Chapter 2

Measuring the Impact of AEC Beyond 2025

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This chapter should be cited as
Itakura, K. (2025), 'Measuring the Impact of AEC Beyond 2025', in Rillo, A.D and B. Shepherd (eds.), *Where Next? Priorities for the ASEAN Economic Community Post-2025*. Jakarta, Indonesia: Economic Research Institute for ASEAN and East Asia, pp. 7-25.

2.

Measuring the Impact of AEC Beyond 2025

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1. Introduction

The Association of Southeast Asian Nations (ASEAN) Economic Community (AEC) is the economic integration of the 10 ASEAN Member States, and it has been moving towards the free movement of goods, services, investments, and skills within the region. The AEC also promotes the development of production networks in the region and participation in global value chains. The AEC Blueprint, adopted in 2007, was the first master plan for economic integration, and the AEC was officially established in 2015. At the birth of the AEC, the successor to the master plan, the AEC Blueprint 2025, was approved for implementation, and the ASEAN Member States have made progress in the strategic areas identified in the plan (ASEAN, 2021).

As the AEC Blueprint 2025 approaches its final year, the ASEAN Member States (AMS) have begun to seek the future path for deeper economic integration beyond 2025. In their discussions, three themes – digitalisation, sustainability, and inclusiveness – are considered salient areas for the upcoming master plan. These three themes cover a wide range of issues, not limited to economic integration. Given the broad scope of these themes, this study narrows its focus to specific policy developments envisioned as future scenarios in the AEC.

This study attempts to evaluate future scenarios, postulating how the AEC will evolve beyond 2025. The future scenarios are constructed to characterise the development of specific events under the three themes of digitalisation, sustainability, and inclusiveness. For digitalisation, we explore the potential effect of e-commerce agreements, which may facilitate trade in goods and services in the AEC. For sustainability, the future scenarios are examined for global net-zero carbon dioxide (CO_2) emissions and emissions trading in the AEC. For inclusiveness, the effect of narrowing the gender gap in the labour force participation rate is explored for the AEC's economic potential.

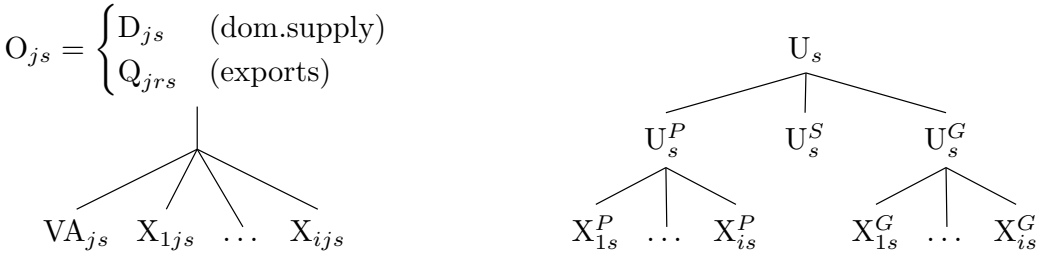
These future scenarios are evaluated in a general equilibrium framework, which quantitatively accounts for the interdependency in the AEC as well as in the global economy. We conduct a set of simulations with a recursively dynamic computable general equilibrium (CGE) model of the global economy for the period of 2014–2050. To capture the economic effect of the future scenario, each scenario is compared against the baseline, which is a hypothetical future state of the global economy without the development postulated in the future scenarios.

In Section 2, we present an overview of the CGE model and database used in this study. Section 3 explains the baseline and the future scenarios, and Section 4 reports the simulation results, followed by concluding remarks in Section 5.

2. Overview of Model and Database

For our simulations of the future scenarios in this study, we use a multiregional, multisectoral recursively dynamic CGE model (GDyn-E) developed by Golub (2013). The GDyn-E model incorporates the energy-environmental module, which was originally developed in a comparative static model (Burniaux and Truong, 2002; and McDougall and Golub, 2007), into the dynamic CGE model (Ianchovichina and McDougall, 2001; and Ianchovichina and Walmsley, 2012). The GDyn-E is an extension of the standard Global Trade Analysis Project (GTAP) model (Hertel ,1997; McDougall, 2003; Corong et al., 2017). In the standard GTAP model, capital is assumed to be mobile across sectors in one country, but not across international borders. The GDyn-E model preserves all the key features of the standard GTAP model: constant return to scale of production technology, perfectly competitive markets, and product differentiation by origin, known as the Armington assumption (Armington, 1969).

