Japan-Acta Integration Through Economic Impacts of Alternative EPA Scenarios[1].

-Examination of the GTAP 10A MRIO Database-

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ABSTRACT

This paper analyzes the impact on an economic partnership agreement (EPA) between African countries and Japan through trade liberalization and reduction in non-tariff barriers. This study aims to investigate sectoral interconnections and participation in the EPA that would facilitate further possible opportunities for the Japan-African businesses. The methodology employed is the Computable General Equilibrium model integrated with the Global Trade Analysis Project version 10A Multi-Region Input-Output database. We first modified the GTAP's structure form to develop a long-run closure under steady-state and thereafter examined the African Continental Free Trade Area-Japan Economic Partnership Agreement (AfJEPA) with several EPAs scenarios relying on the quantitative comparison of economic impacts of different technical measurements. As a result, the AfJEPA can provide new possible opportunities for Africa-Japan businesses, such as contributing to the existing African and Japanese mega-regional trade agreements. Specifically, the electronics, petroleum and coal, and chemical, rubber, and plastic industries in Africa would see the highest percent growth. Likewise, the Japanese industries would improve their productivity in the motor vehicles and transport equipment, chemical, rubber, and plastic, and textiles and apparel industries. To sum up, trade facilitation and knowledge transfer, which policymakers can improve concrete action and investment, would considerably stimulate African and Japanese real GDP. Thus, potential growth would rely on deep regulation policy through a degree of openness and initial level of trade barriers to each country.

Keywords: AfJEPA, AfJEPA-E, Welfare, Value-Added, GCE Modeling

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ABBREVIATIONS AND ACRONYMS

FTAs	Free Trade Agreements
MRTAs	Multi-Regional Trade Agreements
EPAs	Economic Partnership Agreements
NTBs	Non-Tariff Barriers
GTAP	Global Trade Analysis Project
GCE	General Equilibrium Model
MRIO	Multi-Region Input-Output
RCEP	Regional Comprehensive Economic Partnership
CPTPP	Comprehensive and Progressive Agreement for Trans-Pacific Partnership
ASEAN	Association of South-East Asian Nations
AJCEPA	ASEAN-Japan Comprehensive Economic Partnership Agreement
EUJEPA	European Union-Japan Economic Partnership Agreement
AfCFTA	African Continental Free Trade Area
AfJEPA	African Continental Free Trade Area-Japan Economic Partnership Agreement
ROW	Rest of the World
TSE	Technological Spillover Effect
SE	Spillover Effect
TFA	Trade Facilitation Agreement

1. INTRODUCTION

The spread of Corona-19 highlights the need for international cooperation and collaboration to address global issues. There is a need to strengthen global governing bodies/mechanisms such as World Health Organization (WHO) and World Trade Organization (WTO) to function effectively. To address global issues and to maintain a coherent and peaceful society, movements such as that of the mega-regional trade agreements (MRTAs) and economic partnership agreements (EPAs) play a key process as platforms that create regional and global cooperation frameworks based on mutual trust and interest among nations with cooperative orientations. Japan and countries in Africa strive to contribute towards regional and global cooperation frameworks despite the anti-globalization and state-capitalism sentiments. Japan is not only shaping and leading the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) but also is promoting the Regional Comprehensive Economic Partnership (RCEP). Likewise, Africa has also started increasing its free trade agreements (FTAs) and finally completed the African Continental Free Trade Area (AfCFTA) agreement. Indeed, Japan and Africa have been strengthening the links between their economies and the world economy in favor of perpetuating sustainable development and inclusive growth such as increasing each economy's welfare, and profit margin in the Global Value Chains (GVCs).

As many economies, Japanese and African industries face various problems and bottlenecks, but their participation in the EPA will facilitate further possible opportunities. Which would stimulate the development of international frameworks for promoting trade of goods and services, direct and indirect investment, and technological transfer. Also, Japan has been a bridge to strengthen the links between Africa and Asia-Pacific and acted as a front-runner in regional cooperation frameworks. Therefore, the purpose of this paper is to analyze the possible challenges and opportunities for Africa-Japan businesses. This paper examines the African Continental Free Trade Area-Japan Economic Partnership Agreement (AfJEPA) through trade liberalization and reduction in non-tariff barriers (NTBs) under the African and Japanese MRTAs. This study focuses on creative sectors and sectoral linkages, such as how much percentage of African production is necessary to meet the Japanese production and to produce African goods that are domestically consumed or exported to other countries. In conclusion, this paper makes some policy recommendations regarding the regional and sectoral integration which could boost the GDP, welfare, and other opportunities of Japan-African businesses.

Past literature reviews have focused on the impact of the CPTPP, RCEP, European Union-Japan Economic Partnership Agreement (EUJEPA), and AfCFTA (Biyik, 2020; Freund et al, 2018; Grübler et al., 2019; Ji, et al., 2018; Kawasaki, 2017; Rahman & Ara, 2015); but to fill in the research gap and contribute to existing trade studies, this paper examined the AfJEPA by using the Computable General Equilibrium (CGE) model relying on the Global Trade Analysis Project (GTAP) version 10A Multi-Region Input-Output (GTAP-

MRIO) database for the first time. This paper aimed to answer the following questions: to what extent of African and Japanese industries have been integrated based on production processes; how would tax policies, tariff elimination (TE), and NTBs affect each country's welfare and other macro variables; how would technological spillover and trade facilitation affect the sectors within the countries?

As a result of the AfJEPA, NTBs reduction and trade facilitation improvement compared to tariff removals would have a substantial growth in macro variables, which thereby would contribute positive value to the existing African and Japanese MRTAs. Specifically, Japanese industries would improve their productivity in the motor vehicles and transport equipment, chemical, rubber, and plastic, and textiles and apparel industries. In addition, the African electronics, petroleum and coal, and chemical, rubber, and plastic industries would see the highest percent growth. In short, this paper suggests that (i) the EPA including Japan would provide sustainable and promising growth strategies in African macro variables, (ii) trade facilitation and knowledge transfer, which policymakers can improve concrete action and investment, would considerably stimulate African real GDP, and (iii) only tariff liberalization policy would comparatively have less impact across regional real income growth. Thus, potential growth would rely on deep regulation policy through a degree of openness and initial level of trade barriers to each country.

Overall, African output relying on Japanese products is 1.4%; similarly, Japanese dependence on African industrial goods is between 1.1% to 5.5% throughout East Asian countries. Therefore, the EPA would constitute a strategy for Japanese growth, which has been suffering from long-term economic stagnation, allowing Japan to integrate effects of growth outside of Asia. In addition to this, Africa would enhance its economic development strategy by learning from Japanese MRTAs' experiments and integration and would have access to the Japanese high-tech market and capital.

This paper is organized as follows: after the introduction and literature review, the third section provides an explanation of the methodology and the data. The fourth section portrays the framework of the aggregation, tariff and NTBs, trade facilitation and technological spillover, and policy scenarios. The fifth section discusses the empirical results of the AfJEPA and AfJEPA-E. The sixth section then concludes the paper.

2. LITERATURE REVIEW

This section reviewed recent literature about AfJEPA and considered interpreting the MRTAs, such as AfCFTA, RCEP, and CPTPP (see below, sub-section 4.1) as a base case/condition. Empirically, existing studies have already examined the regional Asia-Pacific integration and landlocked African FTA using the CGE model interacted with the GTAP database and multinational Input-Output database.

Kawasaki (2015) and Kawasaki et al. (2019) focused on the analysis of EPAs in Asia-Pacific, such as the trans-pacific partnership (TPP) and RCEP. Other studies by Kawasaki (2017) and Ji et al. (2018) extensively examined the Asia-Pacific integration and alternative regional trade agreements (RTAs). As a result, they reported that NTBs reduction compared to tariff removals would have a strong impact on income gain, so that local market regulation would play a crucial process/role for economic growth from EPAs.

Likewise, Kuwayama (2019) examined CPTPP and alluded to the fact that building a rules-based trading system would help positively to shape the Asia-Pacific region in order to gain benefits from trade for all. Moreover, Biyik (2020), Grübler et al. (2019), and Felbermayr et, al. (2019) analyzed the EUJEPA and documented that non-tariff policy would have a positive impact on each countries' macro variables as well as supporting rules-based trading principles. Another contribution to MRTAs was when Africa finalized the AfCFTA. Accordingly, World Bank (WB) (2020a), Abrego et al. (2019), and African Development Bank (AfDB) (2020) demonstrated that the AfCFTA would have biggest benefit from reduction in NTBs and would provide many opportunity and potential gain through a degree of openness and initial level of trade barriers to each country.

Urata (2016) advocated that mega-free trade agreements (MFTAs) and the WTO could be complementary and that expanding MFTAs to a global level, will lead to the participation of new members and mergers with other MFTAs. Correspondingly, this paper also justifies that each EPA/FTA is complementary and would help to improve the agreements/relationships. In this sense, we generated our assumptions based on previous literature. Nevertheless, scholars have not comprehensively focused on the impact of the AfJEPA on contribution to MRTAs in terms of Japan and Africa. At the same time, few studies have considered the model of trade cost, the endogenous structure of capital, and exogenous trade balance. Consequently, the objective of this paper analyzed the AfJEPA and implemented the applied general equilibrium (AGE) model regarding the GTAP-MRIO database for the first time.

3. METHODOLOGY AND DATA SOURCES

This paper used the CGE model and GTAP-MRIO Database through which we investigated a trade integration between Japan and Africa and provided a description of (tariff) trade policy impact on each economy’s future. In general, the database allows scholars to broadly evaluate the effect of a reducing tariff shock in trade studies (Hertel, 1997). Therefore, we employed the CGE model as the appropriate approach to examine the effect of AfJEPA on Japanese and African markets. This paper modified closure under alternative long-run closure rules, such as capital accumulation and (perfect) capital mobility[2] following Walmslye (1998) and Francois et al., (1996), as seen in Appendix I.

As for the limited African countries' international trade integrated database[3], the GTAP database is to provide the most available data for African countries. The GTAP-MRIO database, which was launched in 2020 (Carrico, et al., 2020) and accounts for 65 sectors in each of the 141 regions, relies on the linkage model by implementing the GTAP 10A with the 2014 base year. The GTAP-MRIO model extends the standard GTAP, such as introducing agent (end-user as firms, consumers, and investors), and provides time series of input-output tables, bilateral trade flows, transport costs, tax (income and factor) and tariff information, and all other data calculating based on Social Accounting Matrices and elasticity parameters (Aguiar et al., 2019; Carrico et al., 2020; Hertel, 1997). The GTAP Database has denominated in millions of base year (2014) US dollars.

