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Abstract

This paper uses a GVC (Global Value Chain)-based CGE model to assess the impact of TTIP between the U.S. and the EU on their main trading partners who are mainly engaged at the low end in the division system of global value chains, such as BRICS countries. The simulation results indicate that in general the TTIP would positively impact global trade and economies due to the reduction of both tariff and non-tariff barriers. With great increases in the US–EU bilateral trade, significant economic gains for the U.S. and the EU can be expected. For most BRICS countries, the aggregate exports and GDP suffer small negative impacts from the TTIP, except Brazil, but the inter-country trade within BRICS economies increases due to the substitution effect between the US–EU trade and the imports from BRICS countries when the TTIP commences.

Keywords: TTIP, BRICS, GVC, NTBs, Spillover
JEL classification: F13, C68, D58

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Spillover Effects of TTIP on BRICS Economies: A Dynamic GVC-Based CGE Model*

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Abstract

This paper employs the Global Trade Analysis Project (GTAP) model to assess the impact of Transatlantic Trade and Investment Partnership (TTIP) between the two largest developed economies, namely the U.S. and the European Union (EU), on their main trading partners who are mainly engaged at the low end in the division system of global value chains (GVCs), such as Brazil, Russia, India, China, and South Africa (BRICS) countries. Compared with the traditional GTAP model in which producers and consumers distinguish the domestic variety of a product from its imported variety without explicit regard to the information regarding the origin of the imported intermediates in detail, we propose a GVCs-based GTAP model in this paper. This model introduces a new nested constant elasticity of substitution (CES) production function in which the sectoral intermediated imports by country of origin (information from the World Input–Output Database (WIOD)) is used to improve the conventional Armington assumption. This improvement can help us simulate the impacts of TTIP on the increasing presence of international fragmentation of production in GVCs with more relevant consideration. The reduction of both tariff and non-tariff barriers (NTBs) between the U.S. and the EU are used as policy scenarios. For the quantification of NTBs, this paper has adopted the equivalent tariff levels of NTBs from the research results of Ecorys (2009). The key point of the paper is that we introduce both direct and indirect spillover effects into the scenario design. This is beyond the traditional bilateral liberalization-based scenario. The direct spillover is based on the assumption that improved regulatory conditions negotiated between the U.S. and the EU will also result in a limited fall in related trade costs for third countries, which export to the U.S. and the EU. The indirect spillover effect occurs when third countries adopt some of

the common standards agreed between the U.S. and the EU. The simulation results indicate that in general the TTIP would positively impact global trade and economies. With great increases in the US–EU bilateral trade, significant economic gains for the U.S. and the EU can be expected. For most BRICS countries, the aggregate exports and GDP suffer small negative impacts from the TTIP, except Brazil, but the inter-country trade within BRICS economies increases due to the substitution effect between the US–EU trade and the imports from BRICS countries when the TTIP commences. In general, when changing the magnitude of direct and indirect spillover effects to a specific level, the TTIP could positively impact BRICS countries. This depends on both the reduction of NTBs that BRICS countries can enjoy in the U.S. and the EU and the reduction of NTBs that both the U.S. and the EU and BRICS itself can enjoy within BRICS.

Key words: TTIP, BRICS, GVC, NTBs, Spillover

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1. Introduction

Trade negotiations were problematic in the Doha Round. In contrast, more and more ambitious and comprehensive bilateral agreements such as the free trade agreements (FTA), economic partnership agreements (EPA), and regional trade agreements (RTA) appeared. The Transatlantic Trade and Investment Partnership (TTIP) between the U.S. and the European Union (EU) is one of the largest trade agreements.

Since the US President Obama was reelected in 2013, America has promoted the Trans-Pacific Partnership (TPP). Moreover, it planned the TTIP with the EU for free trade zone talks that are part of the plan for the U.S. to double its exports, and are important measures to accelerate its economic recovery. The U.S. and the EU are the largest economies in the world and the largest trade partners for each other. The GDP and bilateral trade for both economies account for one half and one third, respectively, among the global volume. If the US－EU free trade area following the TTIP is established, it will profoundly influence the rest of the world as well. This paper investigates the impact of TTIP between the two largest developed economies on their main trade partners who are mainly engaged at the low end in the division system of the global value chain (GVCs), such as the Brazil, Russia, India, China, and South Africa (BRICS) countries.

BRICS, as an important emerging economic block, plays a significant and increasing role in the global trade. Simultaneously, due to the spread of international fragmentation of production through foreign direct investment (FDI) and international trade, BRICS countries have been deeply involved in GVCs with many strong linkages to the U.S. and the EU. As indicated in Table 1, the U.S. and the EU are the most important trade partners for BRICS as measured by exports. In 2013, 25% to 48% of the total BRICS exports were destined to the EU and US markets. The EU and the U.S. are also important sources of BRICS imports. For the EU and the U.S., China and Russia are the key bilateral trade partners of the EU. Moreover, China is a key bilateral trade partner of the U.S.

