation, we further explore the export share of CJK and ASEAN countries to agreement region and rest of the world in various tariff reduction scenarios compared to BAU, 2020.

The degree of trade diversion from ASEAN and CJK region to rest of other countries in the world will be highest in ASEAN+3 integration at 2020. China's export share is likely to be away from rest of the world by 7%, 14.71% for Japan, 15.95% for the Republic of Korea and 19.75% for ASEAN in ASEAN+3 integration scenarios at 2020 (Table 5.10).

On the whole, the export, import and output show significant changes for the agreement countries due to regional economic integration but negative impact for the other regions in the world cannot be ignored. Next we are trying to explore the sectoral contribution in this context.

5.4 Sectoral Analysis of Output

Additional information on the impact of the regional trade agreements can be obtained by investigating the sectors in each country that are most affected by the

agreements. Table 5.11 ranks the top six sectors in terms of their industrial output growth. The ranking remains almost constant in each BAU period (2001, 2010, 2015 and 2020), while fluctuations in ranking are observed within the sectors across the countries. Here we have ranked the top six sectors which are expected to dominate in 2010, 2015, and 2020. In the case of China, vegetable, fruits and nuts and animal products are in the top six sectors in 2001 and continue to be in 2010, but in 2015 and later periods these sectors are replaced by the electronic equipment sector. For Indonesia and Thailand, the food products sector is the most affected sector until 2015, while manufacturing equipment sector and the paper and paper products sector become the most affected sectors respectively in 2020. For Vietnam, Processed rice shows in top six sectors list till 2010 but it is likely to be taken away by the machinery and equipment at 2020.

Now we are discussing how far the agreement is expected to affect the sectoral rankings in the different regional trade agreement scenarios. It is presented for the ten countries under the agreement in Table 5.12.

For each country, the same industrial sectors are found in the top six sectors for the MEI and DEI scenarios. Changes in sectoral impacts between the BAU and the MEI and DEI will not be significant. The sectoral rankings differ only for some countries. For example, in the BAU scenario for Vietnam the paddy rice sector has the third largest impact on total output while this decreases to the fourth position in the MEI scenario and sixth for the DEI and ASEAN+3 scenarios at 2020.

The sectors that are common to all countries that have had increased output growth with the regional trade scenarios are: electrical equipment, machinery and equipment, and chemical and rubber sectors. These three sectors become more prominent in the MEI and DEI scenarios at 2020.

The ASEAN+3, MEI, and DEI scenarios at 2020 are likely to increase output growth in heavy manufacturing as compared to primary and light manufacturing under the BAU scenario. The sectors like ferrous metal and motor vehicle are probably dominating Japan, the Republic of Korea, Thailand, Malaysia, Other ASEAN and Indonesia; while textile and wearing apparel to be leading sectors for Vietnam, other ASEAN, Thailand and China, but vegetable oils and fats, animal products and food products in Philippines.

5.5 Sectoral Analysis of Export and Import

Before going into the deep analysis of sectoral export and import rank, we estimate the Revealed Comparative Advantage (RCA) index for ASEAN and CJK in 2001. The RCA can be a useful indicator of the comparative advantage of countries (Balassa, 1965). Annex 3 presents RCAs for the ASEAN countries and CJK. Following Balassa, 'Revealed' Comparative Advantage is defined as the share of a product group in one country's exports divided by that product group's share in world trade.

Table 5.11 Ranking of the top six industrial sectors' output growth, BAU 2020

China	Japan	Republic of Korea	Indonesia	Thailand	Vietnam	Malaysia	Philippines	Singapore	Other ASEAN
Machinery and equipment nec	Motor vehicles and parts	Machinery and equipment nec	Electronic equipment	Electronic equipment	Mineral products nec	Electronic equipment	Electronic equipment	Electronic equipment	Motor vehicles and parts
Chemical, rubber, plastic products	Chemical, rubber, plastic products	Electronic equipment	Textiles	Machinery and equipment nec	Leather products	Chemical, rubber, plastic products	Machinery and equipment nec	Chemical, rubber, plastic products	Transport nec
Electronic equipment	Electronic equipment	Chemical, rubber, plastic products	Chemical, rubber, plastic products	Motor vehicles and parts	Paddy rice	Vegetable oils and fats	Chemical, rubber, plastic products	Transport nec	textile
Textiles	Machinery and equipment nec	Ferrous metals	Paper products, publishing	Textiles	Oil	Machinery and equipment nec	Vegetable oils and fats	Machinery and equipment nec	wearing apparel
Mineral products nec	Ferrous metals	Motor vehicles and parts	Machinery and equipment nec	Chemical, rubber, plastic products	Food products nec	Oil	Metals nec	Petroleum, coal products	Mineral products nec
Manufactures nec	Paper products, publishing	Petroleum, coal products	Motor vehicles and parts	Wearing apparel	Machinery and equipment nec	Petroleum, coal products	Food products nec	Paper products, publishing	Electronic equipment

Source: Results from the study.

Table 5.12 Ranking of the top seven industrial sectors' output growth in trade scenarios at 2020

China			Japan			The Republic of Korea		
MEI 2020	DEI 2020	ASEAN+3 2020	MEI 2020	DEI 2020	ASEAN+3 2020	MEI 2020	DEI 2020	ASEAN+3 2020
41 ome	41 ome	41 ome	38 mvh	38 mvh	33 crp	41 ome	41 ome	41 ome
33 crp	33 crp	40 ele	33 crp	33 crp	38 mvh	40 ele	40 ele	40 ele
40 ele	40 ele	33 crp	41 ome	41 ome	41 ome	33 crp	33 crp	33 crp
27 tex	27 tex	34 nmm	40 ele	40 ele	40 ele	35 i_s	35 i_s	35 i_s
34 nmm	34 nmm	27 tex	35 i_s	35 i_s	35 i_s	38 mvh	38 mvh	38 mvh
42 omf	42 omf	42 omf	31 ppp	31 ppp	43 ely	32 p_c	27 tex	27 tex
35 i_s	35 i_s	35 i_s	25 ofd	25 ofd	31 ppp	27 tex	32 p_c	32 p_c
Indonesia			Thailand			Vietnam		
MEI 2020	DEI 2020	ASEAN+3	MEI 2020	DEI 2020	ASEAN+3	MEI 2020	DEI 2020	ASEAN+3
40 ele	40 ele	40 ele	40 ele	40 ele	40 ele	29 lea	29 lea	33 crp
33 crp	27 tex	33 crp	41 ome	41 ome	41 ome	33 crp	33 crp	29 lea
27 tex	33 crp	27 tex	33 crp	33 crp	33 crp	34 nmm	34 nmm	28 wap
31 ppp	31 ppp	31 ppp	38 mvh	38 mvh	38 mvh	1 pdr	28 wap	27 tex
41 ome	41 ome	41 ome	27 tex	27 tex	27 tex	41 ome	41 ome	34 nmm
38 mvh	38 mvh	38 mvh	28 wap	28 wap	32 p_c	28 wap	1 pdr	1 pdr
30 lum	30 lum	30 lum	32 p_c	32 p_c	28 wap	30 lum	27 tex	41 ome
Malaysia			Philippines			Singapore		
MEI 2020	DEI 2020	ASEAN+3	MEI 2020	DEI 2020	ASEAN+3	MEI 2020	DEI 2020	ASEAN+3
40 ele	40 ele	40 ele	40 ele	40 ele	40 ele	40 ele	40 ele	40 ele
33 crp	33 crp	33 crp	41 ome	41 ome	41 ome	33 crp	33 crp	33 crp
21 vol	21 vol	41 ome	33 crp	33 crp	33 crp	41 ome	41 ome	41 ome
41 ome	42 omf	21 vol	36 nfm	25 ofd	21 vol	31 ppp	31 ppp	32 p_c

Table 5.12 (continued)

Malaysia			Philippines			Singapore		
MEI 2020	DEI 2020	ASEAN+3	MEI 2020	DEI 2020	ASEAN+3	MEI 2020	DEI 2020	ASEAN+3
42 omf	35 i_s	42 omf	21 vol	10 oap	25 ofd	37 fmp	37 fmp	34 nmm
35 i_s	41 ome	38 mvh	25 ofd	36 nfm	36 nfm	31 ppp	31 ppp	25 ofd
38 mvh	38 mvh	35 i_s	10 oap	21 vol	10 oap	37 fmp	37 fmp	37 fmp

Other ASEAN		
MEI 2020	DEI 2020	ASEAN+3
38 mvh	38 mvh	38 mvh
27 tex	27 tex	27 tex
28 wap	28 wap	28 wap
34 nmm	26 b_t	40 ele
40 ele	33 crp	34 nmm
26 b_t	34 nmm	26 b_t
33 crp	40 ele	41 ome

Source: Results from the study.
N.B.: Sectoral codes are given in Annex 1.

$$\mathrm{RCA}_{ij} = (x_{ij}/xw_j)/(\mathrm{sum}\, x_{ij}/\mathrm{sum}\, xw_j)$$

where x_{ij} is country i's export of commodity j;
x_{wj} is world's exports of commodity j;
SUM x_{ij} is country i's total exports;
SUM x_{wj} is the world's total exports.

This index with its 'normalization' removes the effects of price fluctuations and indicates the importance of particular commodities in world markets. Thus, the index is preferable to the simple share of a group of products in a country's total exports. It facilitates comparisons between countries at any time, and changes in comparative advantage to be looked into over time. The measure reflects the underlying comparative advantage of the country in particular commodities as determined by technology and factor endowments. Of course these might be modified by government policies designed to draw resources into favored sectors. This index helps to classify the major exports of the economies in terms of their respective revealed comparative advantages. Identifying the goods with RCA in each economy throws significant light on the prospects of greater trade between them. A value of greater than one reveals comparative advantage in sectors i. Similarly, if the value is less than one, the country is said to have a revealed comparative disadvantage in the sector.

China has a comparative advantage of wide variety of commodities including agricultural, minerals and manufacturing—leather, wearing apparel, textile, coal, processed rice, animal products, sugarcane and beet mineral products, electronic equipment and manufactures nec (Annex 3). In case of Japan the commodities are restricted to mining and manufacturing especially motor vehicle, transport equipment, Ferro alloys and metal products. The Republic of Korea's comparative advantage is almost similar to Japan except textile. In case of Indonesia, coal, vegetable oils and fats, minerals nec, crops nec, while for Malaysia, vegetable oils and fats, sugarcane and beet, forestry and wood products are in the comparative advantage list. Electronic equipment, vegetable oils and fats, wearing apparel and vegetables, fruit, nuts are in the list of Philippines. For Singapore, the list mainly restricts to services, electronic equipment and beverages and tobacco. The comparative advantage of Thailand mainly on processed rice, food products, crops nec, paddy rice in agriculture and electronic equipment, leather products and wearing apparel in manufacturing. For Vietnam the comparative advantage list is almost similar to Thailand except oil and fishing. Gas, forestry and sugarcane and beet and wearing apparel are in Other ASEAN list. The comparative advantage list of 2001 (calculated from GTAP databases) will help us to compare the sectors with top ranking export list in BAU and different trade integration scenarios.

The list of comparative advantage sectors will be compared with the top ranking export sector across the countries under RTAs. This gives more insight of the sectors whether maintaining the same comparative advantage after tariff reduction. Before heading to comparison, we are presenting the export share list in Tables 5.13 and 5.14. These are also compared with the output sector list in Tables 5.11 and 5.12.

Table 5.13 Top six sectors' export share in BAU, 2001 and ASEAN+3, 2020 (percentage)

BAU 2001

China		Japan		Republic of Korea		Malaysia	
Sectors	Share	Sectors	Share	Sectors	Share	Sectors	Share
40 ele	17.64	41 ome	26.06	40 ele	28.26	40 ele	49.60
41 ome	15.05	40 ele	20.86	41 ome	11.59	41 ome	6.07
42 omf	11.07	38 mvh	17.84	33 crp	10.24	33 crp	5.84
28 wap	9.69	33 crp	9.22	38 mvh	8.83	30 lum	3.37
29 lea	8.33	39 otn	3.73	27 tex	7.69	21vol	2.35
33 crp	6.31	35 i_s	3.30	39 otn	5.48	16 oil	1.80
Indonesia		Thailand		Vietnam		Philippines	
40 ele	12.41	40 ele	24.08	29 lea	17.58	40 ele	57.61
30 lum	8.72	41 ome	12.30	16 oil	13.91	41 ome	9.57
33 crp	7.51	33 crp	8.91	28 wap	10.29	28 wap	6.06
28 wap	6.81	25 ofd	6.81	25 ofd	8.83	25 ofd	2.54
27 tex	6.48	42 omf	4.28	41 ome	5.14	27 tex	1.96
41 ome	5.51	27 tex	4.07	8 ocr	5.10	33 crp	1.86
Singapore		Other ASEAN					
40 ele	44.88	29 lea	21.64				
41 ome	11.21	18 omn	16.32				
33 crp	9.43	28 wap	13.33				
32p_c	3.41	17 gas	12.60				
39 otn	1.53	5 osd	4.08				
31ppp	1.14	14 fsh	3.84				

Table 5.13 (continued)

ASEAN+3 2020									
China		Japan		Republic of Korea		Indonesia		Thailand	
Sectors	Share	Sectors	Share	Sectors	Share	Sectors	Share	Sectors	Share
40 ele	27.95	41 ome	23.73	40 ele	25.55	40 ele	19.49	40 ele	36.18
41 ome	19.26	38 mvh	15.82	41 ome	15.46	27 tex	10.48	41 ome	19.11
42 omf	12.06	33 crp	12.64	33 crp	9.05	33 crp	10.07	33 crp	13.20
28 wap	6.85	40 ele	11.12	27 tex	8.91	41 ome	7.65	24 sgr	5.07
33 crp	6.82	35 i_s	8.46	38 mvh	8.58	31 ppp	6.56	38 mvh	3.52
27 tex	5.51	36 nfm	4.63	35 i_s	6.89	15 coa	5.38	27 tex	3.33
Vietnam		Malaysia		Philippines		Singapore		Other ASEAN	
33 crp	25.90	40 ele	49.71	40 ele	44.67	40 ele	48.84	17 gas	26.81
29 lea	18.87	33 crp	10.27	41 ome	17.85	33 crp	14.63	16 oil	19.05
16 oil	14.97	41 ome	7.35	28 wap	5.61	41 ome	9.19	27 tex	10.72
28 wap	8.82	21vol	5.47	33 crp	5.35	32p_c	7.30	28 wap	10.59
27 tex	6.71	16 oil	2.52	36	4.29	34 nmm	1.69	30 lum	4.95
41 ome	6.56	17 gas	1.47	21vol	3.84	26 b_t	1.37	13frs	4.84

Source: Results from the study.
N.B.: Sectoral codes are given in Annex 1.

Table 5.14 Principal export shares under different economic integration scenarios within the region (percentage)

	MEI 2020		DEI 2020		ASEAN+3 2020
Japan					
41 ome	23.81	41 ome	23.43	41 ome	24.12
40 ele	15.28	40 ele	14.78	33 crp	14.60
33 crp	14.43	33 crp	14.71	40 ele	13.69
35 i_s	13.26	35 i_s	13.46	35 i_s	11.74
36 nfm	6.80	36 nfm	6.98	27 tex	7.53
38 mvh	6.76	38 mvh	6.73	36 nfm	6.96
Indonesia					
40 ele	21.67	40 ele	22.05	40 ele	23.04
33 crp	12.30	33 crp	12.52	33 crp	13.23
27 tex	10.23	27 tex	10.42	27 tex	10.70
41 ome	8.20	31 ppp	8.33	41 ome	8.33
31 ppp	8.14	41 ome	8.16	31 ppp	7.20
30 lum	6.36	30 lum	6.30	30 lum	6.02
Thailand					
40 ele	41.54	40 ele	43.56	40 ele	37.21
33 crp	17.14	41 ome	17.04	33 crp	19.61
41 ome	16.35	33 crp	13.97	41 ome	17.43
27 tex	4.01	27 tex	4.11	24 sgr	7.54
38 mvh	2.38	38 mvh	2.40	27 tex	3.30
32 p_c	1.67	24 sgr	1.72	38 mvh	2.35
China					
40 ele	31.63	40 ele	31.74	40 ele	30.72
41 ome	18.36	41 ome	18.29	41 ome	18.26
33 crp	7.02	33 crp	7.09	27 tex	7.97
27 tex	6.78	27 tex	6.75	28 wap	7.95
28 wap	6.73	28 wap	6.66	33 crp	7.49
42 omf	6.16	42 omf	6.10	42 omf	5.61
Republic of Korea					
40 ele	27.47	40 ele	27.29	40 ele	24.91
41 ome	16.01	41 ome	15.92	41 ome	15.86
33 crp	11.53	33 crp	11.73	27 tex	11.93
35 i_s	10.04	35 i_s	10.04	33 crp	11.54
27 tex	9.03	27 tex	9.08	35 i_s	8.79
32 p_c	5.67	32 p_c	5.64	38 mvh	5.52
Vietnam					
16 oil	24.88	16 oil	24.23	33 crp	31.56
33 crp	13.54	33 crp	14.08	29 lea	16.00
29 lea	11.40	29 lea	11.29	16 oil	15.91
41 ome	10.46	41 ome	10.86	41 ome	7.91
27 tex	6.17	27 tex	6.59	27 tex	6.07
30 lum	5.18	28 wap	5.63	23 pcr	5.04
Malaysia					
40 ele	55.51	40 ele	56.16	40 ele	48.75
33 crp	12.90	33 crp	13.02	33 crp	16.60
41ome	8.350	41 ome	8.15	41 ome	10.23
21 vol	3.961	21 vol	4.15	21 vol	3.86

Table 5.14 (continued)

	MEI 2020		DEI 2020		ASEAN+3 2020
17 gas	1.40	34nmm	1.31	34nmm	1.32
16 oil	1.37	16 oil	1.30	16 oil	1.31
Philippines					
40ele	47.00	40 ele	46.77	40ele	37.45
41ome	19.71	41ome	20.00	41ome	23.99
33crp	8.19	33crp	8.11	33crp	10.42
36 nfm	6.71	36 nfm	6.79	36 nfm	5.46
21vol	3.60	21vol	3.62	21vol	4.31
38 mvh	3.02	38 mvh	2.90	38 mvh	3.73
Singapore					
40ele	47.49	40ele	47.52	40ele	43.85
33crp	17.61	33crp	18.01	33crp	16.91
41ome	11.52	41ome	11.12	41ome	13.10
32p_c	7.72	32 p_c	7.70	32 p_c	7.53
34nmm	2.36	34 nmm	2.38	34 nmm	2.69
26 b_t	2.02	26 b_t	2.01	26 b_t	2.06
Other ASEAN					
17 gas	41.46	17 gas	41.37	17 gas	35.26
16 oil	25.86	16 oil	25.57	16 oil	22.17
30 lum	6.71	30 lum	6.47	33 crp	11.17
13 frs	5.25	13 frs	5.31	40 ele	9.56
40 ele	3.49	40 ele	3.34	30 lum	5.57
27 tex	2.74	27 tex	2.77	13 frs	4.28

Source: Results from the study.
N.B: Sectoral codes are given in Annex 1.

5.5.1 Sectoral Export Analysis

The ranking of the top six sectors' export share for each country is more or less similar to the sectoral output ranking (Table 5.13), except for one or two changes in various BAU scenarios. For China, wearing apparel is in the top six sectors of export share ranking while mineral products is in output rank. For Japan, metals nec is in the top six sector ranking while paper publishing does not belong to the top six. The scenarios indicate that for Indonesia the coal and the leather sector are in the top six export share replacing the chemical rubber and plastic sector and motor vehicle sector that are in the top six output sectors. In the Republic of Korea, the leather sector is in the top six export share and taken over by the chemical rubber and plastic sector in the output list. The leather sector is likely to be replaced by motor vehicle in Thailand and Crops nec, instead of mineral products in Vietnam. The sectoral ranking in export is not showing any significant changes in ASEAN+3 integration at 2020 compared to BAU 2001 except few changes.

The top six sectors export share in BAU 2001 and ASEAN+3 at 2020 are given in Table 5.13. The export share rank for the top six sectors remains fairly constant

for the MEI and DEI scenarios. The percentage share of exports has not changed much with the trade agreements. For example, the electronics equipment sector for China, Malaysia, Philippines, Indonesia, the Republic of Korea and Thailand ranked first in their export share in BAU 2001 and ASEAN+3 integration at 2020. Comparing the export share between BAU (2001) and ASEAN+3 (2020), for China the share has increased from 17.64% (BAU 2001) to 27.95% (ASEAN+3, 2020), while for Thailand the share has increased from 24.08% (BAU 2001) to 36.18% (ASEAN+3 2020). The most interesting result is observed for Japan. The export share of manufacturing equipment would be from 26.06% (BAU 2001) to 23.73% (ASEAN+3 2020), electronic equipment would be from 20.86 to 11.12%, and motor vehicles from 17.84 to 15.82%, while Ferro alloys from 3.30% (BAU 2001) to 8.46% (ASEAN+3). Except ferro alloys, most of the sectors' share have declined. A minor increase in textile and motor vehicle sectors share is observed for the Republic of Korea when comparing BAU 2001 and 2020 ASEAN+3 agreement. For the Republic of Korea, the manufacturing equipment sector increased its share from 11.59 to 15.46% during the same period and scenarios. For Vietnam, chemical rubber and plastic sector will be a new addition in the export share list in the ASEAN+3 scenario. In the ASEAN+3 scenario, this sector will be expected to have the largest export share for Vietnam at 25.90% (ASEAN+3). For Vietnam, the new two sectors in the top export ranking, chemical rubber and plastics sector and the textile sector, accounted for over 32% of the export share under the ASEAN+3 scenario. For Thailand the electronic equipment sector and manufacturing equipment sector export shares are projected to increase by 1.5-fold between BAU 2001 and ASEAN+3 (2020) (Table 5.13). Thailand has had a comparative advantage in electrical equipment since the 1990s. The implications of tariff reductions on the electrical equipment are quite obvious in Thailand. The export-led industrial boom began in the mid-1980s in Thailand and electrical equipment captured market shares of 21.55% in 1990 and 48.87% in 2001 (Mukhopadhyay, 2006). For Singapore and Malaysia, the electronic equipment share continues to be top in ASEAN+3 at 2020, but the share will be down in case of Philippines. For Singapore transport equipment and paper products at BAU 2001 are replaced by mineral products and beverages and tobacco at ASEAN+3 at 2020. For other ASEAN, oil, textile, forestry and wood products are dominating at ASEAN+3 2020 instead of leather products, fishing and minerals nec in BAU 2001. From the above export share analysis it is clear that the export sectors in Japan are not very sensitive to the RTA. However, the impact of the economic integration scenarios on the export sectors of Thailand and Vietnam, other ASEAN, Indonesia and Philippines are quite significant.

