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Trade Liberalization and the Environment- A Case Study of Indonesia

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Introduction

In 1994, after many years of negotiations and set backs, the Uruguay Round (UF) of the General Agreement on Trade and Tariffs (GATT) was finally concluded and signed by more than a hundred countries. It represents the first major worldwide effort in trade liberalization where the signatories agreed to reduce tariffs over time to allow for improved access to their markets. At the same time, the replacement of GATT with the WTO also provides a formal institution to deal with trade disputes and provide a negotiation forum for its members, both aimed to further facilitate trade liberalization efforts. Indeed, it seemed that the world has entered a new era of trade liberalization around the world. Yet, the 1990s also saw a rise in regionalism with the emergence of two major regional trading blocs, the European Union (EU) and the North American Free Trade Agreement (NAFTA). Not only they adopted deeper and broader tariff reductions, they try to reduce non-tariff barriers to further boost trade among member nations.

The conclusion of the UR of GATT and the formation of two powerful trading blocs, the E.U and NAFTA, provide an interesting situation for countries in East Asia. On one hand, they are encouraged to trade in a newly liberalized world and yet are facing the risk of being sidelined from the E.U. and/or NAFTA economic concentration. The later post a significant concern as much of East Asian exports are destined to developed economies in these blocs. Countries in East Asia are initially hesitant in embracing economic regionalism and it was only towards the late 1990s, that East Asian nations became more serious in pursuing a regional trading block and FTAs. Since then numerous FTAs agreements has been signed by countries in the region. The following table shows a brief overview of some of the FTAs negotiations done by a few major countries in the region.

Table 1.1: FTA negotiations involving countries in East Asia

Country	FTA Implemented	FTA Signed	FTA Under Negotiations
China	Thailand (2003), ASEAN (2005), Chile (2006)	Pakistan (2006), New Zealand (2008)	Australia, Iceland
Japan	Singapore (2002), Mexico (2005) Malaysia (2006), Thailand (2007)	Philippines (2006), Chile (2007), Brunei (2007), Indonesia (2007)	ASEAN, Republic of Korea, Gulf cooperation council, Vietnam, India, Australia and Switzerland
Korea	ASEAN (2007), Singapore (2006), EFTA (2006), Chile (2004)	US (2007)	Canada, India, Mexico, Japan, EU
Indonesia	AFTA(1992)	Japan (2007)	
Malaysia	AFTA (1992), Japan (2006)		Australia , Chile, Korea, New Zealand, Pakistan, US
Philippines	AFTA (1992)	Japan (2006)	
Thailand	AFTA (1992), China (2003), India (2004), Australia (2005), New Zealand (2005), Japan (2007)	Peru (2005)	EFTA
Singapore	AFTA (1992), Japan (2002), Australia (2003), EFTA* (2003), United states (2004), Jordan (2005), Panama (2006), Republic of Korea (2006)	New Zealand (2000), India (2005)	Canada, China, Gulf Cooperation Council, Mexico, Pakistan, Peru, Ukraine
ASEAN	China (2005), Korea (2007)		Australia and New Zealand, India, Japan

Source:

Despite the fact that there has been great progress in the development of FTAs in the East Asian region, there is a clear divergence in free trade policies adopted by each country. As the leading economy in the region, Japan has been quite aggressive in pursuing free trade agreements with two main goals, to ensure a secured supply of resources for her economy and to counter the rising geopolitical influence of China. On the other hand, China's objective of signing an FTA with her South East Asian neighbours has been to reduce the anxiety over her growing power. Korea and Thailand has also been actively involved in establishing bilateral FTA in an effort to gain better market access to both existing and promising markets. As the nation with the most FTAs, the city-state of Singapore believes that their economic future and strength will lie in being a FTAs hub in the region. Yet, other countries such as Malaysia and The Philippines are more reluctant in pursuing FTAs as they worry that the FTAs may diminish their influence in the region. In addition, they prefer to work through the ASEAN framework where they may have a stronger negotiating leverage and as not to undermine the regional grouping as well. As with other East Asian countries that are changing their stance on FTAs, Indonesia is in the process of considering several bilateral/multilateral FTAs with other countries in the region. Recently, she has signed a trade agreement with Japan, under the Indonesia-Japan Economic Partnership Agreement (IJEPA) on top of her ongoing engagement in AFTA. Overall, these factors contribute to the interesting dynamics of trade liberalization in the East Asian region and highlight the hurdles in achieving a comprehensive regional trade agreement in East Asia.

As countries in East Asia moved forward in signing FTAs, much of the discussion has been focused on traditional issues such as their impact on growth and welfare. However, the increasing coverage and awareness of environmental issues around the world in the recent years injected a new dimension into this discussion. In East Asia, reports of continued environmental degradation and deterioration in pollution indicators in some countries have only heightened this concern. As a result, in recent years, questions have arisen regarding the possible impact of trade liberalization on pollution in the region. Indonesia has recently gained prominence as a major greenhouse gas emitter in the world is the largest economy in South East Asia. One of the main challenges facing her today is to contain this growth in pollution. Yet, a major environmental concern of trade liberalization is that it may accelerate environmental degradation in developing countries. Unfortunately, few studies have been done in this area, especially employing actual tariff cuts proposed in the FTAs focusing on Indonesia. Towards that direction, the current study investigates whether trade liberalization will lead to an increased pollution in Indonesia in the context of AFTA and IJEPA. The core objective of the study is to analyse the economic impact of AFTA and IJEPA on the environment in Indonesia.

The paper is structured in the following order. Section 1 will present Indonesia's trade pattern, especially between two of her most important partner, Japan and ASEAN. It will also cover Indonesia's environmental situation. A brief review of literature will be discussed in Section 2. Methodology, data and experimental design will be covered in section 3. Section 4 analyses the economic impact of IJEPA and AFTA on the environment. Section 5 concludes the paper.

Section 1 The Indonesian Economy

Indonesia has always been considered as one of the most promising developing economy in the region especially in the early 1990s. During these periods, she enjoyed high economic growth with GDP growth growing at a rapid average rate of around 7% between 1990 and 1996. In 1998, when the Asian Economic crisis was at its worst, Indonesia's GDP contracted. Since then, she has not been able to recapture her pre-crisis economic performance, with growth rates ranging from 4-5% post crisis although there has been a steady increase over the years. The industrial sector is an important influence in GDP during the early 1990s, prior to the crisis in 1998. In 2008, industry sector output as a percentage of GDP is 46.83%, a significant increase from 39.12% in 1990. As a result, changes in the sector can be felt on the growth of the Indonesian economy, helping to explain the pattern of growth rate of GDP in Indonesia. Agricultural growth rate remained low through out the years. Despite this fact, the agriculture sector remained an integral part of the economy as it provides employment to a disproportionate amount of Indonesian labor force through both large farms/plantations and smallholdings. In 2007, it provides employment to about 41.9% of labor force in Indonesia. During all these years, the main focus of Indonesian agriculture production has been the production of rice crops although in recent years there has been a significant growth in palm oil seeds plantations. Service sector growth rate is just slightly less than double of the industrial sector in 2003-7. This meant that it has been an important contributor to Indonesian economic growth in the last few years.

From 1990 to 2005 Indonesia's export and import values have been about 20-30% of her GDP. Over this period, her exports have risen steadily from US$ 25.6 billion in 1990 to US$ 100.8 billion in 2006 and a similar trend can be seen on her import, rising from US$ 21.8 billion in 1990 to US$ 61.1 billion by 2006. Much of the trades can be contributed to a few important trading partners such as China, Japan, Singapore, Korea and the United States. In 2006, these five countries contributed to 57.5 % and 47.7 % of Indonesia's export and import respectively. Among them, however, Japan has always been Indonesia's top export partner and only recently lost her position as the top import partner. Similarly, as a region the ASEAN has been a prominent trading partner to Indonesia. In 2006, ASEAN export to and imports from Indonesia is valued at US$ 18.5 billion and US$ 19.0 billion respectively, accounting for 18.3% and 31.1% of total exports and imports. Since both of these regions play an integral role in Indonesia's trade, these highlight the importance of IJEPA and AFTA to Indonesia and the impact they may have on her economy.

In 1992, Indonesia signed her first ever major trade agreements under the AFTA. Under AFTA, the ASEAN members agreed to reduce intra-regional tariffs of goods placed under a 'Common Effective Preferential Tariff' (CEPT) scheme to within 0-5% by 2002, with the intention of eliminating them. These commitments were deepened at the end of the 1990s with the agreement to phase in sensitive products to the list by the end of 2010. By 2003, the average tariff of CEPT products the initial six signatory countries to the agreement has dropped from 12.76% to 1.51%. Over the same period, Indonesia saw an increasing amount of trade with other ASEAN countries. In 1993, Indonesia's export to the region amounts to 13.5% of its total export and this share has increased to 17.6% in 2003. Similarly, the share of its import from the region increased from 9.38% in 1993 to 23.7% in 2003. This trend has continued and only further reinforces the importance of this intra-regional ASEAN trade and AFTA to Indonesia and how it may her economic and environmental performance.