Table 1: Export and import structure (2013)

Export to→	BRA	CHN	EU27	IND	RUS	USA	ZAF	Others	total
BRA	0%	19%	20%	1%	1%	10%	1%	47%	100%
CHN	2%	0%	15%	2%	2%	17%	1%	61%	100%
EU27	2%	9%	0%	2%	8%	16%	1%	62%	100%
IND	2%	5%	17%	0%	1%	13%	2%	61%	100%
RUS	0%	7%	46%	1%	0%	2%	0%	44%	100%
USA	3%	8%	16%	1%	1%	0%	1%	71%	100%
ZAF	1%	13%	18%	3%	0%	7%	0%	58%	100%
Others	0%	4%	6%	1%	1%	7%	0%	81%	100%

Import from↑	BRA	CHN	EU27	IND	RUS	USA	ZAF	Others
BRA	0%	4%	3%	1%	1%	1%	2%	1%
CHN	18%	0%	19%	22%	17%	20%	19%	8%
EU27	24%	16%	0%	18%	50%	17%	31%	7%
IND	3%	2%	3%	0%	1%	2%	6%	1%
RUS	1%	3%	13%	2%	0%	1%	0%	1%
USA	16%	9%	11%	7%	3%	0%	7%	5%
ZAF	0%	1%	1%	1%	0%	0%	0%	0%
Others	38%	64%	49%	48%	29%	59%	34%	76%
total	100%	100%	100%	100%	100%	100%	100%	100%

Data source：World Bank

Understanding the impact of TTIP on BRICS economies will enable policy makers to make relevant responses to the evolving economic environment. Considerable research using Global Trade Analysis Project (GTAP) models has been conducted to examine the impact analyses on trade policy. For example, Walmsley (2000) adopted a dynamic GTAP to assess the dynamic effects since Japan and Singapore established the FTA. It indicates that in the long run, developing an FTA can benefit both parties more than other regions of the world. Manchin (2004) simulated the economic effects of the EU－Russia FTA. Brown et al. (2005) established a GTAP model with 18 sectors and 22 countries and regions to assess the economic effects of the free trade area of the Americas. Hajrtono et al. (2007) simulated and studied the welfare effect when Indonesia participated in various bilateral, regional, and multilateral FTAs. Kitou (2010) focused on the economic influence of the EU－Canada FTA. Harbuzyuk (2011) analyzed the impact of Ukraine's entry into the EU. Koopman (2013) built a GVC-based GTAP model and compared the simulation results with the standard GTAP model. Their results indicated that the GVC-based model could improve the quality of the empirical analysis.

In terms of research subject, many studies have focused on the impact between trade partners who sign the agreement instead of other countries outside the free trade area. In terms of research methods, first, many prior studies used a static rather than a dynamic GTAP model. Second, most GTAP models are on a simple national basis for trade linkage among countries using the Armington assumption. This assumption cannot explicitly represent the feature of GVCs concerning imperfect substitution of intermediate imports by country of origin. Third, there is little focus on the spillover effects of FTA. Following the idea of Koopman et al. (2013), this paper revises the production function in the GTAP model for reflecting the feature of GVCs and considers the spillover effects to overcome the above three inadequacies. Finally, it applies the latest dynamic GTAP model (2007) to measure the impact of TTIP on BRICS economies.

The rest of the paper is organized as follows. Section 2 provides the modeling description and the design of policy scenarios. Section 3 presents the simulation results. Section 4 concludes the paper.

2. Modeling and Scenario Design

2.1 Modeling

2.1.1 Brief introduction of GTAP

This paper is based on the GTAP model. It is a multi-country, multi-sector applied general equilibrium model following the traditional theory of neo-classical economics. The GTAP model has a high-quality simulation function for quantitative policy analysis given different policy choices and decision-making patterns (for details, see Hertel, 1997). Therefore, this model has been one of the most widely applied tools for analyzing policy impacts.

The latest release available to us is the GTAP 8 database, which has adopted the 2007 social accounting matrix of various countries. The database covers 129 countries and 57 products. To comply with the research demand and maintain consistency with other data sources used, we aggregate the database into 36 sectors and 11 countries and regions (see Appendix 1).

2.1.2 GVCs-based GTAP Model

2.1.2.1 Improvement in the Armington specification

Figure 1 illustrates the implementation of the Armington specification in the conventional GTAP model. The upper part of Figure 1 sketches substitution possibilities in the production process of a particular sector. The domestic variety of a particular intermediate input can be substituted with imported variety; this is the first component of the Armington assumption. The GTAP model incorporates similar substitution possibilities for household demands. The lower part in Figure 1 indicates that the sourcing of imported goods, such as imports from particular countries, is modeled for the economy as a whole. We can visualize the economic mechanisms incorporated in Figure 1 as follows: for each economy and for each good, there is an importing firm which imports the good from other countries; the sourcing of imports changes as the relative prices change. This importing firm blends the country varieties of the particular good and supplies the blended imported good to producers and consumers.