3.1. Modeling Trade Taxes and Iceberg Method

In the GCE model, we implemented tax policies and illustrated a simulation of the trade liberalization and reduction in NTBs. This paper draws tax and iceberg-related equations, following Walmsley Strutt (2019) and Kawasaki (2015). As for the demand function, demand for import $(Q_{s,d})$ relies on Armington CES in the GTAP model obtained from maximizing utility function[4] ($U_{s,d} = [\sum_{s=1}^{n}(Q_{s \cdot d})^{\rho}]^{-\frac{1}{\rho}}$) and budget constrain ($X_d = [\sum_{s=1}^{n} P_{s,d} . Q_{s,d}]$) . Policymakers use the import and export taxes T $\left(1 + T_{s,d}^{m}\right.$, representing the GTAP model$\left.\right)$ to estimate trade liberalization. Thus, import demand with trade taxes represents in Armington (1969):

$$Q_{s,d} = Q_d \left[\frac{P_{s,d}\left(1 + T_{s,d}^{m}\right)}{P_d}\right]^{\sigma} \tag{1}$$

$P_{s,d}$ is the prices of import c from s for use by region d, inclusive of import tax price.

Where: c is the community, s is the source country, and d is the destination country.

Equation 1 is formalized in the GTAP-MRIO model:

$$QXS_{c,s,d} = QIM_{c,d} \left[\frac{PCIF_{c,s,d} \cdot TMS_{c,s,d}}{PMS_{c,d}}\right]^{-ESUBM_c} \tag{2}$$

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[2] Although some study suggested for saving to be invested in the home country, this paper assume perfect capital mobility because foreign capital contributing high growth rate in host country.
[3] Possible MRIO datasets: the WIOD, Exipol, EORA, and GTAP which Owen (2017) and Walmsley at al. (2014) provide more detailed
[4] ρ is an elasticity of substitution parameter between goods in different countries which account for $\left(\sigma = \frac{1}{1+\rho}\right)$.

Equation (2) shows that when tariff, $TMSA_{c,a,s,d}$ ($TMS_{c,s,d}$), start imposing or eliminating, import price change depends on the import of c from s (exporter) for use by agent (a) in region d (importer).

P_d (or $PMS_{c,d}$ in the GTAP-MRIO) is the commodity price of import in region d;

σ (or $ESUBM_c$ in GTAP-MRIO) is the elasticity of substitution between goods from different countries s;

$Q_{s,d}$ (or $QXS_{c,s,d}$ in GTAP-MRIO) is the demand for goods from the county s by country d; and

Q_d (or $QIM_{c,d}$ in GTAP-MRIO) is the demand for imported goods by d.

In the concept of import and export linkages, the free on board (FOB) price and the cost, insurance, and freight (CIF) prices link for export and import prices for each commodity.

In percent changes as a shown lowercase letter in the GTAP-MRIO model:

$$pamds_{c,a,s,d} = pcif_{c,s,d} + tms_{c,s,d} \tag{3}$$

$$pfob_{c,s,d} = pds_{c,s,d} + txs_{c,s,d} \tag{4}$$

Where: $pamds_{c,aa.s.d}$ is the basic price of import c from s for use by an agent a in d;

$pfob_{c,s,d}$ is the FOB price of commodity c from source s to destination d;

$pcif_{c,s,d}$ is the PCIF price of commodity c from source s to destination d;

$pds_{c,s,d}$ is the price of commodity c from source s;

$tms_{c,s,d}$is the import tax rate applied on commodity c; and

$txs_{c,s,d}$ is the export tax rate applied c.

Tariff elimination leads to a reduction of the cost of input and subsequently has a positive impact on the flow of commercial products. Also, trade facilitation agreements and NTBs improving the quality of commercial goods maximize the FTAs' potential benefits. Accordingly, it is the most common approach to model the trade facilitation in trade liberalization and NTBs, we use the iceberg cost variable, $\tau_{s,d}$ or $AMS_{c,s,d}$ which presents "value melt away". Therefore, the demand for import $\left(\frac{Q_{s,d}}{\tau_{s,d}}\right)$ changes so that utility function becomes; $U_{s,d} = \left[\sum_{s=1}^{n} \left(\frac{Q_{s,d}}{\tau_{s,d}}\right)^{\rho}\right]^{-\frac{1}{\rho}}$ and budget constraint becomes; $X_d = \left(\sum_{s=1}^{n} P_{s,d} \cdot \frac{Q_{s,d}}{\tau_{s,d}}\right)$. Demean function would be formalized in equation 5:

$$\frac{Q_{s,d}}{\tau_{s,d}} = Q_d . \left[\frac{P_{s,d} . \tau_{s,d}}{P_d}\right]^{\sigma} \tag{5}$$

$P_{s,d}$ is the prices of import c from s for use by region d, inclusive of iceberg cost.

In the GTAP model,

$$\frac{QXS_{s,d}}{AMS_{c,s,d}} = QIM_{c,d}\left[\frac{PCIF_{c,s,d} \cdot AMS_{c,s,d}}{PMS_{c,d}}\right]^{-ESUBM_c} \tag{6}$$

In percent changes as a shown lowercase letter in the GTAP-MRIO model:

$$qxs_{c,s,d} = qms_{c,d} - ams_{c,s,d} - ESUBM_c\left(pamds_{c,a,s,d} - ams_{c,s,d} - pms_{c,d}\right) \tag{7}$$

Where: $ams_{c,s,d}$ is the percent change in augmenting iceberg cost of commodity c from s to d; and

$qms_{c,d}$ is the percent change of aggregate imports of commodity c in each region.

Hertel et al. (2001) and Walmsley and Strutt (2019) expressed that the iceberg cost variable ($\tau_{s,d}$ or $AMS_{c,s,d}$), which substitutes quantity demand by reducing the input price of an imported commodity through Armington CES, reduces the amount of imported goods because of the productivity effect from technological change. These two opposite directions have a positive impact on reducing the price and increasing demand due to the different multiplier elasticity on domestic and import goods. Nevertheless, note that $ams_{c,s,d}$ shock[5] directly creates productivity shock and thereby boosts real GDP growth considerably (Walmsley & Strutt, 2019).

4. POLICY SIMULATION SCENARIOS

Scholars extensively use the GTAP model to document economic integration and FTAs, applying reductions in trade costs, liberalization of agriculture and industry, and the cross-border flow of people, capital, and technology (Hertel, 2013; van Meijl & van Tongeren, 1999). In this section, we summarized the information on the implication of regional and sectoral aggregation and tariff liberalization and reduction in NTBs, as well as trade facilitation and technological spillover impact on FTAs.

4.1. Regional and Sectoral Aggregation

Firstly, Japan has a high FTAs coverage ratio of export and import, more than 80% (Table A4). ASEAN-Japan Comprehensive Economic Partnership Agreement (AJCEPA) took effect in 2008. In terms of mega FTAs, CPTPP and EUJEPA were a force in 2018, and 2019, respectively. Lastly, after the Indian decision

[5] However, Walmsley and Strutt, (2019) investigated that using the *AMS* shock is inconsistent with the impact on importing countries in terms of real trade volume that quantity exported is less that quantity imported.

of RCEP, it finally signed in November 2020. Likewise, African countries (44 of its 55 member states) signed the AfCFTA agreement in March 2018 and came into force in April 2019 for 22 countries (African Union, 2019).

As for regional and sectoral aggregation, we aggregated the data depending on Japanese and African FTAs and past literature contributions. Thus, this study used the 2014-year base as the last reference year and aggregated 12 regions and 18 sectors (Table 1), as shown in the GTAP concordance in Appendix II. Specifically, we first eliminetd tariff levels of the AfCFTA and the Japanese MRTAs to be a baseline condition and right after started examining the AfJEPA. Which would present potential gain from each agreement and would demonstrate the contribution of the new EPA to Japan and Africa.

Table 1: Classification of Region, Sector, and FTAs

Regions	Origin of Classification Name	Sectors	Origin of Classification Name
Japan	Japan (JPN)	***Agriculture***	Agriculture (AGR)
Korea	Republic of Korea (KOR)	***Fossilfuels***	Fossil fuels (FFL)
China	China (CHN)	***Minerals***	Minerals, NES (OXT)
USA	The United States of America (USA)	***ProcFood***	Processed foods (PFD)
India	India (IND)	***WoodPro***	Wood and paper products (WPP)
ANZ	Australia (AUS), New Zealand (NZL)	***TextWapp***	Textiles and wearing apparel (TWP)
ASEAN6	Cambodia (KHM), Indonesia (IDN), Lao PDR (LAO), Philippines (PHL), Thailand (THA), rest of Southeast Asia-Myanmar-(XSE)	***EnergyIPro***	Energy-intensive manufacturing (KE5)
ASEAN4	Malaysia (MYS), Singapore (SGP), Brunei Darussalam (BRN), Vietnam (VNM)	***PetCoal***	Petroleum and coal products (P_C)
CMCP	Canada (CAN), Mexico (MEX), Chile (CHL), Peru (PER)	***CheRuPla***	Chemical, rubber, and plastic products (CRP)
EU	The European Union (EU)'s 27 countries	***Manufactures***	Manufactures, NES (XMN)
Africa	AfCFTA countries	***Electronic***	Electronics (XELE)
ROW	Rest of the World	***Automobile***	Motor vehicles and transport equipment. (MVT)
		Construct	Construction (CNS)
AJCEPA	Japan, ASEAN4, ASEAN6	***TradeServic***	Trade services (TRD)
CPTPP	Japan, ASEAN4, CMCP, ANZ	***TransComm***	Transport and Communication Service (TPCS)
RCEP	Japan, Korea, China, ASEAN4, ASEAN6, ANZ	***FinanServ***	Financial services, NEC (OFI)
EUJEPA	Japan, EU	***BusiServ***	Business services (XBS)
AfJEPA	Japan, Africa	***PublicServ***	Public services (XSV)

Source: Source: author's aggregation based on GTAP 10A MRIO Data Base.

On one hand, each country regarding FTA has a different economic structure following the percentage of expenditure in GDP and population in the world. For example, the export percent in ASEAN countries' GDP is comparatively much higher than the export percent in East Asian countries' GDP. Moreover, while EUJEPA, RCEP, and CPTPP have positive trade balance, AfJEPA's export is lower than its import (Table A3). Furthermore, RCEP, AfCFTA, EUJEPA, and CPTPP account for 30.3%, 17%, 7.9%, and 6.8% world population, respectively (Table A3). Therefore, enhancing each economic integration, such as AfJEPA, would provide a possible opportunity for the world population.