Reiterating the concept of trade creation and trade diversion due to trade liberalisation, the sectoral exports share in BAU and ASEAN+3 scenarios at 2020 presented above throw some significant insights. The trade creation occurs in ASEAN+3 2020 because the sectoral share has increased compared to BAU 2001 especially for the ASEAN countries. To further explore the impact on the sectoral export shares in different trade liberalisation agreement, we capture the export share within the trade region under RTAs. The result of this analysis is presented in Table 5.14 for each of the economic integration scenarios.

Within the region the share of six most important export sectors for China and Indonesia stays the same in BAU and the economic integration scenarios. For Japan, Thailand, and Vietnam there is movement of one sector into or out of the top six export sectors depending on the scenario investigated. For Japan, the motor vehicle and parts sector is in the top six export sectors share for the MEI and DEI scenarios. However, for the ASEAN+3 scenario, this sector is replaced by the textile sector (Table 5.14). In Thailand, the petroleum and coal products sector is in the top six export share within the region in the MEI scenario while sugar sector is in the DEI and ASEAN+3 scenarios. In the Republic of Korea, petroleum and coal industry is in the top six sectors in the MEI and DEI scenarios. This sector drops out of the top six in the ASEAN+3 scenario and is replaced by the motor vehicle and parts sector. The rank of the top six sector changes for each economic integration scenarios for Vietnam. In the MEI scenario, the wood products sector in the list, is replaced by the wearing apparel sector in the DEI scenario, and the petroleum and coal sector in ASEAN+3. For all countries, except Vietnam, the first ranked sector for exports within the region remains the same in each scenario. But in Vietnam, the oil sector which occupies rank first in the MEI and DEI scenarios is replaced by chemical, rubber, and plastics sector in the ASEAN+3 scenario. For Malaysia and Philippines, the chemical, rubber and plastic and manufacturing equipment share is expected to increase and electronic equipment to decline at ASEAN+3 at 2020 compared to MEI 2020. For Singapore, electronic equipment shows a decline in ASEAN+3 2020 from MEI 2020.

The sectoral export share for most of the countries increased in DEI 2020, particularly for ASEAN countries compared to ASEAN+3 2020 (except Vietnam and Indonesia). For China, Japan and Korea, the change in sectoral share of ASEAN+3 2020 and DEI 2020 is marginal.

From Tables 5.13 and 5.14 we came to know about the top ranking export sectors in BAU and various trade scenarios and Annex 3 presents the RCA index 2001 across the countries. These tables can tell us whether the comparative advantage of the sectors is at all maintained in different tariff reduction scenarios at 2020. For China, Japan and Republic of Korea, the sectoral comparative advantage remains same. Among ASEAN, Malaysia, Philippines and other ASEAN the sectoral comparative advantage does not change. On the other hand, Vietnam and Thailand do not maintain the RCA in sectors biased towards agriculture. It is expected to change the advantage towards heavy manufacturing industries and core emerging sectors. For Indonesia, except coal other top export sectors are not complying with the comparative advantage list. The regional economic integration among ASEAN and China, Japan and Republic of Korea reveals significant changes in the trade sectors particularly for Thailand, Vietnam and Indonesia.

5.5.2 Sectoral Import Analysis

A look at the ranking of the import shares of different sectors would show variations in each of the trade agreement phases, across countries. New sectors entered in the

top six list when comparing the BAU to the economic integration scenarios. There are, however, large commonalities amongst industrial sectors between the share of top six exporting and importing sectors. This occurs because of intra-industry trade. Intra-industry trade occurs when a country exports and imports goods in the same industry. It represents international trade that occurs within industries rather than between industries. The top exports and imports of most industrial countries are actually quite similar items. Such trade is more beneficial than inter-industry trade because it stimulates innovation and exploits economies of scale. We will explain later the intra-industry trade. The top six import sector shares for BAU 2001 are representative of all other BAU periods (2010, 2015, and 2020). Though the percentage shares fluctuate within the BAU periods, the sectors remain constant.

A comparison of the share of top six import sectors for BAU 2001 and ASEAN+3 scenario is given in Table 5.15. For Japan, most of the sector's shares have gone down, while the share of Ferro alloys sector increased from 3.52 to 8.66% and that of chemical, rubber and plastics sector increased from 9.45 to 12.64%. For China, the import shares of the sectors like electrical equipment, machinery and equipment, and manufactures nec, increased in the ASEAN+3 scenario, while the import shares of wearing apparel and textiles decreased. The import share of electrical equipment increased rather dramatically between the BAU 2001 to ASEAN+3 (2020) from 16.43 to 26.93% (Table 5.15). The shares for the Republic of Korea remained similar between the two scenarios with the largest being almost 4% increase in the import share of machinery and equipment in the ASEAN+3 scenario. The import shares of four of the six sectors increased for Indonesia from the BAU to the ASEAN+3 scenario. The only sector that shows a decline is the wood products sector (import share decreased from 9.02 to 5.36%). Sectoral import shares have increased significantly for Thailand. The electrical equipment sector and machinery and equipment sector's import share more than doubled between the two scenarios in Thailand. Vietnam had the largest change in rank of the import share. In the ASEAN+3 scenario, three new sectors enter the top six sectors; chemical rubber and plastics, processed rice, and textiles. These three sectors accounted for almost 44% of the import share in the ASEAN+3, 2020 scenario (Table 5.15).

The import share of electronic equipment for Malaysia, Philippines, and Singapore is expected to decline in ASEAN+3 at 2020 compared to BAU 2001.

Table 5.15 Top six sectors' import share in BAU, 2001 and ASEAN+3, 2020 (percentage)

BAU 2001							
China		Japan		Republic of Korea		Malaysia	
Sector	Share	Sector	Share	Sector	Share	Sector	Share
40 ele	16.43	41 ome	25.87	40 ele	26.82	40 ele	47.95
41 ome	14.46	40 ele	20.18	41 ome	11.55	33 crp	6.17
42 omf	10.87	38 mvh	18.29	33 crp	10.67	41 ome	6.04
28 wap	10.32	33 crp	9.45	38 mvh	9.05	30 lum	3.68
29 lea	8.81	39 otn	3.80	27 tex	8.42	21 vol	3.28
27 tex	6.50	35 i_s	3.52	39 otn	5.57	16 oil	1.97

Table 5.15 (continued)

Indonesia		Thailand		Vietnam		Philippines	
Sector	Share	Sector	Share	Sector	Share	Sector	Share
40 ele	11.43	40 ele	22.25	29 lea	18.29	40 ele	55.46
30 lum	9.02	41 ome	11.80	16 oil	13.32	41 ome	9.47
33 crp	7.57	33 crp	9.31	28 wap	10.54	28 wap	6.77
28 wap	7.34	25 ofd	6.93	25 ofd	8.65	25 ofd	2.88
27 tex	6.71	28 wap	4.28	8 ocr	5.16	27 tex	2.15
41 ome	5.13	27 tex	4.24	41 ome	4.95	33 crp	2.001

Singapore		Other ASEAN	
Sector	Share	Sector	Share
40 ele	43.68	28 wap	22.07
41 ome	11.48	17 gas	15.97
33 crp	9.92	27 tex	13.3
32 p_c	3.62	16 oil	12.0
48 otp	1.625	4 v_f	5.49
39 otn	1.53	13 frs	3.97

ASEAN+3 (2020)

China		Japan		Republic of Korea		Malaysia	
Sector	Share	Sector	Share	Sector	Share	Sector	Share
40 ele	26.93	41 ome	23.39	40 ele	24.60	40 ele	43.76
41 ome	19.17	38 mvh	16.22	41 ome	15.39	33 crp	13.31
42 omf	12.42	33 crp	12.64	27 tex	9.42	41 ome	8.67
28 wap	7.51	40 ele	10.78	33 crp	9.18	21 vol	7.43
33 crp	7.02	35 i_s	8.66	38 mvh	9.07	16 oil	2.47
27 tex	5.82	27 tex	4.71	35 i_s	7.03	38 mvh	1.80

Indonesia		Thailand		Vietnam		Philippines	
Sector	Share	Sector	Share	Sector	Share	Sector	Share
40 ele	18.38	40 ele	53.23	33 crp	28.12	40 ele	36.97
27 tex	10.60	41 ome	27.49	29 lea	17.36	41 ome	20.10
33 crp	10.00	33 crp	13.30	16 oil	12.35	33 crp	7.08
41 ome	7.34	38 mvh	10.61	23 pcr	10.28	28 wap	6.43
31 ppp	6.60	27 tex	6.86	28 wap	7.92	21 vol	4.63
30 lum	5.36	32 p_c	4.89	27 tex	5.93	36 nfm	3.74

Singapore		Other ASEAN	
Sector	Share	Sector	Share
40 ele	44.73	17 gas	23.95
33 crp	14.43	16 oil	17.04
41 ome	10.26	33 crp	12.23
32 p_c	7.43	28 wap	10.00
22 mil	2.33	27 tex	9.39
34 nmm	2.30	40 ele	7.64

Source: Results from the study.
N.B.: Sectoral codes are given in Annex 1.

On the other hand manufacturing equipment in Philippines is likely to increase in ASEAN+3 integration compared to BAU 2001.

The sector specific regional export share and the import share for the 10 countries indicate that the top six sectors are expected to remain more or less constant with few exceptions. As expected, the greatest change in shares occurs when there are higher tariff reductions. This is particularly true for Indonesia, Thailand, Vietnam and Philippines. While for China (electrical equipment), Japan and the Republic of Korea (ferrous), the sectoral performance of export and import is insignificant except few sectors.

What we have learnt from the exercise of export import share within the region in BAU and the different integration scenarios that intra-industry trade is leading in this region. As intra-industry trade generates more trade competitiveness, in the next section we are exploring more on this.

5.6 Intra-Industry Trade

Intra-industry trade arises if a country simultaneously imports and exports similar types of goods or services. Similarity is identified here by the goods or services being classified in the same 'sector'. The phenomenon of intra-industry trade first received attention in the 1960s in studies by Verdoorn and Balassa on the increased trade flows among European countries. Grubel and Lloyd (1975) provided the empirical study on the importance of intra-industry trade and how to measure it. Theoretical foundations for explaining intra-industry trade came later (in the 1980s and 1990s) with the new trade literature, to a large extent based on a monopolistic competition framework. The most comprehensive and widely accepted explanation, at least within economic theory, is that of Paul Krugman's New Trade Theory (Krugman, 2008). Krugman argues that economies specialise to take advantage of increasing returns, not following differences in regional endowments (as contended by neoclassical theory). In particular, trade allows countries to specialise in a limited variety of production and thus reap the advantages of increasing returns (i.e., economies of scale) but without reducing the variety of goods available for consumption.

It is customary to distinguish between two different types of intra-industry trade, each warranting a different type of explanation, namely horizontal and vertical intra-industry trade. Horizontal intra-industry trade refers to the simultaneous exports and imports of goods classified in the same sector and at the same stage of processing. This is based on product differentiation, for example, the Republic of Korea's simultaneous import and export of mobile telephones in the final processing stage. As these mobile phones are produced using similar technology and provide similar functions they are classified in the same sector. Nonetheless, the exported Samsung telephones differ in appearance and product characteristics slightly from the imported Nokia telephones, catering to the desires of different types of consumers (Reinert, Rajan, Glass, & Lewis 2009).

Vertical intra-industry trade refers to the simultaneous exports and imports of goods classified in the same sector but at different stages of processing. This is based on the increasing ability to organize 'fragmentation' of the production process into different stages, each performed at different locations by taking advantage of the local conditions. China, for example, imports technology-intensive computer components and uses its abundantly available labour force to assemble these components in the labour intensive final production stage, before the components (as part of a finished computer) are exported again to Europe or the USA (Marrewijk, 2008).

The most often used method for determining the extent of intra-industry trade was proposed by Grubel and Lloyd (1975). This measure is known as the Grubel–Lloyd index. It is calculated as

$$\mathrm{GL}_i = 1 - [\{\mathrm{mod}(\mathrm{export}_i - \mathrm{import}_i)\}/(\mathrm{export}_i + \mathrm{import}_i)]$$

where i = sector.

If the country only imports or only exports goods or services within the same sector, such that there is no intra-industry trade, the second term on the right-hand side of the above equation is equal to one, such that the whole expression reduces to zero. Similarly, if the export value is exactly equal to the import value (export sector $_i$ = import sector $_i$), the second term on the right-hand side of equation is equal to zero, such that the whole expression reduces to one. The Grubel–Lloyd index therefore varies between zero (indicating pure inter-industry trade) and one (indicating pure intra-industry trade).

In Table 5.16, the index of agriculture and industry (aggregation scheme is shown in Annex 4) is presented in BAU 2020 scenario and MEI 2020 and ASEAN+3 at 2020 for regions under the agreement. The agriculture indexes are in the range of 0.58–0.80 but for the industrial sector the values are mostly 0.90 or above. From

Table 5.16 Grubel–Lloyd index in different trade scenarios

	BAU 2020		MEI 2020		ASEAN+3 2020	
	Agriculture	Industry	Agriculture	Industry	Agriculture	Industry
China	0.74	0.93	0.77	0.93	0.67	0.92
Japan	0.78	0.92	0.78	0.93	0.78	0.78
Republic of Korea	0.81	0.81	0.74	0.83	0.75	0.88
Indonesia	0.74	0.91	0.76	0.92	0.78	0.93
Malaysia	0.82	0.92	0.80	0.93	0.78	0.93
Philippines	0.58	0.90	0.65	0.86	0.59	0.90
Singapore	0.84	0.88	0.82	0.86	0.78	0.86
Thailand	0.69	0.95	0.67	0.94	0.55	0.84
Vietnam	0.79	0.89	0.67	0.90	0.71	0.92
Other ASEAN	0.65	0.88	0.79	0.87	0.73	0.87
Total	0.85	0.93	0.85	0.93	0.76	0.90

Source: Results from the study.

the G–L index it implies that pure intra industry trade is expected to take place in 2020. For most of the countries indexes are increasing due to integration except Japan and Thailand. It reflects that tariff reduction scenarios will further intensify the intra-industry trade.

5.7 Welfare Implication

Let us now analyse the welfare effect of tariff reduction scenarios. In global CGE model each region's representative agent aims to maximize welfare level. When trade policy is changed the agent will calculate a change in income level. The changed income level affects the scale of savings and consumption of each commodity so that the marginal utility of consumption is same across the commodities. In this case price variables are used in the decision making process for clearing markets in the model. While the welfare level of representative agents in trade agreement member countries (here ASEAN and CJK) would improve, the welfare level of agents in other regions (here four regions—Rest of OECD, NAFTA, ROW1 and ROW2) would likely to decline. Since each region's welfare function is different, the impact of trade reforms between ASEAN and CJK on welfare level of other regions would likely to be different.

How do the results of trade liberalization compare in terms of their estimated welfare effects across fourteen regions. Table 5.17 summarizes those results. Gains and losses are not spread evenly. It can be observed that the final round of economic integration scenarios for MEI, and ASEAN+3 leads to increase global welfare. However, further analysis shows that the gain in welfare are mainly attributed to the ten regions involved in the economic integration, while the rest of the regions faced a loss in welfare with the exception of ROW2 under the MEI scenario. Yet, not all the gain in welfare is distributed evenly among the ten regions involved. In the MEI 2020 scenario, China, Malaysia and Thailand are the countries that experienced the greatest welfare increases, while the Republic of Korea faced a decline in total welfare. In case of ASEAN+3 2020 scenario, China, the Republic of Korea and Thailand gained, while Japan is expected to decline in welfare. From these two scenarios, China and Thailand appeared to gain the most welfare from trade liberalization in the region.

The welfare decomposition results provide further insight into the analysis. The impact of trade liberalization on welfare differs between large and small countries. A large country can affect the international terms of trade by raising the world prices of its imports and lowering the world prices of its exports. In contrast, since a small country cannot influence the international terms of trade, it has to accept the world prices of its exports and imports. The present analysis included both small economies, such as Thailand and Viet Nam, and large economies, such as China and Indonesia. Welfare gains from a multilateral (i.e. regional) liberalization are fundamentally determined by two factors: (a) the change in efficiency with which any given economy utilizes its resources; and (b) changes in a country's terms of trade, which permit us to calculate the regional equivalent variation or the amount

Table 5.17 Welfare decomposition of the different trade scenarios (million USD)

	MEI (2020)			ASEAN+3 (2020)		
	Allocative efficiency	Terms of trade effect	Total	Allocative efficiency	Terms of trade effect	Total
China	10072.4	−5991.6	4373.1	27833.1	−13692.5	15894.8
Japan	2253.5	−707.1	1627.9	−8249.6	7686.1	−1624.8
Republic of Korea	477.8	−726.1	−225.2	1849	4416.3	5939.1
Indonesia	1059.4	1793	2753.2	634.9	130.8	894.1
Malaysia	2909.8	3183.7	6688.9	2092.5	−272.4	2070.3
Philippines	996.6	374.3	1379.3	477.9	−108.6	375.1
Singapore	−222.1	3108.6	3035.3	81	993.4	1115.4
Thailand	3628.4	3088	6842.3	2217.3	6504.2	8833.7
Vietnam	2812.1	360	3578.3	1692.4	1292.3	4698
Other ASEAN	401.5	−139.3	238.4	541.1	−78.6	455.3
Rest of OECD	−847.8	−3613.7	−3976.6	−213.5	−3266.6	−3028
NAFTA	−652	−1771.1	−3888.6	−580.8	−1512.4	−4158.4
ROW1	−1431.7	−2200.6	−3743.3	−1700.3	−4094	−6033.8
ROW2	−1248.1	3241.8	1526.9	−1750.1	2002.1	−505.9
Total	20209.7	0	20209.7	24924.9	0	24924.9

Source: Results from the study.

of money that could be taken away from consumers, at initial prices, while leaving them at the same level of post-simulation utility.[15] If a particular country experiences an improvement in its terms of trade, i.e. export prices rise relative to import prices, then the equivalent variation[16] gain will be larger than the efficiency gain.[17] If the terms of trade deteriorate, then the opposite will happen.

Further decomposing these two results (Table 5.17), most regions involved in the economic integration improved in their allocative efficiency resulting in an increase in the global allocative efficiency. However, the exceptions to this general trend are Singapore in the MEI scenario and Japan in the ASEAN+3 scenarios, which experience a deterioration in allocative efficiency (−8249.6 million US$). On the other hand, with economic integration there appears to have resulted in a large deterioration in the terms of trade for China in both scenarios. The terms of trade effect is negative for China, Japan, and the Republic of Korea in the MEI 2020 scenario, while positive terms of trade effects are observed for Japan and Republic of Korea in the ASEAN+3 scenario. The terms of trade (TOT) effect will be clear further if we consider the export price and import price impact.

The terms of trade (TOT), which is usually defined as the ratio of the region's export price to import price, is a key concept in evaluating the effects of price changes on welfare. The trade liberalization in ASEAN and CJK leads to two offsetting effects. (i) Liberalization of ASEAN imports reduces costs in ASEAN and hence increases its supply into world markets. This, in turn, can be expected to

reduce the prices received for exports per unit. (ii) As its East Asia partners reduce their tariffs on ASEAN exports, their demands for ASEAN exports rise, and this in turn improves ASEAN export prices. The net effect depends on which effect is larger. Table 5.18 demonstrates the effects on the terms of trade.

The result implies that in some ASEAN countries(Indonesia, Malaysia, Philippines, other ASEAN) and China terms of trade deteriorate primarily through changes in its export prices in ASEAN+3 scenario at DEI 2020. On the other hand MEI 2020 reveals an improved terms of trade effect for those ASEAN countries but not for China, Japan and the Republic of Korea. The countries like Thailand, Vietnam and Singapore reveals a positive TOT for both scenario cases.

The result on TOT shows that late tariff reduction and restriction in regional integration (i.e., WASEAN and ASEAN-CJK) in MEI scenario is not favourable for China, Japan and Republic of Korea. But it proves to be favourable for ASEAN countries. The deep integration covering all the countries (ASEAN+3) and early reduction in tariff is beneficial for Japan and Republic of Korea and Thailand, Vietnam and Singapore. While the TOT effect of China and Other ASEAN will always be negative.

Most of the terms of trade deterioration results from decline in the prices received for exports, but a part results from increases in the prices of imports. The larger magnitude in change in export prices relative to import prices is related to the assumption of the product differentiation by country of origin on the demand side, a standard feature of the Armington (1969) model. With the standard GTAP elasticities of substitution that we have used in this chapter, increases in China's export supplies require fall in the prices of China's exports if China is to increase its export share. On the import side, China faces highly elastic export supply curves. Thus, China needs to pay higher prices for its imports only to the extent that it is a relatively large importer from world markets. Similar consequences are derived for Japan and the Republic of Korea at MEI 2020 and Malaysia, Philippines and other ASEAN in ASEAN+3 at 2020.