A major source of FDI to Indonesia had been the more developed Asian countries such as Japan, South Korea and Singapore that were also hit by the crisis, leading to a drastic decrease in FDI from these sources. Unfortunately, Indonesia did not seem to be a coordinated policy to promote a particular sector as a FDI destination. The focus of FDI has shifted from the Chemical and Pharmacy sector (24.5%) in 1996, to Hotels sector (45.8%) in 2001 and eventually to metal good sector (18.7%) and construction sector (16.4%) in 2006. There seemed to be a lack of FDI into capital intensive industries other that the chemical and pharmacy sector. In conclusion, this declining and unfocused FDI is unlikely to lead to major changes in Indonesian's output production that may affect her trade pattern. As a result over the past ten years, the focus of Indonesia's exports remain in primary goods.

Despite not being a major economic power, Indonesia has managed to become one of the leading greenhouse gas (GHG) emitters in the world. In a report released by the World Bank in March 2007, Indonesia ranked third in the world for GHG emissions behind the United States and China. It emitted about 3014 million tons of CO2 equivalent (MtCO2e), much of which can be attributed to land use change and deforestation with forestry as an emission source contributing 2563 MtCO2e or about 85% of total emissions.

Section 2 Literature Review

There has been a growing interest in FTAs/RTAs negotiations and implementations among countries in East Asia and despite their recent nature, several studies have been carried out to try and analyze their impacts in the region. The approach that is used mostly in RTAs studies is the computable general equilibrium (CGE) model. This framework employs a detail specification of both economic structure and agents' behavioural parameters to simulate the impact of existing or planned RTAs. The main attraction of using a CGE model is that they allow endogenous price and terms of trade analysis that helps in determining possible welfare impacts of RTAs. Using a CGE model, Llyod and MacLaren (2004) suggested that RTAs have a positive welfare and net trade creating impact on members while the effects on non-members are negative and worsen with increasing RTA size. Other studies by Scollay and Gilbert (2001) and Urata and Kiyota (2003) have also indicated positive RTAs and FTAs impacts on members. Indeed, a review of CGE-based literature on RTAs by Robinson and Thielfelder (2002) has reached the same conclusion. Despite the critique that CGE model often employs random and questionable parameters values in studies by Panaragiya and Dutta-Gupta (2001) and Schiff and Winters (2003), Burfisher et al (2004) argued that sensitivity analysis indicates that the general conclusions derived from CGE studies are robust to a reasonable variation in parameter estimates. In conclusion, while carefully considering these caveats, CGE models can provide a very useful tool in analysing the economic impacts of FTAs and RTAs.

In Ballard and Cheong (1997), the authors carry out simulations 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 stand to gain welfare benefits by participating in the RTA and that these gains increased with increasing RTA size. In addition, their comparison of perfectly-competitive and imperfectly-competitive model indicates that the former results in smaller welfare gain. Focusing on the East Asian region, Urata and Kiyota (2003) tries to examine the effect of an East Asian FTA on trade in the region. Their analysis of trade pattern in East Asia has indicated 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. 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 did gained from trade liberalization. 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 do not have a great impact on export and import composition with less than 5% for most of the sectors and economies studied. Taking a different approach to regionalism in East Asia, Lee and Park (2005) focus their analysis on a select few FTAs/RTAs scenarios that are under considerations. This includes China-Korea, Japan-Korea, China-Japan-Korea and ASEAN-China-Japan-Korea (ASEAN+3) FTAs. Using a gravity model, they first determine the coefficient of the RTA variable chosen and used it to estimate the impact of the different FTAs scenarios under consideration. Their estimation indicates that a China-Japan-Korea FTA will lead to a 54% increase in intra-block trade. Unlike many other studies, they did not find a significant trade diversion effects occurring. The consensus among these studies point to the fact that FTAs in East Asia is likely to have a positive impact on countries in the region. Park (2006) evaluated the effects on East Asian of Regional Trade Agreements (RTA)-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. Chawin (2006) assessed the economic effects of East Asia regionalism assuming ASEAN +3 using the GTAP model. He simulated 8 hypothetical FTAs covering ASEAN and China, Japan, and Korea. The simulation impact of a FTA among North East Asia showed that the welfare gains were contributed in either Japan or Korea. If East Asia regionalism under ASEAN +3 was achieved, benefits would occur. However, ASEAN would be worse off, if Japan, Korea, and China formed a FTA among themselves.

A study focusing on Indonesia by Hartono et al (2007) have also arrived at the same conclusion. The authors analyzed how different FTAs scenarios may affect Indonesia's GDP, welfare, investment, trade and even 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% 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.

The analysis on the different free trade scenarios in East Asia studies discussed so far have clearly concluded that East 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 Asia may have prevented them from using actual tariff shocks that was eventually adopted. However, these studies provide a good indication of the outer boundaries of gain that can be achieved. Yet, 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 used.

Considering the different aspects of the relationship between trade and the environment, how does trade liberalization affect pollution in general? Studies discussed below have attempted to analyze the impact of FTAs on pollutions. 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% to 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 to the same conclusion. The analysis involves creating a two-country, 19-sector CGE framework based on the 1985 SAM of both nations and standard CGE model specifications. 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, however, the study by Strutt and Anderson (2000) indicates that trade may also lead to an improvement of the environment and at worst only results in a small environmental degradation while bringing great economic benefit to the country involved. Employing the Global Trade Analysis Project (GTAP) CGE modelling framework and database with a 23 sectors and 5 regions aggregation, the authors tries to determine the impact of the Uruguay Round tariff reductions and MFN tariff reductions by APEC on Indonesia by the year 2010 and 2020 respectively. They found that changes in the sectoral composition of industries and technical gains may have offset the increase in pollution coming from the increased growth. MFN tariff reduction however resulted in a small increase in pollution in 2020, 2.1%, 3.4% and 3.8% in CO_2, SOx and NOx respectively. Kang and Kim (2004) also provided some empirical support that trade liberalization may have a beneficial environmental impact based on their study of Korea-Japan free trade agreement. Using a GTAP framework too, their results indicates that the complete removal of both tariff and non-tariff barriers between Korea and Japan will result in a reduction of 3.919 kt of SOx and 6.133 kt for NOx. Overall air pollution emission will decrease by 0.36%. Eickhout et al. (2004) quantified the impact of trade liberalization on poverty and environment for developing countries. A modeling framework based on two models, GTAP and IMAGE, was used to obtain the economic and environmental impact of the scenarios. 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, between 70 and 85 per cent of the benefits for developing countries were the result of their own reform policies in agriculture. 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-blocks throughout the world, can also work out negative.

Unfortunately, despite the continuously growing literature in this area, studies of trade liberalization impact on the environment in the East Asian Region remain sparse. Yet, this provides the opportunity to explore further the impacts of the recent FTAs agreement in the region.

Section 3 Methodology, Data and Experimental Design

3.1 Model Specification

As a general equilibrium model where countries and regions in the world economy are linked together through trade, the GTAP model incorporates both the demand and supply in its specifications. On the demand side, the model uses a Cobb-Douglas aggregate utility function to allocate regional household expenditure among private expenditure, government expenditure and savings along a constant budget share to provide an indicator of welfare for the regional household. Here, a representative household in each region maximizes constant difference of elasticity expenditure (CDE) functions that are calibrated to an income level and elasticity of demand that vary according to the level of development and consumption pattern of the region.

On the supply side, firms combine primary factors and intermediate goods using the Leontief production structure and a constant return to scale technology to produce final goods in a perfectly competitive environment. The final goods produced are then sold to both private household and the government. There are five primary factors of production in the model, which are capital, land, natural resources, skilled and unskilled labours. Among these factors, land and natural resources are made to be sector-specific. Labours are considered to be mobile across industries but not countries while capital is both mobile across industries and countries. The GTAP model uses a nested CES functions to determine firms' demand for primary and intermediate inputs. As with many other general equilibrium models, it utilizes the Armington's approach where all goods are differentiated and firms first decide on the sourcing of imports before deriving a composite price. Using this price, the optimal combination of imported and domestic goods to be used can be calculated. All sectors in the model produce a single output and firms face a zero profit assumption.

The GTAP model also incorporates 2 global sectors apart from the regional sectors. They are the global banking sector that facilitates global savings and investments and global transportation to account for the difference between f.o.b and c.i.f values. In addition, domestic support and trade barriers (tariff and non-tariffs) are measured in ad-valorem equivalents. The equilibrium nature of the model is derived from the exhaustive accounting relationship that makes up the model. The GTAP model by itself, does not take into consideration macroeconomic policies or monetary phenomena and since it is static in nature, the impact of investment on production and trade is felt through its effects on final demand.