4.2. Tariff and Nontariff Barriers

Regarding GTAP data version 10A, the reference year 2014, tariff data shows import tax imposed in RCEP countries have higher tariff levels than CPTPP members due to the heavily protected processed food industries (Table A5). Likewise, the African import tariff level is higher than the Japanese. In addition to inter-sector tariff heterogeneity, Africa protects its manufacturing industries in which average tariffs are close to 8%. Conversely, Japanese tariffs on the manufacturing industries are around 0 while Japanese tariffs on agriculture, processed food, and textile industries are comparatively higher than other industries in Japan (Table 2). Regarding sectoral self-sufficiency which presents a domestic share in total use, the Japanese market heavily depends on the import of energy resources and agriculture goods while electronic and automobile industries are highly self-efficient to export. As for the African economy, it is a rich energy resource landlocked but needs to meet mainly foreign manufacturers to produce its own goods. Thus, Japanese industries import energy resources from Africa whose industries import more motor vehicles and transport equipment from Japan (Table 2).

Table 2: Ad Valorem Tax Rate and Domestic Share in Total Use

	Bilateral Trade Flow of Japan and Africa				**Sectoral Self-Sufficiency**	
	Japanese Export to Africa		*African export to Japan*		**Japan**	**Africa**
	Tariff (%)	*Value ($)*	*Tariff (%)*	*Value ($)*		
Agriculture	3.9	$7	2.1	$697	0.765	0.995
Fossilfuels	0.1	$0	0	**$9,003**	0.010	**3.380**
Minerals	0.4	$2	0	$1,210	0.215	**1.690**
ProcFood	4.7	$79	6.3	$538	0.850	0.885
WoodPro	6.9	$25	0.1	$227	0.909	0.819
TextWapp	7.1	$273	7.3	$159	0.463	0.765
EnergyIPro	6	$1,045	0.2	**$3,452**	1.060	1.060
PetCoal	6.3	$235	0.7	$954	0.927	0.663
CheRuPla	8.3	$1,018	0.1	$255	1.090	0.661
Manufactures	7.4	$271	0.2	$31	0.971	0.709
Electronic	6	$953	0	$32	**1.130**	0.473
Automobile	13.3	**$9,340**	0	$723	**1.430**	0.496
Construct	0	**$1,275**	0	$180	1.000	0.978
TradeServic	0	$540	0	$429	1.000	0.995
TransComm	0	$488	0	$1,426	1.030	1.060
FinanServ	0	$71	0	$64	0.983	0.982
BusiServ	0	$1,015	0	$714	0.976	0.888
PublicServ	0	$391	0	$407	0.996	0.991

Source: GTAP 10A, author's calculations.

Moreover, trade services function to set up businesses, such as banks, to strengthens the connection between countries which leads to a smooth flow of commercial products. On the other hand, trade-in service is difficult to capture an impact by tariff but is instead affected by behind-the-border regulations and technical measurements such as Technical Barrier to Trade (TBT) and Sanitary and Phytosanitary (SPS) standard, as known NTBs simulating growing concern healthy and quantity and environmental attributes (Herghelegiu, 2018). Accordingly, many studies documented that reduction in NTBs is more beneficial to stimulate trade than the only tariff policy (Kee, et al., 2009; Webb et al., 2020).

Implementing NTBs in GTAP, this paper first translated NTBs to ad valorem equivalents (AVE) to be incorporated into the tariff and export taxes by applying the Altertax procedure (Malcolm, 1998), which modified the original database to minimize disturbances. In other words, this paper designed the model to minimize the changes to the rest of the database while the required change in tax rates is large (Walmsley & Strutt, 2019). The NTB changes were assumed to imply to most-favored-nation (MFN) countries. Moreover, it was assumed that removing tariffs in the NTBs would have 50% with spillover effect (SE) to third countries at 50 %. In other words, GDP gain from NTBs reduction relies on assuming a 50% of NTBs reduction with a 50% spillover effect. If the AVEs of NTBs in the RCEP member of Japan is 10%, we have assumed Japan will reduce the AVEs of NTBs by 5% (50% of NTBs) for the imports from RCEP member countries and by 2.5% (50% spillover effects of 50% NTBs reductions) from non-RCEP member countries. This is due to the reduction of the cost of compliance with foreign standards and regulations. This assumption was based on previous studies on AfCFTA, RCEP, and CPTPP (Kawasaki, 2017; Maliszewska & Ruta, 2020; Petri & Plummer, 2016). Estimating the quantification of NTBs from the Word Integrated Trade Solution (WITS) relies on Kee, Nicita, and Olarreaga's (2009) study. Moreover, service sectors in NTBs are documented by Jafari and Tarr (2017). This special case used trade weighs regarding the model's regions and sectors aggregated.

4.3. Trade Facilitation and Technological Spillover

Trade facilitation interacts with the cost of time delay at the border. Such FTA/EPA partners aim to improve reciprocal trade facilitation provisions that would lead to the smooth flow of commercial goods. For instance, CPTPP and ASEAN documented the "custom procedures under the trade in goods", representing advance ruling such as defining a harmonized standard, tariff classification, and valuation criteria and rules of origin are to secure participants and customers, as well as Niamey Declaration in AfCFTA (Ji et al., 2018; WB, 2020). Empirically, ADB and UNESCAP (2013) represented that the trade facilitation measurement had a positive impact on enhancing export/import performance and trade competitiveness, FDI, and GDP. Accordingly, this paper assumes that implementing the WTO's Trade Facilitation Agreement (TFA)[6] under EPAs/FTAs would have the benefit of average trade cost reduction of 0.9% for imports and 1.2% for export

[6] Scholars commonly use the iceberg cost variable ($\tau_{s,d}$ or $ams_{c,s,d}$) to model trade facilitation.

relying on Hillberry and Zhang (2018) study, roughly 7 % for AfCFTA regarding Maliszewska et al. (2020) and Melo and Sorgho (2019) papers.

In addition, joining the GVCs through FTA, which accounts for strong firm-to-firm relationships and specialization (specializing in specific parts and components) for the long term (WB, 2020b), can boost growth, create more jobs, and importantly reduce poverty (Aldaba, 2012; Nabeshima, et al., 2018). For example, empirical studies documented that international trade stimulated the cross-border flow of technology because knowledge is embodied in goods (Coe, Helpman, & Hoffmaister, 1997) so that a country importing commodities and receiving FDI is directly influenced by technology depending on its absorption capacity and its structural similarity (van Meijl et al, 1998). WB (2020b) also reported that multinational firms relocating their productions such as designing, producing, and assembling parts and components due to the most cost-effective location would have to exchange knowledge when their products meet the border restrictions, such as import-related law and regulations. Accordingly, such an emerging imitation or innovation in a country allows firms to reduce their input cost that may trigger an increase in their output under the multi-region and general equilibrium setting. This represents technical change gaining a competitive edge over exporters on the world market. Thus, this paper assumed that the cross-border flow of the knowledge would have the benefit of reducing an average of between 0.1% and 0.5% of input cost in trade commodities (Table 3). Basically, we assumed that the degree of knowledge regarding the percentage of export and import in total bilateral trade (Table A4) were to transfer: (i) from Japan to Africa and from Africa to Japan (whole sectors) (ii) only from Japan to Africa (electronic sector in particular). Note that the technological spillover effect (TSE) relies on strong assumptions through a technical change in the GTAP model. We implemented a simple assumption is to fit the closure. Further, we also address this limitation in sub-section 5.2, below.

4.4. Scenarios

In the policy experiment, this paper used the full version of model structure and parameter values regarding the aggregated data to represent economic reality in trade liberalization function as accurately as possible. This paper also examined selected FTAs/EPAs by estimating the quantification of the NTBs (Table 3). To capture the reality of the selected FTAs, this paper's assumptions were in line with previous studies on CPTPP, RCEP, and AfCFTA (Ji et al., 2018; Kawasaki, 2017; Maliszewska & Ruta, 2020; Petri & Plummer, 2016). In literature, common sense is that policymakers should consider underpinning trade facilitation, NTBs, and connectivity measurements that demonstrate a potential fruit of FTAs. To evaluate the quantitative impacts of selected FTAs, this paper implemented series of trade-related shocks: (1) up to full tariff elimination; (2) 50% of reduction in NTBs with 50% of a spillover effect to third countries; (3) up to

2.1% (roughly 7% for AfCFTA) of reduction of time in customs due to the TFA and up to 0.5% of the cross-border flow of technological spillover effect (Table 3).

Table 3: Summary of Simulation Assumptions

Regional Integration	FTA/EPA	Removal of Tariffs and NTBs on Selected FTAs		FTAs Impact in Long-Run	
		Tariff Reduction	***SE***	***TFA***	***TSE***
Asia-Pacific Integration	AJCEPA	Full removal of import tariff and export subsidies	No	1%	-
	CPTPP				
	RCEP				
Japan-EU Integration	EUJEPA				
Africa Integration	AfCFTA	97% of import tariff and export subsidies	No	3.5%	-
Japan-Africa Integration	AfJEPA	94% by Japan, 94% by African + 97% in AfCFTA	No	1% in AfJEPA, 3.5% in AfCFTA	0.1%
	AfJEPA in NTBs	50% of import tariff and export subsidies in NTBs	Yes	2.1% in AfJEPA, 7% in AfCFTA	0.2%
	AfJEPA-E	Same as AfJEPA			0.5%

Note: SE: Spillover Effect; TFA: Trade Facilitation Agreement; TSE: Technological Spillover Effect.

Source: Author's assumptions.