Figure 2.1. Structure of Production and Consumption

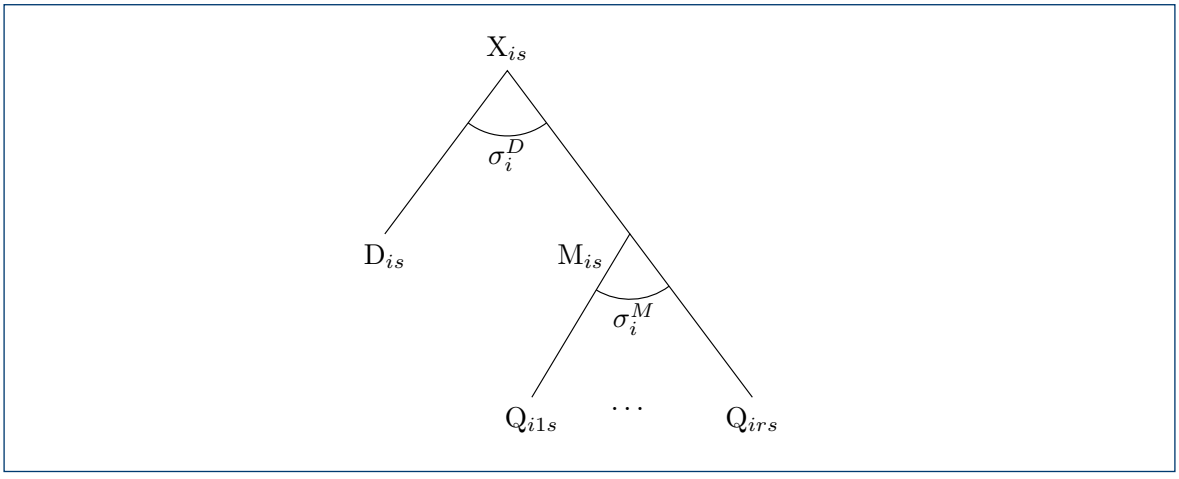


Source: Author's calculations.

The structure of the model is summarised in Figure 2.1. The tree diagram on the left illustrates the production structure. To produce an output O_{js} of industrial sector *j* in country *s*, the Leontief production function combines the value-added composite VA_{js} and intermediate input bundle *i*, X_{ijs}. Sectoral output is supplied to the domestic market D_{js} for producers' intermediate input use, for private household consumption, and the government's expenditure. The sector output also serves foreign markets (indexed with *r*) through exports Q_{ijs}.

On the tree to the right, the representative household's utility U_s, the basis of the welfare measure, is derived from sub-utilities for the private household U_s^P, the government U_s^G, and savings U_s^S, with a Cobb-Douglas-type function. The private household's utility is, then, determined by the constant difference elasticity function of the composite goods *i*, "X_{is}^P. For the government, a constant elasticity of substitution (CES) function is applied. Because of the non-homotheticity in the private household's sub-utility, an adjustment parameter to shift expenditure is introduced to the Cobb-Douglas-type function, following McDougall (2003).