5.8 Effects on Factor Returns

Besides the effects on output, export and import, FTAs also have some impact on factor returns. As regional integration makes trade easier, it tends to raise the returns on at least some factors of production (Winters, 1996). A simple application of the Heckscher–Ohlin model might lead us to expect ASEAN's returns to capital to fall since ASEAN is capital-scarce relative to its partner countries in East Asia (Japan and Korea). Since international trade tends to increase the returns to the abundant factor and reduce those to the scarce factor, assuming protection against capital intensive goods from the partner countries in East Asia, increased trade with ASEAN might be expected to reduce the returns to capital in the new members. However, there are a number of reasons to believe that the basic Hecksher-Ohlin model is too simple for our purpose. First, the standard Heckscher–Ohlin model

Table 5.18 The effects of terms of trade in different trade scenarios (percentage change)

	MEI 2020				ASEAN+3 2020			
	World price effect	Export price effect	Import price effect	Total TOT effects	World price effect	Export price effect	Import price effect	Total TOT effects
China	−0.066	−0.220	0.163	−0.448	−0.107	−0.473	0.377	−0.956
Japan	−0.092	−0.019	−0.013	−0.099	0.121	1.200	0.264	1.057
Republic of Korea	−0.079	−0.093	0.016	−0.187	−0.064	1.230	0.042	1.124
Indonesia	−0.010	1.043	0.164	0.870	−0.281	0.424	0.169	−0.026
Malaysia	0.100	1.122	0.201	1.021	−0.083	0.281	0.461	−0.263
Philippines	0.003	0.614	0.154	0.463	−0.176	0.444	0.352	−0.084
Singapore	−0.011	1.366	0.151	1.205	−0.016	0.444	0.064	0.364
Thailand	−0.032	1.500	0.137	1.331	0.114	2.539	0.326	2.327
Vietnam	0.164	0.894	0.170	0.888	0.202	2.373	0.240	2.336
Other ASEAN	0.314	−0.418	0.696	−0.799	−0.072	0.384	0.680	−0.368

Source: Results from the study.

applies only to a so-called square model with equal numbers of factors of production and goods, and there is no indication that this is the way the real world is. The GTAP six database identifies five factors of production: land, unskilled labor, skilled labor, capital, and natural resources and 57 commodities. Second, the Heckscher–Ohlin model presumes homogeneous products, whereas experience suggests that many markets are better represented by differentiated products and intra-industry trade. The GTAP model assumes the so-called Armington assumption[18] with the goods being differentiated by country of origin. In addition, the substitutability of domestic and foreign goods also becomes very important. Third, integration might affect the rate of return on capital through the price of intermediate and capital goods. A reduction in tariffs and trading costs on the imports of capital equipment reduces the prices which industry has to pay for investment goods (Fukase & Martin, 1999).

Table 5.19 shows the results of the simulation for the changes in returns on the factors of production. The measure reflects the changes in factor prices relative to the price index for private consumption expenditure. It does not, however, take into account the effects of changes in the revenue position of the Government and its ability to redistribute tax revenues to individuals, either through transfers or through the provision of public goods.

If we compare the scenarios, then MEI 2020 showed a favourable return in the countries participating in RTAs (except China, Japan and the Republic of Korea)

Table 5.19 Real returns on the factors of production in different trade scenarios (percentage change)

	MEI 2020			ASEAN+3 2020		
	UnSkilled labour	Skilled labour	Capital	UnSkilled labour	Skilled labour	Capital
China	0.519	0.558	0.599	1.04	1.072	1.026
Japan	0.004	0.015	0.029	0.259	0.139	0.176
Republic of Korea	0.199	0.139	0.136	0.765	0.093	0.448
Indonesia	1.737	1.574	2.113	−0.277	−0.419	−0.504
Malaysia	5.185	4.44	4.793	2.022	1.898	2.067
Philippines	2.077	2.407	3.504	0.802	0.837	1.502
Singapore	2.582	2.261	2.074	1.16	0.904	0.342
Thailand	4.079	3.247	4.26	0.271	−0.315	−1.896
Vietnam	11.883	5.758	9.084	10.067	4.511	8.195
Other ASEAN	0.35	0.366	0.362	−0.312	−0.203	−0.304
Rest of OECD	−0.136	−0.112	−0.068	−0.132	−0.101	−0.072
NAFTA	−0.038	−0.038	−0.032	−0.037	−0.032	−0.041
ROW1	−0.195	−0.179	−0.213	−0.447	−0.37	−0.42
ROW2	−0.105	−0.073	−0.099	−0.105	−0.083	−0.127

Source: Results from the study.

for three factors: skilled labour, unskilled labour and capital. It seems that high tariff reductions are not beneficial to achieve good factor returns in the ASEAN region. In ASEAN, Vietnam had good factor returns, followed by Malaysia, in MEI 2020, which reflects the wider scope of Vietnam's liberalization, which is likely to induce its industrialization. Further, the concept of comparative advantage is supported by the case of Vietnam because unskilled labour returns were comparatively higher than capital returns. On the contrary, the comparative advantage theory is not supported in the case of Indonesia and Thailand. Though they are labour-intensive countries, the capital return is likely to increase more under the MEI 2020 scenario.

5.9 Poverty Implications

An attempt is also made to capture the poverty implication from the study. The analysis of links between trade reform and poverty is in its infancy, but considerable progress has been made in recent years (McCulloch, Winters, & Cirera, 2001; Winters, 2002).

U and *y* define the per capita utility of aggregate household expenditures and regional household income respectively (Table 5.20). Both are positive for China and most of other countries under the two scenarios. This implies that overall countries household expenditures and incomes have increased. While for Japan and the Republic of Korea, these values of the variables are reduced in MEI 2020. The impact on the unskilled labour impact is further analyzed to investigate the poverty aspect of the analysis. Results for the MEI scenario indicate that the unskilled labour return is higher than GDP growth for most of the economies. This reflects the reduction in poverty. But for ASEAN+3, opposite results are obtained (Table 5.20). Though, the household expenditures and incomes improved for these regions, this improvement will not make a significant impact on the poorer section of the population. Thus, if ASEAN+3 scenario materializes it will not be helpful for poverty alleviation of the countries, even though the economies are expected to be benefited overall.

In summary, countries who participate in the economic integration are better off because of increased economic growth, industrial output that occurs because of the integration. Countries that are not part of the economic integration have lower industrial output compared to the BAU scenario. The economic benefit varies with the different countries involved in the integration. Japan is predicted to experience positive economic impacts under the ASEAN+3 and MEI 2020 economic integration scenarios, however, under DEI 2020 it is expected to have a negative economic impact. In the DEI 2020 scenario, Japan experienced negative industrial output growth, along with a reduction in both export and import shares as compared to BAU 2020. The Republic of Korea will have positive economic impacts with DEI 2020 and ASEAN+3, while negative economic impacts with MEI 2020 as compared to the BAU 2020 scenario. Though it experienced negative economic growth with

Table 5.20 Poverty scenario (percentage change)

	ASEAN+3 2020				MEI 2020			
	Unskilled wages	VGDP	*U*	*Y*	Unskilled wages	VGDP	*U*	*Y*
China	1.04	–0.032	0.37	0.02	0.52	0.069	0.1	0.08
Japan	0.26	1.034	–0.04	1.04	0.004	–0.071	0.04	–0.1
Republic of Korea	0.77	2.948	0.8	3.16	0.20	–0.227	–0.03	–0.24
Indonesia	–0.28	0.716	0.25	0.8	1.74	1.678	0.8	1.78
Malaysia	2.022	0.541	1.20	0.686	5.185	3.16	3.96	3.66
Philippines	0.802	0.110	0.30	0.134	2.077	1.59	1.143	1.75
Singapore	1.16	1.215	0.90	1.439	2.582	4.24	2.55	4.88
Thailand	0.27	5.998	4.4	7.4	4.08	4.979	3.5	6.0
Vietnam	10.07	11.542	4.76	11.9	11.88	7.803	3.85	8.19
Other ASEAN	–0.312	0.532	0.30	0.602	0.35	–1.155	0.159	–1.13

Source: Results from the study.

MEI, its exports increased marginally but imports reduced compared to the BAU scenario. For China, the real growth in output is insignificant with the various economic integration scenarios, however, it shows positive for all agreement phases. Its export and imports shares would likely to increase marginally compared to the BAU scenario. The other countries involved in the agreement are expected to be benefited from increased industrial output as a result of the economic integration. The countries that benefited the most were Vietnam and Thailand. These countries experience greater industrial output growth as well as export and import growth with higher tariff reductions. This is expected for these countries because the greater the tariff reduction, i.e. the greater the trade liberalization, the larger the opportunities for these countries. The real output growth will be increasing for Malaysia, Philippines, Singapore, while Other ASEAN will be deriving a very insignificant growth due to economic integration.

High export and import share are observed for all the agreement countries due to trade agreement. Further, the direction of trade for the countries that are part of the economic integration is concentrating within the region. ASEAN exports to other countries of the World (NAFTA, rest of OECD, ROW1 and ROW2) will be declining due to the trade agreement between ASEAN and CJK. The export will be away from other countries of the World to the region especially for ASEAN+3 integration at 2020. But China's export to other countries of the world will not be impacted much like ASEAN and Japan and the Republic of Korea. Thus, trade moves into the region between the countries that are part of the economic integration and away from those regions that are not part of the agreement. Welfare implication shows a mixed result in different integration scenarios. In MEI 2020 scenario, China, Malaysia and Thailand are the countries that experienced the greatest welfare increase, while the Republic of Korea faced rather a decline in total

welfare. In ASEAN+3 2020 scenario, China, Republic of Korea and Thailand show a gain, while Japan is expected to decline in welfare. From these two scenarios, China and Thailand appeared to gain the most welfare from trade liberalization in the region. The highest factor returns are observed for Vietnam. The factor returns to rest of ASEAN countries is also encouraging.

The rank of the six sectors output growth differs depending upon the trade agreement phase and the country. New industrial sectors entered the top six sectors due to the trade agreement scenarios when compared to BAU. The percentage shares of the top sectors fluctuate, but the sectors themselves remain constant from BAU to ASEAN+3. The top six sectors in both exports and imports are common in most cases. This is due to intra industry trade. Shares are sensitive to high tariff reductions in Thailand and Vietnam. In China, Japan, and the Republic of Korea, the changes in the sectoral performance of exports and imports are insignificant except for a few cases (electrical equipment in China, and ferrous metals in Japan and the Republic of Korea).

The sectoral performance reflects that the composition of trade is likely to deepen during the various phases (2001–2010, 2015 and 2020) of the economic integration for almost all countries in South and SouthEast Asia. The change in trade may likely to move from agriculture and light industries towards heavy industries except for Japan and the Republic of Korea. This result appeared in all of the scenarios analyzed. These sectoral impacts from the various trade scenarios helped in the analysis of the environmental implications of the economic integration in Chapter 6.

Chapter 6
Environmental Impact of Economic Integration

6.1 Introduction

In the earlier chapter (Chapter 5) we have seen that trade pattern influences the composition and scale of exports that ultimately change the industrial output growth, export and import growth which, it is expected, will impact the environment.

The chapter evaluates how the changes in the aggregate level of output, composition of that output, and inputs and technologies used, as a consequence of trade liberalization are likely to impact the environment of countries in the agreement. The analyses focus on air pollution (CO_2, N_2O, and CH_4), water pollution (BOD, COD, and Suspended Solids), and industrial waste for these countries. This chapter also uses the decomposition analysis to find the factors responsible for changes in pollution. The study deals with the likely impact of different trade scenarios till 2020. In that case the period is subdivided into three years-2010, 2015, and 2020. For the assessment of environmental impact we need to estimate the projected environmental coefficient for the years, 2010, 2015 and 2020 on the basis of historical environmental coefficient trend. It should be noted that the environmental coefficients are likely to change over time with technological improvement. Keeping this in mind, we have updated the environmental coefficients for the years 2010, 2015 and 2020. These updated coefficients are applied to estimate the volume of pollution in each scenario. The estimation procedure for the up-dating of the environmental coefficients has been outlined in Chapter 4.

6.2 Environmental Impact in BAU and Trade Scenarios

In this section, we discuss the impact of air pollution mainly GHG emission, water pollution restricted to BOD, COD and SS and industrial waste for BAU and trade scenarios.

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6.2.1 Air Pollution

Tables 6.1, 6.2 and 6.3 report the total GHG emissions (CO_2, CH_4 and N_2O) across the countries during 2001 and 2020. In the business as usual period, the growth of CO_2 emission is higher for China followed by Vietnam, Indonesia, and Malaysia while the lowest growth is achieved by Japan. Since the economy of China and ASEAN countries are projected to grow significantly from 2001 to 2020 (in Chapter 5), this finding is not surprising. Carbon emission is increased by 331%, methane by 341% and N_2O by 211% for China at BAU 2020.

The trend of CH_4 growth is almost same like CO_2. CH_4 emission is high for China, Vietnam and Indonesia, while the lowest is achieved by the Republic of Korea and Japan. Due to the paucity of data we could not include Malaysia and Other ASEAN in discussion. N_2O emission is highest for Indonesia followed by China, Vietnam, the Republic of Korea and Singapore. Japan is on the lower end.

This emission and growth shows the business as usual growth, i.e. the growth of GHG emission at BAU 2020. The growth rate of GHG emission clearly reveals that the developing East and South East Asian countries are likely to generate more GHG emission compared to developed nations like Japan and Republic of Korea.

Table 6.1 CO_2 growth in business as usual period (Gg)

CO_2	BAU 2001	BAU 2020	% change
China	2603783	11235245	331.50
Japan	859206.9	1070769	24.62
Republic of Korea	315667.1	590379.4	87.03
Indonesia	222079.3	773033.2	248.09
Thailand	155830.4	404056.8	159.29
Vietnam	43986.8	161078.2	266.20
Malaysia	107196.6	337332.9	214.68
Philippines	61375.5	182821.6	197.87
Singapore	53453.7	145413.2	172.03
Other ASEAN	15510.78	78721.41	407.52

Source: Result from the study.

Table 6.2 CH_4 growth in business as usual period (Gg)

CH_4	BAU 2001	BAU 2020	% change
China	36892.05	162926.11	341.63
Japan	816.85	1135.00	38.95
Republic of Korea	894.22	1211.56	35.49
Indonesia	7163.03	21239.75	196.52
Thailand	4377.19	10744.41	145.46
Vietnam	3087.39	11631.87	276.75
Philippines	1236.74	3546.47	186.76
Singapore	16.89	31.75	87.93

Source: Results from the study.

Table 6.3 N_2O growth in business as usual period (Gg)

N_2O	BAU 2001	BAU 2020	% change
China	2032.05	6330.58	211.54
Japan	62.26	87.31	40.23
Korea	34.98	74.27	112.31
Indonesia	110.50	388.91	251.97
Thailand	25.74	58.77	128.29
Vietnam	23.01	54.35	136.22
Philippines	29.38	53.31	81.49
Singapore	3.09	6.98	125.76

Source: Results from the study.

Let us discuss about GHG emission growth behaviour in different trade liberalisation scenarios in 2020. Here we try to compare the growth in BAU 2020 and medium and deep integration at 2020. It will reflect the extra amount of emission generated due to trade liberalisation in various economic integration scenarios.

Tables 6.4, 6.5 and 6.6 provide estimates of the volume of CO_2 (Gg), CH_4 and N_2O (Gg) in both the BAU 2020 and the economic integration scenarios in 2020. The percentage difference shows the pollution generated either increases or decreases due to economic integration across the countries. For CO_2 emission, Thailand has the largest growth in MEI integration at 2020 followed by Vietnam and Indonesia, while Japan, the Republic of Korea and the Philippines having nominal change in MEI scenario at 2020 compared to BAU 2020 while Singapore, China, Malaysia and Other ASEAN show a minor decline in emission.

Table 6.4 CO_2 growth in different trade scenarios at 2020 (Gg)

CO_2	BAU 2020	MEI 2020	MEI-BAU 2020 % change	DEI 2020	DEI-BAU 2020 % change	ASEAN+3	ASEAN+3 DEI-BAU 2020 % change
China	11235245	11156248	−0.70	11167295	−0.60	11016997	−1.94
Japan	1070769	1075495	0.44	1075555	0.45	1080315	0.89
Korea	590379.4	593815	0.58	597662	1.23	593271	0.49
Indonesia	773033.2	789774	2.17	792247	2.49	800801	3.59
Thailand	404056.8	419526	3.83	420166	3.99	423065	4.70
Vietnam	161078.2	165212	2.57	167125	3.75	187888	16.64
Malaysia	337332.9	336784.6	−0.16	341547.8	1.25	361028.4	7.02
Philippines	182821.6	183697.6	0.48	184851.9	1.11	186668.4	2.10
Singapore	145413.2	144006.5	−0.97	141634.6	−2.60	142203	−2.21
Other ASEAN	78721.4	78361.3	−0.46	77698.0	−1.30	76658.7	−2.62

Source: Results from the study.

Table 6.5 CH_4 growth in different trade scenarios at 2020 (Gg)

CH_4	BAU 2020	MEI 2020	MEI-BAU 2020 % change	DEI 2020	DEI-BAU 2020 % change	ASEAN+3	ASEAN+3 DEI-BAU 2020 % change
China	162926.11	163189.70	0.16	162936.35	0.01	160856.89	−1.27
Japan	1135.00	1131.92	−0.27	1056.25	−6.94	1248.33	9.99
Korea	1211.56	1207.50	−0.34	1224.90	1.10	1301.30	7.41
Indonesia	21239.75	20766.42	−2.23	20652.75	−2.76	20641.73	−2.82
Thailand	10744.41	10016.49	−6.77	9249.58	−13.91	8345.87	−22.32
Vietnam	11631.87	11803.98	1.48	11584.65	−0.41	11651.31	0.17
Philippines	3546.47	3449.24	−2.74	3269.33	−7.81	3196.46	−9.87
Singapore	31.75	31.69	−0.19	31.41	−1.07	31.58	−0.54

Source: Results from the study.

Table 6.6 N_2O growth in different trade scenarios at 2020 (Gg)

N_2O	BAU 2020	MEI 2020	MEI-BAU 2020 % change	DEI 2020	DEI-BAU 2020 % change	ASEAN+3	ASEAN+3 DEI-BAU 2020 % change
China	6330.58	6321.42	−0.14	6306.59	−0.38	6261.07	−1.10
Japan	87.31	87.28	−0.03	87.03	−0.32	87.45	0.16
Korea	74.27	73.07	−1.62	73.56	−0.96	74.99	0.97
Indonesia	388.91	388.34	−0.15	379.79	−2.35	377.71	−2.88
Thailand	58.77	55.90	−4.88	51.14	−12.98	48.91	−16.78
Vietnam	54.35	56.74	4.40	56.25	3.50	53.87	−0.88
Philippines	53.31	52.37	−1.76	50.77	−4.76	50.54	−5.20
Singapore	6.98	7.45	6.73	8.14	16.62	7.77	11.32

Source: Results from the study.

In DEI integration, for most of the countries emission growth has increased compared to MEI integration at 2020 except Japan which continues the same minor positive emission growth and China remains with minor negative growth. While Singapore and Other ASEAN show further decline in emission compared to MEI integration at 2020.

Further in ASEAN+3 integration at DEI 2020, Vietnam achieves significant emission growth compared to other scenarios. Other countries like Malaysia, Thailand and Indonesia also show an increase in CO_2 emission growth compared to MEI integration at 2020.

Singapore, Other ASEAN and China record a less emission compared to BAU 2020. It implies that the higher tariff reduction is not increasing these countries CO_2 emission growth rather decline in emission is found compared to BAU 2020.

The emission growth of Japan shows a marginal rise in ASEAN+3 at 2020 but for the Republic of Korea the higher CO_2 growth is expected in DEI 2020 compared to MEI 2020 and ASEAN+3 at 2020.

Overall Vietnam's CO_2 emission growth is still high in all of the economic integration scenarios compared to other countries. While Singapore shows a negative CO_2 growth in various scenarios compared to BAU 2020. Japan's CO_2 growth is modest compared to other countries and CO_2 growth in economic integration scenarios is insignificant compared to BAU 2020.

CH_4 emission growth in different trade scenarios reveals a completely different picture compared to CO_2 emission growth. The behaviour of CH_4 emission is fluctuating across the countries. Negative emission growth is achieved by Thailand, Indonesia, the Philippines and Singapore in three scenarios at 2020 compared to BAU 2020. Vietnam's emission is expected to increase at MEI 2020 and ASEAN+3 integration at 2020 and decline at DEI 2020 compared to BAU 2020, while for Republic of Korea most of scenarios show a positive emission growth except MEI 2020 compared to BAU 2020. The CH_4 emission growth in Japan fluctuates significantly in different integration scenarios. A minor decline is observed in MEI, and almost 7% decline in DEI 2020 while approximately 10% increase is observed in ASEAN+3 at 2020 compared to BAU 2020. Japan and Korea have the largest growth in CH4 emission in ASEAN+3 scenario compared to BAU 2020.

We can relate this result of Japan with the sectoral importance in as discussed Chapter 5. Ferro alloys and mining sector will be dominating at 2020 in different scenarios. And it is well known that mining sector releases CH_4 emission. The high CH_4 growth is expected in Japan probably due to the increased importance of the mining sector. Vietnam has significant increases in CH_4 in MEI and ASEAN+3 scenario. Increased production in the Paddy rice sector is a major contributor to this high growth. As we know that agricultural sectors mainly release CH_4 emission, Thailand reduced its CH_4 growth in all of the economic integration scenarios compared to the BAU situation reflecting that Thailand is losing its position in the international market in the context of agricultural production. The reasons behind this fluctuating behaviour across the countries in different trade liberalisation scenarios will be explored in sectoral analysis. The data for CH_4 is not available for Malaysia and Other ASEAN.

The largest N_2O growth is observed in Vietnam under MEI and DEI 2020 integration scenarios compared to BAU 2020, but a minor decline is noted in ASEAN+3 at 2020. Thailand shows a significant decline in N_2O emission due to tariff reduction followed by the Philippines, Indonesia and China having with a minor decline compared to BAU 2020. Japan and Korea show a decline in emission growth in DEI and MEI 2020 but record small rise in emission growth in ASEAN+3 integration at 2020.