5. RESULTS OF THE ANALYSIS

This section presents the result of this paper's questions. We first modified the GTAP's structure form to develop a long-run closure (long-term macroenvironment) under steady-state, as shown in Appendix I. The long-term macroenvironment, through which capital can be mobile across regions, causes capital shock depending on a rate of return across regions and across time. We comparatively examined the two different approaches, *EXPAND*[7] and *RORC*[8], impact on real GDP growth and welfare[9], which will be discussed results in subsection 5.2, below. The difference is that in the case of *'expand'* closure, *'rorc'* remains endogenous, but is equalized across regions, while a change in investment relative to endowment stock is fixed/exogenous. When *'rorc'* became closure works, such as everything is captured by the expansion/change in quantities. Moreover, *'rorc'* has a positive correlation with a rental price of capital through substitution between capital and labor. Two different compensatory effects cause the price of capital goods to change: The first effect is a decrease in the price of capital goods due to the reduction in tariffs on imported inputs into capital goods and the second effect is conversely an increase of the price of capital goods because of increased demand for inputs (Walmsley, 1998)

As for portraying the result, this paper, firstly, eliminated tariffs for the AfCFTA and the Japanese MRTAs which created the base data set so that this paper would present the contribution of AfJEPA to Japan and Africa. Secondly, this paper displayed the AfJEPA, through which this paper revealed the trade facilitation

[7] expand(e,r) = qinv(r) - qe(e,r) in GTAP-MRIO; "r" is region and "e" is capital
[8] rorc(r) = GRNETRATIO(r) * [rental(r) - pinv(r)] in GTAP-MRIO; the rental price is determined by capital goods.
[9] See more detail in Francois et al. (1996) Walmsley (1998) papers.

improvement (TFI), NTBs, and TSE. Lastly, the knowledge transfer occurs in mainly electronics-related technology which was implemented and indicated the final scenario (AfJEPA-E) impact on each industrial value-added (Table 3). This section was divided into two subsections, sub-suction 5.1 and 5.2 below, and implemented long-run closure for the scenarios. We did not focus on presenting results with baselines simulation because the AfJEPA is a possible EPA. In other words, we did not consider updated data to run baseline scenarios due to minimizing unnecessary distortion. Nevertheless, we considered the contribution of economic impacts of several EPA scenarios relying on the quantitative comparison of economic impacts of different technical measurements, such as *rorc* and *expand*. Therefore, this paper's result came out differently than previous studies. Also, we preferred to demonstrate the equivalent variation (EV) and the real GDP impacts which look more familiar to policymakers.

5.1. African Continental Free Trade Area-Japan Economic Partnership Agreement

This paper analyzed the AfJEPA because of a sectoral integration, as presented in Appendix III. A sectoral integration between Japan and Africa, the AfCFTA would contribute by 0.004 percent of Japanese GDP, and the Japanese MRTAs would stimulate African GDP to increase between 0.001% to 0.015% throughout East Asian countries (Table A6). To enhance this integration, this paper suggested the EPA between Japan and Africa, called AfJEPA. In other words, not only would the AfJEPA constitute a strategy for growth for Japan suffering from long-term economic stagnation and allow Japan to integrate the effect of growth outside of Asia, but also Africa would enhance its economic development strategy by learning from Japanese MRTAs' experiment and would have accessed the Japanese high-tech market and capital.

Primarily, reducing tariff level leads comparatively to cheaper input, which constitutes competitiveness of local goods. Therefore, the AfJEPA would subsidize the African and Japanese markets and benefits to member countries, lowering the price of import and benefits customers of final (household) and intermediate (firms) goods. Therefore, trade liberalization and reduction in NTBs would deliver more promising gains for member countries. However, while there are countries with a higher level of MFN border protection and trade-to-GDP ratio that would gain more, imposing a low level of prevailing MFN tariff rates countries would have modest benefit through the EPA (Table 4 and Table A6)

In general, we analyzed the AfJEPA by implementing the two different approaches of *'rorc'* and '*expand'* closure. Technically, *'rorc'* closure has a strong impact on real GDP than '*expand'* closure; in contrast, the impact of *'rorc'* closure on welfare gain compared to '*expand'* closure has significantly less effect (Table 4). This is because '*expand'* closure leads (regional) saving to be invested in the home country and thereby is likely to improve (national) household income. In other words, *'rorc'* closure with endogenous '*expand'* allows the capital shock to spread out across regions and thereafter has a positive impact on other nations' welfare and GDP due to the positive effect of the flow of commercial goods. For instance, the EU with *'rorc'* closure which is not the trade deal would have a positive impact on its welfare from the AfJEPA due to EUJEPA and regional integration with Africa (Table 4). In short, while the *'rorc'* swap leads to comparatively higher impacts on GDP growth due to the large increase in capital shock, *'expand'* swap has a strong effect on raise welfare due to the regional saving and investment correlation. Therefore, to capture the efficient impact of the AfJEPA on macro variables, this paper preferred to present the result of the macro variables by using *'rorc'* swap, but only welfare by implementing *'expand'* swap because each variable should take into account different approaches regarding their own different condition.

Table 4: Aggregated Impact on Real GDP and Welfare

	NTBs			Trade Liberalization			Welfare (US$ millions)		
	Standard	Long-Run Closure		Standard	Long-Run Closure		Standard	Long-Run Closure	
		EXPAND	*RORC*		*EXPAND*	*RORC*		*EXPAND*	*RORC*
Japan	**0.136**	**0.147**	**0.319**	**0.06**	**0.121**	**0.175**	**$4,103**	**$5,975**	**$353**
Africa	**0.378**	**1.366**	**1.147**	**0.198**	**0.619**	**0.834**	**$7,399**	**$16,338**	**$12,479**
Korea	0.011	0.097	0.11	-0.003	0.017	0.018	($261)	($106)	$232
China	0.014	0.095	0.09	-0.004	0.011	0.01	($1,530)	($1,410)	$846
USA	0.001	0.005	0.008	0	0.006	0	($505)	$214	$112
India	0.015	0.127	0.069	-0.005	0.007	0	($497)	($385)	$124
EU	0.009	0.071	0.046	-0.004	0.025	0.027	($2,074)	$1,255	$2,892

Note: Standard references to standard GTAP model (RORDELTA=1)

Source: GTAP 10A MRIO Data Base, author's estimation

As a result of empirical analysis, AfJEPA would boost Japanese GDP by 0.175% in tariff elimination (TE) and 0.319% in NTBs, and African GDP by 0.834% in TE and 1.147% in NTBs (Table 4). This agreement with capital mobility would also stimulate other regions' GDP. For example, the EU could have a positive impact and could increase its GDP by 0.027% in TE and 0.046% in NTBs with capital shock; however, the AfJEPA would harm non-members' GDP in TE in terms of implementing standard closure, without capital shock (Table 4).

Table 5: Real GDP and Welfare (US$ millions) under AfJEPA

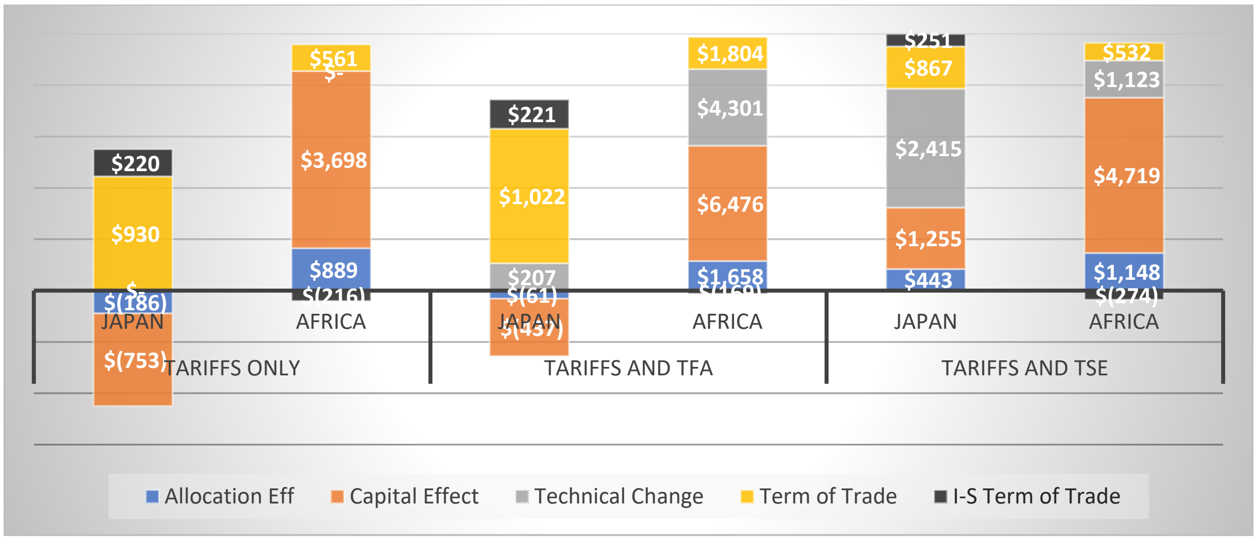
	NTBs with *RORC*			Trade Liberalization with *RORC*			Welfare (EV) with *EXPAND*		
	Tariffs only	Tariffs and TFA/TFI	Tariffs and TSE	Tariffs only	Tariffs and TFA	Tariffs and TSE	Tariffs only	Tariffs and TFA	Tariffs and TSE
Japan	**0.031**	**0.064**	**0.286**	**0.015**	**0.032**	**0.158**	**$943**	**$1,272**	**$3,774**
Africa	**0.253**	**0.939**	**0.461**	**0.295**	**0.733**	**0.397**	**$763**	**$6,259**	**$1,903**
Korea	0.088	0.098	0.1	0.006	0.012	0.012	($136)	($248)	($149)
China	0.074	0.082	0.083	0.002	0.005	0.007	($782)	($1,400)	($912)
USA	0.005	0.006	0.006	-0.001	-0.003	-0.001	($238)	($412)	($331)
India	0.025	0.036	0.035	-0.002	-0.004	0	($235)	($473)	($259)
EU	0.008	0.009	0.009	0.01	0.021	0.016	($971)	($1,933)	($1,112)

Note: TFA/TFI: Trade Facilitation Agreement/ Improvement; TSE: Technological Spillover Effect.

Source: GTAP 10A MRIO Data Base, author's estimation

This paper also investigated each instrument variable's impact, such as a calibrated change by only tariff effect, tariff and trade facilitation agreement (TFA), and tariff and technological spillover effect (TSE), respectively. Accordingly, we can track the most stimulant variable regarding GDP and welfare. It is also obvious that Japanese and African economic structures are different from their firms' input cost of land and labor. For example, while the TSE has a comparatively higher impact on Japanese real GDP than trade facilitation improvement (TFI), Africa gaining benefit from TFI would have remarkably a crucial effect of welfare than TSE (Table 5).