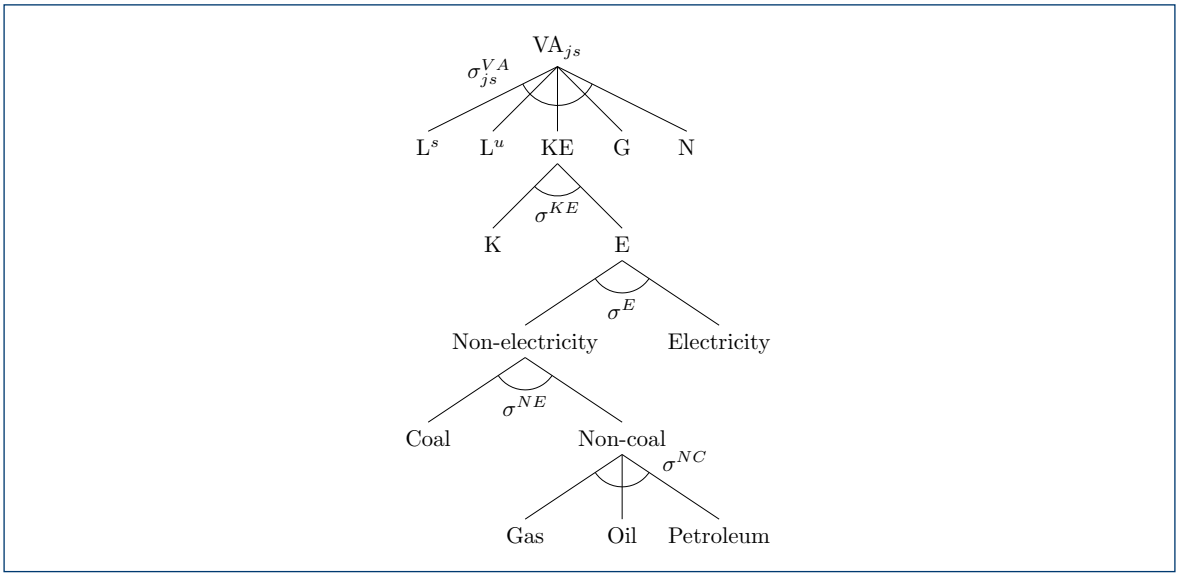
Figure 2.2. Aggregation of Domestic and Imported Goods



Source: Author's calculations.

At the border of country *s*, imports of goods *i* from different countries *r*, Q_{irs}, are aggregated into an import composite M_{is} using a CES function (Figure 2.2). Then, the import composite is aggregated with domestically produced goods D_{is}. Thus, there are two stages of aggregation; first at the bottom of the diagram, aggregation from each import source to a composite, and then aggregation of the composite with a domestic good. This is the double-nested Armington import demand structure implemented in the GDyn-E model.

Figure 2.3. Value-Added Composite Structure



Source: Author's calculations.

Figure 2.3 illustrates the value-added composite defined in the GDyn-E model. Starting from the bottom, gas, oil, and petroleum products are aggregated into the non-coal subproduct via a CES function with substitution parameter of σ^{NC}. Non-electricity subproduct consists of the non-coal and coal. Further, electricity is combined with the non-electricity subproduct to become energy subproduct (E). Capital (K) is integrated with the energy subproduct and becomes capital-energy subproduct (KE) which is a primary factor input to production activity. The value-added (VA_{js}) is composed of skilled and unskilled labour (L^s, L^u), the capital-energy subproduct, and specific factors such as land (G) and natural resources (N).

In the GDyn-E model, each region is endowed with a fixed physical capital stock, and the physical capital is accumulated over time with new investments. Investment is sourced from regional households' savings. Investment is a composite of domestic investment and foreign investment. Incentive for investments is governed by rates of return, which would be equalised across regions if capital were to be perfectly mobile. However, this equalisation of the rates of return seems unrealistic, at least in the short run. The GDyn-E model allows for interregional differences in rates of return in the short run, which are eventually equalised in the long run.