We build a GVCs-oriented computable general equilibrium (CGE) model using the recently developed World Input–Output Data (WIOD) (see www.wiod.org). As illustrated in Figure 2, a particular producer decides not only how much to import of a particular good, but also where to source these imports from. Thus in the GVC-Based GTAP model we have potentially established tighter linkages between sectors located in different economies than the linkages contained in the conventional GTAP model. Similar to Starbucks and Japan's coffee restaurant chain group, Doutor, who imports coffee beans from different countries to make the best taste combination and then sells to both domestic and world markets. The coffee beans with the same name from different source countries have different tastes. Given the increasing presence of international fragmentation of production, this fact was not fully and explicitly expressed by the conventional GTAP model. Therefore, we propose to use the GVCs-based nested CES production function to deal with imported intermediates in the GTAP model, as illustrated in the lower part of Figure 2.

2.1.2.2 Improvement in non-tariff barriers (NTBs)

Tariffs and tariff revenues are explicit in the standard GTAP database, which can be directly incorporated into the model used here. However, NTBs affecting goods and services trade as well as cost savings linked to trade facilitation are not explicit in the database and we need to take steps to capture these information. For NTBs data, we follow the standard approach to model NTBs costs in the GTAP framework, originally developed by Francois (1999, 2001) with support from the European Community.

2.2 Analysis Description

For measuring the quantitative economic influence of TTIP on BRICS economies, we require two preconditions. First, the quantitative level of current tariff barriers and NTBs between the U.S. and the EU. Second, the possible agreement of TTIP, which is the reduction of those barriers between the two economies. To explain how the analysis is conducted, the above two perspectives are described as follows.