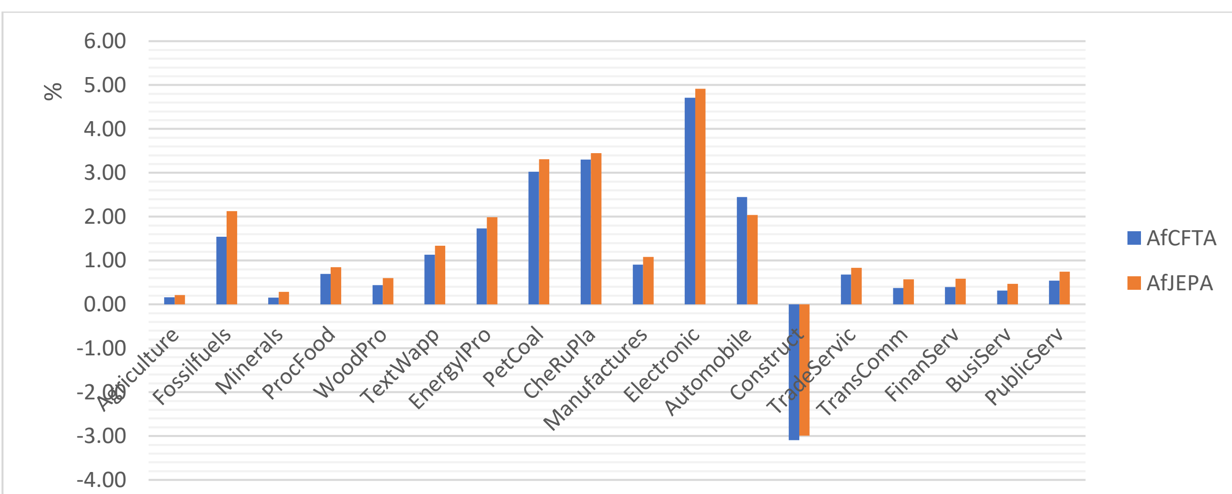
Figure 1: Source of Income Gaining from the AfJEPA (US$ millions)



Note: TFA: Trade Facilitation Agreement; TSE: Technological Spillover Effect. $() represents minus/negative value of US$ millions

Source: GTAP 10A MRIO Data Base, author's estimation

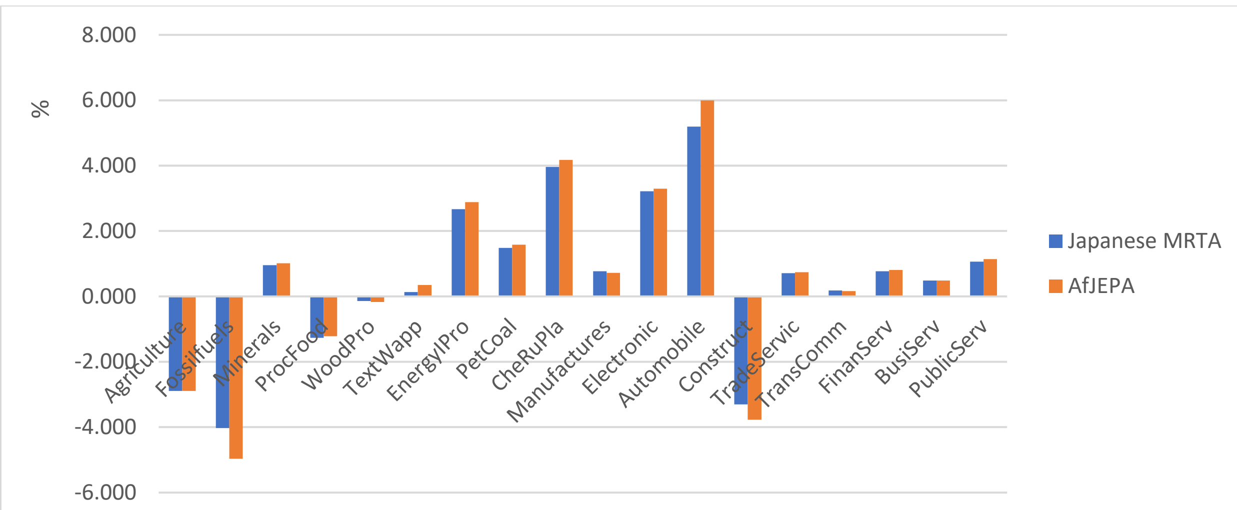
Figure 2: Value-added in Africa by the MRTAs



Source: GTAP 10A MRIO Data Base, author's estimation

To recapitulate the finding of the different instrument experiments, TFI and TSE have a larger impact on GDP than only tariff elimination. This is due to the fact that technological change directly increases the amount of production, but tariff elimination relatively affects saving and allocative effect, and mainly the term of trade effect in Japan and capital effect in Africa (Figure 1). Empirically, while the African market is quite sensitive to the TFI impact, boosting GDP by 0.733% in TE and 0.939% in NTB, the Japanese economy influences larger effect from TSE, enhancing GDP by 0.158% in TE and 0.286 in NTBs (Table 5), as well as the same impact accrued on their welfare growth (Figure 1). Africa would get a higher total welfare change due to the contribution of capital and allocation effect is positive, but negative in Japan which would cause by factor movement into the distorted each sector. Furthermore, another effect of the AfJEPA would have a negative value in African saving in which the TSE variable would lead to shrinking comparatively more (Figure 1).

Figure 3: Japanese Productive Sector by the MRTAs



Source: GTAP 10A MRIO Data Base, author's estimation

In this subsection, we demonstrated each agreement's contribution to African value-added and Japan's output percent change. Value-added would increase higher because capital, allocative, and technological improvements positively impact on factors (Figure1) that move out of the subsidized sectors (Figure 2). The AfJEPA would indeed contribute to AfCFTA and thereby have a positive impact on African value-added, the highest growth in the fossil fuel industry particularly (Figure 2). Likewise, adding a new EPA to Japanese MRTAs would comparatively have a small impact on Japanese output due to the regional and sectoral integration through export/import percent (Table A4) and therefore could contribute a positive impact on the output of agriculture, processed foods, wood and paper, manufacturing, and service industries mainly (Figure 3).

To summarize the key points here, we documented that GDP is not a useful instrument to present national welfare[10] (Table 4). We also reported that tariffs and TFA have a substantial impact on the Japanese and African economies. However, firms' cost of input relying on TSE analysis would be biased to distribute the possible impact on selected countries because this change should consider a specific technical change in the GTAP model, such as Meijl et al., (1999) did. Therefore, we modified the final scenario of AfJEPA-E to be a proper/simple approach and investigates it in subsection 5.2, below.

5.2. Technological Spillover Effect in Electronic Sector, AfJEPA-E

This subsection provided information on the final scenario that accounts for the different technological spillover effects from Japan to Africa (Table 3). An empirical study documented that most of the knowledge accrues in mainly consumer electronics industries, such as television, computer, and phone (van Meijl et al., 1999). Also, Timmer (1988) and van Meijl et al., (1999) analytically portrayed the "biased technical change in the agricultural sector" due to the limited experiment capacity of biological and mechanical technology. Moreover, Japan has relatively a higher land and labor share in its costs and, therefore, would receive a larger gain than Africa through TSE (Table 5 and Figure 1). In that sense, we assumed there would be a 0.5% technological spillover effect on only African electronic sectors from the advanced/innovative country, Japan (Table 3). Since we investigated different impacts of each instrument (Tariff and TFA) on real GDP and welfare in the subsection of 5.1, above, we focused on presenting the AfJEPA-E effect on African and Japanese macroeconomic variables in this subsection.

Table 6 shows the real GDP growth and welfare change for only Japan and African countries. The AfJEPA would provide many opportunities for Japan-African business, as well as non-members countries (Table 5; 6). African countries would enjoy through not only AfCFTA but also AfJEPA-E (Table 6; Table A7). Specifically, Southern Africa would have a relatively higher real income growth rate and welfare gain (by 1.49% and 6,496 US$ millions, respectively) than other regions. As for each country[11], Namibia, Botswana, and Burkina Faso could be the top three highest real GDP growth rate countries, increasing[12] by 10.14%, 4.94%, and 4.04%, respectively. Besides, East and North Africa would importantly improve their welfare gain. Similarly, the Japanese economy gaining benefits from AfJFTA-E would improve its real income by 0.03%. More importantly, including Japan in the EPA compared to AfCFTA would remarkably hike up real GDP in Egypt and Tunisia, increasing from 0.07% to 0.30% and from 0.17% to 0.43%, respectively

[10] Walmsley (1998) also reported that GDP change by ownership of capital shock does not consider and should not be correlated welfare change. However, dynamic model can capture the change in the ownership of capital and rental income earned which represents impact of regional income on regional welfare.
[11] As for AfJEPA-E contribution to each African country, we presented comparatively AfCFTA and AfJEPA-E in Appendix III (Table A7).
[12] Note that the large difference in distribution between Japan and African countries' GDP is because of the distribution of trade-related shocks, export/import percent in total trade, and regional integration.

(Table A7). In addition to this, TSE-related electronics would have a relatively strong impact on Tunisia and the Rest of South Africa (Table A7).

Table 6: AfJEPA-E Impact in Trade Liberalization

	Real GDP with *RORC*				Welfare (EV) with *EXPAND*			
	Total	**Tariffs only**	**Tariffs and TFA**	**Tariffs and TSE**	**Total**	**Tariffs only**	**Tariffs and TFA**	**Tariff and TSE**
Japan	***0.033***	***0.015***	***0.032***	***0.015***	***$982***	***$232***	***$960***	***$255***
Africa	***0.776***	***0.295***	***0.732***	***0.339***	***$14,798***	***$5,216***	***$14,019***	***$5,996***
Northern Africa	0.341	0.132	0.289	0.184	$2,220	$850	$1,923	$1,146
Egypt	*0.302*	*0.179*	*0.261*	*0.221*	*$332*	*$322*	*$248*	*$406*
Morocco	*0.273*	*0.061*	*0.23*	*0.104*	*$489*	*$199*	*$447*	*$242*
Central African	**1.24**	0.608	1.21	0.638	$1,372	$782	$1,348	$806
Cameroon	*0.603*	*0.398*	*0.59*	*0.411*	*$130*	*$65*	*$126*	*$69*
Southern Africa	**1.497**	0.549	1.419	0.627	**$6,398**	$2,048	$6,064	$2,382
Namibia	***10.139***	*2.692*	*10.042*	*2.79*	*$870*	*$296*	*$862*	*$304*
Botswana	***4.938***	*0.602*	*4.91*	*0.63*	*$476*	*$27*	*$474*	*$30*
East African	1.022	0.37	0.992	0.4	$3,383	$1,314	$3,292	$1,405
Ethiopia	*0.314*	*0.241*	*0.303*	*0.251*	*$173*	*$109*	*$168*	*$115*
Kenya	*0.769*	*0.353*	*0.715*	*0.407*	*$394*	*$154*	*$366*	*$182*
Mozambique	***3.118***	***0.754***	*3.095*	*0.777*	*$438*	*$91*	*$435*	*$94*
Western Africa	0.72	0.353	0.692	0.381	$1,773	$757	$1,695	$834
Burkina Faso	***4.044***	*2.242*	*3.999*	*2.287*	*$437*	*$235*	*$432*	*$240*
Senegal	*1.817*	*0.689*	*1.738*	*0.768*	*$412*	*$160*	*$403*	*$169*

Note: TFA: Trade Facilitation Agreement; TSE: Technological Spillover Effect.