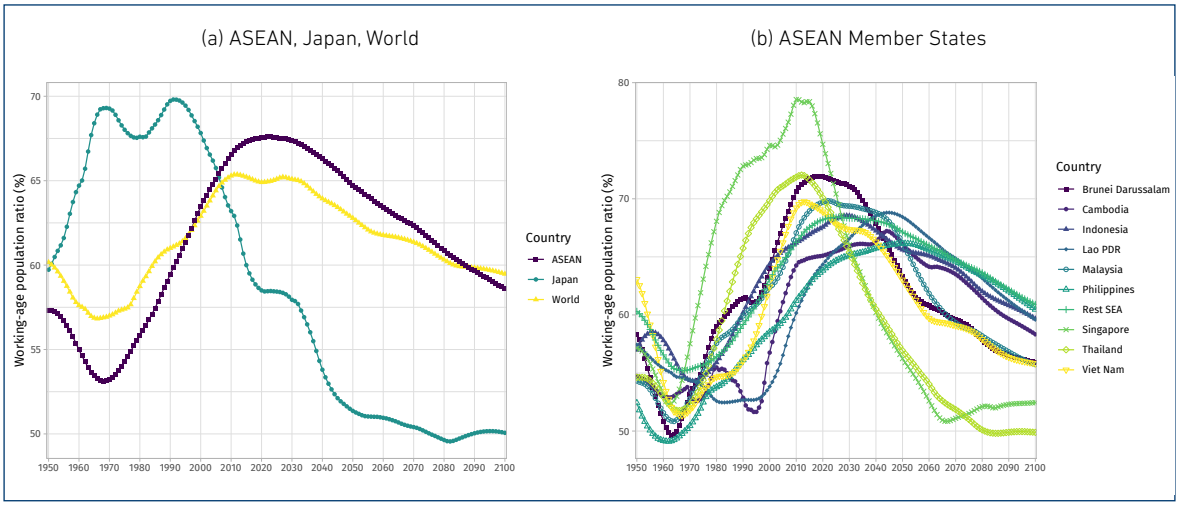
We use the GTAP database version 10 (Aguiar et al., 2019) and economic estimates and forecasts from international organisations. The GTAP database represents the global economy with detailed information about 65 industrial sectors for 141 countries and regions. With this database, we can observe the economic structure of production, international trade and protection, and consumption, benchmarked in the year 2014. The database is supplemented with international factor income flows arising from domestic and foreign asset holdings. For the energy-environmental data extension, we utilise the GTAP-E database. To reduce the computational burden, we aggregate the database to 25 countries and regions and 27 industrial sectors. The mappings from the original data are reported in Tables 2.A1 and 2.A2

3. Baseline and Future Scenarios in the ASEAN Economic Community

3.1. Baseline

For our simulation experiments, we construct a baseline scenario for 2014–2050 which is a hypothetical future state of the global economy without the events specified in each future scenario. The baseline scenario is used as the basis to measure the impact of future scenarios. We incorporate the projection of total population, working-age population, gross domestic product (GDP), and gross investment, into our baseline construction. Projections for the total and working-age population growth rates are computed from the United Nations's World Population Prospects (UN, 2022) based on the medium projection variant. Projections for the real GDP and gross investment are obtained from the International Monetary Fund (IMF)'s October issue of the World Economic Outlook (IMF, 2023). We extrapolate the real GDP growth rates in 2028 to the end of the simulation period. Given these estimates and projections for 2014–2050, the model can compute change in efficiency variables as a measure of productivity. To trace the CO_2 emission by country, we impose the emission data from the Global Carbon Budget (Global Carbon Project, used in our baseline scenario, Figure 2.4a shows the long-term demographic trend for ASEAN, Japan, and the world. From 1950 to 2100, the ratio of the working-age population to the total population peaks and declines thereafter, but the peak for ASEAN arrives later – around 2023 – as compared to Japan. Each ASEAN Member State shown in Figure 2.4b, shares a common pattern of long-term demographic change but there exists heterogeneity in the peak and the declining trend.2022) for 2015–2021.