Lastly, there are two ways to achieve macroeconomic closure in the model based on the accounting identity $S - I \equiv X - R - M$ where $R = 0$ in the model due to the absence of observation in the database. The first is to fix trade balance to zero while national savings or investment is allowed to adjust. The second is through the use of the global bank that adjusts its purchase of shares in regional investment goods to account for changes in global savings. The later allow modellers to endogenize both side of the identity above. Both the methods above are neoclassical in nature. Closure is an important part of the model because it is used to capture policy changes and structural rigidity. It is the classification of the different variables in the model into either endogenous or exogenous variable. Some examples of closure element in the GTAP model are population growth, capital accumulation, industrial capacity, technological changes and policy instruments such as tax and subsidies. For the closure to work, the number of endogenous variable considered has to be equal to the number of equations used. This is a necessary but insufficient condition. The choice of exogenous variable will help determine whether the model is in a general or partial equilibrium. Last but not least, in a standard GTAP closure, all markets are in equilibrium with all firms earn zero profit and regional household on its budget constraint.

3.2 Data and Aggregation Strategy

For the simulation, the paper will use the GTAP 6 database that cover 57 sectors and 87 regions. The trade data in this database was obtained from the UN Comtrade while the sectoral/regional data are based on IO data of each country economy. Due to the large nature of the trade database, common problems such as quality, availability and consistency exist. These are compensated by the extensive data available that allow for an in-depth analysis. To deal with missing data, the authors of the database estimate them using a time-series method developed by the USDA. A partner country approach is also used to check for the consistencies of trade data as there are 3 source of systematic bias: export, import and commodity specific margin. Unfortunately, the GTAP database only account for non-factor service (i.e. business, insurance) trade and not factor service trade (i.e. interest, dividend) due to the availability of data. As for tariffs data, the GTAP database uses an aggregated tariff derived from applied tariff rates.

Given that the main focus of this paper is to study the possible impact of Indonesia's participation in AFTA and IJEPA, the 87 regions in the original database were aggregated to nine regions with an emphasis on countries in East Asia to facilitate and focus the scope of analysis. The 9 aggregated regions are ASEAN, China, Indonesia, Japan, Korea, NAFTA, Rest of Asia (ROA), Rest of OECD (ROO) and Rest of the World (ROW). ASEAN is grouped as a region because the region collectively is a major trading partner of Indonesia and has a much liberalized trade relationship with Indonesia through AFTA. Similarly, China and Korea is listed as individual countries because they play an important role in the region and are major trading partners of both Indonesia and Japan. In the aggregation, ROO is separated from ROW because their distinct development stages may influence their trade relationship and composition with Indonesia. The model that will be used in the study of the objectives will include 9 regions and 57 sectors.

3.3 Experimental design

To analyze the impacts of AFTA and IJEPA economic integrations on Indonesia's economy and environment, 5 different simulation scenarios are run using the GTAP program. First, a counterfactual equilibrium benchmarks is created by projecting the economies to the year 2022 through a recursive process using estimated macroeconomic variables. Next, the process is repeated with the addition of tariff shocks to carry out the trade liberalization scenarios. The results are then compared to analyze the impact of trade liberalization on the Indonesian economy. Lastly, using a set of environmental coefficient that was prepared separately, the impacts of the different scenarios on the environment are examined.

Macroeconomic Variable Estimates

In this study, the macroeconomic variable estimates used to project the economies are adopted from the paper by Thomassin and Mukophadhyay (2008). The exogenous projections of GDP growth in each region are estimated using data from the World Bank, World Development Indicators, 2007 while estimates of capital stock, population, skilled and unskilled labour growths are based on Dimaranan, et al., 2007, UN2006, World Bank 2007. Aggregation of the data to correspond the regional classification used in this study is done using a simple average. In the model, total factor productivity was determined endogenously to permit the application of these exogenous shocks. In this way, the diverse range of variable such as level and growth of GDP, trade flows and welfare can be measured

Scenario Development

There are a total of five scenarios that are considered in this study: a) Business as Usual (BAU), b) IJEPA, c) AFTA, d) AFTA and IJEPA and e) AFTA and IJEPA with Simulated Agriculture Liberalization. Table 3.1 below provides a brief outline of the 5 scenarios and the tariff reductions involved.

Table 3.1: Outline of 5 scenarios considered

Scenarios	Regional scope	Commodity Scope	Tariff changes
Business as Usual (BAU)	All regions	All commodities	None
IJEPA	Indonesia-Japan	5 export and 8 import commodities	Variable tariff reductions
AFTA	Indonesia-ASEAN	13 export and 7 import commodities	Variable tariff reductions
IJEPA+AFTA	Indonesia-Japan	5 export and 8 import commodities	Variable tariff reductions
	Indonesia-ASEAN	13 export and 7 import commodities	Variable tariff reductions
AGRI IJEPA+AFTA	Indonesia-Japan	5 export and 8 import commodities	Variable tariff reductions
		All remaining agriculture sector	25% in 2007, 50% in 2012, 100% in 2017
	Indonesia-ASEAN	13 export and 7 import commodities	Variable tariff reductions
		All remaining agriculture sector	25% in 2007, 50% in 2012, 100% in 2017

1) *Business as Usual (BAU)*

Here, the 2001 model will be projected in a 5-year interval up to the year by shocking it with the estimated macroeconomic variables. In this scenario, no tariff shocks are employed. This scenario will provide a counterfactual base of comparison for the other scenarios together with economic and environmental changes in Indonesia in the year 2022.

2) IJEPA

In this scenario, tariffs shocks based on Annex I of the IJEPA are applied to the model beginning with the year 2007 in accordance to the timeline that has been agreed under the agreement. Based on UNComtrade database in 2006 and existing tariff rates only sectors that play an important role in trade between the two countries are considered. As a result, import tariff shocks are applied to 5 sectors in Japan and 8 sectors in Indonesia. This scenario will allow the analysis of the impact of IJEPA on Indonesia's economy.

3) AFTA

For this scenario, tariffs shocks based on Common Effective Preferential Tariff (CEPT) scheme of AFTA will be applied in the year 2007 and 2012 to capture its trade liberalization objectives. Tariff from three countries: Malaysia, Singapore and Thailand are used to represent the ASEAN as they make up about 85% of Indonesia's export to and import from ASEAN. Based on the UNComtrade and existing GTAP tax rate data, import tariff shocks are applied to

13 sectors in ASEAN and 87 sectors in Indonesia. The main aim of this scenario is to study the impact of AFTA on Indonesia.

4) AFTA and IJEPA

In this scenario, both AFTA and IJEPA shocks are applied at the same time. The results from this scenario will then be compared with those of 'AFTA' and 'IJEPA' scenarios to determine whether there are any significant interactions between the two policy shocks. In addition, it will also provide comparison to study the potential effect of simulated agriculture tariff reductions that are carried out under the next scenario.

5) AFTA and IJEPA Agriculture Tariff Elimination

Tariff shocks in this scenario are similar to that of the fourth scenario but with the addition of simulated agriculture liberalization. In IJEPA and AFTA much of the existing agricultural protection is left untouched. Since agricultural sectors still play an important role in the Indonesian economy it will be interesing to see the impacts were it included in the trade agreements. To do so, agriculture tariffs will be reduced by 25% in 2007, 50% in 2012 and completely eliminated by 2017.

Environmental Coefficients and Analysis

There are six environmental indicators that are used to analyse the environmental impact of trade liberalization on Indonesia in this study. They are CO2 (Gg), CH4 (Gg), N2O (Gg), BOD (tons), COD (tons) and Soluble Solids (SS) emissions. They are chosen because of the limited availability of data and their use in other environmental studies. To measure these emissions, the study uses environmental coefficients and their associated growth rates employed in Thomassin and Mukhopadyay (2008). To estimate these coefficients, they utilized the GHG emissions data for Indonesia from the GTAP environmental databases (V6.2, Lee 2006). For BOD, COD and SS emissions, the data is collected from BAPEDAL BPS statistics of Indonesia. These pollution indicators has been updated to 2022 to capture changes accruing from technological change based on existing trends in emissions. For GHGs, coefficient growth rates are reduced by half in after each 5-year period starting from 2007 while this reduction begins in 2012 for BOD, COD and SS with the assumption of a significant technological progress in the period

Section 4 Results and Analysis

4.1 Projected Economic and Environmental effects in Indonesia due to Growth and Structural Changes

In the BAU run, the world economy is projected to the future without implementing any policy shocks in the form of tariff reductions. Tables 4.1 shows the projected percentage changes in the output level of the different economies up to the year 2022.

Table 4.1: Percentage changes in output level in BAU scenario

	Percentage Changes 2001-2007	Percentage Changes 2007-2012	Percentage Changes 2012-2017	Percentage Changes 2017-2022
1 Indonesia	41.99	31.50	37.75	41.31
2 Japan	13.86	9.96	9.47	9.56
3 China	69.06	45.25	47.72	54.44
4 Korea	35.76	28.63	28.93	31.43
5 ASEAN	35.55	28.62	29.52	31.27
6 NAFTA	21.53	18.32	17.84	17.59
7 Rest of Asia	40.43	31.45	32.08	34.93
8 Rest of OECD	13.30	13.15	13.06	13.22
9 ROW	22.91	18.49	17.74	16.80
Total	22.17	19.00	19.68	21.47

Table 4.1 showed that China has the highest rate of output growth throughout the period, growing by 457% over the 22. Among the three regions of interest, Indonesia has the highest output growth followed by ASEAN and Japan. Overall, world output is expected to grow by 111% over the period. In Indonesia, the ‘lea’ sector experienced the fastest growth followed by ‘ppp’ sector growing by 572% and 530% respectively. Yet, despite differences in growth rate among the different sectors, there was no significant change in the sectoral output rankings in the country. Table 4.2 shows the top 6 sectors by output in Indonesia from 2000 to 2022.