Thus, the analysis of the growth of the three GHG emissions across the countries under BAU 2020 and different trade liberalization scenarios shows that Vietnam is affected environmentally for most of the GHG indicators, while Japan and Korea will face a marginal change, though trade liberalization promotes output growth of these two economies. Highest GHG emitters in this region will be China in BAU 2020, however, the liberalization impact will not add further to GHG emissions.

For Thailand, trade liberalization under different scenarios is growth inducing and pollution reducing in terms of CH_4 and N_2O (except CO_2). There are various

reasons behind this phenomenon. Firstly, the growth of the CO_2 intensive sectors has increased. Secondly, the growth of the agricultural sector, which is more CH_4 and N_2O intensive, has declined rapidly since the 1990s and also is reflected in BAU 2001 to 2020 and different trade liberalization scenarios. Thus, freer trade would likely to push Thailand away from agricultural activities towards the industry, thus affecting the environment differently (Mukhopadhyay, 2007).

The results for GHG indicator especially for CO_2 in East and South East Asian countries are not encouraging. As GHG emission is transboundary in nature, the volume of CO_2 generation in this region at 2020 will likely to be significant. If the emission growth trend continues and tight measures are not adopted, the goal of achieving Kyoto target will remain unfulfilled for Japan and Korea belonging to Annex 1 countries. And Japan and Republic of Korea will be penalized even though the CO_2 growth is less compared to China and ASEAN countries at BAU 2020(China and ASEAN countries under Annex 2, are not included in the bindings of Kyoto Protocol).

6.2.2 Water Pollution

Now we are discussing water pollution growth under the BAU and different trade scenarios across the countries in South and South East Asia.

6.2.2.1 BOD

Figure 6.1 illustrates the growth in BOD (tons) in the BAU and the economic integration scenarios. China's BOD growth is likely to be largest at 2020 compared to BAU 2001 followed by Vietnam and Indonesia among the countries under study. But

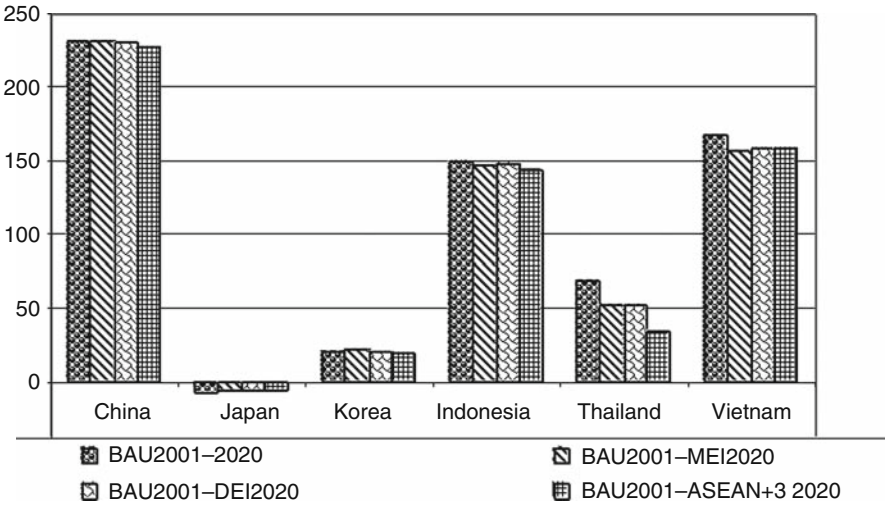

Fig. 6.1 BOD growth from 2001 to 2020 in Different Scenarios (%)

the generation of BOD for these countries show a minor decline in MEI, DEI and ASEAN+3 scenario compared to BAU 2020. Korea's BOD growth has increased slightly in BAU 2020, and continues to be same in different integration at 2020. While Japan shows a negative growth in BOD in BAU 2020 and MEI, DEI and ASEAN+3 at 2020 compared to BAU 2001. It is interesting to note that BOD growth shows a decline in all economic integration scenarios compared to BAU growth at 2020. This is the result of the positive technological effect. The drastic fall in BOD growth (68% in BAU, 2020 to 33.63% in ASEAN+3 at 2020) in Thailand occurred because of the decrease in output from sectors such as paddy rice and textile in the ASEAN+3 agreement. We will discuss this effect in sectoral analysis.

6.2.2.2 COD

Figure 6.2 shows the COD growth under various trade liberalization scenarios at 2020. COD growth is highest for China and lowest for Japan (negative growth). For the Republic of Korea and Thailand the growth remains almost same in different scenarios except ASEAN+3 at 2020. On the other hand, COD growth has increased for Indonesia and Vietnam in different scenarios at 2020 compared to BAU 2020.

6.2.2.3 Suspended Solid (SS)

We observed almost similar growth trend for SS, like COD. Interesting to note that SS growth of Thailand has increased under all trade liberalization scenarios compared to BAU 2020. But for other countries especially for Japan the growth rate has declined compared to BAU 2020 (Fig. 6.3).

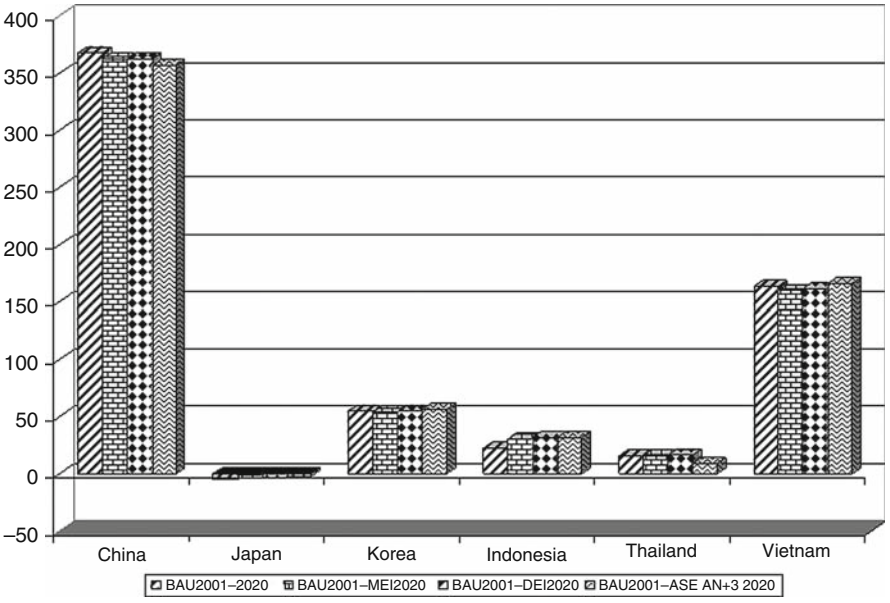

Fig. 6.2 COD growth from 2001 to 2020 in Different Scenarios (%)

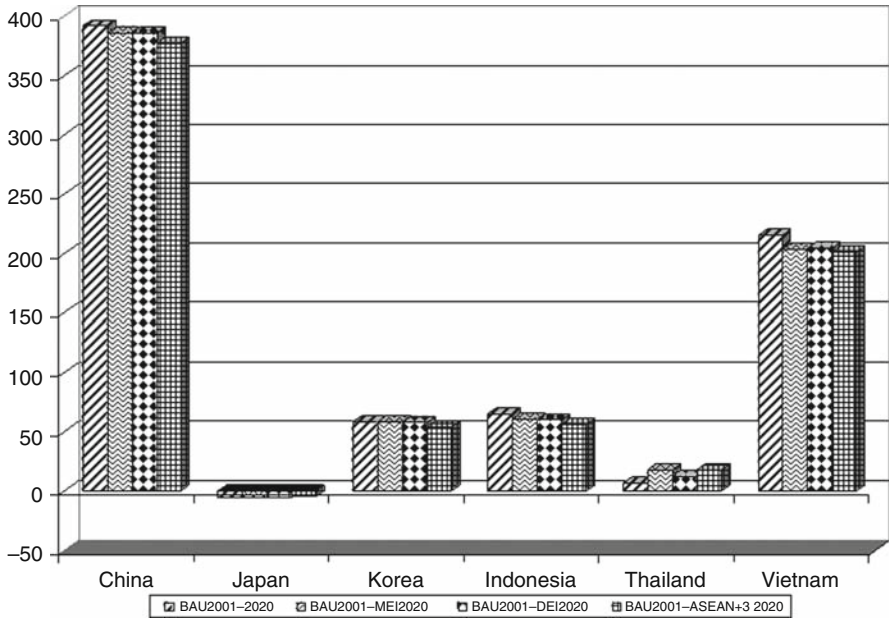

Fig. 6.3 Suspended solid growth from 2001 to 2020 in Different Scenarios (%)

Though the features of the water pollutants like BOD, COD and SS are almost same, it is expected that growth of these pollutants will also be similar. But we receive a mixed growth pattern across the countries except Japan (which shows negative for the three water pollutants). Due to trade liberalization some pollutants are getting increased from the BAU 2020 level for some countries. Among them Suspended Solid is for Thailand and COD for Indonesia and Vietnam. For BOD on the other hand, significant increment is not observed for most countries under trade liberalization scenarios compared to BAU 2020.

6.2.3 Industrial Waste

Industrial waste is increasingly becoming a major environmental problem in both developing and developed world, especially in our study area. As a result of trade liberalization in this region, industrial waste would likely to increase. Figure 6.4 depicts the growth of the industrial waste of the six countries (detail in Chapter 4) during 2001−2020 under BAU and various trade liberalization scenarios.

The growth of the industrial waste is highest for China and least for Japan among the six countries under the study. The rising trend of industrial waste growth is noted for all the six countries under various trade scenarios compared to BAU 2020.

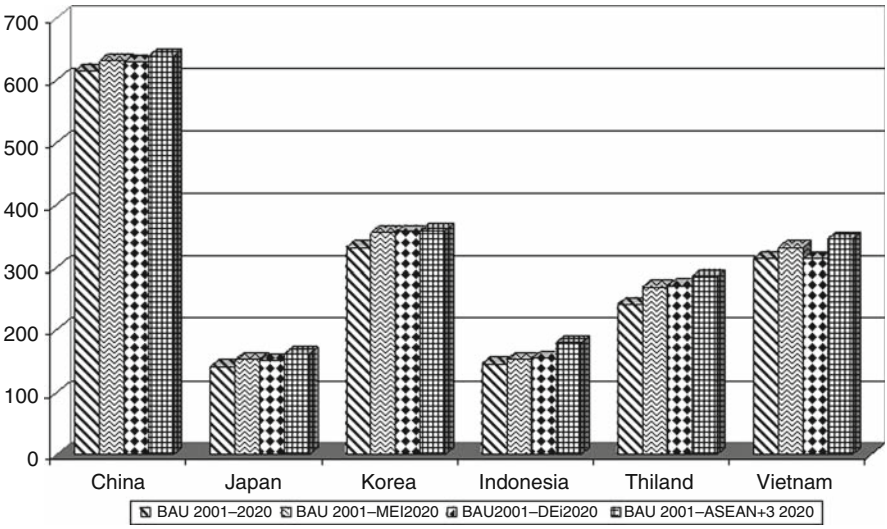

Fig. 6.4 Industrial waste growth from 2001 to 2020 in Different Scenarios (%)

If we evaluate the total seven pollutants including air, water and industrial waste it is observed that China is leading in BAU for all the pollutants (except N_2O), but trade liberalization does not show any additional impact on the country's emission (except industrial waste).

On the other hand, Vietnam and Indonesia will rank second and third in BAU. And in these two countries emission is likely to increase further due to trade liberalization for most of the pollutants (primarily CO_2). Overall, for Korea and Japan, the two developed countries of the study area, emission growth is reasonable (except industrial waste). Thailand provides a mixed outcome. The emission growth of CO_2, SS and Industrial waste is expected to increase while growth of the other environmental indicators tends to decline in trade liberalization scenarios.

The growth rate of each environmental indicator varies by country, economic integration scenario, and the BAU. Among all the environmental indicators, the CH_4 is likely to have the most significant response to the different trade scenarios compared to the BAU scenario. The other environmental indicators show relatively insignificant changes in the economic integration scenarios compared to BAU scenario. The overall change in the environmental indicators depends on the sectoral performance of a particular country. The environmental indicators varied by sector and by country. As a result, the environmental impact of a change in industrial output of the same sector in two different countries could result differently. This can occur for several reasons including: different technology used in different countries, the age of the infrastructure, or the existing domestic regulations. Further the analysis of each of these emission growth at sectoral level is presented in the next Section 6.3.

6.3 Sectoral Analysis in BAU and Trade Scenarios

We are exploring the most important (affected) sectors[19] in case of different environmental indicators under BAU and different trade scenarios.

6.3.1 BAU Scenario

When total change in emission of seven pollutants is examined by sectors more insight emerges. The overall change depends on the sectoral performances. In this context, we need to explore the pollution intensive sectors for each indicator (CO_2, CH_4, N_2O, BOD, COD, SS and industrial waste) across the countries under study.

The sectoral rank of CO_2, CH_4, N_2O, water pollutants and industrial waste depends on the pollution intensity (environmental coefficient) and the sectoral pollution share in total volume of pollution. While the volume of pollution is influenced by the sector's output growth in different BAU scenarios—2010, 2015, and 2020 and the sectoral pollution intensity, we observed that almost same pollution intensive sectors are players in different BAU scenarios in each country till 2020.

Table 6.7 identifies the six most CO_2 intensive sectors for each country. Even though the top sectors differ across countries, the most important sectors are chemical, rubber, plastic products, and mineral products nec, ferrous metal, petroleum and coal products being major contributors to CO_2 emissions.

The rank of the emission for the sector is to some extent influenced by the country's economic structure, technological development, output growth, comparative advantage of the sectors and behaviour of economic drivers for future development.

For example, petroleum and coal products are identified as CO_2 intensive sector in ASEAN countries among top six. ASEAN is a strategic international market and a major supplier of energy and raw materials to the PPRD (The Pan Pearl River Delta region). In the first half year of 2005, the PPRD purchased finished oil, liquefied petroleum, gas and coal valued at 530, 160 and 150 million US$, respectively, from ASEAN countries (NEWSDG, 2005). This indicates the possibility of supply of energy from ASEAN countries in future.

On the other hand mineral product is identified as CO_2 intensive sector in the top six list for China, Japan and Korea, while Ferro alloys in China and Korea. As we know that China is a major supplier of mineral products and ferrous and non-ferrous metals to the world and due to trade liberalisation its export is likely to increase.

As we have seen that CO_2 emission is released from the 57 sectors but CH_4 and N_2O emission is restricted to few selected sectors. Agricultural sector and mining are the main source of CH_4 and N_2O emissions.

Of the mining sector, oil and gas production and coal production and handling are the important CH_4 contributors, while transport and stationary combustion emits N_2O.

The categories of methane emissions in different stages of production can be identified as: CH_4 emissions from oil industries involve mainly the venting and

Table 6.7 CO_2 intensive sectors for the ten countries at BAU 2020

China	Japan	Korea	Indonesia	Thailand	Vietnam	Malaysia	Philippines	Singapore	Other ASEAN
Mineral products nec	Mineral products nec	Mineral products nec	Oil	Petroleum, coal products	Metals nec	Petroleum, coal products	Mineral products nec	Petroleum, coal products	Petroleum, coal products
Ferrous metals	Machinery and equipment nec	Chemical, rubber, plastic products	Petroleum, coal products	Mineral products nec	Manufactures nec	Mineral products nec	Oil	Gas	Chemical, rubber, plastic products
Chemical, rubber, plastic products	Paper products, publishing	Ferrous metal	Machinery and equipment nec	Machinery and equipment nec	Petroleum, coal products	Ferrous metal	Petroleum, coal products	Chemical, rubber, plastic products	Mineral products nec
Coal	Chemical, rubber, plastic products	Textile	Manufactures nec	Forestry	Mineral products nec	Manufactures nec	Fishing	Electronic equipment	Ferrous metals
Oil	Metals nec	Fishing	Ferrous metals	Chemical, rubber, plastic products	Electronic equipment	Electronic equipment	Ferrous metals	Mineral products nec	Ferrous metals
Machinery and equipment nec	Fishing	Paper products, publishing	Electronic equipment	Minerals nec	Paper products, publishing				

Source: Results from the study.

flaring of the associated gas from oil production; CH_4 emissions from gas industries are mostly from gas production and gas transportation; CH_4 emissions from coal production and handling-it may be underground and surface coal production. Methane is released mostly as by-product of coal production, whose quantity depends on many factors. Methane is emitted as well during handling, preparation, storage, transportation and end-use, but generally these emissions are small (less than 10% of total methane emissions from coal production). Generally, methane emissions are distinguished between underground and surface mining. Approximately 90% of emissions of this category are due to underground mining activities.

In agriculture, CH_4 emissions arise principally as a by-product of the digestion of feedstuffs by farm animals via a process known as enteric fermentation. So it is expected that the agriculture based economy is likely to emit more CH_4. N_2O emission is primarily released from sectors based on agriculture and transport. It is completely dominated by those arising from nitrogen (N) in animal wastes and synthetic fertilisers deposited on to agricultural soils. There are two principal sources of nitrogen (N) substrate in grazed pastoral systems; recycled dietary N and applied synthetic fertilisers. Ruminants are relatively poor converters of ingested dietary N into products, and the retention of N in meat, wool or milk ranges from 3 to 25% of the N ingested (Whitehead, 1995). As a result, large quantities of N are recycled via excreta deposited directly onto pastures by grazing livestock. The relative importance of these two sources of N substrate to nitrous oxide production is likely to vary markedly from country to country (MAF, 2004). Besides that transport and stationary combustion are also important emitters of N_2O emission.

The results show that livestock is the main CH_4 emitter in Japan and Korea. Apart from that gas sector and underground mining activities are also responsible for this emission growth in Japan. The important sectors for CH_4 emissions by country are given in Table 6.8. Paddy rice, and animal products are found to be important across the countries for CH_4 emission.

The important sectors for N_2O emissions are given in Table 6.9. Vegetables, fruits and nuts and transport nec are the two common sectors considered as important N_2O emitting sectors almost for all the countries. In particular, transport nec is found to be the top ranked sector in Japan, Korea, and Vietnam during the BAU 2020 scenario while livestock product is a major contributor of N_2O among other ASEAN countries.

BOD emissions are assumed to be determined by the quantity of waste water. BOD provides information on the biologically-convertible proportion of the organic content of a sample of water. This leads to the consideration of these materials in terms of their susceptibility to oxidation by the use of oxygen. BOD indicates how discharges to water bodies deplete their oxygen levels, and is widely accepted as a broad measure of water pollution. A high BOD indicates a high content of easily degradable, organic material in the sample.

BOD values are generally determined and evaluated in association with other parameters (e.g., COD) and this makes them more useful in formulating predictions. BOD detects only the destructible proportion of organic substances and as a general

Table 6.8 CH_4 intensive sectors for the eight countries at BAU, 2020

China	Japan	Korea	Indonesia	Thailand	Vietnam	Philippines	Singapore
Coal	Paddy rice	Paddy rice	Animal products nec	Bovine cattle, sheep and goats, horses	Paddy rice	Paddy rice	Animal Products
Paddy rice	Animal products	Animal products	Bovine cattle, sheep and goats, horses	Paddy rice	Gas	Animal Products	Gas
Animal products	Coal	raw milk	Paddy rice	Sugar cane, sugar beet	Animal products nec	Bovine cattle	Bovine cattle
Cereal grains	Raw milk	Coal	Cereal grains	Gas	Sugar cane, sugar beet	Cereal Grains	Oil
Gas	Gas	Bovine cattle, sheep and goats, horses	Gas	Animal products nec	Raw milk	Sugar cane and sugar beet	Raw Milk

Source: Results from the study.

Table 6.9 N_2O intensive sectors for the eight countries at BAU 2020

China	Japan	Korea	Indonesia	Thailand	Vietnam	Philippines	Singapore
Crops nec	Transport nec	Transport nec	Paddy rice	Sugar cane, sugar beet	Transport nec	Vegetables, fruit, nuts	Chemical rubber and plastic
Paddy rice	Chemical rubber and plastic	Chemical rubber and plastic	Cereal grains	Bovine cattle, sheep and goats, horses	Sugar cane, sugar beet	Paddy rice	Transport nec
Transport nec	Animal products	Animal products	Vegetable fruits and nuts	Plant-based fibers	Animal products nec	Animal Products	Cops nec
Vegetable fruits and nuts	Raw milk	Raw milk	Transport nec	Transport nec	Crops nec	Cereal grains nec	Vegetables, fruit, nuts
Cereal grains nec	Vegetable fruits and nuts	Paddy rice	Plant based fibre	Paddy rice	Vegetables, fruit, nuts	Sugar cane and sugar beet	Animal products
Plant-based fibers	Paddy rice	Vegetable fruits and nuts	Animal products	Vegetables, fruit, nuts	Paddy rice	Cops nec	Bovine cattle

Source: Results from the study.

Table 6.10 BOD intensive sectors for the six countries, BAU 2020

China	Japan	Korea	Indonesia	Thailand	Vietnam
Textiles	Chemical, rubber, plastic products	Animal products nec	Leather products	Animal products nec	Fishing
Food products nec	Ferrous metals	Bovine cattle, sheep and goats, horses	Wood products	Food products nec	Sugar
Vegetable oils and fats	Petroleum and coal tar products	Paper products, publishing	Bovine cattle, sheep and goats, horses	Gas	Chemical, rubber, plastic products
Chemical, rubber, plastic products	Wearing apparel	Textiles	Vegetable oils and fats	Bovine cattle, sheep and goats, horses	Textile
Animal products nec	Paper products, publishing	Chemical, rubber, plastic products	Textiles	Crops nec	Leather products
Electronic equipment	Bovine cattle, sheep and goats, horses	Ferrous metals	Beverages and tobacco products	Wool, silk-worm cocoons	Manufacturing nec

Source: Results from the study.

principle is therefore lower than the COD value, which also includes inorganic materials and those materials which cannot be biologically oxidized.