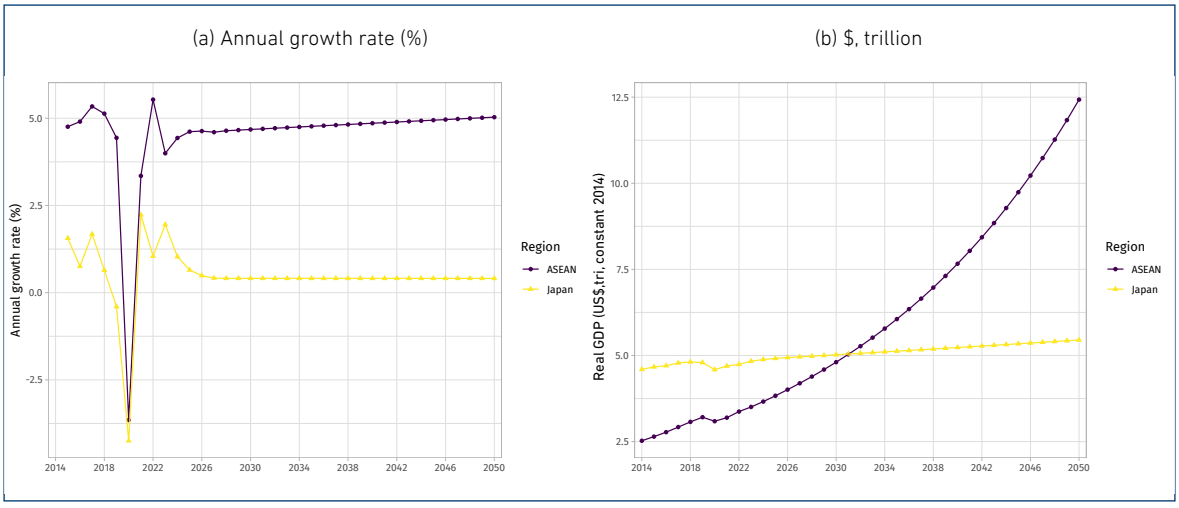
Figure 2.4. Working-Age Population Ratio in the Baseline
(%)



ASEAN = Association of Southeast Asian Nations, Lao PDR = People's Democratic Republic of Lao, SEA = Southeast Asia.
Source: Author's computation based on United Nations (2022).

To illustrate the projections, Figure 2.5a shows the annual growth rate of real GDP for ASEAN and Japan for comparison. ASEAN's annual growth rate of real GDP plummeted in 2020 to -3.7 % because of the coronavirus disease (COVID-19) pandemic, but it is projected to recover quickly to the pre-pandemic level at about 4.6%. IMF's World Economic Outlook provides the projection up to 2028, and they are extrapolated thereafter. Simple extrapolation is applied to extend the growth trend. Real GDP in level is drawn for 2014–2050 in Figure 2.5b. Given the annual growth rate of the real GDP projection, ASEAN's real GDP will continue to grow and exceed $12 trillion[1] by 2050. In Figure 2.6, the economic presence of ASEAN in the world in terms of real GDP share also keeps growing, surpassing Japan in 2032, and it accounts for 6% of the world GDP in 2050.

Figure 2.5. Real Gross Domestic Product in the Baseline



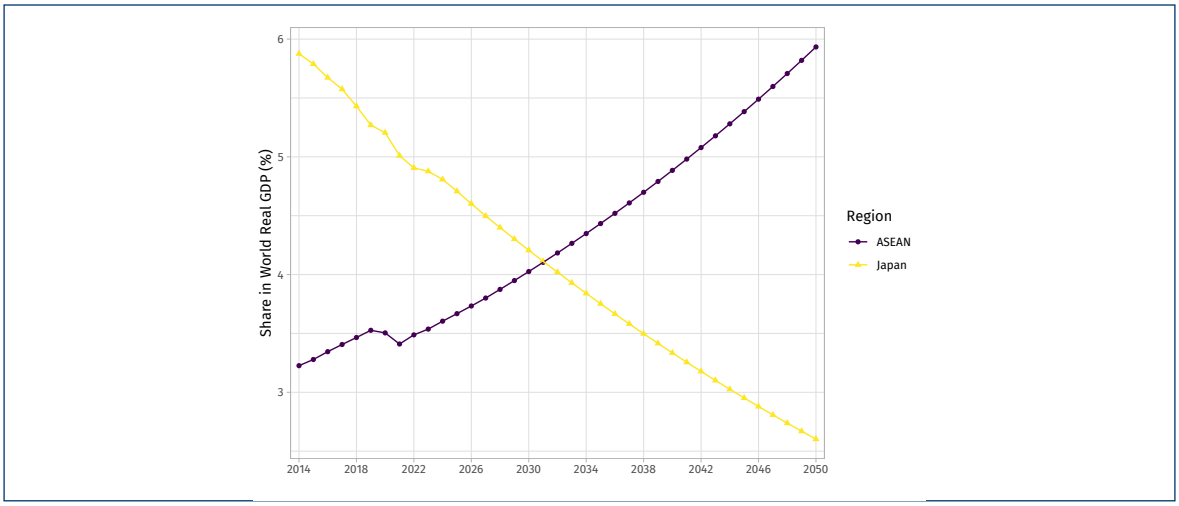
US$ = US dollar, ASEAN = Association of Southeast Asian Nations, IMF WEO = International Monetary Fund World Economic Outlook, Tri = trillion.