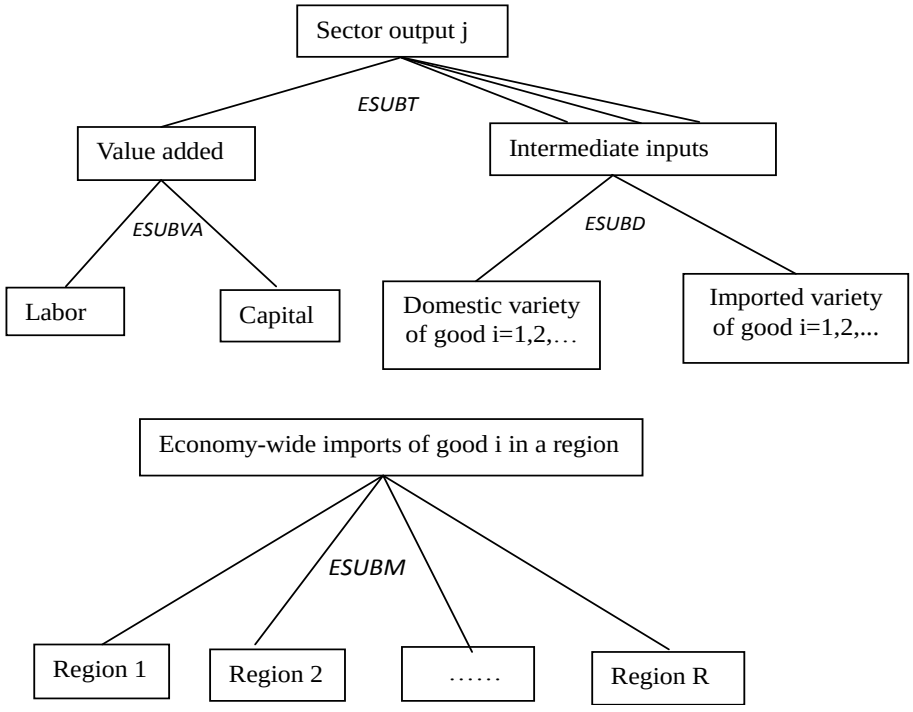


Figure 1: Armington assumption in the conventional GTAP model

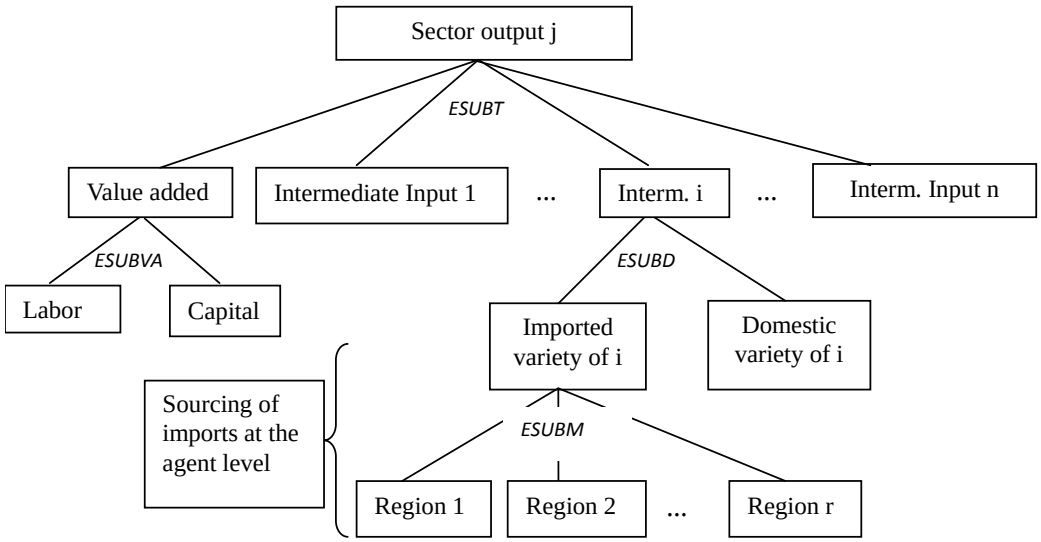
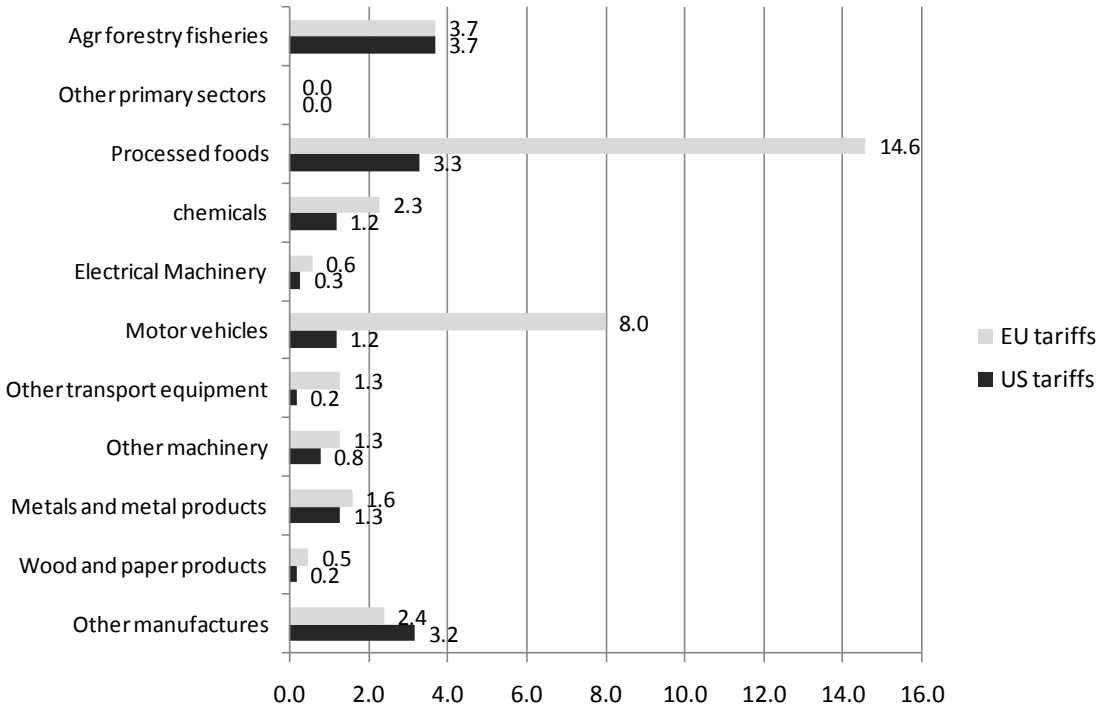


Figure 2: Armington assumption in the GVCs-based GTAP model

2.2.1 Tariff and non-tariff barriers between the U.S. and the EU

This section focuses on existing tariff barriers. Figure 3 indicates a definite difference in terms of tariff protections between the U.S. and the EU at the sector level; for example, in most sectors, the EU's tariffs are slightly higher than those imposed by the U.S. However, there are two main exceptions: motor vehicles and processed foods. For motor vehicles[1], the EU applies an average tariff (8.0%) which is almost seven times higher than the U.S. level. For processed food products, the EU's average tariffs (14.6%) are more than four times higher than the U.S. level. For agriculture, forestry, and fisheries, the average tariff is also relatively high (approximately 3.7%); however, for these products there is no difference between the U.S. and the EU. The tariffs for energy products and service sectors are generally zero. Given the current tariff structure, the impact of tariff reductions on trade flows is supposed to be limited. Indeed, for most sectors, a further reduction in tariffs implies very small absolute changes in the level of protection. Nevertheless, in some sectors, such as processed foods, agriculture, forestry and fisheries, and motor vehicles, the impact is likely to be more substantial. For other sectors, NTBs are the primary drivers of potential impacts.