The most important sectors for BOD emissions differed by country (Table 6.10). It is found that the most common sectors that release BOD include textiles; Bovine cattle, sheep and goats, horses; animal products nec; and chemical, rubber, plastic products; and paper and pulp across the countries investigated (three ASEAN and CJK). Sugar appears only for Vietnam while paper and paper products for Korea and Japan. Textile is the most important sector for China, the Republic of Korea, Vietnam and Indonesia while wool silk cocoons and wearing apparel are important BOD intensive sectors for Thailand and Japan respectively.

The presence of agricultural and industrial sectors is in the top six COD intensive sectors across the countries (except Vietnam). The leading sectors in agriculture are animal products nec; bovine cattle, sheep and goat, horses; vegetable fruits and nuts; while chemical rubber and plastic sector is primarily dominating for all the countries (Table 6.11).

Suspended solids refer to small solid particles which remain in suspension in water as a colloid or due to the motion of the water. It is used as an indicator to measure water quality. Suspended solids are important as pollutants and pathogens

Table 6.11 COD intensive sectors for the six countries, BAU 2020

China	Japan	Korea	Indonesia	Thailand	Vietnam
Pulp and paper industries	Paddy rice	Forestry	Chemical, rubber, plastic products	Textiles	Manufactures nec
Chemical, rubber, plastic products	Bovine cattle, sheep and goats, horses	Paddy rice	Leather products	Electronic equipment	Chemical, rubber, plastic products
Food products	Chemical, rubber, plastic products	Bovine cattle, sheep and goats, horses	Wood products	Paddy rice	Oil
Beverages and Tobacco	Animal products nec	Vegetables, fruit, nuts	Vegetable oils and fats	Chemical, rubber, plastic products	Beverages and tobacco products
Textile	Crops nec	Crops nec	Animal products	Motor vehicles and parts	Mineral products nec
Ferrous metal	Vegetables, fruit, nuts	Animal products nec	Meat products nec	Crops nec	Transport equipment nec

Source: Results from the study.

are carried on the surface of particles. The smaller the particle size, the greater the surface area per unit mass of particle, and so the greater the pollutant load that is likely to be carried. Textile, chemical, leather, pulp and paper and mining are the important contributors of suspended solids. These sectors appear in the list of top six sectors for some countries (Table 6.12).

The waste discharges are normally from the mining, smelting and energy industries. These discharges are typically in the form of liquid effluent, solid waste and air emissions. It is well known that the industrial waste prone sectors are pulp and paper, petroleum products, construction industry, petroleum refinery and fertilizer, electronic equipment, motor vehicle and parts, different metal industries and minerals. Table 6.13 shows that Korea's top sectors for industrial waste are quite different from those of other five countries. Metal products, minerals and transport sector belong to the top in this respect. On the other hand Ferrous metal, electronic equipment, and Chemical rubber and plastics are found to be common for China, and Thailand; paper products and publishing is common for Japan, Indonesia and Vietnam; Petroleum, coal products is for Indonesia, Thailand and Vietnam. Already it is observed that these industrial waste prone sectors are found to be common in the top ranking sector of output and export and likely to dominate in different trade scenarios at 2020.

Table 6.12 Suspended solid intensive sectors for the six countries, BAU 2020

China	Japan	Korea	Indonesia	Thailand	Vietnam
Paper products, publishing	Chemical, rubber, plastic products	Forestry	Bovine cattle, sheep and goats, horses	Chemical, rubber, plastic products	Manufactures nec
Chemical, rubber, plastic products	Ferrous metals	Vegetables, fruit, nuts	Leather products	Textiles	Fishing
Ferrous metals	Petroleum, coal products	Paddy rice	Chemical, rubber, plastic products	Paper products, publishing	Chemical, rubber, plastic products
Minerals nec	Bovine cattle, sheep and goats, horses	Crops nec	Textiles	Electronic equipment	Oil
Food products nec	Wearing apparel	Bovine cattle, sheep and goats, horses	Raw milk	Beverages and tobacco products	Beverages and tobacco products
Beverages and tobacco products	Paper products, publishing	Animal products	Animal products nec	Food products nec	Mineral products nec

Source: Results from the study.

Table 6.13 Industrial waste intensive sectors for the six countries, BAU 2020

China	Japan	Korea	Indonesia	Thailand	Vietnam
Minerals nec	Ferrous metals	Mineral products nec	Motor vehicles and parts	Petroleum, coal products	Paper products, publishing
Ferrous metals	Paper products, publishing	Metal products	Paper products, publishing	Ferrous metals	Vegetable oils and fats
Chemical, rubber, plastic products	Chemical, rubber, plastic products	metal nec	Petroleum, coal products	Electronic equipment	Mineral products nec
Metals nec	Minerals nec	Transport nec	Metals nec	Metal products	Petroleum, coal products
Mineral products nec		Construction	Wood products	Manufactures nec	Metals nec
Electronic equipment			Metal products	Chemical, rubber, plastic products	

Source: Results from the study.

6.3.2 Trade Liberalization Scenarios

Now let us see which sectors are relatively sensitive to trade liberalization scenarios. As we have seen that the growth rate of each pollutant is not the same in the trade liberalization scenarios and BAU. Among three GHG indicators CO_2 responded strongly under the different trade scenarios compared to BAU. But other indicators have shown relatively moderate response in trade agreement scenarios. Due to trade liberalization some sectors reduce and other sectors increase their output level. Some sectors are sensitive for some environment indicator in one country, but the same will not hold for the other country.

The volume of CO_2 emission for some sectors increased during the trade agreement scenarios. Here we identify the sectors which responded significantly in each scenario (Table 6.14). And also we like to see how far the ranking of the sectors in BAU scenario prevails in the trade liberalization scenarios. For CH_4 and N_2O, similar sectors are found to dominate in each trade liberalization scenario across the countries but for CO_2 the variation is noted for some countries. For China, the Gas sector replaces manufacturing equipment in the top six sectors list in ASEAN+3 integration along with other common sectors identified in BAU scenarios. For Japan and Indonesia, no as such changes are observed. Three new sectors—motor vehicle, transport equipment, and food products are added in the top six sectors' list in the Republic of Korea in ASEAN+3 scenario at 2020. For Thailand and Vietnam, sugarcane and sugar beet sector entered in the top six sectors' list in ASEAN+3 at 2020.

These sectoral rankings in trade liberalization scenarios and business as usual differ due to the following reason. The increase in sectoral output may push up the ranking of the sectors for each pollutant. This will happen due to the rise in demand for a particular sector in the region under a RTA. For example, Sugar cane and sugar beet is likely to be produced more by Thailand, Vietnam, and so also the generation of CO_2 emission under ASEAN+3 integration at 2020. For Malaysia, wood products sector is expected to be important emitter. Motor vehicle sector is likely to create more emission in Philippines and Other ASEAN in ASEAN+3 integration. The output growth of these sectors may drive up the emission for these economies. Singapore maintains almost the same sectors in BAU and trade integration scenarios except machinery and equipment (ASEAN+3 2020) instead of electronic equipment (BAU 2020).

The sectoral ranking for ASEAN+3 at 2020 and BAU 2020 for the environmental indicators is likely to be influenced by the sectoral share in total emission. If the share is high, the sector will have a higher rank. We have already seen that the sectoral ranking of CO_2 differs in BAU 2020 and ASEAN+3 2020. But the highest percentage change in emission across the sectors for different pollutants in trade liberalization scenarios compared to BAU 2020 is worth checking in this context. From Table 6.14, it has been observed that few sectors for some countries differ in ASEAN+3 integration at 2020 compared to BAU 2020 in the top sectors' rank list.

Here an attempt has been made to identify the sectors with highest percentage changes in emission in ASEAN+3 at 2020 compared to BAU 2020.

Table 6.14 CO_2 intensive sectors for the ten countries at ASEAN+3, 2020

China	Japan	Korea	Indonesia	Thailand	Vietnam	Malaysia	Philippines	Singapore	Other ASEAN
Coal	Mineral products nec	Mineral products nec	Oil	Petroleum, coal products	Metals nec	Machinery and equipment nec	Petroleum, coal products	Gas	Motor vehicle and parts
Oil	Machinery and equipment nec	Textile	Petroleum, coal products	Machinery and equipment nec	Manufactures nec	Petroleum, coal products	Ferrous metal	Petroleum, coal products	Petroleum, coal products
Gas	Paper products, publishing	Motor vehicle	Machinery and equipment nec	Mineral products nec	Petroleum, coal products	Mineral products nec	Paper products, publishing	Mineral products nec	Manufactures nec
Mineral products nec	Chemical, rubber, plastic products	Transport equipment	Manufactures nec	Forestry	Paper products, publishing	Minerals nec	Motor vehicles and parts	Chemical, rubber, plastic products	Ferrous metals
Ferrous metals	Fishing	Fishing	Ferrous metals	Sugar cane and sugar beet	Chemical, rubber, plastic products	Wood products	Sugarcane and sugar beet	Machinery and equipment nec	Paper products, publishing
Chemical, rubber, plastic products	Metals nec	Food products	Electronic equipment	Chemical, rubber, plastic products	Sugar cane and sugar beet				

Source: Results from the study.

In China, 31% increase in CO_2 emission is expected from sugar sector, 18% from electronic equipment, 9% from gas sector and 6% from wearing apparel, respectively. So the gas is the common sector that falls under the top six sectors' rank in ASEAN+3 2020 and also contributes highest emission in China due to tariff reduction. Though the sectors like electronic and wearing apparel do not appear in top six sectors' rank but it is expected to emit more emission in ASEAN+3 integration. Similarly for Japan and the Republic of Korea where metal nec and motor vehicle are common in both BAU and integration scenario responsible for highest CO_2 emission. Metal nec (9.97%), meat products (7.98%) and ferrous metal (7.15%) are likely to add CO_2 emission in Japan. While for the Republic of Korea the sectors are leather products, metal nec and motor vehicles, which may increase the CO_2 emission. For Indonesia, chemical rubber and plastic, manufacturing equipment, electronic equipment and textile and for Philippines only motor vehicle sector are the leading contributor of CO_2 emission at ASEAN+3 2020 compared to BAU 2020. For Thailand, sugar cane and beet, sugar, transport equipment and chemical rubber and plastic are expected to increase the volume of CO_2 emission at ASEAN+3 2020 scenarios compared to BAU 2020 (Table 6.15). The principle sectors for Vietnam are chemical rubber and plastic, textile, wearing apparel and wood products. For the other economies like Singapore, Malaysia, and Other ASEAN, sectoral variation is observed.

These CO_2 intensive sectors will help us to evaluate the environmental performance of the economy, how it would be if the economic integration materialises. Further, the sectors that will be major actors in the country's economy in 2020 throw some light on the development pattern of the country's economy under free trade. The question here is whether at all Japan and the Republic of Korea push the ASEAN economy away from agriculture to non agriculture/emerging economies through the economic integration. The developed economies might be influencing the neighbouring nations through various tariff reforms. For example, sugar cane and sugar beet is an agricultural commodity. Apart from traditional use, this sector

Table 6.15 Sectoral CO_2 growth in ASEAN+3 integration at 2020 compared to BAU 2020 (%)

Sector	China	Sector	Japan	Sector	Korea	Sector	Indonesia	Sector	Thailand
24 sug	30.96	36 nfm	9.973	29 lea	39.01	33 crp	24.16	24 sug	17.307
40 ele	18.26	20 omt	7.98	36 nfm	18.64	40 ele	20.67	6 c_b	13.56
17 gas	8.96	35 i_s	7.15	38 mvh	10.82	41 ome	19.82	39 otn	10.65
28 wap	5.77					27 tex	19.03	33 crp	7.29

	Malaysia		Philippines		Singapore		Vietnam		Other ASEAN
27 tex	53.34	3 8mvh	59.45	24 sug	62.45	33 crp	45.00	9 ctl	14.43
28 wap	43.98	41 ome	42.65	20 omt	43.94	28 wap	32.54	8 ocr	9.87
29 lea	35.65	33 crp	39.30	23 pcr	41.65	27 tex	16.28		
21 vol	29.56	28 wap	29.84	26 b_t	35.77	29 wap	12.06		

Source: Results from the study.

can be used as bio-fuel and exported to the neighbouring region. Through the economic integration the demand for this commodity would likely to be enhanced in Thailand and Vietnam.

It has been observed that few selected sectors are releasing CH_4 emission and these sectors are almost similar in BAU and trade liberalisation scenario (Table 6.16).

It has been observed that sectors which generate BOD and COD in BAU and trade scenarios are mostly common for some countries as identified in Tables 6.17 and 6.18.

For industrial waste, the identified sectors in the BAU 2020 continue to be important in the trade scenarios across the countries. The electronic equipment is expected to generate more waste in Thailand and China, while metal and minerals are likely to add more waste in Japan and Republic of Korea in ASEAN+3 2020 (Table 6.19). For Vietnam, chemical rubber and plastic and textile are likely to add more waste in the country in ASEAN+3, 2020.

Due to trade liberalization some sectors increase their output level so also emission and other sectors reduce. Some sectors are sensitive for some pollutant in one country, but the same does not hold for the other country. Among three GHG indicators, CO_2 responded strongly under the different trade scenarios compared to BAU. But other GHG indicators responded moderately in trade agreement scenarios.

Water pollution would likely to increase in some ASEAN countries but industrial waste in all the countries under RTAs.

Increase in emissions offsets the reduction in emissions for some sectors in China, Japan and the Republic of Korea so the environmental impact will not be unfavourable except industrial waste tariff reduction under different scenarios. For the rest of the countries the environmental impact will not be too encouraging especially for Vietnam and Indonesia (except BOD) due to trade liberalization. Thailand shows a mixed result, however.

Many environmental groups would claim that adverse resource depletion and environmental degradation effects of trade policy reforms will be substantial, but very few empirical studies have sought to investigate this (Chapter 2). On environmental degradation, the following section suggests a way to examine the factors responsible for changes in pollution. Changes in the scale of output, in tastes, in the relative size of sectors, and in inputs and production technologies associated with economic growth and market reform would likely to affect the level of pollution.

Table 6.16 CH_4 growth in ASEAN+3 integration at 2020 compared to BAU 2020 (%)

China		Japan		Korea		Indonesia		Thailand		Vietnam	
17 gas	8.96	1 pdr	32.24	1 pdr	24.39	6 c_b	2.51	6 c_b	13.56	1pdr	4.65
6 c_b	3.57	17 gas	1.11	6 c_b	2.69					9ctl	2.11
3 gro	3.13	16 oil	0.43								

Source: Results from the study.

Table 6.17 BOD growth in ASEAN+3 integration at 2020 compared to BAU 2020 (%)

Sectors	China	Sectors	Japan	Sectors	Korea	Sectors	Indonesia	Sectors	Thailand	Sectors	Vietnam
24 sug	30.96	36 nfm	9.97	29 lea	39.01	33 crp	24.16	24 sug	69.30	21 vol	96.03
40 ele	18.26	35 i_s	7.15	36 nfm	18.64	27 tex	19.03	33 crp	57.29	33 crp	44.23
28 wap	5.77	34 nmm	3.17			30 lum	6.80	35 i_s	10.23	28 wap	39.54
										27 tex	16.28
										29 lea	12.06

Source: Results from the study.

Table 6.18 COD growth in ASEAN+3 integration at 2020 compared to BAU 2020 (%)

China		Thailand	
Wearing apparel	5.77	Electronic equipment	43.98
Indonesia		CRP	57.29
CRP	24.8	Motor vehicle	7.39
Wood prod	6.8	Korea	
Japan		Paddy rice	24.39
Paddy rice	32	Vietnam	
		Beverages and tobacco	49.77

Source: Results from the study.

6.4 Decomposition Analysis

To understand further the different factors that might have contributed to the environmental effects of growth and structural changes in ASEAN countries and CJK, a decomposition analysis has been attempted. The environmental effects of trade policy changes across the environmental indicators can be explained by the scale (the change in the level of aggregate economic activity), composition (the change in the contribution of each sector to output), and technology effect (the change in production technology) (Strutt & Anderson, 2000). The decomposition developed here is similar to the 'scale', 'composition' and 'technique' effects of income growth on the level of environmental emissions discussed by Dean (1996, 1998) and Beghin, Dessus, Roland-Holst, and Van der Mennsbrugghe (1997), Beghin, Bowland, Dessus, Roland-Holst, and Van der Mennsbrugghe (1998).

This decomposition analysis is useful for finding the causes of changes in environmental impact.

6.4.1 Methodology of Decomposition Analysis

Following Strutt and Anderson (2000), the total change in pollution (P) can be defined as the sum of the changes in pollution in each sector (P_j):

$$P = \sum_{j=1}^{n} P_j$$

The change in pollution in each sector j is the sum of the aggregate activity effect (Ajo), the intersectoral composition effect (Cjo), and the technology effect (T_j). Thus,

$$P_j = Ajo + Cjo + Tj$$

Table 6.19 Industrial waste growth in ASEAN+3 integration at 2020 compared to BAU 2020 (%)

China		Japan		Thailand		Vietnam		Indonesia		Korea	
Mineral products nec	2.08	Ferrous metal	7.15	Electronic equipment	43.98	Chemical, rubber, plastic products	32.00	Vegetable oils and fats	96.22	Metal nec	18.64
Oil	0.49	CRP	2.28	Ferrous metal	10.23	Wearing apparel	29.54				
Electronic equipment	18.26	Mineral products nec	3.17			Textiles	16.28				
						Leather products	12.06				

Source: Results from the study.

Activity Effect

In the aggregate activity effect, increased economic activity results in increased demand for all goods and services and therefore increased emissions. The change in output due to the aggregate activity effect is the proportional change in aggregate real output in the economy (w) multiplied by the initial output in each sector (X_j). From this we get the change in the scale of output in each sector with all sectors growing at the aggregate growth rate of the economy. The change in the scale of output in each sector is then multiplied by the initial environmental coefficient for each sector (Eoj). This will provide the change in environmental emissions in each sector due to the aggregate activity effect.

This can be written as

$$Ajo = X_j \times w \times Eoj$$

Composition Effect

Because some sectors are more polluting than others, changes in the composition of output will change pollution, even if aggregate output does not change. The intersectoral effect is measured by allowing the composition of output to change while maintaining aggregate output at its initial level. Some sectors contract while others do expand. The change in sectoral output due to the intersectoral composition effect is obtained by multiplying the initial output in each sector by the difference between the proportional change in output in that sector (x_j) and the aggregate proportional change in output in the economy (w) to provide the change in the relative size of each sector. This change in the contribution of each sector is then multiplied by the initial environmental coefficient for each sector so that we can get sector's change in environmental emissions due to the intersectoral composition effect. This can be expressed as

$$Cjo = X_j \times (x_j - w) \times Ejo$$

Technology Effect

The technology effect is modeled using past behaviour of the environmental parameters and also considering anticipated changes in production methods. Changes in technology will change the amount of degradation caused by each unit of output in each sector. Total emissions with the new coefficients are then compared to total emissions with the old environmental coefficients in place. This effect can be written as

$$T_j = \{(Ajn - Ajo) + (Cjn - Cjo)\} + \{X_i \times (Ejn - Ejo)\}$$

where

$$Ajn = X_j \times w \times Ejn$$

and

$$Cjn = X_j \times (x_j - w) \times Ejn$$

The first square bracketed term of the above equation reflects the new environmental coefficient (*Ejn*) applied to both the aggregate activity and the intersectoral composition components of changes in output. The second square bracketed part of the equation reflects the idea that the initial output in each sector will also be produced using the new technology and will therefore contribute to a change in emissions.

However, for policy changes such as trade reforms where we start from the appropriate updated database, it is assumed that the new technology is in place and that the trade liberalization itself does not change the environmental coefficients (Strutt & Anderson, 2000).

Here we analyse the decomposition of the GHG emissions (CO_2, CH_4, and N_2O) and BOD effects to give a more precise indication of the relative magnitudes of the aggregate activity, the intersectoral composition and the technology effects. As we know that, the aggregate output effect increases each sector's output, while the technology and intersectoral composition effects may add to or dampen the impact of increased aggregate output on emissions.

6.4.2 GHG Indicators at BAU 2020

The decomposition of air pollution suggests that the aggregate activity effect is the main driving force behind the increase in projected emissions. But the intersectoral composition effects of structural change add to that effect for some GHG indicators across the countries. This is because there is a relatively high increase in the contribution to output of high air polluting sectors such as electricity, chemical rubber and plastic, manufacturing and transport sector.

While the aggregate activity effect, and to a much lesser extent the intersectoral composition effect, increase air pollution in 2020, many sectors' emissions of carbon, methane and nitrogen dioxide grow less rapidly than output because of improvements in energy efficiency. This is shown by the technology effect which is negative in China, Japan, Republic of Korea, Singapore and Vietnam for CO_2 and NO_2; and Japan and Republic of Korea for CH_4. This reflects that the improved technologies are expected to become available in 2020. On the other hand, for rest of the countries, the positive sign on technology effect over the period implies that technological improvement would not be possible for the CO_2 and other GHG indicators (Tables 6.20, 6.21, 6.22).

Table 6.20 Decomposition effect of CO_2, BAU 2020 (Gg)

BAU 2020	Activity effect	Composition effect	Technology effect	Total changes
China	12035458	−172787	−3231209	8631462
Japan	428251.6	8911.385	−225601	211562.4
Korea	523823.3	−65246.4	−183865	274712.3
Indonesia	482134	−86238.4	155058.4	550953.9
Thailand	317998.7	−88501.9	18729.61	248226.4
Vietnam	128411.8	10903.51	−22223.9	117091.4
Malaysia	178442.4	−16599.7	68293.54	230136.3
Philippines	83415.29	−5001.98	43032.77	121446.1
Singapore	71938.1	−6173.3	−26195	39570.2
Other ASEAN	21667.68	−516.364	42059.31	63210.63

Table 6.21 Decomposition effect of CH_4, BAU 2020 (Gg)

BAU 2020	Activity effect	Composition effect	Technology effect	Total change
China	170526.04	−82397.49	37905.51	126034.1
Japan	407.14	−31.77	−57.23	318.14
Korea	1246.78	−624.65	−161.92	460.217
Indonesia	15550.93	−4103.49	2629.28	14076.72
Thailand	8932.41	−6918.20	4353.01	6367.21
Vietnam	9013.10	−2795.17	2326.56	8544.48
Philippines	1268.654	−365.915	1420.442	2323.18
Singapore	13.73997	−4.40939	8.977639	18.30

Source: Results from the study.