Note: _TS is based on time-series projection by a state-space model.

Source: Author's computation based on IMF (2023).

[1] In this chapter, $ refers to US dollars.

Figure 2.6. Share in the World Real Gross Domestic Product



ASEAN = Association of Southeast Asian Nations, GDP = gross domestic product.

Note: _TS is based on time-series projection by a state-space model.

Source: Author's computation based on IMF (2023).

3.2. Future Scenarios of the ASEAN Economic Community

Three scenarios are designed as the AEC's future scenarios in our simulation experiments, under the theme of digitalisation, sustainability, and inclusiveness. Each scenario is implemented to obtain the difference from the baseline, and this deviation is considered as the impact of AEC's future scenario. Given the breadth of each theme, we focus on specific events that are likely to occur when considering the AEC beyond 2025.

Scenario 1: Digitalisation

Effect of ASEAN's E-Commerce Agreement and the World Trade Organization (WTO)'s Joint Initiative

Scenario 2: Sustainability

Global net zero of CO_2 emissions and emissions trade

Scenario 3: Inclusiveness

Narrowing the gender gap in the labour force participation rate in ASEAN

For Scenario 1, we empirically estimate the effect of the e-commerce clause in trade agreements on trade cost, and then we apply the obtained estimates to the simulations with the GDyn-E model. For the simulations, we explore the ASEAN Agreement on E-Commerce and the WTO Joint Initiative on E-Commerce. Given that the ASEAN Agreement entered into force in December 2021 whilst the WTO Joint Initiative was under negotiation, we assume that the ASEAN Agreement takes effect in 2022 and the WTO Initiative in 2026. It should be noted that some ASEAN Member States – Cambodia, the Republic of the Union of Myanmar, and Viet Nam – are not taking signatories to the WTO Joint Initiative.

In our empirical ordinary least squares estimation, $trade\_cost_{ijt}$ between country *i* and *j* in year *t* is regressed on dummy variable of e-commerce agreement constructed from the Trade Agreements Provisions on Electronic Commerce and Data database (Burri, Callo-Müller, and Kugler, 2022) and fixed effects on importer–exporter, importer–year, and exporter–year. The estimating model can be expressed as follows,

$$trade\_cost_{ijt} = E\text{-}commerce_{ijt} + Y_{ij} + Y_{it} + Y_{jt} + E_{ijt}$$

where *trade_cost*=CIF/FOB is computed from the UN Comtrade data for 2000–2020, based on the Broad Economic Categories classification (UN, 2023).

Estimation results are reported in Table 2.1. Except for food and beverages, and the fuels and lubricants, the effect of e-commerce on trade cost is negative and statistically significant. It can be interpreted that the e-commerce agreement tends to lower the trade cost between the countries in the accord. The effect on industrial supplies shows 8.5% lower trade cost as compared with the country pairs without e-commerce agreement. In our simulations, we map the estimates to merchandise trade excluding primary products and energy products, and we exogenously reduce the iceberg trade cost variable defined in the GDyn-E model. We implement the ASEAN Agreement on E-commerce in 2022 and the WTO Joint Initiative in 2026. Because the exogenous decline in the trade cost is applied to international transactions and the trade cost on domestic transactions is left unchanged, the impact of e-commerce may be underestimated.