Table 4.2: Top 6 sectors by output in Indonesia

2001		2007		2012		2017		2022	
Sector	Share	Sector	Share	Sector	Share	Sector	Share	Sector	Share
trd	6.00	Trd	6.30	trd	6.58	trd	7.03	trd	7.78
cns	5.99	Cns	6.25	cns	6.28	ele	6.21	osg	6.97
crp	5.45	Crp	5.50	crp	5.49	cns	6.13	ele	6.81
tex	4.22	Ele	4.84	ele	5.42	osg	5.64	cns	5.48
ele	4.12	Osg	4.46	osg	4.93	crp	5.42	crp	5.24
osg	4.06	Tex	4.43	tex	4.63	tex	4.78	tex	4.72

As Indonesia output increases over the period, her exports increased to US$ 244.92 billion and imports to US$ 166.86 billion in 2022 from US$ 68.54 billion and US$ 47.05 billion respectively from 2001. However, the share of export and import as a percentage of output stayed relatively stable over the period as shown in table 4.3 below. The shares of Indonesia trade with Japan continue to decline over this period. In 2022, Japan's share of Indonesia's export and import declined from 17.9% and 15.5% to 11.9% and 10.9% respectively. At the same time, ASEAN emerged as Indonesia's most important trading partner, accounting for 16.6% and 17.3% of Indonesia's export and import in 2022 respectively.

Table 4.3: Indonesia's Export and Import datafrom 2000 to 2022

	2000	2007	2012	2017	2022
Export	68549.72	95691.88	124768.06	171404.21	244925.18
Import	47047.12	66915.70	87602.36	119665.02	166862.65
Output	289798.00	411478.00	541106.00	745350.00	1053269.00
Expor-Output Ratio	23.65	23.26	23.06	23.00	23.25
Import-Output Ratio	16.23	16.26	16.19	16.05	15.84

The changes in exports and imports are also accompanied by a noticeable shift in their composition. In export, there is a significant rise in the share of fossil fuels and natural gas, rising from 12.6% to 24.5%. This increase has been driven by the increase in the export of 'coa' sector that saw its overall export share jump from 3.15% to 11.0%. On the other hand, sectors such as 'lum', 'crp', 'wap' and 'tex' saw a decline in their share of exports due to slower export growth. For imports, Indonesia saw a rise in the share of imports from the ‘p_c’ and ‘oil’ sectors where both rose by 4.9% but the ‘ome’, ‘crp’ and ‘obs’ sectors continue to dominate the share of Indonesian imports. Table 4.4 and 4.5 provides the break down of the top 5 Indonesian exports and imports and their shares in 2001 and 2022. In conclusion, the results of the BAU scenarios seems to indicate that as Indonesia grew economically there is little changes in the structure of her economy although there are some adjustments in her export and import composition.

Table 4.4: BAU Export rank for Indonesia

2001		2022	
Sectors	Share (%)	Sectors	Share (%)
Electronic Equipment (ele)	12.41	Electronic Equipment (ele)	14.05
Woods Products (lum)	8.72	Coal (coa)	10.98
Chemical, Rubber and Plastic Prod. (crp)	7.51	Oil (oil)	8.04
Wearing Apparels (wap)	6.81	Machinery and Equipment (ome)	6.31
Textiles (tex)	6.48	Chemical, Rubber and Plastic Prod. (crp)	5.93

Table 4.5 BAU Import rank for Indonesia

2000		2022	
Sectors	Share (%)	Sectors	Share (%)
Machinery and Equipment (ome)	14.21	Machinery and Equipment (ome)	13.02
Chemical, Rubber and Plastic Prod. (crp)	13.77	Chemical, Rubber and Plastic Prod. (crp)	12.96
Business Services (obs)	11.68	Business Services (obs)	9.00
Electronic Equipment (ele)	6.27	Petroleum and Coal products (p_c)	8.88
Trade (trd)	5.02	Oil (oil)	7.64

4.2 Projected Economic Effects of Trade Liberalization

Output Changes

Given the growth that occurs in the Indonesia without the presence of any additional trade policies in the BAU scenario, how would Indonesia's pursuit of trade liberalization through FTAs affect this outcome? Table 4.6 shows the percentage changes in total output that arises from the different trade liberalization scenarios in 2022 compared to the BAU case.

Table 4.6: Percentage changes in output compared to the BAU scenario in 2022

	IJEPA	AFTA	AFTA+IJEPA	AGRI AFTA+IJEPA
Indonesia	0.11	0.47	0.51	0.52
Japan	0.01	-0.02	0.04	0.04
China	-0.01	0.00	-0.01	-0.01
Korea	-0.01	-0.01	-0.03	-0.03
ASEAN	-0.02	0.11	0.07	0.10
NAFTA	-0.01	-0.01	-0.01	-0.01
Rest of Asia	-0.01	-0.01	-0.02	-0.02
Rest of OECD	-0.01	-0.01	-0.01	-0.01
ROW	-0.04	-0.04	-0.04	-0.04

Trade liberalization impacts output growth in two ways, by affecting demand in outputs and supply of inputs. The results in table 5.6 indicate that Indonesia stands to benefit from participating in both AFTA and IJEPA. However, the magnitude of changes is small when compared to total projected output under the BAU scenario because Indonesia already has a relatively liberalized trading relationship with both Japan and ASEAN as can be seen on table 4.7.

Table 4.7: Aggregate tax rate for Indonesia based on GTAP6 Database

Import	Japan	ASEAN	Export	Japan	ASEAN
Agriculture	2.1	3	Agriculture	1.6	7.9
Industry	5.7	4	Industry	1.2	4.5

Table 4.6 also indicates that the agreements only benefited member countries while non-member countries lost out in all scenarios. In the case of IJEPA scenario, Indonesia and Japan output is 0.11% and 0.01% higher over the BAU output respectively while other countries saw a decline. Similarly, in the AFTA scenario, Indonesia and ASEAN output increased by 0.47% and 0.11 % respectively while other countries faced negative output changes. The same pattern can be seen in the 'AFTA+IJEPA' and 'AGRI AFTA+IJEPA' scenarios. The inclusion of additional reduction in agriculture products in the 'AGRI AFTA+IJEPA' scenarios appears to only have a marginal impact on Indonesia, Japan and ASEAN output as agriculture trade between the countries is relatively small. For example, in BAU 2022, agriculture exports from Indonesia to Japan and ASEAN are only 0.41% and 1.93% of total exports respectively.

Sectoral Output Changes

Given the changes in overall output, the tariff reductions in under the various agreements appear to have varying impact on the associated sectors. Table 4.8 shows some selected sectors that are experienced tariff changes under the IJEPA. It showed that the sector most affected by the tariff reductions is the 'mvh' sector that saw its output decreased by US$ 834.81 million compared to the BAU scenario. Similarly, the 'crp' sector is also adversely affected by IJEPA as it's output declined by US$ 142.44 million. However, the several other sectors benefited from the agreement such as the 'ome' sector that saw its output jumped by US$ 454.62 million. Overall, impact for the sectors involved are mixed in the IJEPA case and that the relative changes are minor.

Table 4.8: Output change in selected sectors in the IJEPA scenario (US$ million)

Sector	tex	wap	crp	mvh	ele	ome
Output Change	333.93	159.64	-142.44	-834.81	179.03	454.62
%	0.67	0.76	-0.26	-2.71	0.25	1.37

On the other hand, tariff reductions under AFTA have a more significant impact on the output of the sectors involved. Contrary to the IJEPA case, the 'mvh' sector saw its output increased by US$ 1778.23 million over the BAU scenario. The 'ome' sector also saw an increase similar in magnitude. Yet, the sector that saw the most significant relative change is the 'otn' sector whose output increased by US$ 460.05 million or 11.50%. The only sector that saw a large decline in output is the 'ele' sector. Its output declined by US$ 626.61 million but this is relatively small compared to its existing output, accounting only for 0.87%. Table 4.9 shows the sectoral output changes under AFTA. Overall, the tariff reductions in AFTA appear to have benefited the associated sectors in Indonesia.

Table 4.9: Output change in selected sectors in the AFTA scenario (US$ million)

Sector	ppp	crp	mvh	otn	ele	ome
Output Change	296.67	673.83	1778.23	460.05	-626.61	1747.12
%	0.67	1.22	5.76	11.50	-0.87	5.26

When both sets of tariff cuts are combined under the AFTA+IJEPA scenario, the effects appear to be compounded with AFTA changes being dominant. As a result, output increase in the 'ome' sector is further enhanced to US$ 2198.84 million. On the other hand, the impact of AFTA liberalization on the 'mvh' sector is dampened by the IJEPA tariff cuts and therefore its output increase declined from a high of by US$ 1778.23 million to only US$ 1003.16 million.