[1] The motor vehicle sector, in this case, also includes parts and components.



Data source: GTAP 8 database

Figure 3: Differences in the sectoral tariffs between the U.S. and the EU.

Unlike traditional tariffs, NTBs include price and quantity controls (import quota and certificates), technical standard specifications, testing and quarantine of animals and plants, and import monopolies. Compared with tariff barriers, NTBs are difficult to be quantified. This paper has adopted the research results from the European consultancy firm, Ecorys (2009)2. As indicated in Table 2, in terms of arithmetic means, the U.S. imposes a NTB equivalent of 21.2% on products imported from the EU, whereas the EU level is 17.1% on American products. This indicates that NTBs are much higher than traditional tariff barriers.

With reference to specific products, we can see that agro-processing industries, which set high tariffs, have even higher NTBs. For manufacturing products, the traditional tariff is relatively low, while the NTBs are quite high. For example, for petroleum products and chemical industries, the traditional tariff is only 1%, but the NTB equivalents have reached a range

[2] Ecorys offered questionnaires to export businesses and applied econometric models to estimate the equivalent tariff levels of NTBs.

Table 2: NTB equivalents between the U.S. and the EU

	US Customs Duty on EU-Imported Products（%）	EU Customs Duty on American Imported Products（%）
Agricultural Sector	73.3	56.8
Agro-processing	73.3	56.8
Wood Products	7.7	11.3
Pulp, Paper, Printing and Publishing	7.7	11.3
Petroleum Products	19.1	13.6
Chemical Industry	19.1	13.6
Non-metallic Mineral Products	17	11.9
Steel	17	11.9
Other Metal	17	11.9
Metal Products	17	11.9
Automobiles	26.8	25.5
Manufacturing of Other Transport Equipment	19.1	18.8
Office Machinery and Communication Equipment	14.7	12.8
Machinery and Equipment	25.4	21.5
Other Manufacturing Industries	25.4	21.5
Construction Work	2.5	4.6
Water Transport	8	8
Air Transport	2	2
Communications	1.7	11.7
Financial Service	31.7	11.3
Insurance	19.1	10.8
Average	21.2	17.1

Data source: Ecorys (2009)

between 13% and 19%. For automobile manufacturing, the traditional tariff is below 8%, while the NTB equivalent is above 25%. For services and trade, more variation can be easily confirmed.

2.2.2 Simulation scenarios

A. Baseline setting

The GTAP 8 database only offers database and structures of various countries and sectors in 2007. This may not fully represent the current economy and trade situation. To overcome this difficulty, as illustrated in Figure 4, this paper adopts Walmsley's dynamic recursion to update the GTAP 8 database to the year of 2012 in terms of the officially published information on population, unskilled labor, skilled labor, natural endowments, capital stock, and GDP growth.

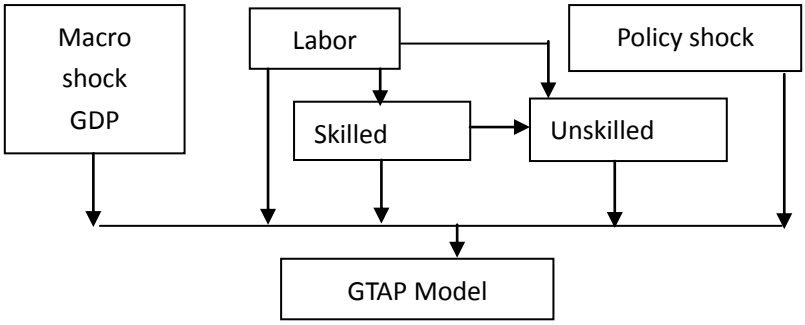


Figure 4: Update of the GTAP database.

Besides the update of GDP, population, labor, capital stock, and other macroeconomic information, the baseline has been enhanced mainly as follows: First, according to the agreement on trade in goods between China and Association of Southeast Asian Nations (ASEAN) FTA, by 2010, China and the six old members of ASEAN (Brunei, Indonesia, Malaysia, Philippine, Singapore, and Thailand) should reduce the tariffs of most normal goods down to zero. Furthermore, tariffs will be reduced to zero by China, as well as the four new members of ASEAN (Cambodia, Laos, Burma, and Vietnam) by 2015. Second, tariffs for all products among the 27 EU members have been reduced to zero. Third, the EU – South Korea FTA was finalized on July 13, 2009 and commenced from July, 2011. In accordance with its agreement, the EU would reduce 96% of the tariffs within the three years between 2011 and 2013. South Korea would reduce 99% of the tariffs within this period, and remove all tariffs for industrial products by 2015.