Table 2.1. Estimation Results

Dependent variable	Trade costs					
	(1)	(2)	(3)	(4)	(5)	(6)
Variables						
E-commerce	-0.007	-0.0853 ***	-0.0442	-0.0643 ***	-0.0564 *	-0.0726 ***
	(0.0213)	(0.0228)	(0.0552)	(0.0217)	(0.0297)	(0.0232)
Fixed effects						
Importer-exporter	Yes	Yes	Yes	Yes	Yes	Yes
Importer-year	Yes	Yes	Yes	Yes	Yes	Yes
Exporter-year	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics						
Observations	243,881	290,284	114,024	253,643	195,809	267,012
R^2	0.51112	0.47393	0.52633	0.48131	0.47744	0.53061

R^2 = coefficient of determination.

Note: Clustered (Importer–exporter) standard-errors in parentheses. Significant Codes: ***: 0.01, **: 0.05, *: 0.1.

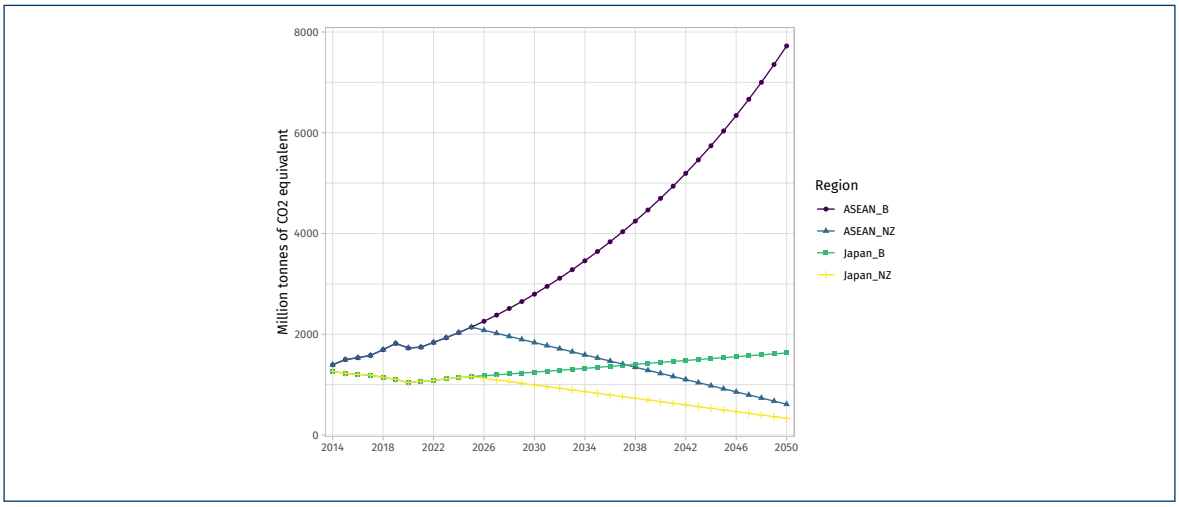
Broad Economic Categories classification: (1) Food and beverages, (2) Industrial supplies, (3) Fuels and lubricants, (4) Capital goods, (5) Transport equipment, (6) Consumption goods.

Source: Author.

For Scenario 2, we explore the global net zero of CO_2 emissions with and without emissions, trading in ASEAN and in the world. In the baseline, we trace CO_2 emissions by country based on the data from the Global Carbon Budget for 2015–2021 (Global Carbon Project, 2022). After that period, the model simulation produces the time path of CO_2 emissions. Figure 2.7 illustrates the CO_2 emissions for ASEAN and Japan for the baseline and the net-zero scenario. For the baseline, ASEAN's growing CO_2 emissions reflect the region's fast economic growth which makes a contrast with Japan, where the growth rate of real GDP is slower. It should be noted that no assumption on the improvement of energy efficiency is imposed on the baseline, so the increasing trend may be overestimated.

For the global net zero of CO_2 emissions, we assume that the net zero is globally attained in 2050 by imposing carbon pricing from 2026. Revenues accrued from the carbon pricing which acts as a tax are returned to the private household in a lump-sum. With this setting of carbon pricing, CO_2 emissions are linearly reduced towards 2050. Following the International Energy Agency's Net-Zero Emissions by 2050 Scenario, we also assume the decreasing trend of energy intensity by 4% per year. On top of the net zero of CO_2 emissions, we experiment with emissions trading amongst the ASEAN Member States and global emission trade. Within the emissions trading block, the carbon price is equalised because of the emissions trading.