Table 4.10: Output changes in selected sectors in the AFTA+IJEPA scenario (US$ million)

Sector	tex	wap	ppp	crp	mvh	otn	ele	ome
Output Change	-298.62	-211.34	177.34	517.94	1003.16	475.21	-496.95	2198.84
%	-0.60	-1.01	0.40	0.94	3.25	11.88	-0.69	6.62

Lastly, table 4.11 shows that agricultural tariff reductions under 'AGRI AFTA+IJEPA' scenarios brought varying changes on the agriculture related sectors. The 'ocr' sector saw a significant increase in output of US$ 174.86 million while the 'sgr' sector output declined by US$ 172.43 million. For the 'pdr' sector, an important agricultural sector to Indonesia, output declines by 1.10% or US$ 96.76 million.

Table 4.11: Output changes in selected sectors in the AFTA+IJEPA scenario (US$ million)

Sector	pdr	c_b	ocr	mil	pcr	sgr
Output Change	-96.76	-41.28	174.86	59.04	-78.83	-172.43
%	-1.10	-2.37	3.06	3.77	-0.71	-3.41

Overall, there are no changes in the sectoral rank of output across the different scenarios. The top five sectors in the BAU maintained their positions with little changes in their shares of total output. However, some of the sectors that experienced tariff reductions appeared to be among those that experience the greatest change. Tables 4.12 and 4.13 list the sectors that experience the greatest increase and decrease in their output.

Table 4.12: Top 5 sectors with greatest increase in output (US$ million)

IJEPA	Output increase	AFTA	Output increase	AFTA + IJEPA	Output increase	AGRI AFTA + IJEPA	Output increase
ome	454.62 (1.37)	mvh	1778.23 (5.76)	ome	2198.84 (6.62)	ome	2187.05 (6.58)
ppp	411.43 (0.93)	ome	1747.12 (5.26)	cns	1197.29 (2.07)	cns	1238.44 (2.15)
cns	374.69 (0.65)	cns	861.96 (1.49)	mvh	1003.16 (3.25)	mvh	1010.57 (3.28)
tex	333.93 (0.67)	trd	728.65 (0.89)	trd	871.24 (1.06)	trd	904.80 (1.10)
trd	181.63 (0.22)	crp	673.83 (1.22)	crp	517.94 (0.94)	crp	545.33 (0.99)

Table 4.13: Top 5 sectors with greatest decrease in output. (US$ million)

IJEPA	Output decrease	AFTA	Output decrease	AFTA + IJEPA	Output decrease	AGRI AFTA + IJEPA	Output decrease
mvh	-834.81 (-2.71)	lea	-675.84 (-2.86)	lea	-756.69 (-3.20)	lea	-734.47 (-3.11)
crp	-142.44	ele	-626.61	ele	-496.95	ele	-561.01

	(-0.26)		(-0.87)		(-0.69)		(-0.78)
lea	-67.55 (-0.29)	tex	-596.93 (-1.20)	tex	-298.62 (-0.60)	tex	-314.96 (-0.63)
osg	-39.59 (-0.05)	wap	-355.77 (-1.70)	wap	-211.34 (-1.01)	wap	-220.80 (-1.06)
nfm	-34.67 (-0.25)	dwe	-226.61 (-0.48)	dwe	-196.83 (-0.42)	dwe	-174.30 (-0.37)

Export-Import Changes

Accompanying the impacts on output arising from trade liberalization, there are changes in export and import pattern. From table 4.14, it is observed that increased trade liberalization resulted in increased export and import for Indonesia. Under the IJEPA, export and import increased by a 0.44% and 0.40% respectively when compared to the BAU scenario. Similarly, AFTA resulted in an increase in export and import by 1.01% and 1.25% respectively. The greatest increase is seen in 'AGRI AFTA+IJEPA' scenario where export and import increased by 1.67% and 1.91% respectively. While the increases may not be large, they clearly indicate that tariff reductions have a positive impact on Indonesia trade.

Table 4.14: Changes in Export and Import in 2022 under different trade liberalizations compared to the BAU

	IJEPA	AFTA	AFTA+IJEPA	AGRI AFTA+IJEPA
Export (million US$)	1078.21	2467.89	3381.53	4085.85
Changes (%)	0.44	1.01	1.38	1.67
Import (million US$)	665.47	2087.62	2632.73	3190.93
Changes (%)	0.40	1.25	1.58	1.91

Table 4.15: Changes in the share of Indonesia's Export and Import against the BAU scenario.

	IJEPA		AFTA		AFTA+IJEPA		AGRI AFTA+IJEPA	
	Export	Import	Export	Import	Export	Import	Export	Import
Japan	0.09	1.71	-0.24	-0.24	-0.15	1.46	-0.16	1.46

China	-0.02	-0.48	-0.21	-0.33	-0.23	-0.79	-0.25	-0.85
Korea	-0.02	-0.21	-0.1	-0.19	-0.12	-0.4	-0.13	-0.41
ASEAN	0.03	-0.46	1.9	1.55	1.94	1.05	2.04	1.47
NAFTA	-0.01	-0.11	-0.41	-0.15	-0.42	-0.25	-0.44	-0.31
Rest of Asia	-0.04	-0.17	-0.25	-0.13	-0.29	-0.3	-0.3	-0.44
Rest of OECD	-0.03	-0.23	-0.47	-0.21	-0.5	-0.43	-0.52	-0.54
ROW	0.00	-0.05	-0.23	-0.29	-0.23	-0.34	-0.24	-0.39

Analysis of trade flows further indicates that trade liberalization has a positive impact on export-import flows between agreement countries and a negative impact on non-agreement countries indicating the presence of trade diversion. In the IJEPA scenario, Japan share of Indonesia's export increased only marginally by 0.09% while her share of import increase by 1.71% compared to the BAU scenario. With AFTA, ASEAN share of Indonesia's export and import increases by 1.9% and 1.55% respectively to the detriment of other regions' shares. In both the 'AFTA+IJEPA' scenario and the 'AGRI AFTA+IJEPA' scenarios, there appears to be an interaction between the impacts of the two agreements. The negative impact of AFTA on Indonesia's export to Japan resulted in a declining Japan share while the IJEPA dampened the increase of Indonesia's import originating from the ASEAN region. These also meant that the decline in trade shares of the other regions is compounded.

Sectoral Export-Import Performance

Futher sectoral analysis of export and import impact of tariff reductions showed that in general, they benefit the affected sectors. Under the IJEPA scenarios, tariff liberalization resulted in an increase in both export and import of the sectors affected by tariff cuts. The largest increase are seen on the 'ome' sector where its export and imports increased by US$ 373.80 million and US$ 151.90 million respectively. On the other hand the mhv sector saw a significant relative increase of 6.14% in export volume and 3.16% in import volume.

Table 4.16: Export-Import changes in selected sectors in the IJEPA scenario (US$ million)

Sector	tex	wap	crp	mvh	ele	ome
Export	191.71	116.92	140.61	118.89	137.16	373.80
%	1.41	1.04	0.97	6.14	0.40	2.42
Import	55.41	2.16	69.33	146.67	22.32	151.90
%	1.01	0.53	0.32	3.16	0.26	0.70

Similar to the IJEPA scenario, under AFTA, most of the sector that saw tarif reductions saw an increase in their export-import volume over the BAU case. Again, the ‘ome’ sector saw the largest increase in both export and import at US$ 1206.64 million and US$ 617.08 million respectively. In addition, the ‘mvh’ and ‘otn’ sectors saw a very large relative increase in their exports. For the ‘mvh’ sector, export volume rose by 50% compared to the BAU case while for ‘otn’ sector, it increased by 27.27%. Unlike the IJEPA case however, the ‘ele’ sector actually saw a decline in exports volume by US$ 281.38 million.

Table 4.17: Export-Import changes in selected sectors in the AFTA scenario (US$ million)

Sector	ppp	crp	mvh	otn	ele	ome
Export	158.14	1005.61	984.08	328.38	-281.38	1206.64
%	1.12	6.92	50.79	27.27	-0.82	7.81
Import	41.39	220.19	242.34	135.99	78.47	617.08
%	1.44	1.02	5.22	2.99	0.92	2.84

With the compounding of the effects of both set tariff cuts under the AFTA+IJEPA scenario, the ‘ome’ sector continue to see its export and import increase significantly. Compared to the BAU case, exports and imports of the ‘ome’ sector is US$ 1576.93 million and US$ 751.15 million higher in the AFTA+IJEPA scenario. In addition, the ‘mvh’ and the ‘otn’ sector continue to see a very significant increase in their export. Interestingly, the ‘wap’ sector export declined by US$ 147.76 million despite seeing an increase in the IJEPA scenario.