B. Policy scenario

As mentioned in the previous section, tariffs between the U.S. and the EU are already low; thus, it would be easy for both sides to comply with the tariff reduction given its marginal and limited impact. The US – EU FTA mainly focuses on the reduction of NTBs and improvement of investment environment. In conjunction with the progress and schedule of the US – EU FTA, this paper presumes that the talks will conclude in 2016 and that the TTIP will officially commence before 2027. Specific results of the FTA could be as follows. Comprehensive and ambitious FTA will be implemented, 99% of traditional tariffs will be cut to zero, and NTBs could see solid achievements with 40% reduction.

C. Spillover effects

The policy simulations also consider the spillover effects. More specifically, in arranging the experiments, we have included two sets of possible effects beyond bilateral liberalization. They are defined as follows. First, we have included direct spillover effects that are based on the assumption that the improvement of regulatory conditions, especially the non-country specific NTBs negotiated between the U.S. and the EU, will also result in a limited fall in related trade costs for third countries, which export goods and services to the U.S. and the EU. This positive market access effect for third countries is modeled as being approximately 20% of the bilateral fall in trade costs related to NTBs for the core scenarios. This concept was introduced in the EU – Japan Study of Copenhagen Economics (2009). In practice, it means that if there is a 5% NTB-related trade cost reduction between the U.S. and the EU, there will also be a 1% trade cost reduction for third countries, which export to the U.S. and the EU. The logic is that firms in third countries may find it easier to meet either the U.S. or the EU regulatory requirements if bilateral negotiations lead to simplifications that are not inherently discriminatory.

In contrast, it is meant to gauge the economic implications if third countries adopt some of the common standards agreed between the U.S. and the EU. Given that, collectively, the U.S. and the EU stand as the biggest trading block in the world, there is a very real possibility that mutual agreement on regulations and standards would be partially adopted by third countries as well. This implies that a bilateral agreement will give the EU and the U.S. improved market access into markets of third countries from reduced NTBs. In addition, there will be scope for reductions in NTBs among third countries as they converge further on common standards. Therefore, this type of indirect spillover effect will lead to lower costs and greater trade between third countries as well. We have modeled indirect spillovers as 50% of the direct spillover rate. This implies that, for example, a 5% trade cost reduction between the EU and US, with 20% corresponding direct spillovers, will have a 1% (direct spillover) reduction for third countries who export to the U.S. or the EU, and a 0.5% (indirect spillover) reduction for the U.S. and the EU exporting costs to third countries, and for trade within third countries.

3. Simulation Results

The simulation results are reported with respect to an economic benchmark projected out to the year 2027. First, we present results for the EU, U.S., and the world. Thereafter, we examine the results for BRICS economies.

3.1 Impact on the U.S. and the EU economies

The reduction of tariff and non-tariff barriers between the U.S. and the EU under a comprehensive FTA will increase bilateral trade and stimulate economic growth in both economies. As indicated in Table 3, aggregated exports and imports for the U.S. will, respectively, increase by 4.58% and 3.11%. For the EU, aggregated exports and imports increase by 3.17% and 2.02%, respectively. The real GDP of the U.S. and EU will, respectively, increase by 0.37% and 0.28%, which would greatly promote the economic recovery of both economies.

3.2 Impact on global economy

The US－EU FTA covers the largest free trade zone in the world, which has significant effect on the global economy. According to the results of our model, as indicated in Table 5, led by the economic growth of EU and U.S. and its spillover effect, global GDP and trade will, respectively, increase by 0.13% and 0.61% while global welfare increases by 31.24 billion US$ (Table 5).

Table 3 : Impact on macroeconomies of the U.S. and the EU（%, 2027 benchmark）

	EU	US
Real GDP (%)	0.28	0.37
aggregate export（%）	3.17	4.58
aggregate imports（%）	2.02	3.11
US export to EU（%）	—	28
EU export to US（%）	21	—

Data source：Authors' calculation based on the GVCs-based GTAP model

Table 4 : Impact on industry-level bilateral trade （%, 2027 benchmark）

Sector	US export to EU	EU export to US
agriculture	41.1	34.3
Coal	0.0	2.6
Oil	2.4	3.3
Natural Gas	8.8	11.5
Other Mining Industries	0.1	1.2
agricultural processing	45.3	36.5
Clothes	13.1	4.8
Leather Products	15.3	2.2
Wood Products	20.5	11.7
Pulp, Paper, Printing and Publishing	12.9	8.9
Petroleum Products	14.5	12.5
Chemical Industry	24.6	19.2
Non-metallic Mineral Products	22.2	16.6
Steel	15.6	16.2
Other Metal	26.9	23.3
Metal Products	26.3	24.3
Automobiles	32.5	25.2
Manufacturing of Other Transport Equipment	30.8	26.1
Office Machinery and Communication Equipment	24.7	26.4
Machinery and Equipment	39.4	35.9
Other Manufacturing Industries	36.0	35.6
Electricity	0.3	2.4
Gas and Heat Supply	1.2	2.8
Tap Water Production and Supply	-0.2	2.3
Construction Work	6.6	4.2
Trade	-0.8	1.9
Inland Transport	0.6	1.4
Water Transport	11.8	11.7
Air Transport	3.2	2.8
Communications	15.9	3.2
Financial Service	14.5	30.4
Insurance	14.4	18.2
Renting Services	-0.6	1.4
Recreational, cultural and sporting services	6.3	3.9
Public Services	-0.8	1.2
Real Estate	0.8	1.7