Source: GTAP 10A MRIO Data Base, author's estimation

This paper also supports Strutt's and Walmsley's (2019) paper and documented that the iceberg cost variable ($\tau_{s,d}$ or $ams_{c,s,d}$) has a productivity impact through reducing the cost of (importer) rent which leads to directly boost value-added growth. The larger you use TFA/TSE the larger productivity is to boost directly sectoral output and value-added. Also, the African tariff rate is higher than the Japanese tariff level (Table 2). As a result, African industries would have a positive impact from the tariff, tariff plus TFA, tariff plus TSE, and thereupon could considerably improve their value-added. In detail, the electronics, petroleum and coal and chemical, rubber, and plastic industries in Africa would be the highest percent growth while only the African construction industry would have a negative value, shrinking by 3.17% (Table 7). Besides, the Japanese industries would improve their productivity in the motor vehicles and transport equipment, chemical, rubber, and plastic, and textiles and apparel industries; however, the fossil fuel and construction industries in Japan would negatively have an influence on value-added (Table 7).

Table 8 shows the result of industrial production and consumption change through AfJEPA-E. That is, we investigated the trade dependence of industrial production and consumption change because of a trade-related policy strategy for policymakers. As a result of the EPA, the Japanese and African industrial export share in total production would increase due to the decreased trade-related input cost and increased trade flow of commercial goods. Specifically, whereas the Japanese mining, fossil fuel, and financial service industries' export percent in total output could shrink, the automobile, construction, and textile and apparel industries in Japan would take leads, increasing by 0.9% 0.5%, and 0.4%, respectively (Table 8). However, Japanese import share in its industrial consumption has a different structure. The consequences of increased export would forward the energy-intensive manufacturing and automobile industries in Japan to demand more for import products due to the limited Japanese energy resource; however, the Japanese construction, manufacture, and electronics industries would comparatively decrease to consume import-related production (Table 8).

Table 7: Value-Added in Japan and Africa (%)

	Africa				Japan			
Sectors	***Only Tariffs***	***Tariffs and TFA***	***Tariffs and TSE***	***Total***	***Only Tariffs***	***Tariffs and TFA***	***Tariff and TSE***	***Total***
Agriculture	0.087	0.196	0.096	0.205	-0.012	-0.022	-0.011	-0.021
Fossilfuels	0.832	2.065	0.967	2.2	-0.167	-1.021	-0.185	-1.038
Minerals	0.257	0.259	0.26	0.262	0.071	0.021	0.069	0.019
ProcFood	0.403	0.789	0.424	0.811	-0.002	0.007	-0.001	0.007
WoodPro	0.394	0.55	0.39	0.545	-0.037	-0.039	-0.037	-0.039
TextWapp	0.635	1.228	0.665	1.257	0.137	0.166	0.137	**0.166**
EnergyIPro	0.888	1.868	0.911	1.891	0.174	0.158	0.172	0.156
PetCoal	1.525	3.195	1.58	**3.251**	0.04	0.062	0.039	0.062
CheRuPla	1.57	3.304	1.613	**3.347**	0.139	0.16	0.139	**0.159**
Manufactures	0.671	0.97	0.677	0.975	-0.087	-0.076	-0.086	-0.075
Electronic	2.807	4.732	3.426	**5.35**	-0.001	0.004	-0.008	-0.004
Automobile	1.097	1.884	1.161	1.947	0.659	0.734	0.659	**0.734**
Construct	-0.962	-3.029	-1.1	-3.168	-0.439	-0.461	-0.435	-0.457
TradeServic	0.407	0.777	0.449	0.819	-0.009	0.002	-0.009	0.002
TransComm	0.256	0.513	0.289	0.546	-0.053	-0.046	-0.052	-0.045
FinanServ	0.245	0.53	0.279	0.564	0.005	0.017	0.006	0.017
BusiServ	0.205	0.423	0.238	0.456	-0.02	-0.01	-0.02	-0.01
PublicServ	0.245	0.656	0.284	0.695	0.026	0.043	0.027	0.043

Note: TFA: Trade Facilitation Agreement; TSE: Technological Spillover Effect.

Source: GTAP 10A MRIO Data Base, author's estimation

The African manufacturing industries' export share in total production would marginally rise, such as automobile and electronic sectors could shoot up by 14.8% and 13.3%, respectively, whereas services-based sectors would decrease their export percent in total production. The consequences of increased export would trigger the fossil fuel, processed food, and textile and apparel industries to demand more import-related goods, increasing by 12,23%, 2.07%, and 1.22%, respectively (Table 8). In contrast, the construction and electronics industries in Africa would reduce consumption of the import goods. In short, the result is to also show a promising signal that Africa would improve the production of the manufacturing-related sectors in total export such as an Asian development relied on export oriented and impoprt substitution growth strategy, increasing export-related manufacturing goods; however, the African service sector has a negative impact from the EPA so that policymakers should consider more TFI and regional regulation policy (Table 8), such as infrastructure investments.

Table 8: Trade Dependence of Industrial Production and Consumption Change

	Export Share of Industrial Production [a]						Import Share of Industrial Consumption [b]					
	Africa			Japan			Africa			Japan		
	Tariffs only	*Tariff and TFA*	*Tariff and TSE*	*Tariffs only*	*Tariff and TFA*	*Tariff and TSE*	*Tariffs only*	*Tariff and TFA*	*Tariff and TSE*	*Tariffs only*	*Tariff and TFA*	*Tariff and TSE*
Agriculture	0.354	1.086	0.292	0.165	0.241	0.173	1.46	2.84	1.489	0.004	0.02	0.003
Fossilfuels	-0.03	1.033	-0.007	-0.287	-0.294	-0.316	1.709	**12.232**	1.694	0.001	-0.17	-0.002
Minerals	0.008	0.206	0.013	-0.088	-0.071	-0.087	0.201	-1.385	0.14	0.051	-0.176	0.048
ProcFood	5.458	9.776	5.441	0.108	0.1	0.107	1.316	**2.07**	1.319	0.055	0.067	0.054
WoodPro	5.26	11.486	5.279	0.114	0.09	0.113	0.904	1.08	0.866	-0.176	-0.167	-0.174
TextWapp	2.962	5.383	2.954	0.377	**0.434**	0.377	0.757	**1.221**	0.752	0.022	0.023	0.022
EnergyIPro	1.501	3.629	1.538	0.147	0.203	0.144	0.653	0.191	0.594	0.169	**0.353**	0.171
PetCoal	6.118	**10.276**	6.141	0.154	0.238	0.152	0.585	-0.004	0.562	0.027	-0.008	0.027
CheRuPla	5.125	**10.875**	5.125	0.098	0.101	0.097	0.914	1.183	0.906	**0.092**	**0.086**	0.091
Manufactures	6.325	**12.524**	6.378	0.31	**0.363**	0.309	0.315	-0.367	0.231	-0.179	-0.193	-0.177
Electronics	7.028	**13.347**	7.789	0.07	*0.072*	0.063	0.027	-1.09	-0.516	-0.09	-0.099	-0.09
Automobile	8.15	**14.769**	8.279	0.816	**0.897**	0.814	0.36	-0.772	0.232	0.078	**0.11**	0.082
Construct	1.106	4.318	1.329	0.373	**0.461**	0.354	-1.345	-3.91	-1.576	-0.546	-0.564	-0.541
TradeServic	-0.706	-1.027	-0.747	-0.008	0.004	-0.008	0.247	0.411	0.246	-0.012	0.025	-0.011
TransComm	-0.027	0.244	-0.014	0.094	0.129	0.092	-0.131	-0.375	-0.167	-0.017	0.027	-0.015
FinanServ	-0.698	-1.205	-0.739	-0.036	-0.059	-0.038	0.181	0.13	0.163	0.015	0.04	0.015
BusiServ	-0.43	-0.411	-0.433	0.004	0.08	0.003	0.007	-0.255	-0.029	-0.025	0.004	-0.025
PublicServ	-0.247	0.453	-0.272	-0.038	0.049	-0.039	0.282	0.719	0.275	0.025	0.063	0.025

Note: TFA: Trade Facilitation Agreement; TSE: Technological Spillover Effect.

[a] is calculated by total export percent (including FOB) change minus total output percent change

[b] is calculated by total import percent (including CIF) change minus private (household) consumption percent change

Source: *GTAP 10A MRIO Data Base, author's* estimation

6. CONCLUSION REMARKS

This paper analyzed the impact of an EPA between Africa and Japan through trade liberalization and reduction in NTBs. This study aimed to investigate sectoral interconnection participation in the EPA. Therefore, this paper made some policy recommendations regarding the regional and sectoral integration which could efficiently boost the GDP, welfare, and other opportunities of Japan-Africa businesses. We used the CGE model integrated with the GTAP-MRIO version 10A database. We first modified default closure to build the long-run closure and thereafter examined the AfJEPA with several possible EPA scenarios relying on the quantitative comparison of economic impacts of different technical measurements. As a result of this analysis, the AfJEPA would provide a new opportunity for Africa and Japan, as well as other regions. First, this agreement would contribute positive value to the existing African and Japanese MRTAs. Specifically, Namibia, Botswana, and Burkina Faso are the top three highest real GDP growth rate countries in Africa where electronics, petroleum and coal, and chemical, rubber, and plastic industries would comparatively have strong effects on their value-added. In addition to this, the EPA including Japan compared AfCFTA would boost remarkably real GDP in Egypt and Tunisia, and TSE-related electronics would have a relatively strong impact on Tunisia and the Rest of South Africa. Therefore, Africa would improve the production of the manufacturing sectors in total export. Likewise, the Japanese industries would improve their productivity in the motor vehicles and transport equipment, chemical, rubber, and plastic, and textiles and apparel industries. Briefly, we in line with previous studies suggested that (i) the AfJEPA would provide sustainable and promising growth strategy in African macro variables, (ii) trade facilitation and knowledge transfer, which policymakers can improve concrete action and investment, would considerably stimulate African real GDP and other macro variables, and (iii) only tariff liberalization policy would comparatively have less impact across regional real income growth. Thus, potential growth would rely on deep regulation policy through a degree of openness and initial level of trade barriers to each country.

To conclude, Japanese dependence on industrial input and output depending on import goods from African is between 1.1% to 5.5% throughout East Asian countries. Similarly, African output relying on Japanese products is 1.4%. Therefore, the EPA would constitute a strategy for growth for Japan, which has been suffering from long-term economic stagnation, allowing Japan to integrate effects of growth outside of Asia. In addition to this, Africa would enhance its economic development strategy by learning from Japanese MRTAs' experiments and would have access to the Japanese high-tech market and capital.