Table 4.18: Export-Import changes in selected sectors in the AFTA+IJEPA scenario (US$ million)

Sector	tex	wap	ppp	crp	mvh	otn	ele	ome
Export	28.89	-147.76	115.98	1134.57	1122.53	348.14	-180.72	1576.93
%	0.21	-1.32	0.82	7.81	57.93	28.91	-0.53	10.20
Import	35.59	0.38	39.42	271.65	386.26	150.03	94.10	751.15
%	0.65	0.09	1.37	1.26	8.32	3.30	1.10	3.46

Lastly, the agricultural tariff cuts undertaken in the ‘AGRI AFTA+IJEPA’ scenario appear to have a positive impact on trade volumes of the sectors affected. On the export side, the ‘oct’ sector saw its exports increased significantly by US$ 194.48 million or 19.50% compared to the BAU scenarios. Similarly, ‘mil’ exports increased by US$63.45 million. On the contrary, the reductions appear to have very little impact in the export of ‘pdr’ and ‘pcr’ sectors. For imports however, it is the ‘pcr’ sector that saw the largest increase in volume as ‘pcr’ imports increased by US$ 171.08.

Table 4.19: Export-Import changes in selected sectors in the AGRI AFTA+IJEPA scenario (US$ million)

Sector	pdr	c_b	ocr	mil	pcr	sgr
Export	0.11	0.00	194.48	63.45	0.46	14.42
%	-100.00	0.25	19.50	17.82	36.71	123.86
Import	32.01405	-0.22098	29.95216	9.163353	171.0843	103.5139
%	28.5193	-9.774	1.935265	0.728883	11.62019	11.24782

Analysis of sectoral import and export changes under the different scenarios so far has indicated that tariff cuts has a very diverse impact on the sectors involved. However, similar to the sectoral output changes, there are no major shift in the export and import ranks on the sectoral level arising from tariff reductions adopted in the different scenarios. The top five sectors in export and import remained at their respective positions across the different scenarios. Yet, the ranking of sectors that gained the greatest export and import shares in Tables 4.20 and 4.21 below clearly indicates that the sectors that are directly impacted by tariff reductions are the one that experience the greatest change in trade volumes. Overall, the results also showed that the AFTA has a greater impact on trade flow than IJEPA and thus when the both agreement are in place, the effect of AFTA is the dominant one.

Table 4.20: List of sectors with the largest increase in export shares (%)

IJEPA	Changes in Shares	AFTA	Changes in Shares	AFTA + IJEPA	Changes in Shares	AGRI AFTA + IJEPA	Changes in Shares
ome	0.12	ome	0.42	ome	0.55	ome	0.54
tex	0.05	mvh	0.39	mvh	0.44	mvh	0.44
mvh	0.04	crp	0.35	crp	0.38	crp	0.37
crp	0.03	otn	0.13	otn	0.13	otn	0.13
wap	0.03	fmp	0.04	fmp	0.04	ocr	0.07

Table 4.21: List of sectors with the largest increase in import shares (%)

IJEPA	Changes in Shares	AFTA	Changes in Shares	AFTA + IJEPA	Changes in Shares	AGRI AFTA + IJEPA	Changes in Shares
mvh	0.08	ome	0.20	ome	0.24	ome	0.22
ome	0.04	mvh	0.11	mvh	0.18	mvh	0.18
tex	0.02	i_s	0.05	trd	0.05	pcr	0.08
pfb	0.01	otn	0.05	otn	0.05	sgr	0.05
trd	0.01	trd	0.05	i_s	0.04	trd	0.05

In conclusion, there seems to be a correlation between the changes in output and the changes in export and import share of some sectors. Under the IJEPA scenario, the 'ome' and 'tex' are both among the top 5 sectors with the greatest increase in both output and export share. Results of the AFTA scenario where the 'ome' and 'mvh' sectors saw the greatest increase in export-import share and output over the BAU continue to support the idea that increased output is closely linked with increased in export and import shares.

Welfare Changes due to Trade Liberalization

Thus far, the discussion of the results has focused on changes in output and trade arising from the trade policy adopted in the different scenarios. Yet, how did these different policies affect the welfare of the different region involved? Table 4.22 below outlines the welfare changes that occur across the four scenarios together with the decomposition of total welfare into three components: allocative efficiency, term of trade (ToT) and investment goods-saving (I-S) effects. Welfare results indicate that trade liberalization lead to welfare level improvement in agreement countries at the expense of non-agreement countries resulting in a net loss in global welfare. The distributions of welfare increase among agreement countries however are varied. Further analysis into the components of welfare changes showed that the source of welfare gain for the agreement countries differed and positive ToT effect played an important role in this gain. For Indonesia allocative efficiency also increased with greater trade integration. Unfortunately, these welfare measures did not take into account the value of the environment, ignores the impact of resource depletion and pollution in their assessment. Therefore it will be interesting to study the impact of the tariff reduction on pollution to provide a more analysis.

Table 4.22: Welfare gain arising from trade liberalization (US$ million)

IJEPA	Allocative Efficiency	Term of Trade	I-S Effect	Total
Indonesia	8.9	-21.4	127.4	114.9
Japan	48.9	341.3	-90	300.2
ASEAN	-15.2	-61.6	3.7	-73.4
Total	-26.6	0	0	-26.6
AFTA	Allocative Efficiency	Term of Trade	I-S Effect	Total
Indonesia	29.5	268.1	-64	233.7
Japan	-17.3	-137.4	29.5	-125
ASEAN	-8.4	86.4	7.3	85.1
Total	-102.2	0	0	-102.2
AFTA+IJEPA	Allocative Efficiency	Term of Trade	I-S Effect	Total
Indonesia	50.9	246.9	58.7	356.4
Japan	30.8	203	-60	173.7
ASEAN	-32.8	19.6	12.5	-0.8
Total	-125.6	0	0	-125.6
Agri AFTA+IJEPA	Allocative Efficiency	Term of Trade	I-S Effect	Total
Indonesia	84.9	260.3	58	403.2
Japan	24.9	196.9	-58.6	163
ASEAN	-57.9	53.1	10.3	5.6

Total	-125.2	0	0	-125.2

4.3 Environmental Impact of Growth in the BAU Scenario

Thus far, the discussion has focused mostly on the economic changes Indonesia. Yet, the growth in output in the Indonesian economy is expected to have a direct impact on the environment. Table 4.23 shows the summary of the changes in the level of pollution indicators of Indonesia in the BAU scenario. While it is expected that the pollution level in Indonesia will increase, the rate of growth in air pollution greatly exceeded the rate of output growth. By 2022, the emission of CO2 and NO2 has increased by 731% and 664% respectively, which is more than double the rates of output growth (263%) while CH4 emission grew by 497%. In general water pollutions growth appears to be slower than those of air pollutions. The COD indicator grew by 374% while BOD and SS grew by 228% and 96.9% respectively. Further analysis each of these emission growths revealed several interesting trends on the sectoral level.

Table 4.23: Changes in pollution indicators in BAU scenario in Gigagrams (Gg)

	2001	2007	2012	2017	2022
CO2 (Gg)	222079.3	450779.1	792970.2	1273543	1845504
CH4 (Gg)	7163.029	14096.15	21117.96	30041.04	42785.35
NO2 (Gg)	110.4962	263.8143	430.1832	625.5395	844.4202
BOD (Gg)	1176116	1542913	1984898	2715441	3861099
COD (Gg)	1152592	1599655	2227525	3390385	5470303
SS (Gg)	13726.41	15595.04	18047.56	21834.54	27028.27

CO2

In CO2 emission, the ‘otp’ sector has emerged to play a leading role in driving the increase of emissions. In 2022, it emitted 822506 Gg of CO2, accounting for 44.6% of total CO2 emission. This large increase in emission appears to be driven primarily by the deteriorating coefficient of the sector, which increased by 522% in2022. As the main source of CO2 emission, the share of ‘ely’ sector has declined over the years, from 29.7% in 2000 to only 5.6 % in 2022 as projected improvement in its CO2 coefficient helped to slow down emission growth to only 57% over the period despite output growth of 228%. There is a clear picture however, that fuel production, processing and consumptions will form the large part of CO2 emissions in Indonesia in the future.

Table 5.24: Top 5 sectors in CO2 emissions

2000	Share (%)	2007	Share (%)	2012	Share (%)	2017	Share (%)	2022	Share (%)
ely	29.8	otp	33.0	otp	39.2	otp	42.5	otp	44.6
otp	17.6	ely	13.2	oil	9.7	oil	9.9	oil	9.3
p_c	8.1	p_c	10.4	p_c	9.7	p_c	8.6	p_c	7.6
nmm	6.2	oil	8.1	ely	8.5	ely	6.6	ely	5.6
gas	5.8	atp	3.6	gdt	4.6	gdt	5.3	gdt	5.6

CH4

In the case of CH4, the three most important contributor in Indonesia are the ‘osg’, ‘pdr’ and ‘oap’ sectors, each emitting 16738.33Gg (38.9%), 13254.12Gg (30.8%) and 6729.69 (15.7%) respectively in 2022. Among them, the ‘oap’ sector grew the fastest as it increased by 749%, followed by ‘osg’ at 628% and ‘pdr’ sector at 314%. For the ‘oap’ and ‘pdr’ sector, the deterioration of emission coefficients contributed to this rapid growth as both sectors despite a decline in their output share. As for the ‘osg’ sector, the increase of output appears to be the main factor driving the pollution growth since its CH4 coefficient was projected to only deteriorate slightly. In conclusion, this observation highlights that the agricultural sectors played a very important role in CH4 emissions.