Table 6.22 Decomposition effect of N_2O, BAU 2020 (Gg)

BAU 2020	Activity effect	Composition effect	Technology effect	Total change
China	9392.734	−4703.39	−390.82	4298.53
Japan	31.03	−1.08	−4.91	25.05
Korea	58.04	−17.55	−1.21	39.29
Indonesia	239.88	−150.75	189.28	278.41
Thailand	52.53	−38.30	18.79	33.03
Vietnam	67.163	−10.88	−24.95	31.34
Philippines	27.15	−9.91	7.80	25.04
Singapore	5.32	0.82	−1.85	4.30

Source: Results from the study.

It is important to note that for most of the developing countries and also for the Republic of Korea, composition effect is negative for the CO_2 indicator under BAU 2020. Japan and Vietnam have positive results in BAU 2020. This implies that the CO_2 intensive industries are expected to expand in Japan and Vietnam in 2020.

On the whole, the scale or activity effect is positive for all the countries in BAU, 2020.

Table 6.23 Decomposition Effect of BOD, BAU 2020 (tons)

BAU 2020	Activity effect	Composition effect	Technology effect	Total change
China	68053052	−18106465.2	−15729812	34216775
Japan	1007504	11080.2281	−1169669.8	−151085
Korea	3577600	−1534733.94	−1615555.7	427310.6
Indonesia	2553348	142550.487	−941807.02	1754091
Thailand	5548998	−2220819.14	−1470930.7	1857248
Vietnam	431891	−57154.07	−127133.5	247603.5

Source: Results from the study.

6.4.3 GHG Indicators in Trade Liberalisation Scenarios

In the trade scenarios, in which economic growth is assumed to be boosted by trade liberalization, some sectors reduce and other sectors increase their output level because of trade reforms. We therefore can expect the composition effects to be much stronger relative to the aggregate activity effects in these reform cases, in contrast to the growth and structural change scenarios. The decomposition analysis shows that the aggregate activity effect adds to air pollution (CO_2) but the change in the intersectoral composition of output reduces air pollution to some extent (Table 6.24). This phenomenon is not being observed for all the countries.

The negative composition effect is found in MEI and DEI 2020 for all the countries under study except Japan, Republic of Korea and Indonesia for CO_2 emission. But China, Thailand, Philippines, Singapore and other ASEAN show negative composition effect for ASEAN+3 at 2020 also. The rest of the countries (Japan, Korea, Indonesia, Vietnam and Malaysia) record positive composition effect under ASEAN+3 at 2020. It highlights the fact that both the developed and developing countries under the study are likely to increase CO_2 intensive industries as a result of trade liberalisation. This mixed evidence neither supports nor contradicts the pollution haven hypothesis.

The composition effect of N_2O and CH_4 is negative for all the countries in different trade scenarios (except Japan and the Republic of Korea) (Tables 6.25 and 6.26). However, the exceptions are found for Japan and the Republic of Korea under ASEAN+3 at 2020 and the Republic of Korea at DEI 2020 in case of CH_4.

6.4.4 Decomposition Effect on BOD in BAU and Trade Scenarios

It has been observed from the study that aggregate activity effect is positive for emissions of BOD (Table 6.23). However, emissions rise is significantly less than the proportional increase in total output in all the countries. This is mainly due to the improved technology assumed to be available in BAU 2020. The negative technology effect is observed for all the countries in BAU 2020. The intersectoral

Table 6.24 Decomposition effect of CO_2 under different scenarios (Gg)

MEI 2020	Activity effect	Composition effect	Total changes
China	25484.49	−104481.81	−78997.32
Japan	412.92	4313.10	4726.02
Korea	−1212.68	4648.15	3435.48
Indonesia	10064.06	6676.99	16741.04
Thailand	21455.34	−5986.61	15468.73
Vietnam	10505.08	−6371.01	4134.07
Malaysia	2828.25	−3376.51	−548.26
Philippines	1803.80	−928.39	875.41
Singapore	2496.55	−3903.18	−1406.64
Other ASEAN	102.84	−462.92	−360.08
DEI 2020			
China	24767.06	−92717.17	−67950.11
Japan	−572.84	5358.67	4785.83
Korea	906.82	6375.80	7282.62
Indonesia	15211.77	4001.85	19213.62
Thailand	31548.08	−15438.60	16109.49
Vietnam	13551.55	−7504.65	6046.90
Malaysia	8710.67	−4495.73	4214.95
Philippines	5070.42	−3040.06	2030.36
Singapore	4970.09	−8748.62	−3778.52
Other ASEAN	198.33	−1221.69	−1023.36
ASEAN+3 2020			
China	27562.96	−245810.85	−218247.90
Japan	85.85	9459.78	9545.63
Korea	1817.53	1074.11	2891.64
Indonesia	17808.21	9959.48	27767.70
Thailand	27812.88	−8804.28	19008.60
Vietnam	21884.97	4925.28	26810.26
Malaysia	12319.47	11376.04	23695.51
Philippines	4329.44	−482.24	3847.20
Singapore	3118.80	−6328.99	−3210.19
Other ASEAN	108.34	−2171.01	−2062.67

Source: Results from the study.

composition effect for BOD is positive for Indonesia and Japan due to the increased relative significance of the polluting industries in BAU 2020. But for the other countries it turns out to be negative. This was due to the fact that the technology would be improved and coefficients reduced in 2020.

The assumed technology effect offsets the aggregate activity effect for BOD in BAU 2020. The technology effect is sufficiently strong to dampen the positive aggregate activity and intersectoral effects to produce a net reduction in pollution for BOD in Japan.

For trade agreement scenarios the composition effect for BOD is positive for Japan and the Republic of Korea in MEI 2020 and DEI 2020, while it is negative for other countries. The activity effect is positive for all the countries except Japan

Table 6.25 Decomposition effect of CH_4 under different scenarios (Gg)

MEI 2020	Activity effect	Composition effect	Total changes
China	369.56	−105.98	263.58
Japan	0.44	−3.51	−3.08
Korea	−2.49	−1.57	−4.06
Indonesia	276.52	−749.85	−473.33
Thailand	570.53	−1298.45	−727.92
Vietnam	758.60	−586.49	172.11
Philippines	38.06	−135.29	−97.24
Singapore	0.60	−0.65	−0.05
DEI 2020			
China	359.16	−348.92	10.23
Japan	−0.61	−78.14	−78.75
Korea	1.86	11.48	13.35
Indonesia	417.96	−1004.96	−587.00
Thailand	838.91	−2333.73	−1494.83
Vietnam	978.59	−1025.82	−47.22
Philippines	106.98	−384.12	−277.14
Singapore	1.19	−1.53	−0.33
ASEAN+3 2020			
China	399.70	−2468.93	−2069.23
Japan	0.09	113.25	113.34
Korea	3.73	86.01	89.74
Indonesia	489.30	−1087.32	−598.02
Thailand	739.58	−3138.12	−2398.54
Vietnam	1580.37	−1560.93	19.44
Philippines	91.34	−441.36	−350.02
Singapore	0.75	−0.91	−0.17

Source: Results from the study.

(DEI 2020) and the Republic of Korea (MEI 2020). It is also evident from the output growth in Table 5.3. The total effect shows negative for all the countries except Japan and Korea in these two scenarios (Table 6.27). For ASEAN+3 2020, the difference in the contribution of the effects have been observed. The activity is adding a little to total change in BOD in Japan, while composition effect contributes significantly to total change. But composition and activity effect are positive for Japan, Korea and Indonesia in all economic integration scenarios. The rest of the countries had negative composition effects, similar to the CO_2. This reflects that pollution intensive industries expanded in Japan, Korea and Indonesia.

Thus the decomposition analysis throws insight into the role of different factors responsible for pollution changes of the countries under the BAU and various trade scenarios. The contribution of factors on the pollution change varies across countries and scenarios.

Table 6.26 Decomposition effect of N_2O under different scenarios (Gg)

MEI 2020	Activity effect	Composition effect	Total changes
China	14.36	−23.51	−9.15
Japan	0.03	−0.07	−0.03
Republic of Korea	−0.15	−1.04	−1.19
Indonesia	5.06	−5.63	−0.57
Thailand	3.12	−5.99	−2.87
Vietnam	3.54	−1.15	2.39
Philippines	0.58	−1.52	−0.94
Singapore	0.11	0.36	0.47
DEI 2020			
China	13.96	−37.94	−23.99
Japan	−0.05	−0.24	−0.28
Republic of Korea	0.11	−0.82	−0.71
Indonesia	7.65	−16.77	−9.12
Thailand	4.59	−12.22	−7.63
Vietnam	4.57	−2.67	1.91
Philippines	1.63	−4.18	−2.54
Singapore	0.22	0.94	1.16
ASEAN+3 2020			
China	15.53	−85.04	−69.51
Japan	0.01	0.13	0.13
Republic of Korea	0.23	0.49	0.72
Indonesia	8.96	−20.16	−11.20
Thailand	4.05	−13.91	−9.86
Vietnam	7.38	−7.86	−0.48
Philippines	1.40	−4.16	−2.77
Singapore	0.14	0.65	0.78

Source: Results from the study.

Overall, the decomposition of total pollution shows that activity effects play a significant role across pollutants and among countries. The role of technology and composition effects fluctuated.

In conclusion, the values of the composition effect for different environmental indicators seem to contradict or at least not to support the pollution haven hypothesis. It is observed that the composition of the industries in the developing countries tends to become cleaner with trade liberalization while the opposite happens in the industrialized countries. Also given the MEI and DEI scenarios, Thailand benefits the most in term of negative composition effect. On the other hand, the composition effect becomes positive for Japan in case of CO_2 and BOD. However, with the adoption of trade liberalization among all countries under the ASEAN+3 scenario, results indicate that all countries benefit with increased economic growth and a slight decrease in environmental damage when compared to the BAU. This may provide a further incentive to pursue greater trade liberalization among the countries in the study.

Table 6.27 Decomposition effect of BOD under different scenarios (tons)

MEI 2020	Activity effect	Composition effect	Total changes
China	111007.79	−257116.87	−146109.08
Japan	721.24	9151.31	9872.55
Korea	−5306.15	48264.37	42958.22
Indonesia	38148.14	−61776.72	−23628.58
Thailand	243008.61	−698806.65	−455798.04
Vietnam	25796.39	−40308.83	−14512.44
DEI 2020			
China	107882.71	−309220.77	−201338.06
Japan	−1000.57	12933.05	11932.48
Korea	3967.86	21063.23	25031.10
Indonesia	57660.69	−67885.80	−10225.11
Thailand	357321.55	−816574.58	−459253.02
Vietnam	33277.34	−46347.10	−13069.77
ASEAN+3 2020			
China	120061.35	−807253.48	−687192.13
Japan	149.96	20608.09	20758.05
Korea	7952.73	−16898.67	−8945.94
Indonesia	67502.60	−131895.80	−64393.20
Thailand	315015.69	−1257565.65	−942549.96
Vietnam	53740.99	−67458.02	−13717.03

Source: Results from the study.

Chapter 7
Strategies for Green Trade

7.1 Introduction

In Section 3.3 of Chapter 3 we have reviewed the environmental problem of the East and South East Asian countries. We also discuss the policies adopted by the respective government.

In Chapter 6, we estimate the impact of RTA scenarios on the environment among ASEAN and China, Japan and the Republic of Korea for the year 2020. The RTA scenarios developed among ASEAN and Japan, the Republic of Korea and China for 2020 reveal positive outcomes for most of the countries in terms of economic growth and welfare, but deterioration in the environment has also been noted for some countries. The environmental impact depends on the country's output growth due to trade liberalisation and technological development. Overall, the environmental impact is found to be marginal in Japan and the Republic of Korea due to the economic integration. The environmental quality is likely to decrease in other countries, however. This is particularly observed for Vietnam and Indonesia (except BOD). Thailand shows mixed results concerning the environmental impact.

East and South East Asia experienced remarkable economic growth over the last two decades or more. However, this economic progress has created serious environmental consequences (detail in Chapter 3). Market-based instruments, such as pollution charges, green taxes, tradeable permits, and penalties for the infringement of environmental regulations, are common tools to internalize externality costs into the market prices. Many Asian countries have traditionally relied on rigid command-and-control (CAC) approaches. With the poor environmental performance of such approaches and the cost and complexity associated with their implementation, more and more countries in this region are shifting from current reliance on CAC regulations to market-based policy instruments (Zhang, 2008). The added pollution charges will be imposed on polluting companies as a simple cost of doing business that can be reduced by cutting pollution. This is seen to increase not only cost effectiveness but also flexibility in complying with the set of environmental regulations. For example, some Provinces in China raised charges for SO_2 emissions from current level of 0.6 to 1.2 Yuan per kilo of pollution equivalent from July 1, 2007 (People Net, 2007; Sinanet, 2007). Economic instruments such as pollution charges increase the costs of production, and thus provide positive incentives to abate

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emissions. Inspite of good economic reasons these economic instruments do not work to their full potential, however. Normally the pollution is tolerated up to the point where the expected penalty for pollution becomes greater than the cost of controlling emissions. However, if the charges and fines are set too low as have been the case in many developing countries, many polluting firms consider their compliance costs higher than the fines, and accordingly choose to pay the fines rather than to reduce their pollution (Zhang, 2008).

Now we are turning to the discussion of the policies for the selected pollutants derived from the analysis of the findings of the study. The chapter also assesses the feasibility of the suggested policies to achieve sustainable development.

For that, the impacts of alternative environmental policy packages are estimated on the economic growth, environment and welfare of the study areas.

In order to address the environmental concerns that resulted from the economic integration a number of environmental policies are introduced into the analysis. This is done using trade related environmental policies (TREMS) and environment related trade measures (ERTM). The integration of TREMS and ERTM into the analysis is expected to achieve the objective of benefiting from the gains from trade while protecting the environment.

Several environmental policy scenarios are investigated to analyze their impact on the economy and environmental indicators. Since the scenarios are expected to be materialised at 2020, the policy implementation is also framed on 2020 scenarios. It should be mentioned that the experiment has been carried out considering only one environmental indicator, CO_2.

The policies introduced into the analysis are:

(1) A multiple sector tax is imposed across countries depending on the CO_2 emission level. This scenario is introduced for two cases—moderate and drastic, taking into account different tax rates.
(2) The electricity sector is found to be a major source of CO_2 across all the countries and indirectly responsible for other pollution intensive sectors (see note 19). Therefore, a tax on the electricity sector is introduced into the model to tackle the pollution generated directly from this sector as well as indirectly from other sectors.
(3) Finally, a tax on high polluting primary energy inputs is also introduced. This tax is applied on coal and oil as a measure to control the pollution from these inputs.

Such application of economic instruments is one way of promoting more eco efficient production and consumption which, in turn, will promote sustainable development.

7.2 Multiple Sector Tax

A set of sectors are targeted for a tax after assessing one to one correspondence between exports of the ASEAN region and Japan, China and the Republic of Korea

under the economic integration scenarios and the most pollution intensive sectors for each economy. DEI 2020 and MEI 2020 are the two economic integration scenarios that are considered for the tax implementation. Moderate and drastic measures are attempted under this strategy.

7.2.1 Assessment of Moderate Multiple Sector Tax

The weight of the tax is determined by the extra pollution (percentage increase), generating from each trade scenario compared to BAU 2020. The range of tax weights on DEI and MEI varies from 2 to 60% and varies by industrial sectors (Table 7.1).

A mixed outcome is observed from both trade scenarios (Table 7.2). The implementation of the tax is expected to reduce output in all countries marginally except the Republic of Korea. The tax is likely to decrease CO_2 in all countries except Vietnam and China under DEI scenario and Vietnam, China and Thailand under MEI scenario. It is interesting to note that welfare is likely to be improved for most of the countries in both the scenarios (MEI and DEI) except China, Indonesia and

Table 7.1 Multiple sector tax (moderate)

Countries	Sectors
China	Electronic equipment
	Gas
Japan	Ferrous metals
	Mineral products nec
Republic of Korea	Ferrous metals
	Textile
	Motor Vehicle
	Animal products
Indonesia	Machinery and equipment
	Wood products
	Electronic equipment
	Textile
Thailand	Chemical rubber and plastic
	Machinery and equipment
	Sugarcane and beet
Vietnam	Leather products
	Textile
	Transport equipment
	Chemical rubber and plastic
Malaysia	Textile
	Wearing Apparel
	Leather products
	Vegetable oils and fats
Philippines	Chemical rubber and plastic
	Wearing Apparel
	Motor vehicle
Singapore	Mineral products nec

Table 7.2 Impact of multi-sector tax (moderate) in different scenarios

Multi-Sector tax for DEI scenario						
	China	Japan	Korea	Indonesia	Thailand	Vietnam
Output Changes (mUSD)	−16753.2	−192.77	829.96	−2256.35	−1671.38	−1637.87
CO_2 reduction (Gg)	17027.34	−1651.15	−2459.02	−7796.32	−8499.44	5175.04
Welfare (mUSD)	−713.52	318.32	785.69	−459.09	899.4	1871.32
	Malaysia	Philippines	Singapore			
Output Changes (mUSD)	−1489	−1062	−545			
CO_2 reduction (Gg)	−2765	−953	−827			
Welfare (mUSD)	1806.78	−1715.82	2000.09			
Multi-Sector tax for MEI scenario						
	China	Japan	Korea	Indonesia	Thailand	Vietnam
Output Changes (mUSD)	−16911.6	−225.94	136.93	−1719.02	−694.04	−1673.02
CO_2 reduction (Gg)	17395.66	−1446.44	−2644.33	−6277.4	−5941.13	4986.88
Welfare (mUSD)	−55.72	−10.27	94.32	11.09	95.5	−509.49
	Malaysia	Philippines	Singapore			
Output Changes (mUSD)	−1356	−1178	−967			
CO_2 reduction (Gg)	−2190	−1021	−1103			
Welfare (mUSD)	5.24	78.98	−71.97			

Source: Results from the study.

the Philippines in DEI scenario and China, Vietnam, Singapore and Japan in MEI scenario.

7.2.2 Assessment of Drastic Multiple Sector Tax

In this scenario the tax rate is determined by setting the pollution target to the amount of pollution generated in the 2010 BAU scenario. Setting the volume of pollution at this level requires a much larger tax than in the previous scenario, and thus is labelled ‘drastic’. This is done for the intensive pollution industries across the countries and directed mainly at CO_2 emissions. The 2010 target is then compared with the DEI and MEI scenario. The multiple sector tax weights varied from 5 to 70% across the sectors (Table 7.3).

The results indicate that the implemented tax would likely to decrease industrial output in all countries except Japan in the DEI scenario. It is also expected to reduce CO_2 emissions across all countries (Table 7.4). For the MEI scenario, all countries would likely to have decreased industrial output with the implementation of the tax except Japan. Japan has positive output growth. The tax is expected to decrease CO_2 emissions in all countries including Japan under this scenario (Table 7.4). The

Table 7.3 Multi-sector tax (drastic)

Countries	Sectors
China	Ferrous metals
	Mineral products nec
	Gas
Japan	Textile
	Paper products
	Chemical rubber and plastic
Republic of Korea	Ferrous metals
	Textile
	Motor Vehicle
	Transport Nec
Indonesia	Machinery and equipment
	Petroleum and coal tar products
	Electronic equipment
	Oil
Thailand	Mineral products nec
	Petroleum and coal tar products
	Machinery and equipment
Vietnam	Petroleum and coal tar products
	Manufactures nec
	Metals nec
Malaysia	Petroleum and coal tar products
	Mineral Products Nec
	Wood products
Philippines	Motor vehicle
	Ferrous metal
Singapore	Petroleum and coal tar products
	Mineral Products Nec

welfare is expected to reduce in China, Indonesia and Vietnam. But the rest of the countries will increase marginally in DEI scenario. In MEI scenario, all the countries will reduce welfare except Japan, Thailand and Singapore.

7.3 Tax on Electricity

Another policy option is to implement a tax that would bring the CO_2 emissions of the electricity sector to 2010 level. Different tax weights (e.g. China 48%, Japan 5.5%) are implemented on electricity across the countries on the basis of the percentage changes in the volume of pollution compared to BAU 2010. This experiment is applied to both DEI and MEI scenarios. The results of the experiment are reported in Table 7.5.

Though the output reduced marginally for the sector itself and total output for almost all the countries, it reduced CO_2 emissions substantially, especially in China and Japan under both the scenario. However, there is no change observed for the electricity sector in Indonesia, but total output increased along with a CO_2 reduction under DEI scenario. For Thailand, a marginal decline in CO_2 emission in the

Table 7.4 Impact of multi-sector tax (drastic) in different scenarios

Multi-sector tax for DEI scenario 2020 based on 2010 emissions						
	China	Japan	Korea	Indonesia	Thailand	Vietnam
Output changes (mUSD)	−9481.32	5045.51	−10141.3	−12340.6	−4612.57	−874.95
CO_2 Changes (Gg)	−8359.75	−6271.7	−36726.5	−95058.2	−71187.4	−32762
Welfare (mUSD)	−295.54	73.4	70.03	−61.14	4.17	−39.24
	Malaysia	Philippines	Singapore			
Output changes (mUSD)	−4907	−3745	−438			
CO_2 Changes (Gg)	−13612	−10536	−8987			
Welfare (mUSD)	0.36	1.53	10.63			
Multi-sector tax for MEI scenario 2020 based on 2010 emissions						
	China	Japan	Korea	Indonesia	Thailand	Vietnam
Output changes (mUSD)	−9480.2	5620.413	−9771.15	−11950.9	−4035.37	−831.461
CO_2 Changes (Gg)	−7255.41	−6462.92	−36247.5	−93259.1	−65975.3	−31735.2
Welfare (mUSD)	−453.6	103.2	−278.3	−591.4	10.25	−193.26
	Malaysia	Philippines	Singapore			
Output changes (mUSD)	−6034	−4076	−345			
CO_2 Changes (Gg)	−12831	−9576	−9541			
Welfare (mUSD)	−45.39	−97.33	31.22			

Source: Results from the study.

electricity sector is observed but total CO_2 emission for the country increased under both scenarios. It is interesting to note that the tax on electricity sector affects the other sectors indirectly. A marginal welfare improvement has been possible for most of the countries except China, Indonesia and Vietnam under both scenarios.