Having said that, the limitation of this study is to face the difficulty of addressing ownership of capital shock correlated with welfare change and productivity shock-related real trade volume change; however, further study should consider a dynamic model for regional income on regional welfare and essentially examine the EPA integrated exporter and importer cost in NTBs.

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APPENDIX

Appendix I: *Modification to the Standard GTAP Model for the Long-Run Closure*

```
Variable (all,r,reg)
     real_ret(r) # Change in real investment returns relative to the price of consumption #;
Equation E_real_ret (all,r,reg)
real_ret(r) = rorc(r) - [yp(r) - up(r)]; 13
```

Implementation Through Closure Rules

This paper created subset variables for the steady-state such as REGLESS1 which equals All regions – Rest of World (ROW). In this example, the ROW region will act as the lender/borrow of last resort[14].

Technically, the availability of capital within a country is not active, instead global saving should be able to finance global investment. Therefore, we used two different closures to examine the long-run effects. Particularly, the "*expand(e,r)",* which is the highly welfare gain-related variable, is the change in investment relative to endowment stock. The "*rorc(r)",* which is the highly GDP growth-focused variable, is the current net rate of return on capital stock in the region (r). These two different closures with capital mobility under a steady-state developed by Francois et al. (1996) and Walmsley (1998). In that case this paper assumed the current rate of return (rorc[r]) is equal to expected rate of return (rore[r]) by RORDELTA value=0 (Dixon, Parmenter, & Rimmer, 1981). The following variables are exogenous/endogenous:

qe("capital",REGLESS1)	endogenous
cgdslack(REGLESS1)	exogenous
expand("capital",REGLESS1)	exogenous
real_ret(REGLESS1)	endogenous

Moreover, the second approach is (perfect) capital mobility. This paper assumes RORDELTA value=0. The following variables are exogenous/endogenous

qe("capital",REGLESS1)	endogenous
cgdslack(REGLESS1)	exogenous
rorc(REGLESS1)	exogenous
real_ret(REGLESS1)	endogenous

[13] Change in real return to investment that is calculated as the difference between the price of the current composite consumption good relative to the real return to the capital good

[14] However, it can be any region – e.g., EU, USA.

Appendix II: Descriptive Statistics

Table A1: Regional Aggregation

Region		GTAP concordance
Japan (JPN)		Japan (JPN)
Korea (KOR)		Republic of Korea (KOR)
China (CHN)		China (CHN)
United States (USA)		United States of America (USA)
India (IND)		India (IND)
ANZ		Australia (AUS), New Zealand (NZL)
ASEAN6		Cambodia (KHM), Indonesia (IDN), Lao PDR (LAO), Philippines (PHL), Thailand (THA), rest of Southeast Asia-Myanmar-(XSE)
ASEAN4		Malaysia (MYS), Singapore (SGP), Brunei Darussalam (BRN), Vietnam (VNM)
CMCP		Canada (CAN), Mexico (MEX), Chile (CHL), Peru (PER)
The European Union (EU)		Austria (AUT), Belgium (BEL), Cyprus (CYP), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), Ireland (IRL), Italy (ITA), Latvia (LVA), Lithuania (LTU), Luxembourg (LUX), Malta (MLT), Netherlands (NLD), Poland (POL), Portugal (PRT), Slovakia (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), Bulgaria (BGR), Croatia (HRV), Romania (ROU)
African Continental Free Trade Area (AfCFTA) Countries	***Northern Africa***	Egypt, Arab Rep. (EGY), Morocco (MAR), Tunisia (TUN), Rest of North Africa (XNF),
	Central African	Cameroon (CMR), Central Africa (XCF), Congo, Dem. Rep. (COD=XAC),
	Southern Africa	Botswana (BWA), Namibia (NAM), South Africa (ZAF), Rest of South African Customs Union (XSC)
	East African	Ethiopia (ETH), Kenya (KEN), Madagascar (MDG), Malawi (MWI), Mauritius (MUS), Mozambique (MOZ), Rwanda (RWA), Tanzania (TZA), Uganda (UGA), Zambia (ZMB), Zimbabwe (ZWE), Rest of East Africa (XEC),
	Western Africa	Burkina Faso (BFA), Côte d'Ivoire (CIV), Ghana (GHA), Benin (BEN), Guinea (GIN), Nigeria (NGA), Senegal (SEN), Togo (TGO), Rest of West Africa (XWF),
Rest of World (ROW)		Hong Kong, SAR, China (HKG), Mongolia (MNG), Taiwan, China (TWN), rest of East Asia (XEA), United Kingdom (GBR), Switzerland (CHE), Norway (NOR), rest of EFTA (XEF), rest of Oceania (XOC), Bangladesh (BGD), Nepal (NPL), Pakistan (PAK), Sri Lanka (LKA), rest of South Asia (XSA), rest of North America (XNA), Argentina (ARG), Bolivia (BOL), Brazil (BRA), Colombia (COL), Ecuador (ECU), Paraguay (PRY), Uruguay (URY), Venezuela (VEN), rest of South America (XSM), Costa Rica (CRI), Guatemala (GTM), Honduras (HND), Nicaragua (NIC), Panama (PAN), El Salvador (SLV), rest of Central America (XCA), Dominican Republic (DOM), Jamaica (JAM), Puerto Rico (PRI), Trinidad and Tobago (TTO), rest of Caribbean (XCB), Albania (ALB), Belarus (BLR), Russian Federation (RUS), Ukraine (UKR), rest of East Europe (XEE), rest of Europe (XER), Kazakhstan (KAZ), Kyrgyzstan (KGZ), Tajikistan (TJK), rest of former Soviet Union (XSU), Armenia (ARM), Azerbaijan (AZE), Georgia (GEO), Bahrain (BHR), Iran, Islamic Rep. (IRN), Israel (ISR), Jordan (JOR), Kuwait (KWT), Oman (OMN), Qatar (QAT), Saudi Arabia (SAU), Turkey (TUR), United Arab Emirates (ARE), rest of Western Asia (XWS), rest of the world (XTW)

Note: [a] See https://www.gtap.agecon.purdue.edu/databases/regions.aspx?version=10.131 for the GTAP countries and regions.

[b] In the current GTAP Data Base, Myanmar and Timor-Leste are bundled in 'Rest of Southeast Asia (xse)'. This study used 'xse' to represent Myanmar. Likewise, South centrical Africa (XAC) represents Congo.

Source: Source: author's aggregation based on GTAP 10A MRIO Data Base.

Table A2: Sectoral Aggregation

Sector name	GTAP concordance
Agriculture (AGR)	Paddy rice (PDR); wheat (WHT); cereal grains, NEC (GRO); vegetables, fruit, nuts (V_F); oilseeds (OSD); sugar cane, sugar beet (C_B); plant-based fibers (PFB); crops, NEC (OCR); bovine cattle, sheep and goats, horses (CTL); animal products, NEC (OAP); raw milk (RMK); wool, silkworm cocoons (WOL); forestry (FRS)
Fossil fuels (FFL)	Coal (COA); oil (OIL); gas (GAS), gas manufacture, distribution (GDT)
Minerals, NES (OXT)	Other extraction (formerly other manufacturing (omn) minerals, NEC) (OXT)
Processed foods (PFD)	Fish (FSH); bovine meat products (CMT); meat products, NEC (OMT); vegetable oils and fats (VOL); dairy products (MIL); processed rice (PCR); sugar (SGR); food products, NEC (OFD); beverages and tobacco products (B_T)
Wood and paper products (WPP)	Wood products (LUM); paper products, publishing (PPP)
Textiles and wearing apparel (TWP)	Textiles (TEX); wearing apparel (WAP); leather products (LEA)
Energy-intensive manufacturing (KE5)	Mineral products, NEC (NMM); ferrous metals (I_S); metals, NEC (NFM)
Petroleum and coal products (P_C)	Petroleum, coal products (P_C)
Chemical, rubber, and plastic products (CRP)	Chemical products (CHM); basic pharmaceutical products (BPH); rubber and plastic products (RPP)
Manufactures, NES (XMN)	Metal products (FMP); manufactures, NEC (OMF)
Electronics (XELE)	Computer, electronic, and optical products (ELE); electrical equipment (EEQ);
Motor vehicles and Machinery (XMVH)	Motor vehicles and parts (MVH); transport equipment nec (OTN); machinery and equipment nec (OMG)
Construction (CNS)	Construction (CNS)
Trade services (TRD)	Trade (TRD); accommodation, food, and service activities (AFS); warehousing and support activities (WHS)
Transport and Communication Service (TPCS)	Transport, NEC (OTP); communication (CMN); water transport (WTP); air transport (ATP);
Financial services, NEC (OFI)	Financial services, NEC (OFI)
Business services (XBS)	Real estate activities (RSA); business services, NEC (OBS); insurance (formerly ISR) (INS)
Public services (XSV)	Electricity (ELY); water (WTR); recreational and other service (ROS); public administration and defense (OSG); education (EDU); human health and social work activities (HHT); dwellings (DWE)

Source: Source: author's aggregation based on GTAP 10A MRIO Data Base.

Table A3: Structure of Each Region

Region	***Percent of Expenditure in GDP***					***GDP value (US$ millions)***	***(%) GDP in the World***	***(%) Population in the World***
	Cons	***Inv***	***Gov***	***Exp***	***Imp***			
Japan	59%	21%	20%	20%	-20%	$4,596,162	**6%**	***1.8%***
Korea	51%	29%	15%	**48%**	**-44%**	$1,411,312	2%	0.7%
China	38%	44%	14%	24%	-20%	$10,351,105	13%	*18.8%*
USA	69%	20%	15%	11%	-15%	$17,348,106	22%	4.4%
India	60%	32%	11%	21%	-25%	$2,042,442	3%	*17.9%*
ANZ	55%	26%	18%	21%	-19%	$1,654,988	2%	0.4%
ASEAN6	60%	29%	12%	37%	-38%	$1,675,916	2%	6.9%
ASEAN4	55%	29%	12%	**94%**	**-90%**	$847,758	1%	1.8%
CMCP	62%	23%	17%	30%	-32%	$3,543,215	5%	2.9%
EU	57%	20%	22%	**41%**	**-40%**	$15,542,450	20%	6.1%
Africa/AfCFTA	66%	22%	15%	**28%**	**-31%**	$2,812,808	**4%**	***17.%***
ROW	59%	22%	18%	29%	-28%	$16,399,854	21%	21.4%
AJCEPA	59%	24%	17%	33%	-33%	$7,119,836	9%	10.4%
CPTPP	59%	23%	18%	**29%**	**-30%**	$10,642,123	**14%**	***6.8%***
RCEP	47%	35%	15%	**29%**	**-26%**	$20,537,241	**26%**	***30.3%***
EUJEPA	57%	21%	21%	36%	-36%	$20,138,612	26%	***7.9%***
AfJEPA	62%	22%	18%	**23%**	**-24%**	$7,408,970	**9%**	***18.8%***

Note 1: *Cons: Consumption; Inv: investment; Gov: Government expenditure; Exp: Export; Imp: Import.*

Note 2: ANZ: Australia and New Zealand; ASEAN4: Singapore, Malaysia, Vietnam, and Brunei; ASEAN6: Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, and the Philippines; CMCP: Canada, Mexico, Chile, and Peru.