Table 5.25: Top 5 sectors in CH4 emissions

2000	Share (%)	2007	Share (%)	2012	Share (%)	2017	Share (%)	2022	Share (%)
pdr	44.7	pdr	44.2	pdr	41.0	pdr	36.6	osg	38.9
osg	32.1	osg	27.9	osg	28.0	osg	31.5	pdr	30.8
oap	11.1	oap	14.8	oap	16.3	oap	16.6	oap	15.7
gas	4.0	ctl	6.3	ctl	8.4	ctl	9.5	ctl	9.4
ctl	3.4	gro	2.5	gro	3.1	gro	3.2	gro	3.0

NO2

Sectoral analysis of NO2 pollution indicates that there are slight changes in the sectoral composition of emissions with the ‘pdr’, ‘v_f’ and ‘gro’ sectors being the top three emitters of NO2 in 2022, emitting 190.4 Gg (22.5%), 136.22 Gg (16.1%) and132.2 Gg (15.7%) respectively. However, there is a steady decline in the NO2 pollution shares of the ‘pdr’ and ‘v_f’ sectors while the ‘gro’ and ‘otp’ sector are seeing an increase in their NO2 pollution share. The decrease in the ‘pdr’ and ‘v_f’ are caused by the decrease in the output share since their NO2 coefficient expected to increase by 228% and 204% respectively. On the other hand, the rapid rise in the NO2 emission share of the ‘gro’ and ‘otp’ sectors is driven by the increase in their pollution coefficient that increases by 756% and 3724% respectively. Despite these changes, the NO2 pollution ranks remain relatively the constant.

Table 5.26: Top 5 sectors in NO2 emissions

2000	Share	2007	Share	2012	Share	2017	Share	2022	Share

	(%)		(%)		(%)		(%)		(%)
pdr	30.5	pdr	29.2	pdr	27.0	pdr	24.7	pdr	22.5
v_f	23.4	v_f	21.4	v_f	19.5	v_f	17.6	v_f	16.1
oap	8.3	gro	12.1	gro	14.5	gro	15.6	gro	15.6
gro	8.0	pfb	9.9	pfb	10.9	pfb	11.0	pfb	10.6
pfb	7.4	oap	8.7	oap	8.6	oap	8.5	otp	10.3

BOD

BOD emissions in Indonesia throughout the BAU scenario are dominated by 3 sectors: 'lum', 'lea' and 'crp' that account for 92.3% of total BOD emissions. This is a trend that is observed through out the simulation period. However, in 2022, the 'lea' sector accounted for 39.6% of BOD emissions in Indonesia above the 'lum' sector that accounts for 33.5%. Given that the growth rates of the BOD coefficients among the different sectors are set to be equal, the changes is a reflection of the decline in 'lum' sector output share and the growth of the 'lea' sector's share.

Table 5.27: Top 5 sectors in BOD emissions

2000	Share (%)	2007	Share (%)	2012	Share (%)	2017	Share (%)	2022	Share (%)
lum	44.6	lum	43.9	lum	41.7	lum	38.1	lea	39.6
lea	23.1	lea	25.2	lea	28.5	lea	33.2	lum	33.5
crp	21.5	crp	21.0	crp	20.6	crp	20.2	crp	19.2
tex	4.2	tex	4.3	tex	4.4	tex	4.5	tex	4.4
ctl	3.4	ctl	2.9	ctl	2.6	ctl	2.2	ctl	1.9

COD

Similar to the BOD emissions, the top three sectors that dominate COD emissions in Indonesia is dominated are 'lea', 'crp' and 'lum' sectors. They account for most of the COD pollution calculated. However, unlike BOD, the share of COD emissions is highly concentrated in 'lea' sector, accounting for 80.9% of COD emissions by 2022 while the 'crp' and 'lum' sectors only accounted for 15.9% and 3.1% respectively. The high shares of COD pollution of the 'lea' sector can be contributed to its high COD coefficient of 223.8 Gg per unit output in 2000. Since, emissions coefficients over the period are projected to decrease at a steady rate for all sectors, the rapid growth in the ‘lea’ output has led to a very significant share of total COD emission originating from the sector.

Table 5.28: Top 5 sectors in COD emissions

2000	Share (%)	2007	Share (%)	2012	Share (%)	2017	Share (%)	2022	Share (%)
lea	68.2	lea	70.6	lea	73.5	lea	77.0	lea	81.0
crp	25.8	crp	23.8	crp	21.6	crp	19.0	crp	15.9
lum	5.9	lum	5.5	lum	4.8	lum	3.9	lum	3.1
ely	0.1	ely	0.1	ely	0.1	ely	0.1	ely	0.1
vol	0.0	vol	0.0	vol	0.0	vol	0.0	vol	0.0

SS

Unlike the other two water pollution, the three sectors that played an important part in BOD and COD did not contribute significantly to the SS pollution. While ‘lea’ and ‘crp’ sectors ranked second and third in term of SS emission shares in 2022, they only accounted for 9.2% and 3.0% respectively. Despite its steady decline, the ‘ctl’ sector accounts for 86.3% of total SS emission at 23320Gg. Again, given that emissions coefficient reductions are set to be uniform across all sectors, SS pollution share is is a direct reflection of the changing importance of output shares among the different sectors.

Table 5.29: Top 5 sectors in SS emissions

2000	Share (%)	2007	Share (%)	2012	Share (%)	2017	Share (%)	2022	Share (%)
ctl	93.7	ctl	92.5	ctl	91.2	ctl	89.2	ctl	86.3
lea	3.2	lea	4.0	lea	5.1	lea	6.7	lea	9.2
crp	2.0	crp	2.3	crp	2.5	crp	2.8	crp	3.0
tex	0.5	tex	0.6	tex	0.7	tex	0.8	tex	0.9

rmk	0.2	ely	0.2	ely	0.2	ely	0.2	ely	0.2

In conclusion, over the course of the BAU scenario is that there is a significant increase in all the pollution indicators. The changes in pollutions also appear to be driven mainly by a few select sectors rather than economy wide increases. The increase of emission of CO2 is driven by the ‘otp’ sector while in CH4 much of the increase can be attributed to the ‘pdr’ and ‘osg’ sector while it is a few agricultural sectors that drove the increase in NO2. A similar pattern can also be seen in the water pollution side where the ‘lea’ sector is a dominant contributor to the increase in BOD and COD pollutions while the ‘ctl’ sector is the sole driver behind the bulk of SS emission increases.

4.4 Environmental Impact of Trade Liberalization

With the projected rapid growth of pollution in the BAU case, it will be interesting to study the impacts AFTA and IJEPA on the pollution indicators. Table 5.26 below shows the changes in pollution indicator in each scenario compared to the BAU in the year 2022.

Table 5.30: Total changes in pollution indicators compared to the BAU scenario

	IJEPA	AFTA	AFTA + IJEPA	AGRI AFTA + IJEPA
CO2 (Gg)	1604.44	7647.45	8447.51	8787.70
%	0.09	0.41	0.46	0.47
CH4 (Gg)	-25.75	128.71	94.66	-53.37
%	-0.06	0.30	0.22	-0.12
NO2 (Gg)	0.04	-0.05	-0.21	-0.89
%	0.00	-0.01	-0.02	-0.11
BOD (Gg)	-4805.67	-40679.57	-47172.94	-45106.34
%	-0.12	-1.06	-1.24	-1.18
COD (Gg)	-14851.41	-116541.43	-134164.55	-129604.88
%	-0.27	-2.14	-2.51	-2.43
SS (Gg)	-23.92	-55.87	-88.36	43.65

%	-0.09	-0.21	-0.33	0.16

A quick look at the results indicates that the tariff reduction has varying impact on the different pollution indicators under different scenarios. However, the impacts are small in magnitude, ranging from –2.51% to 0.47%. While CO2 pollution increased in all the scenarios when compared to BAU, BOD and COD experienced a decline. For CH4, NO2 and SS pollution increased and decreased depending on the trade agreement adopted. Given these varying trends, it will be useful to analyze the changes to each pollution indicator individually and to explore them further on the sectoral level.