Data source：Authors' calculation based on the GVCs-based GTAP model

Table 5: Impact on global economy（%, 2027 benchmark）

	World
Real GDP (%)	0.13
volume of world trade（%）	0.61
welfare（billion US$）	31.24

Data source：Authors' calculation based on the GVCs-based GTAP model

3.3 TTIP's economic impact on BRICS economies

As mentioned before, there are two factors affecting the macroeconomy of BRICS. First, the trade substitution effect when the TTIP commences. Second, the spillover effect of TTIP. Under the impact of these two factors, BRICS suffer differently. As indicated in Table 6, India, Russia, South Africa, and China will suffer negative effects because the export substitution effect of the US－EU FTA is greater than the spillover effect, which will make the real GDP of India, Russia, South Africa, and China decrease by 0.09%, 0.1%, 0.08%, and 0.12%, respectively.

For Brazil, because the spillover effect is greater than the export substitution effect of the US－EU FTA, total exports of Brazil to the U.S. and the EU will increase, which is translated into improved growth in Brazil's GDP. As indicated in Table 6, exports and real GDP of Brazil will increase by 0.33% and 0.1%, respectively. For the bilateral trade of BRICS, as indicated in Table 7, because the strengthened trade linkage between the U.S. and the EU substitute the imports from BRICS countries, for most BRICS countries, their exports to the U.S. and the EU decline. As indicated in Table 8, due to the substitution and spillover effects, trade linkage between BRICS countries will be strengthened with an increase in bilateral trade within BRICS countries.

Table 6: Impact on macroeconomies of BRICS （%, 2027 benchmark）

	India	Brazil	Russia	South Africa	China
Real GDP (%)	-0.09	0.1	-0.1	-0.08	-0.12
aggregate export（%）	-0.12	0.33	-0.17	-0.14	-0.14
aggregate import（%）	-0.06	0.29	-0.11	-0.08	-0.05

Data source：Authors' calculation based on the GVCs-based GTAP model

Table 7 : Impact on BRICS exports to U.S. and EU （%, 2027 benchmark）

Importers / Exporters	US	EU
India	-3.1	-1.0
Brazil	4.7	1.6
Russia	-4.3	-1.4
South Africa	-5.7	-1.9
China	-3.5	-1.2

Data source：Authors' calculation based on the GVCs-based GTAP model

Table 8: Impact on the bilateral trade inside BRICS （%, 2027 benchmark）

Importers / Exporters	China	India	Brazil	South Africa	Russia
China	-	0.95	1.05	1.12	1.70
India	0.26	-	0.55	0.77	1.51
Brazil	0.21	0.16	-	0.77	1.07
South Africa	0.31	0.57	1.06	-	1.08
Russia	1.27	0.36	0.63	0.22	-

Data source：Authors' calculation based on the GVCs-based GTAP model

3.4 Impact on South Africa

3.4.1 South Africa's macroeconomy

In BRICS, just South Africa has relatively small economic size and unique features concerning its economic structure and participation in GVCs. This leads us to elaborate further on this country. Compared with the baseline scenario, South Africa's real GDP will decrease by 0.08%, with a decrease in social welfare by $384 million. In general, the impact is not big, and the main reason is that South Africa's total exports face less impact (0.14%). There are two reasons for this. First, because exports among South Africa, Europe, and the U.S. have certain complementarity, only a few sectors of South Africa are adversely affected; primarily, these include agricultural products, coal, metal products, and transportation equipment. Second, the TTIP will increase the exports of South Africa to other developed countries.

In terms of the price level, the TTIP causes South Africa's total economic demand to decline, reduces the price of factors, and generates an inhibitory effect on the consumer price index (CPI). As indicated in Table 9, wages, capital price, and land price will decline by 0.16%, 0.19%, and 0.17%, respectively, and the CPI will decline by 0.2%.

3.4.2 Industry in South Africa

There are two factors affecting the industrial output of South Africa. The first is how the industrial export is affected, and the second is the proportion of industry exports in total output. Taking these two factors together, as indicated in Table 10, the top ten industries whose outputs are adversely affected are also the top ten industries whose exports are adversely affected, which mainly include manufacturing of other transport equipment, construction, metal, non-metallic mineral products, automobiles, coal, real estate, financial service, agriculture, and public service, whereas the output of the top ten adversely affected industries will decline between −3.6% and −0.05%. The top ten industries whose outputs are positively affected include oil, metal products, steel, leather products, machinery and equipment, natural gas, pulp, paper, printing and publishing, office machinery and communications equipment, wood products, and gas and heat supply, whereas the output of the top ten positively affected industries will decline between 0.25% and 0.84%.