Source: GTAP 10A MRIO Data Base, author's calculations.

Table A4: Percent of Japanese and African Total Trade

	Japan		Africa	
	Export	*Import*	*Export*	*Import*
Japan	-	-	**2.7%**	**2.0%**
Korea	6.6%	4.1%	2.7%	2.4%
China	**26.0%**	**21.9%**	**13.4%**	**15.4%**
USA	15.6%	9.8%	8.3%	7.4%
India	1.2%	1.2%	8.3%	4.9%
ANZ	2.4%	5.7%	0.7%	0.9%
ASEAN6	7.6%	7.1%	1.8%	2.4%
ASEAN4	5.6%	6.4%	1.6%	2.1%
CMCP	4.3%	3.1%	1.4%	1.3%
EU	**11.0%**	**11.6%**	**29.1%**	**28.4%**
Africa	**2.0%**	**2.3%**	11.6%	10.8%
ROW	17.7%	26.9%	18.3%	22.0%

Source: GTAP 10A MRIO Data Base, author's calculations.

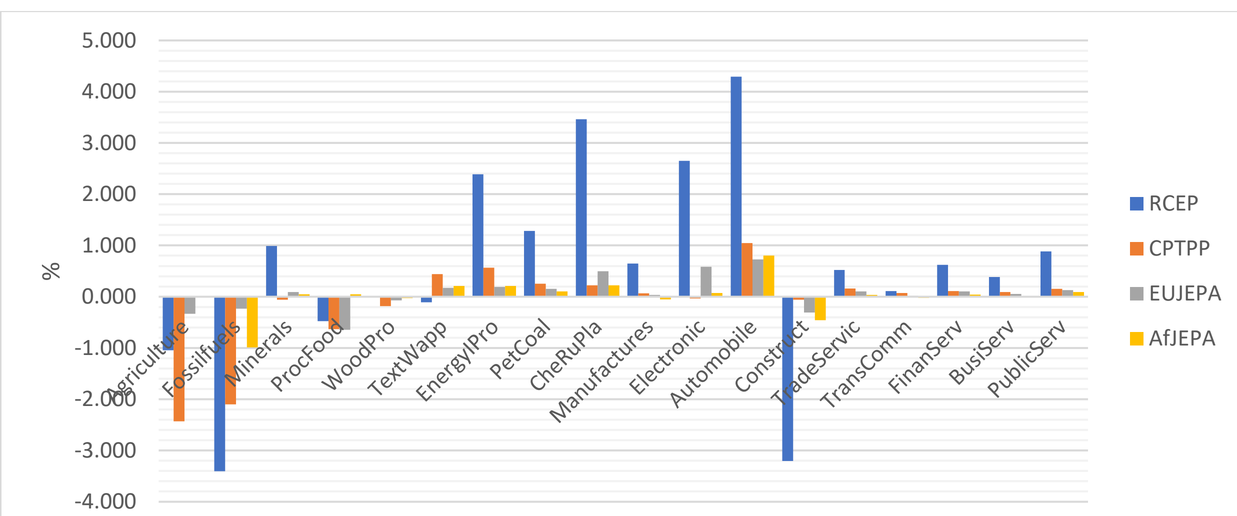
Table A5: Ad Valorem Rate Import Taxes, by Source

%	Japan	Korea	China	ANZ	ASEAN6	ASEAN4	CMCP	EU	Africa
Japan	0	67	68	35	34	23	11	31	70
Korea	31	0	71	41	22	55	24	3	85
China	25	175	0	27	16	24	33	40	135
ANZ	60	98	39	0	31	11	13	46	62
ASEAN6	16	55	7	2	12	8	35	22	108
ASEAN4	11	60	8	2	9	10	39	24	102
CMCP	41	59	47	17	58	20	2	13	87
EU	44	66	69	31	69	40	13	0	59
Africa	17	198	48	36	54	33	26	4	43

Note1: Rows represent exporters; columns represent importers.

Source: GTAP 10A Data Base, author's calculations.

Table A: Japanese Productive Sector by Each FTA



Source: *GTAP 10A MRIO Data Base, author's* estimation

Appendix III: Result of MRTAs with Different Approaches

1. Japan and Africa Integration Under Standard GTAP Model

We investigated Japan and African integration by examining the MRTAs (Table 3) under special conditions. The special approach of GTAP, in which we modified closure and parameters' values to be 0 or 1, is to interpret integration between countries as close as World Input-Output Database (WIOD) does. That is, this approach allows scholars to track international trade-based sectoral integration. Accordingly, another question in the paper was to determine the production cycle and the form of international fragmentation of production that represents sectoral integration between Japan and Africa as an example. Thus, Table A6 shows that Japanese industries integrated into Africa through East Asia has a large impact than ASEAN countries. In other words, when Japanese industrial output increases by 0.274% through RCEP which would trigger African industry to increase by 0.015%. Similarly, African output, increasing by 0.276%, is in need to meet Japanese industrial output, enhancing by 0.004%, when the AfCFTA concluded. Indeed, Japanese output relying on African export products is between 1.1% to 5.5% through MRTAs and African industrial output interacting with Japanese export goods depends on 1.4 % by AfCFTA. It seems that the sectoral interconnection between Japan and Africa could have a strong effect on their macro variables through East Asia countries and India (Table A6). In this sense, the purpose of this paper was to investigate how these countries boost their GDP growth and other opportunities if there is a possible EPA (AfJEPA) that would create opportunities for the Japan-African businesses.

Table A6: Japan and African Integration Through MRTAs

	Standard Model (RORDELTA=1)				
	AJCEPA	**CPTPP**	**RCEP**	**EUJEPA**	**AfCFTA**
Japan	**0.081**	**0.092**	**0.274**	**0.066**	**0.004**
Africa	0.003	0.001	**0.015**	0.001	**0.276**
Korea	0.007	0.011	0.633	0.005	0.008
China	0.007	0.01	0.22	0.013	0.009
USA	0.001	0.001	0.006	0.001	0.001
India	0.004	0.004	0.012	0.002	**0.014**
AZ	0.007	0.107	0.263	0.007	0.002
ASEAN6	0.295	0.003	0.553	0.004	0.003
ASEAN4	0.462	0.371	1.067	0.003	0.002
CMCP	0.003	0.083	0.016	0.002	0
EU	0.003	0.002	0.017	0.039	0.008

Note 1: ANZ: Australia and New Zealand; ASEAN4: Singapore, Malaysia, Vietnam, and Brunei; ASEAN6: Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, and the Philippines; CMCP: Canada, Mexico, Chile, and Peru.

Source: GTAP 10A MRIO Data Base, author's calculations.

2. AfCFTA and AfJEPA-E Contribution to Africa

Table A7 shows each African country's real GDP growth by the AfCFTA and AfJEPA-E in which we presented the contribution of the Japanese market to the individual African country. Therefore, each country would enhance their real GDP due to the AfJEPA-E, boosting between 0.74% and 10.14% (Table A7). Including Japan in the EPA compared to the AfCFTA would remarkably hike up real GDP in Egypt and Tunisia, increasing from 0.07% to 0.30% and from 0.17% to 0.43%, respectively. This paper, such as WB (2020a) and Abrego (2019), reported that facilitation improvement compared to tariffs elimination would stimulate significantly individual economies in Africa. On the one hand, TSE-related electronics would have a strong impact on Tunisia and the Rest of South Africa and would have less effect on the Rest of West Africa and Côte d'Ivoire. Moreover, the individual country would comparatively be sensitive (to) from TFA. For instance, TFA's impact on Zambia, Madagascar, and Botswana would boost particularly their real GDP about eight times higher than TSE. To put it briefly, the opening of a deal or a country reaching larger / more markets, the more economically stimulating the country's GDP growth.

Table A7: Contribution to Each African Country's Real GDP

	AfCFTA	AfJEPA-E			
		Total	Tariffs only	Tariffs and TFA	Tariffs and TSE
Egypt	0.066	0.302	0.179	***0.261***	***0.221***
Morocco	0.186	0.273	0.061	0.23	0.104
Tunisia	0.168	0.426	0.018	0.333	0.111
Rest of North Africa	0.473	0.641	0.256	0.584	0.313
Burkina Faso	**3.969**	**4.044**	2.242	3.999	2.287
Cameroon	0.544	0.603	0.398	0.59	0.411
Côte d'Ivoire	0.629	0.681	0.19	0.67	0.2
Ghana	1.363	1.406	0.822	1.386	0.843
Rest of West Africa	2.438	3.213	2.042	3.191	2.063
Nigeria	0.413	0.563	0.278	0.527	0.314
Senegal	1.674	1.817	0.689	1.738	0.768
Central Africa	1.687	1.84	0.997	1.796	1.041
Ethiopia	0.217	0.314	0.241	***0.303***	***0.251***
Kenya	0.496	0.769	0.353	0.715	0.407
Madagascar	0.275	0.425	***0.088***	***0.394***	0.12
Malawi	1.976	2.206	0.962	2.178	0.99
Mauritius	0.62	0.741	0.158	0.696	0.203
Mozambique	2.95	3.118	0.754	3.095	0.777
Rwanda	0.782	0.862	0.278	0.854	0.286
Tanzania	0.787	0.875	0.561	0.863	0.573
Uganda	1.191	1.628	0.947	1.544	1.031
Zambia	0.989	1.072	0.067	1.051	0.087
Zimbabwe	3.624	3.833	1.478	**3.756**	1.556
Rest of East Africa	0.382	0.475	0.181	0.446	0.21
Botswana	**4.748**	**4.938**	***0.602***	***4.91***	0.63
Namibia	**9.875**	**10.139**	2.692	10.042	2.79
South Africa	0.453	0.89	0.357	0.801	0.447
Rest of South Africa	0.545	0.764	0.069	0.582	0.252

Note: TFA: Trade Facilitation Agreement; TSE: Technological Spillover Effect.

Source: GTAP 10A MRIO Data Base, author's calculations.