CO2

Indonesia's participation in both AFTA and IJEPA whether separately, combined or with the addition of agriculture tariff reductions appears to have a negative impact on CO2 emission in the country. More importantly, the greater the trade liberalization adopted, the greater the increase in CO2 emission. Under IJEPA, which is the least extensive and deep of the trade liberalization scenarios, CO2 emission in Indonesia increased only marginally by 0.09% compared to under the 'AGRI AFTA+IJEPA' scenario that saw CO2 emission increased by 0.47%. In all the scenarios, the 'ome' sector saw the largest increase in CO2 pollution followed by the 'otp' sector. For the 'ome' sector, the increase in CO2 emission is driven mainly by the increase in output as a result of trade liberalization while for the 'otp' sector, a high CO2 coefficient level helped magnifies the effect of small changes in its output.

CH4

Unlike CO2 emission, AFTA and IJEPA had different impacts on CH4 emission in Indonesia. Under the IJEPA, Indonesia saw only marginal changes in CH4 pollution, decreasing only by 0.06% where the 'osg' and the 'pdr' sectors that saw their CH4 emission declined by 9.02 Gg and 8.32 Gg respectively. For AFTA however, these two sectors contributed the most to the increase 0.40% increase in total CH4 pollution, as their emissions increased by 70.4 Gg (0.42%) and 39.6 Gg (0.30%) respectively. When both AFTA and IJEPA are adopted, the effect of IJEPA helps to dampen the increase of CH4 emission arising from AFTA resulting in a lower increase in total CH4 emission.

Lastly, CH4 pollution declined by 0.12% with the adoption of agriculture tariff reductions due to a decline in emission from the 'pdr' by 1.09% CH4. These results indicate that the 'osg' and 'pdr' sectors played an important role in the changes of CH4 emission in Indonesia.

NO2

The impact of AFTA and IJEPA seems to be minimal on the emission of NO2. In the IJEPA, AFTA and 'AFTA+IJEPA', there is almost no change in total emission when compared to the BAU scenario. However, the adoption of agriculture tariff cuts cause emission to decrease by 0.11% in the 'AGRI AFTA+IJEPA' scenario compared to the BAU case. Here, tariff cuts resulted in the decline of NO2 emission from the 'pdr' sector by 2.09 Gg (1.09%). Considering that the bulk of NO2 emissions considered originates from the agricultural sector, it is not surprising to see that it is the agricultural tariff cuts that have the most impact on NO2 pollution emission.

BOD

The results in table 5.26 indicate that BOD emission will decline in all trade liberalization scenarios. The decrease in BOD pollution however is much more significant under AFTA compared to under the IJEPA. In the IJEPA scenario, BOD pollution decreased by 0.12%. This small decrease is driven by the 'lea' sector whose BOD emission declined by 4367.62 Gg (0.28%) compared to the BAU case. Under AFTA, the 'lea' sector continued to significantly contribute to the decline of BOD emission as emission from the sector declined by 43698.8 Gg (2.86%). Combining the two set of tariff cuts, the 'AFTA+IJEPA' scenario saw the largest decline in emission as net BOD pollution decreased by 1.24% compared to the BAU case. The adoption of the agriculture tariff cuts however, resulted in a slight increase in BOD emissions compared to the 'AFTA+IJEPA' case. Studying the changes in BOD across the scenarios clearly indicates that the 'lea' sector played the most important role in the decline of BOD emissions.

COD

Similar to BOD, COD pollution declined under all scenarios with the greatest decrease seen in the 'AFTA+IJEPA' scenario. Since COD emission is closely associated with BOD pollution, similar pattern can be seen in COD emission changes like those in BOD emissions. Therefore, the decrease in COD emission is also driven by the decline of emission from the 'lea' sector. Under the IJEPA scenario COD emission from the 'lea' sector declined by 12661.2 Gg (0.28%) contributing the most to the total emission decline of 14851.4 Gg. The decrease in emission from the sector is even larger under AFTA as it declined by 126678 Gg. A similar situation is observed under the remaining two scenarios. Since the 'lea' sector contributed to 81.0% of COD pollution for the BAU case in 2022 due to its high pollution coefficient, any changes in the sector due to trade liberalization are expected to be magnified and thus have a big impact on COD emission level.

SS

For SS pollution, trade liberalization led to the decrease of emission in all scenarios except for the 'AGRI AFTA+IJEPA' scenario. SS pollution declined the most in the 'AFTA+IJEPA' scenario and much of this decline can be attributed to the 'lea' sector. In the IJEPA scenario, emission from the 'ctl' and 'lea' sector decreased by 16.3 Gg and 7.07 Gg respectively, accounting for most of the 23.9 Gg decline in SS emission. Under AFTA, the 'lea' sector emission declined by 70.8 Gg, resulting in negative net emission change. Similarly, in the 'AFTA+IJEPA' scenario, the 'lea' sector account for most of the decline in SS pollution in the scenario. However, in the 'AGRI AFTA+IJEPA' scenario, agricultural tariff reduction led to a slight increase in 'ctl' sector's output, causing its emission to increase by 112.87 Gg and resulting in a net increase in SS pollution. In conclusion, these observations indicate that 'ctl' and 'lea' sectors play an important role in the changes of SS emission arising from trade liberalization.

Chapter 5 Conclusion and Discussion

The relationship between trade reforms and the environment is a subject that is still much debated. The recent drive towards trade liberalization among developing nations has increase the concern that it will have a negative impact on the environment, especially given the lax environmental standard in most of these countries. Indonesia is a developing nation that has recently tried to further liberalized its economies by pursuing bilateral free trade agreements. However, it is also a country that is plague by a rising pollution issue, having emerged as one of the major polluter in the world. Thus, there is a concern that its participation may further deteriorate this situation.

Given this background, the current paper tries to estimate the impact of trade liberalization in Indonesia, more specifically its participation in AFTA and IJEPA, on the environment up to the year 2022 using a GTAP framework. Initial projection indicated that the Indonesian economy is expected to grow rapidly with a great consequence on its pollution emission. Indonesia's output is expected to grow by 263% by 2022, with the public administration and the electricity sectors playing a prominent role. However, there do not appear to have a significant change in Indonesia's export/import pattern during this period. This growth ufortunately is accompanied with a significant increase among the air pollutants. Emission of CO_2 grew the fastest as it increased by 731% to 1.84 million Gg with the transportation sector contributing to the bulk of it. Interestingly, air pollution emission grew at a much faster rate than the water pollution emission with BOD pollution growing by 228% to 3.86 million Gg.

In comparison with this base projection, the trade liberalization scenario results indicate that the agreements will only have a marginal positive impact on both Indonesia's economic output. Individually, AFTA appear to have a much greater impact on Indonesia compared to IJEPA as AFTA resulted in 0.47% increase in Indonesia's output compared to 0.11% under IJEPA. Combined, the agreements resulted in a 0.54% increase in output in Indonesia. The addition of agriculture tariff reductions, however, appear to have little impact on the projected output. Under all the scenarios, Indonesia is the country that gain the largest relative increase in output. The results also showed that in term of output, member countries benefited from the agreements while non-member countries loses out. The agreements, nevertheless, did increase Indonesia's export and import volume Indonesia especially in sectors that experience tariff cuts. Trade shares among member countries also increased. While trade liberalization created new export/import between agreement regions, the decrease of export/import to/from non-agreement regions indicates the preence of trade diversion. Such is the case in the IJEPA scenario. Last but not least, the agreements brought welfare gains to Indonesia and it increased with greater integration.

While there is a clear trend in the economic impact of the trade agreements on Indonesia, their impact on the environment is mixed at most. Among the air pollution indicators, the trade agreements on general have a negative impact on CO2 and CH4 emission while its effect in NO2 is negligible. Here, CO2 saw the greatest increase when Indonesia adopts both agreements, increasing by 0.47% compared to the BAU case. The results also indicate that adopting agricultural tariff liberalization will result in a reduction in CH4 pollution that can be contributed to the decrease in output from the paddy rice sector. On the other hand, the agreements did have a positive impacts on all water pollution indicators especially COD emissions. Including agricultural sector in the trade liberalization however reduced the decrease in water pollution as it encourages agriculture productions, which are a mjor source of water pollution. Sectoral analysis of these changes did, however, indicate that it is caused mainly by a few select sector. For example, the transportation sector played a significant role in CO2 pollution growth due to its high emission coefficient.

In conclusion, it appears that the Indonesia's current participation in AFTA and IJEPA as part of its trade policy is unlikely to have a huge impact both economically and environmentally.

5.1 Limitations and Further Consideration

Based on these results, there are a few areas of further research that may still be done. This study uses a static CGE framework that limits incorporating changes in total factor productivity. Therefore this provides an opportunity to carry out a comparative study using a dynamic CGE can be conducted to see whether the same conclusions will be derived. As with many environmental studies, obtaining a complete and reliable environmental data for the different indicators especially those of the developing countries has also been a challenge. This is an issue that plagues many economic studies in environmental assessment especially those dealing with multi-regions analysis. Last but not least, this study limits itself in analyzing the pollution impact of the agreements without looking into policies that can be adopted to negate them. It will interesting to study the different possible measures that can be done to minimize this growth, especially considering that Indonesia is already a major contributor of GHGs and does not have a substantial environmental policy to tackle this issue. These discussions hopefully will provide interesting areas that can be further explored in future studies.

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