7.4 Tax on Coal and Oil

The major inputs used by the electricity sector are primarily coal and oil. Other sectors use coal and oil as inputs besides the electricity sector. A tax is implemented on coal and oil sector. For example, Thailand, the Republic of Korea and Japan used coal and gas as the major input into their electricity sector and only oil marginally. China, Malaysia and the Philippines used coal and oil, but gas only marginally. Vietnam and Indonesia are mainly using coal for the electricity sector while gas and oil marginally. Since the coal sector is already taxed in Japan and Republic of Korea these countries are not included in this tax scenario. For other countries tax weight is used similar to the electricity tax. A tax is not implemented on gas because it is a cleaner input relative to coal and oil. The results of the experiment are produced in Table 7.6.

The result from this tax scenario indicates that sectors such as coal and oil are expected to reduce their output marginally except Indonesia, Thailand and Vietnam

Table 7.5 Impact of electricity tax in different scenarios

Electricity tax on DEI						
	China	Japan	Korea	Indonesia	Thailand	Vietnam
Output changes for electricity (mUSD)	−2512.41	−563.929	6.490	0	−22.67	−9.34
CO_2 reduced (Gg)	−63293.5	−897.025	11.11	0	−75.84	−36.33
Total output changes (mUSD)	−803.626	−343.809	−77.66	18.39	−3.05	−86.22
Total CO_2 reduced (Gg)	−72518.8	−1014.91	237.44	−189.074	119.422	−870.95
Welfare (mUSD)	−302.28	103.02	98.79	−62.71	12.26	−41.3
	Malaysia	Philippines	Singapore			
Output changes for electricity (mUSD)	−91.80	−81.45	−37.64			
CO_2 reduced (Gg)	−205.23	−191.12	−127.92			
Total output changes (mUSD)	−231.66	−321.41	−134.75			
Total CO_2 reduced (Gg)	−494.33	−380.41	−298.39			
Welfare (mUSD)	8.69	1.56	10.35			
Electricity tax on MEI						
	China	Japan	Korea	Indonesia	Thailand	Vietnam
Output changes for electricity (mUSD)	−2509.72	−563.172	6.41	2.069	−12.30	−19.62
CO_2 reduced (Gg)	−63225.8	−895.822	10.98	5.75	−41.16	−76.3001
Total output changes (mUSD)	−837.957	−313.022	−31.8417	36.66	−18.52	−81.32
Total CO_2 reduced (Gg)	−72242.8	−1008.49	326.4269	−139.204	115.35	−870.357
Welfare (mUSD)	−227.31	123.33	76.77	−47.26	11.41	−28.63
	Malaysia	Philippines	Singapore			
Output changes for electricity (mUSD)	−121.80	−56.45	−23.65			
CO_2 reduced (Gg)	−185.23	−101.12	−104.10			
Total output changes (mUSD)	−262.12	−189.34	−178.23			
Total CO_2 reduced (Gg)	−394.33	−217.41	−314.19			
Welfare (mUSD)	9.37	1.13	8.08			

Source: Results from the study.

Table 7.6 Tax on coal and oil in different scenarios

Coal, oil tax on DEI						
Coal sector	China	Indonesia	Thailand	Vietnam	Malaysia	Philippines
Output changes (mUSD)	−20.222	−5.59	−0.209	−0.28	−3.325	−4.67
CO_2 changes (Gg)	−2670.85	−0.00015	−9E-05	−0.0056	−10.456	−10.953
Oil sector	China	Indonesia	Thailand	Vietnam	Malaysia	Philippines
Output changes (mUSD)	−134.487	1.512	0.046	0.566	−10.524	−9.358
CO_2 changes (Gg)	−9610.18	31.422	6.81E-05	5.13E-07	−39.309	−28.34
Total output changes	China	Indonesia	Thailand	Vietnam	Malaysia	Philippines
Output changes (mUSD)	1535.682	51.211	17.786	−32.0442	−42.36	−29.65
Total CO_2 Changes (Gg)	−14153.4	4.3712	−77.2361	−57.664	−92.42	56.71
Coal, oil tax on MEI						
Coal sector	China	Indonesia	Thailand	Vietnam	Malaysia	Philippines
Output changes (mUSD)	−19.99	−5.67	−0.25	−0.29	−9.327	−4.231
CO_2 changes (Gg)	−2640.23	−0.00015	−0.00011	−0.005	−100.23	−76.23
Oil sector	China	Indonesia	Thailand	Vietnam	Malaysia	Philippines
Output changes (mUSD)	−134.438	1.53	0.050	0.580	−23.346	−12.43
CO_2 changes (Gg)	−9606.67	31.9	7.39E-05	5.26E-07	−269.45	−136.12
Total output	China	Indonesia	Thailand	Vietnam	Malaysia	Philippines
Output changes (mUSD)	1510.748	50.85	9.66	−34.66	−61.73	−45.31
CO_2 changes (Gg)	−14118.2	0.825	−79.481	−79.66	−349.34	−196.14

Source: Results from the study.

for oil under both scenario. The total output is reduced for Vietnam, Malaysia and the Philippines under both scenarios while it has increased for other countries. CO_2 emissions are likely to be reduced significantly for China under both scenarios. This is expected to occur because China uses more coal to generate electricity than any other country under the agreement.

As we have seen from the environmental impact in Chapter 6 that CO_2 is an important pollutant, but the other pollution indicators also cannot be ignored.

7.5 Policy Option for Industrial Waste

The discussion of the results of Chapter 6 suggests that industrial waste is likely to increase in 2020 and will be a matter of concern for the East and South East Asian countries in future. Chapter 5 also reveals that waste generated sectors are expected to be prominent in BAU and various trade liberalisation scenarios at 2020. Though Japan, the Republic of Korea already implemented several industrial policies to control industrial waste (as briefed in Chapter 3), however, not reflected from the result of Chapter 6. The industrial waste management is weak in the ASEAN countries.

In this context, we can suggest few common best practices particularly for ASEAN countries to manage the effective disposal of industrial waste, to reduce the volume of waste generated, and to promote the development of waste minimization technology (ASEANSEC[20]).

The following practices can be thought of for application.

Waste disposal and collection—Provision of adequate and appropriate municipal waste disposal facilities (e.g. incineration plant, landfill) to handle the refuse generated, and a "cradle to grave" system to manage and dispose of industrial and toxic wastes and a comprehensive waste collection system.

Legislation and enforcement—Policy and prospective plan for enhancement and conservation of national environmental quality and performance-based legislation with effective and transparent enforcement system to regulate waste collectors and curb illegal dumping and open burning of waste.

Waste reduction—Adoption of disposal fees/tax based on polluter-pays principle and incorporation of costs for waste collection and disposal in a combined bill to reflect full cost of disposal and discourage excessive waste generation.

Recycling technology—National/City Recycling Programme; 3R Programme (Reduce, Reuse and Recycle) and creation of a conducive environment and market to attract a diversified scope of recycling companies (e.g. horticultural waste, food waste, paper, copper slag, construction and demolition waste, etc) in the recycling market.

Waste minimisation—Programmes/measures to encourage minimal packaging for consumer products, for e.g. to minimize excessive distribution of plastic bags, introduction of take-back scheme for certain products.

Awareness and education—Introduction of formal and informal environmental education programmes to increase awareness and inculcate environmental responsibility on waste minimisation and recycling, to implement eco-labelling as a means for encouraging green awareness and raising public awareness on the proper management and disposal of waste.

Several environmental policies are suggested and applied in the analysis. These include different environmental taxes to assess their impact on the economy and the environment. Among all the tax scenarios, the electricity tax is found to be most effective in reducing CO_2 emission for most of the countries. Thus the chapter demonstrates the possibility of the application of market based instruments in a multi regional general equilibrium framework. The chapter also outlines few policy options for industrial waste.

Chapter 8
Summary and Conclusion

'The natural benchmark for thinking about international economic integration is to consider a world in which markets for goods, services, and factors of production are perfectly integrated' (Rodrik, 1999). Economic integration among the East and South East Asian countries has been an important agenda item for the academic and policy communities in recent years.

As we have seen in Chapter 3 that most of the East and South East Asian countries have broadly similar growth pattern. The region has been bestowed with human and natural resources essential for rapid development. Many common challenges call for mutual beneficial cooperation and exchange in different fields such as economic, political, environmental, social and cultural. The financial crisis of 1997–1998 which affected these economies had made them aware of the necessity to institutionalize their cooperation and consolidation to cope with their problems (Hasmi & Lee, 2008). These economies have started to pursue trade liberalization policies, to enhance and strengthen economic cooperation for achieving economic prosperity.

Towards that direction, the current book evaluates the impacts of regional economic integration in East and South East Asian countries. In particular, the study estimates the economic and environmental impacts of trade liberalization in these countries by the year 2020 using a GTAP framework. The environmental impacts are estimated with a number of environmental indicators-air pollutants (CO_2, CH_4, and N_2O), water pollutants (BOD, COD, and SS) and industrial waste. The impact of alternative environmental policy packages is also evaluated.

The book consists of eight chapters.

Chapter 1 contains the research problem of the study. It presents a thorough overview of the regional economic integration around the world with particular attention on East and South East Asian integration.

Chapter 2 makes an extensive literature survey in the field of regional economic integration covering different frameworks attempted. The review analyzes studies related to the economic effects of RTAs and its sectoral and regional implications as well as environmental and poverty implications. To address these impacts the empirical research identifies different methods to evaluate these. One relies on a simulation approach based on global general equilibrium models to analyze the

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economic effects of policy changes due to the formation of a RTA. The other method applies econometric techniques to historical trade data and assesses the impacts of the formation of a RTA on bilateral trade flows. The review critically addresses all these literatures. The chapter continues by evaluating trade impact on the environment, particularly addressed by those studies that use the general equilibrium framework. This provides a picture of the gap on trade and environment literature using different methods in East and South East Asian countries.

The economic and environmental status of the East and South East Asian economies since the 1990s is portrayed in Chapter 3. This chapter provides the background material for the model building and the subsequent empirical experiments to trace the direction of the future development of these economies to achieve both their economic and environmental goals.

Chapter 4 describes the economic and environmental framework used in the book. The GTAP database is augmented with environmental database to produce a model that is used to evaluate the impact of economic integration in the region.

The book uses a CGE global model which includes households, industry, government and global sectors across countries. Countries and regions in the world economy are linked together through trade. Prices and quantities are determined through factor and commodity markets.

Apart from the theoretical framework, the chapter also includes detailed data description of GTAP, data for macro projections (collected from various sources), and environmental data sourced for East and South East Asian countries. The detail regional aggregation scheme of GTAP data is also presented. This aggregation includes 9 individual countries in East and South East Asia (Indonesia, Thailand, Vietnam, Malaysia, the Philippines, Singapore, China, Japan, and the Republic of Korea) and five other regions (Other ASEAN, NAFTA, Rest of OECD, ROW 1 and ROW2) in the world. Further, the chapter provides various scenarios for the regional trade agreement. The scenarios developed are based on regional scope (for example: Within ASEAN or ASEAN-CJK or ASEAN+3), timing of tariff reductions (for example: the reduction implemented at 2010 or 2015), degree of tariff reduction (for example: 80 or 100% import tariff reduction and export subsidies), and the nature of the commodities-agricultural versus non agricultural. Three major integrations have been structured on the basis of tariff reduction policy, timing of tariff and regional agreement. Deep integration (DEI) considers the early tariff reduction, while medium integration (MEI) as late tariff reduction and business as usual (BAU) is based on tariff structure in GTAP V6 of 2001.

Chapter 5 analyses the result on the economic impact of regional economic integration at 2020. The result shows that the East and South Asian economic integration would increase output growth among the participating countries in the agreement. Other countries will have a marginal negative growth. Among the participating countries, Vietnam is estimated to achieve the highest output growth followed by Thailand. The lowest positive growth is attained by Japan and the Republic of Korea. China's real output growth was not significantly affected with the different economic integration scenarios, but China would gain in all of the trade agreement scenarios. Among different regional agreement ASEAN+3 is favourable for most of the

countries under RTAs compared to the other scenarios. It reflects that if an economy moves to a higher tariff reduction scenario (e.g. a deeper trade integration scenario), output growth will increase for the participating countries, while non-agreement countries decrease industrial output growth and are losers in all scenarios. The model predicted a marginal increase in the total world exports and imports between 2001 and 2020 but a significant increase among the ten economies in the agreement when compared to BAU. This was especially true for Vietnam, Indonesia, Thailand, and Other ASEAN. It reflects that trade creation is likely to occur due to integration. Moreover, the direction of trade for member countries in each agreement under various scenarios is concentrated within the region under the agreement which predicts a trade diversion movement (i.e. trade is diverted away from non- agreement countries).

The percentage share of the top six sectors' output fluctuate depending upon the trade agreement scenarios across the countries but the sectors themselves remain more or less constant from BAU to ASEAN+3, 2020. Some new sectors have entered in the top six sectors, list due to the trade agreement scenarios compared to BAU. The top six sectors in both exports and imports are common in most cases. This is due to intra industry trade. Shares are sensitive to high tariff reduction in Thailand, Vietnam and Indonesia. In China, Japan, and the Republic of Korea, the changes in the sectoral performance of exports and imports are fairly small except for a few cases (Electrical equipment for China, Ferrous for Japan).

The gains in welfare are mainly attributed to the countries belonging to the ASEAN+3 region involved in the trade liberalization, while the rest of the regions face a loss in welfare. Yet, not all the welfare gains are distributed evenly among the ten economies involved in trade agreement. In the MEI scenario, China, Malaysia and Thailand are the countries that experience the greatest welfare increases by 2020, while the Republic of Korea faces rather a decline in total welfare. In the ASEAN+3 scenario, China, the Republic of Korea, and Thailand are the gainers by 2020. From these two scenarios, China and Thailand appear to gain the most welfare from trade liberalization in the region.

Though medium economic integration at 2020 may likely to help reduce the poverty but the ASEAN +3 agreement would not be helpful for poverty alleviation in the region.

The region specific analysis shows that Vietnam's performance is significant compared to other countries in our scenario analysis. This is also reflected from the recent ADB country report. Vietnam's economy is robust and continues to expand rapidly with GDP growth of 8.3% in 2007, and 8.5% in 2008. The country indeed has been making a good progress in its economic development and reforms. Buoyant investment and consumption pushes high economic growth. Rising investment led to a steep 30.4% increase in merchandise imports in the first half of 2007, and imports of capital goods increased by 46.5%. Imports of raw materials and intermediate goods were also strong. With regard to exports, following WTO accession, textiles and clothing rose by 25.9% in the first half of the year after the abolition of quotas, and wooden furniture exports also increased by 23% (ADB, 2007). Our current research also supports this. In the current study, wearing apparel (10.29%)

at BAU 2001 is the important export item under top six sectors' list of Vietnam. But ASEAN+3 agreement at 2020 will increase the share to 16% together with textile.

In this context we can compare our results with those of other literatures which have considered the regional integration in East and South East Asia. The current study supports Urata and Kiyota (2003), Scollay and Gilbert (2001), Lloyd and MacLaren (2004) and Thierfelder et al. (2007) in respect of gain achieved by the regions under the agreement, while the regions outside agreement are the losers. The study also supports the view of Ando and Urata (2006) and Park (2006) in respect of highest growth achieved under ASEAN+3. The current results are also in the same tune of JETRO (2003) regarding Thailand's welfare and growth. JETRO (2003) further finds that the East Asian FTA will boost the exports of IT products along with synthetic rubber and plastic and steel within the region. It also supports our results. It is observed that the composition of trade would likely to change during the course of the period (2001–2010, 2010–2015 and 2015–2020) almost for all countries under the agreement moving from agriculture and light industries towards heavy industries except Japan and Republic of Korea.

Chapter 6 of the book analyses the environmental impact of the regional economic integration. It also exercised the decomposition analysis to explore the major factors behind the changes in pollution.

The results show that a high CO_2 growth is likely to be in BAU period and different trade scenarios. Highest GHG emitters in this region will be China in BAU 2020, however, the liberalization impact will not add further to GHG emissions in China. Due to high macro growth in output, export and import, it is expected that the air pollution growth will also be high and also its technological improvement is not at the desired level to reduce emission. Other GHG indicators like CH_4 and N_2O growth are marginal in various trade scenarios across the countries compared to BAU 2020, except Vietnam. Thailand's impact is favourable relative to Vietnam at ASEAN+3, 2020. BOD growth is not unfavourable in the different economic integration. The key point to draw from these results is that the air pollution effect (particularly for CO_2) of trade liberalization is small for China, Japan and the Republic of Korea and fairly large for Vietnam, Indonesia and Thailand.

Overall, the growth of GHG indicators especially CO_2 in East and South East Asian countries is alarming. As GHG emission is transboundary in nature, the volume of pollution will likely to increase in this region by 2020. Unless any strong measures are taken, the goal of achieving Kyoto target may not be fulfilled for Japan and the Republic of Korea (Annex 1 countries).

As with air pollution, findings on BOD and SS show that trade reforms will at most add only a tiny amount to water pollution, associated with the general expansion of the economies under the study overtime. But COD will contribute relatively high due to economic integration except Japan. On the other hand, the growth of industrial waste will add a considerable amount to the environmental degradation in different scenarios at 2020 for six countries in East and South East Asia. Interesting to note that Japan and Korea will not be affected much by air pollution due to trade liberalization rather in a win-win situation. This finding implies that freer trade will

not always be environment unfriendly for most of the countries under the agreement (except industrial waste). While for Vietnam and Indonesia, the impact is not too encouraging. Further, industrial waste will be a serious concern for all the participating countries in BAU and various trade scenarios. It needs attention from the policy makers for regional economic integration. With the adoption of trade liberalization under the ASEAN+3 scenarios at 2020 we observe that most of the countries under study tend to gain environmentally (except COD and industrial waste). Overall, economic integration had a moderate impact on the environment except for a few specific sectors across countries.

The decomposition analysis of total pollution change shows that activity effects play a significant role across pollutants and countries at BAU scenario. Technology effect is negative for Japan, Republic of Korea and Singapore for the GHG indicators and Japan and Korea for BOD. For other countries under study, technology effect is negative for BOD and varies for GHG indicators. Further, composition effect is negative for all countries studied for CO_2 (except Japan, Vietnam) and BOD (except Japan, Indonesia).

An interesting result has been found for the composition effect under different trade liberalisation scenarios. The negative composition effect is shown in MEI and DEI 2020 for all the countries under study except Japan, Korea and Indonesia for CO_2 emission. But China, Thailand, Philippines, Singapore and other ASEAN show negative composition effect for ASEAN+3 at 2020 also. Rest of the countries (Japan, Korea, Indonesia, Vietnam and Malaysia) in ASEAN+3 at 2020 record a positive composition effect. It highlights the fact that both the developed and developing countries are likely to increase CO_2 intensive industries as a result of trade liberalisation. This mixed evidence neither supports nor contradicts the pollution haven hypothesis.

Chapter 7 suggests the strategies for green trade. Several environmental policies for a specific pollutant, CO_2 are applied in the analysis. These include different environmental taxes to assess their impact on the economy and the environment. Among all the tax scenarios, the electricity tax is found to be most effective-instrument for most of the countries. Thus this chapter demonstrates the possibility of the application of market based instruments in a multi regional general equilibrium framework. The chapter also outlines the policy option for industrial waste, an emerging concern for the East and South East Asian economies.

At the beginning, the book raised the issue of trade and environment debate. Now the question is at the end how far the book contributes to the debate. We have seen from the analysis that trade liberealisation is not too unfavourable for the environment especially for Japan, Republic of Korea and some ASEAN countries. Among the entire environmental indicators studied, industrial waste is a serious concern in this region. It is reflected from the increased importance of the sectors like electronic equipment, metal products, mineral, motor vehicles, chemical rubber and plastic across the countries. It has also been found that ASEAN+3 integration tends to be beneficial for the participating countries. However, it is not easy to generalize the impact of trade liberalisation on the environment covering ten ASEAN countries and China, Japan and the Republic of Korea. It is well known that the impact on the

environment depends on various factors-degrees of economic integration, features of the economy, and sensitive sectors in individual country and so on.

Thus the study provides a further insight in pursuing a concrete multilateral trade liberalization policy (combining ASEAN and other countries in East Asia) and throws more light on the ongoing trade environment debate.

The novelty of the current study lies with the comprehensive and integrated analysis of economic and environmental impacts of a regional trade agreement of East and South East Asia using a global model.

Regional economic integration has emerged as a major policy alternative for countries trying to overcome the impediment of a small domestic market. How far they will be successful by joining a regional economic integration to gain access to regional market which will enable them to face the competition from the developed countries is a matter of empirical research. The book has attempted to make a careful assessment of this through a comprehensive analysis.

The book estimates the detailed environmental implications of RTAs focusing on air, water, and waste pollution. This is rarely attempted in the literature. Further, the sector specific analysis of individual countries that include ASEAN along with China, Japan, and the Republic of Korea is minimal. Moreover, the present study provides a detailed sectoral analysis that is used to identify those sectors that had the largest impact on the environment. This approach is unique in the trade environment literature. In addition, the study also evaluated the economic and environmental impacts caused by implementing strategic environmental policies (taxes etc). Further, the study applies recursive updating process of the GTAP simulation that integrates a time dimension into the analysis. This is a valuable addition to the literature.