Table 9: Impact on the macroeconomy of South Africa （%，2027 benchmark）

	South Africa
Real GDP (%)	-0.08
aggregate export（%）	-0.14
aggregate imports（%）	-0.08
welfare（million dollar）	-384
Real wage（%）	-0.16
Capital price（%）	-0.19
Land price（%）	-0.17
CPI（%）	-0.2

Data source：Authors' calculation based on the GVCs-based GTAP model

Table 10: Impact on industrial output of South Africa （%, 2027 benchmark）

Top ten benefited sectors		**Top ten suffering sectors**	
Sectors	**output（%）**	**Sectors**	**output（%）**
Oil	0.25	manufacturing of other transport equipment	-3.60
Metal Products	0.28	construction	-0.83
Steel	0.34	metal	-0.53
Leather Products	0.34	non-metallic mineral products	-0.22
Machinery and Equipment	0.44	automobiles	-0.18
Natural Gas	0.44	coal	-0.18
Pulp, Paper, Printing and Publishing	0.63	real Estate	-0.09
Office Machinery and Communication Equipment	0.67	financial service	-0.07
Wood Products	0.75	agriculture	-0.05
Gas and Heat Supply	0.84	public services	-0.05

Data source：Authors' calculation based on the GVCs-based GTAP model

4. Conclusions

Informed by these simulation results, we draw the following conclusions. First, in general, liberalizing trade between the U.S. and EU would positively impact global trade and economy with approximately $31.2 billion welfare gain. Second, a significant increase of the US－EU bilateral trade under the TTIP is mainly benefited by the reduction of NTBs. This further translates to significant economic gains as a whole for the U.S. and the EU. Third, most of BRICS exports to the U.S. and the EU would decline; however, the aggregate exports and GDP of BRICS suffer just limited impacts. The exceptional case occurs in Brazil, which aggregates exports and GDP benefits from the TTIP. Fourth, the TTIP will increase the bilateral trade within BRICS economies because of substitution and indirect spillover effects. Finally, when changing the magnitude of direct and indirect spillover effects to a specific level, the TTIP could positively impact BRICS countries in general. This depends on the reduction of NTBs that BRICS countries can enjoy in the U.S. and the EU, and the reduction of NTBs that will benefit the US－EU area and BRICS itself within BRICS.

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Appendix 1: Mapping of model sectors

Table A1 Mapping of Model Sectors to GTAP

NO.	GTAP Sector	Model Sector	NO.	GTAP Sector	Model Sector
1	pdr	1 agriculture	30	lum	9 Wood Products
2	wht	1 agriculture	31	ppp	10 Pulp, Paper, Printing and Publishing
3	gro	1 agriculture	32	p_c	11 Petroleum Products
4	v_f	1 agriculture	33	crp	12 Chemical Industry
5	osd	1 agriculture	34	nmm	13 Non-metallic Mineral Products
6	c_b	1 agriculture	35	i_s	14 Steel
7	pfb	1 agriculture	36	nfm	15 Other Metal
8	ocr	1 agriculture	37	fmp	16 Metal Products
9	ctl	1 agriculture	38	mvh	17 Automobiles
10	oap	1 agriculture	39	otn	18 Manufacturing of Other Transport Equipment
11	rmk	1 agriculture	40	ele	19 Office Machinery and Communication Equipment
12	wol	1 agriculture	41	ome	20 Machinery and Equipment
13	frs	1 agriculture	42	omf	21 Other Manufacturing Industries
14	fsh	1 agriculture	43	ely	22 Electricity
15	coa	2 Coal	44	gdt	23 Gas and Heat Supply
16	oil	3 Oil	45	wtr	24 Tap Water Production and Supply
17	gas	4 Natural Gas	46	cns	25 Construction Work
18	omn	5 Other Mining Industries	47	trd	26 Trade
19	cmt	6 agricultural processing	48	otp	27 Inland Transport
20	omt	6 agricultural processing	49	wtp	28 Water Transport
21	vol	6 agricultural processing	50	atp	29 Air Transport
22	mil	6 agricultural processing	51	cmn	30 Communications
23	pcr	6 agricultural processing	52	ofi	31 Financial Service
24	sgr	6 agricultural processing	53	isr	32 Insurance
25	ofd	6 agricultural processing	54	obs	33 Renting Services
26	b_t	6 agricultural processing	55	ros	34 Recreational, cultural and sporting services
27	tex	7 Clothes	56	osg	35 Public Services
28	wap	7 Clothes	57	dwe	36 Real Estate
29	lea	8 Leather Products			