Rapid economic growth has enabled significant economic and social progress in East and South East Asia but the goal of sustainable development remains elusive (UNESCAP, 2006). Developing economic growth patterns which do not compromise environmental sustainability is an urgent global priority and most relevant to the dynamic East and South East Asian region. Environmentally sustainable growth or green growth is a new policy focus aimed at resolving the current conflict between liberalization of trade and environmental sustainability—i.e. to build synergies between economic growth and environmental sustainability (UNESCAP, 2006).

The current research can be extended further using a dynamic general equilibrium model in the analysis. A more detailed investigation of the environmental coefficients over time is required. Moreover, economic integration scenarios should be exercised to incorporate existing and negotiated tariff reductions.

Endnotes

1. The original Andean Pact was signed in 1969 by Bolivia, Chile, Colombia, Ecuador and Peru. In 1973, Venezuela joined as a sixth member. In 1976, however, its membership was again reduced to five when Chile left. Venezuela withdrew in 2006, reducing the Andean Community to four member states only. Recently, with the new cooperation agreement with Mercosur, the Andean Community gained four new associate members: Argentina, Brazil, Paraguay and Uruguay.
2. Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Macedonia, Moldova, Romania, Serbia and Montenegro and UNMIK/Kosovo.
3. The CAFTA-DR was signed on August 5, 2004. The agreement took effect for El Salvador and the United States on March 1, 2006, for Honduras and Nicaragua on April 1, 2006, and for Guatemala on July 1, 2006. Costa Rica and the Dominican Republic will be joining soon.
4. Japan has FTAs with Singapore and Malaysia; one signed with the Philippines; and it is negotiating with Indonesia, the Republic of Korea, Thailand as well as ASEAN.
5. The Chiang Mai Initiative (CMI) is under the ASEAN+3 framework. Its objective is to create a network of Bilateral Swap Arrangements (BSAs) among ASEAN+3 countries. This initiative was started after 1997 Asian Financial Crisis to manage regional short-term liquidity problems and to facilitate the work of other international financial arrangements and organizations like IMF. In May 2007, CMI further progress was agreed upon. (http://en.wikipedia.org/wiki/Chiang_Mai_Initiative)
6. ASEAN+3 comprises the 10 ASEAN members plus China, Japan and the Republic of Korea. ASEAN+4 includes ASEAN members plus China, Japan, the Republic of Korea and India. ASEAN+6 covers the East Asia Summit group, comprising ASEAN+3, Australia, New Zealand and India.
7. At the Ninth ASEAN Summit in Bali in October 2003, ASEAN leaders agreed to establish an ASEAN Economic Community (AEC) by 2020. AEC is one of three pillars (the other two being the ASEAN Security Community and the ASEAN Socio-cultural Community) that make up the ASEAN

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Community, as declared by ASEAN leaders in the Bali Concord II (available at www.aseansec.org/15159.htm). In line with the ASEAN Vision 2020, it is envisaged that AEC will be a single market and production base with a free flow of goods, services, investment, capital and skilled labour.

8. WorldScan is based on neoclassical theories of economic growth and international trade. The core of the model is extended to include

   (a) an Armington trade specification, explaining two-way trade and allowing market power to determine trade patterns in the medium run, while allowing Heckscher-Ohlin mechanisms in the long run;
   (b) imperfect financial capital mobility;
   (c) consumption patterns depending upon per capita income, and developing towards a universal pattern;
   (d) a Lewis-type low-productivity sector in developing regions, from which the high-productivity economy can draw labour, enabling high growth for a long period.
   (e) two types of labour: low- and high-skilled.

9. The ORANI model is one of the early general equilibrium models that later on known as Computable General Equilibrium (CGE) models. The CGE models have been treated as the operationalisation of the abstract Arrow-Debreu general equilibrium model. The ORANI model applied the Johansen procedure (Johansen, 1960).
10. As indicated in Brockmeier (2001), according to a Cobb–Douglas per capita utility function, the regional income is distributed over the three forms of final demand: private household expenditures; government expenditures; and savings. But the constancy of this proportionality between the three may sometimes not be maintained because of the endogenous nature of the private expenditure through its non-homothetic function.
11. GTAP 6 has 87 regions—more than six times the number in the original GTAP 1 database. All of these additions to the database have been provided by members of the GTAP network. The regional sectoral data (57 sectors) draw heavily on the source input-output tables from varying years. The GTAP 6 database was constructed by combining the I–O tables with 2001 macroeconomic data. Details are available in Dimaranan and McDougall (2006) and Hertel (2006).
12. for details see, Vietnam Environment Monitor (World Bank, 2004), UNESCAP, 2006, World Bank (2001, 2002, 2003) for Thailand and Indonesia's No. 1 waste technology, management and solution event (2008) www.waste.indowater.com
13. Published BOD data was collected from the World Bank, Development Data Group for China. The data collected from World Bank source only covered industrial water pollution: organic water pollution. In this case we compared the World Bank data with the data supplied by other countries under study. The World Bank covers only 25% (approx.) of the reported BOD estimate from

other countries (Japan, the Republic of Korea and for other countries). For that reason, data for China has been scaled up accordingly.

Unfortunately, the available source data is for total BOD only and the data source does not provide a sectoral distribution of the BOD. For the agricultural sector various options have been considered. We tried to incorporate additional information into the BOD and COD emissions from the agriculture sector. Harvest area of the various crops was used to estimate the BOD release from the agricultural sectors (paddy rice, wheat, cereal grains nec, vegetables, fruit, nuts, oil seeds, sugar cane and sugar beet, plant-based fibers, crops nec) in China. The BOD and COD from the agriculture sectors in China was estimated by taking the harvested area per crop times the BOD and COD release per hectare, using the Thailand data for the latter relationship.

For the livestock sector some additional modifications were used. Instead of harvested area we have considered the production quantity per BOD and COD release for Bovine cattle, sheep and goats, horses and Animal products nec.

For the forestry and fishery sectors, we have estimated the BOD and COD release on the basis of production quantity (ton).

The data was collected from the FAO statistics (Prodstat Foresstat and Fishstat) for the year 2000. For the rest of the sectors BOD release was estimated following Thailand pattern and COD collected from Environmental Yearbook of China.

14. Due to the paucity of Industrial waste data for Indonesia, we use the average environmental coefficient of Thailand and Vietnam.
15. Post-simulation utility is the level of utility obtained after the trade scenario exercise is carried out.
16. Equivalent variation is a measure of how much more money a consumer would pay before a price increase to avert the price increase. John Hicks is attributed with introducing the concept of equivalent variation.
17. When a country participates in a free trade region, it may gain due to trade creation and may either gain or lose due to trade diversion. The former has a positive effect on welfare because the removal of tariffs within the region allows the country to allocate its resources more efficiently in production. The country can import the goods that it formerly produced inefficiently under tariff from member countries that are more efficient producers (Caves & Jones, 1981).
18. The Armington assumption differentiates commodities by their country of origin. It takes the products of an industry which come from different countries to be imperfect substitutes for each other. This has become a standard assumption of international CGE models. These models generate smaller and more realistic responses of trade to price changes than implied by models of homogeneous products.
19. Electricity sector though identified an important sector in case of air and water pollution for all the countries under the study is not included in the analysis of the results. This sector is being used as an input by most of the sectors of all the economies.

Percentage share of CO_2 emission from electricity sector in total CO_2 emission in different trade scenarios at 2020

	BAU 2020	MEI 2020	DEI 2020	ASEAN+3 2020
China	71.35	71.20	71.21	71.00
Japan	37.82	36.86	37.91	37.95
Korea	18.60	18.49	18.59	18.99
Indonesia	27.39	27.28	27.34	27.29
Thailand	29.55	26.36	27.41	27.26
Vietnam	18.52	20.08	19.76	20.64
Malaysia	32.13	34.64	37.01	36.44
Philippines	18.29	19.32	21.49	19.46
Singapore	30.08	31.20	32.82	32.88
Other ASEAN	10.50	10.48	10.68	10.98

Source: Results from the study.

20. ASEANSEC- Proposed List/Types of Best Practices—Clean Land http://www.aseansec.org/files/bestpractice_clean_land.doc

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Annex

Annex 1 Sector listing of GTAP V6

Number	Code	Description
1.	pdr	Paddy rice
2.	wht	Wheat
3.	gro	Cereal grains nec
4.	v_f	Vegetables, fruit, nuts
5.	osd	Oil seeds
6.	c_b	Sugar cane, sugar beet
7.	pfb	Plant-based fibers
8.	ocr	Crops nec
9.	ctl	Cattle, sheep, goats, horses
10.	oap	Animal products nec
11.	rmk	Raw milk
12.	wol	Wool, silk-worm cocoons
13.	frs	Forestry
14.	fsh	Fishing
15.	coa	Coal
16.	oil	Oil
17.	gas	Gas
18.	omn	Minerals nec
19.	cmt	Meat: cattle, sheep, goats,horse
20.	omt	Meat products nec
21.	vol	Vegetable oils and fats
22.	mil	Dairy products
23.	pcr	Processed rice
24.	sgr	Sugar
25.	ofd	Food products nec
26.	b_t	Beverages and tobacco products
27.	tex	Textiles
28.	wap	Wearing apparel
29.	lea	Leather products
30.	lum	Wood products
31.	ppp	Paper products, publishing
32.	p_c	Petroleum, coal products
33.	crp	Chemical,rubber,plastic prods

Annex 1 (continued)

Number	Code	Description
34.	nmm	Mineral products nec
35.	i_s	Ferrous metals
36.	nfm	Metals nec
37.	fmp	Metal products
38.	mvh	Motor vehicles and parts
39.	otn	Transport equipment nec
40.	ele	Electronic equipment
41.	ome	Machinery and equipment nec
42.	omf	Manufactures nec
43.	ely	Electricity
44.	gdt	Gas manufacture, distribution
45.	wtr	Water
46.	cns	Construction
47.	trd	Trade
48.	otp	Transport nec
49.	wtp	Sea transport
50.	Atp	Air transport
51.	cmn	Communication
52.	Ofi	Financial services nec
53.	Isr	Insurance
54.	obs	Business services nec
55.	ros	Recreation and other services
56.	osg	PubAdmin/Defence/Health/Education
57.	dwe	Dwellings

Annex 2 Regional aggregation

GTAP code	Country	Region
aus	Australia	Rest of OECD
nzl	New Zealand	Rest of OECD
xoc	Rest of Oceania	ROW1
chn	China	China
hkg	Hong Kong	ROW1
jpn	Japan	Japan
kor	Korea	Korea
twn	Taiwan	ROW1
xea	Rest of East Asia	ROW1
idn	Indonesia	Indonesia
mys	Malaysia	Malaysia
phl	Philippines	Philippines
sgp	Singapore	Singapore
tha	Thailand	Thailand
vnm	Vietnam	Vietnam
xse	Rest of Southeast Asia	Other ASEAN
bgd	Bangladesh	ROW1
ind	India	ROW1
lka	Sri Lanka	ROW1
xsa	Rest of South Asia	ROW1

Annex 2 (continued)

GTAP code	Country	Region
can	Canada	NAFTA
usa	United States	NAFTA
mex	Mexico	NAFTA
xna	Rest of North America	ROW2
col	Colombia	ROW2
per	Peru	ROW2
ven	Venezuela	ROW2
xap	Rest of Andean Pact	ROW2
arg	Argentina	ROW2
bra	Brazil	ROW2
chl	Chile	ROW2
ury	Uruguay	ROW2
xsm	Rest of South America	ROW2
xca	Central America	ROW2
xfa	Rest of FTAA	ROW2
xcb	Rest of the Caribbean	ROW2
aut	Austria	REST OF OECD
bel	Belgium	REST OF OECD
dnk	Denmark	REST OF OECD
fin	Finland	REST OF OECD
fra	France	REST OF OECD
deu	Germany	REST OF OECD
gbr	United Kingdom	REST OF OECD
grc	Greece	REST OF OECD
irl	Ireland	REST OF OECD
ita	Italy	REST OF OECD
lux	Luxembourg	REST OF OECD
nld	Netherlands	REST OF OECD
prt	Portugal	REST OF OECD
esp	Spain	REST OF OECD
swe	Sweden	REST OF OECD
che	Switzerland	REST OF OECD
xef	Rest of EFTA	ROW2
xer	Rest of Europe	ROW2
alb	Albania	ROW2
bgr	Bulgaria	ROW2
hrv	Croatia	ROW2
cyp	Cyprus	ROW2
cze	Czech Republic	ROW2
hun	Hungary	ROW2
mlt	Malta	ROW2
pol	Poland	ROW2
rom	Romania	ROW2
svk	Slovakia	ROW2
svn	Slovenia	ROW2
est	Estonia	ROW2
lva	Latvia	ROW2
ltu	Lithuania	ROW2
rus	Russian Federation	ROW2

Annex 2 (continued)

GTAP code	Country	Region
xsu	Rest of Former Soviet Union	ROW2
tur	Turkey	ROW2
xme	Rest of Middle East	ROW2
mar	Morocco	ROW2
tun	Tunisia	ROW2
xnf	Rest of North Africa	ROW2
bwa	Botswana	ROW2
zaf	South Africa	ROW2
xsc	Rest of South African CU	ROW2
mwi	Malawi	ROW2
moz	Mozambique	ROW2
tza	Tanzania	ROW2
zmb	Zambia	ROW2
zwe	Zimbabwe	ROW2
xsd	Rest of SADC	ROW2
mdg	Madagascar	ROW2
uga	Uganda	ROW2
xss	Rest of Sub-Saharan Africa	ROW2

Annex 3 Revealed comparative advantages for ASEAN and CJK

	China	Japan	Republic of Korea	Indonesia	Malaysia	Philippines	Singapore	Thailand	Vietnam	Other ASEAN
1 pdr	0.418	6.841	0.002	0.027	0.241	0.033	0.014	3.266	2.232	0.583
2 wht	0.059	0.001	0.000	0.071	0.001	0.000	0.009	0.001	0.000	0.011
3 gro	0.933	0.000	0.002	0.043	0.015	0.013	0.012	0.418	0.107	0.782
4 v_f	0.805	0.011	0.211	0.363	0.210	2.086	0.107	0.801	2.446	6.004
5 osd	0.549	0.004	0.002	0.097	0.099	0.053	0.035	0.066	0.913	0.903
6 c_b	1.531	0.000	0.000	0.084	9.713	0.130	0.008	0.047	5.845	71.281
7 pfb	0.207	0.004	0.026	0.040	0.071	0.271	0.185	0.077	0.240	0.550
8 ocr	0.658	0.063	0.258	5.231	0.989	0.739	0.609	4.138	8.812	1.380
9 ctl	0.068	0.072	0.001	0.044	0.018	0.033	0.023	0.028	0.088	2.899
10 oap	1.737	0.111	0.126	0.637	0.726	0.281	0.104	0.568	1.774	0.573
11 rmk	0.328	0.002	0.004	0.011	0.012	0.009	0.000	0.010	0.017	0.004
12 wol	1.591	0.010	0.015	0.049	0.010	0.000	0.038	0.008	0.131	0.009
13 frs	0.200	0.012	0.016	3.162	3.841	0.149	0.145	0.088	0.425	26.928
14 fsh	1.187	0.256	0.544	3.061	0.728	1.414	0.748	1.431	2.845	1.551
15 coa	2.501	0.000	0.000	9.923	0.001	0.002	0.000	0.000	2.567	0.133
16 oil	0.057	0.000	0.000	1.515	0.543	0.000	0.000	0.007	4.178	3.782
17 gas	0.000	0.000	0.000	5.130	1.607	0.000	0.000	0.000	0.001	19.197
18 omn	0.489	0.056	0.047	6.214	0.100	1.252	0.184	0.124	0.598	0.516
19 cmt	0.050	0.019	0.019	0.122	0.029	0.042	0.034	0.022	0.005	0.027
20 omt	0.819	0.033	0.084	0.871	1.211	0.222	0.160	2.970	0.467	0.084
21 vol	0.125	0.032	0.015	8.763	10.255	4.069	0.583	0.496	0.370	0.030
22 mil	0.024	0.007	0.026	0.341	0.134	0.180	0.161	0.254	0.028	0.067
23 pcr	1.913	0.055	0.139	0.432	0.187	0.702	0.081	25.253	28.983	7.616
24 sgr	0.061	0.023	0.052	0.204	0.078	0.797	0.151	5.633	0.678	0.155
25 ofd	0.781	0.165	0.441	1.844	0.507	1.315	0.358	3.517	4.558	1.040
26 b_t	0.333	0.185	0.240	0.313	0.469	0.226	1.303	0.297	0.192	0.236
27 tex	2.195	0.706	2.695	2.269	0.446	0.688	0.308	1.426	1.025	4.670
28 wap	4.169	0.046	0.832	2.932	0.426	2.610	0.186	1.728	4.429	9.317
29 lea	6.402	0.050	0.985	3.309	0.135	0.923	0.168	1.808	13.516	1.652

Annex 3 (continued)

	China	Japan	Republic of Korea	Indonesia	Malaysia	Philippines	Singapore	Thailand	Vietnam	Other ASEAN
30 lum	1.810	0.065	0.115	4.874	1.886	0.891	0.127	1.176	2.159	1.821
31 ppp	0.401	0.270	0.565	2.245	0.198	0.195	0.530	0.482	0.145	0.032
32 p_c	0.579	0.151	1.699	0.792	0.455	0.297	2.285	0.832	0.000	0.154
33 crp	0.618	0.904	1.004	0.737	0.573	0.183	0.924	0.874	0.314	0.107
34 nmm	1.376	0.975	0.544	1.013	0.489	0.436	0.444	1.229	0.893	0.026
35 i_s	0.384	1.576	1.607	0.340	0.291	0.084	0.200	0.415	0.086	0.055
36 nfm	0.388	0.587	0.689	1.469	0.335	0.766	0.453	0.246	0.076	0.326
37 fmp	1.672	0.755	0.980	0.481	0.388	0.274	0.391	0.765	0.337	0.045
38 mvh	0.090	2.334	1.155	0.080	0.086	0.125	0.041	0.294	0.007	0.042
39 otn	0.518	1.250	1.833	0.139	0.111	0.195	0.512	0.201	0.203	0.206
40 ele	1.492	1.765	2.390	1.050	4.196	4.873	3.797	2.037	0.244	0.029
41 ome	1.018	1.762	0.784	0.373	0.411	0.647	0.758	0.832	0.348	0.039
42 omf	4.150	0.714	0.578	0.690	0.604	0.518	0.397	1.603	0.956	0.406
43 ely	0.224	0.000	0.000	0.000	0.000	0.000	0.000	0.066	0.000	0.205
44 gdt	0.000	0.001	0.001	0.314	0.945	0.000	0.002	0.190	0.134	0.001
45 wtr	0.634	0.135	0.660	0.356	1.586	1.227	0.460	1.156	0.722	0.842
46 cns	0.460	2.191	0.127	0.588	0.574	0.362	0.036	0.813	1.449	0.277
47 trd	0.829	0.633	0.335	0.230	1.342	0.261	1.573	0.628	0.438	0.633
48 otp	0.565	0.201	0.643	0.419	0.430	0.661	0.839	1.474	0.357	1.078
49 wtp	0.175	0.956	0.931	0.376	0.484	0.425	0.654	0.659	0.861	0.778
50 atp	0.163	0.721	0.613	0.391	0.543	0.444	0.478	1.694	0.661	1.069
51 cmn	0.227	0.343	0.587	0.134	0.447	1.464	0.105	0.381	1.473	0.648
52 ofi	0.220	0.474	0.379	0.454	0.182	0.133	0.146	0.078	1.047	0.265
53 isr	0.122	0.090	0.227	0.636	0.500	0.378	1.844	0.295	1.400	0.290
54 obs	0.115	0.490	0.615	0.263	1.814	0.131	1.909	0.430	0.685	0.545
55 ros	0.163	0.187	0.539	0.733	0.421	0.693	0.302	1.016	0.857	0.754
56 osg	0.406	0.230	0.839	0.171	0.112	0.198	0.528	0.200	1.264	0.784
57 dwe	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Annex 4 Aggregation scheme for Grubel–Llyod index

Agriculture		
1	*PDR*	Paddy rice
2	*WHT*	Wheat
3	*GRO*	Cereal grains nec
4	*V_F*	Vegetables, fruit, nuts
5	*OSD*	Oil seeds
6	*C_B*	Sugar cane, sugar beet
7	*PFB*	Plant-based fibers
8	*OCR*	Crops nec
9	*CTL*	Bovine cattle, sheep and goats, horses
10	*OAP*	Animal products nec
11	*RMK*	Raw milk
12	*WOL*	Wool, silk-worm cocoons
13	*FRS*	Forestry
14	*FSH*	Fishing
Industry		
15	*COA*	Coal
16	*OIL*	Oil
17	*GAS*	Gas
18	*OMN*	Minerals nec
19	*CMT*	Bovine meat products
20	*OMT*	Meat products nec
21	*VOL*	Vegetable oils and fats
22	*MIL*	Dairy products
23	*PCR*	Processed rice
24	*SGR*	Sugar
25	*OFD*	Food products nec
26	*B_T*	Beverages and tobacco products
27	*TEX*	Textiles
28	*WAP*	Wearing apparel
29	*LEA*	Leather products
30	*LUM*	Wood products
31	*PPP*	Paper products, publishing
32	*P_C*	Petroleum, coal products
33	*CRP*	Chemical, rubber, plastic products
34	*NMM*	Mineral products nec
35	*I_S*	Ferrous metals
36	*NFM*	Metals nec
37	*FMP*	Metal products
38	*MVH*	Motor vehicles and parts
39	*OTN*	Transport equipment nec
40	*ELE*	Electronic equipment
41	*OME*	Machinery and equipment nec
42	*OMF*	Manufactures nec

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