Figure 2.7. Carbon Dioxide Emissions for the Baseline and the Net-Zero Scenario



B = baseline, CO_2 = carbon dioxide, NZ = net-zero scenario.

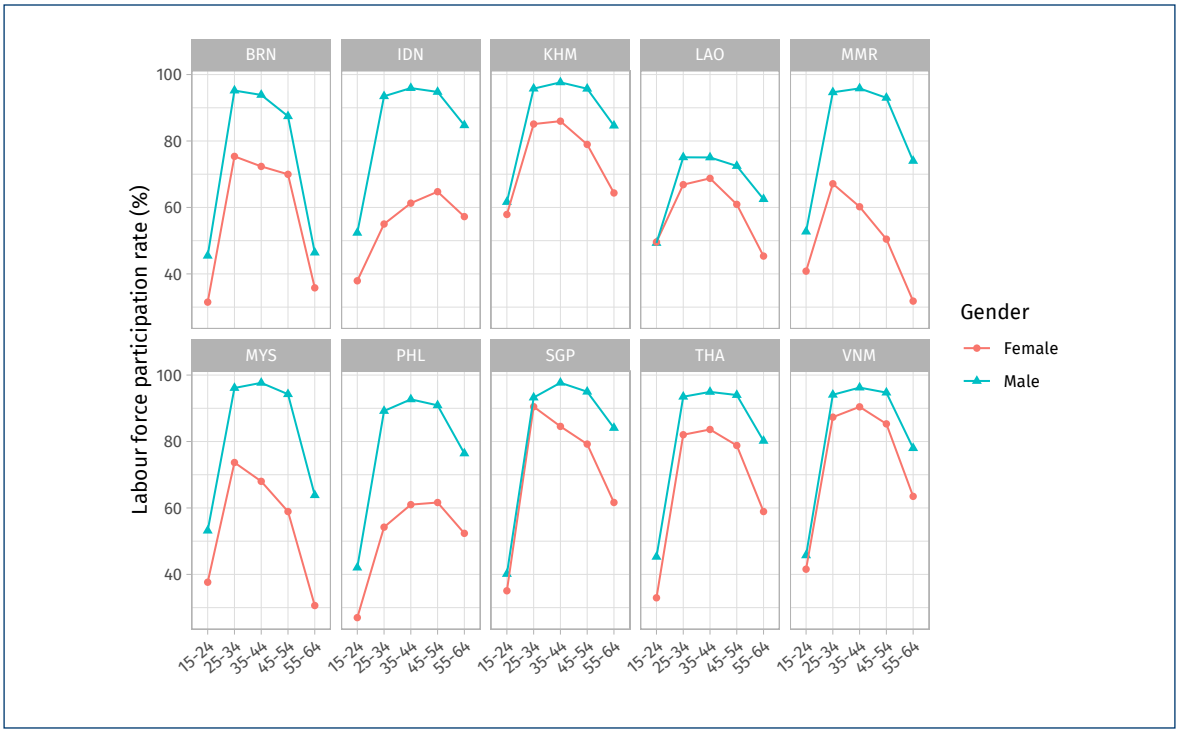
Source: Global Carbon Project (2022) and author's simulation results.

For Scenario 3, we simulate the potential effect of narrowing the gender gap in the labour force participation rate in the ASEAN Member States. As Figure 2.4 illustrates, the long run trend of the shrinking, working-age population relative to the total population is universal with no exception to ASEAN countries. Sustaining a high level of labour force participation rate is one of the key elements to help ASEAN to cope with the demographic change in the long run. Reducing the gender gap in the labour force participation rate can also serve that purpose.

Figure 2.8 shows the labour force participation rate by gender and age group for the ASEAN Member States. The International Labour Organization (2023) provides recent data on Indonesia, Singapore, Thailand, and Viet Nam for 2022; Brunei, Cambodia, the Republic of the Union of Myanmar, Malaysia, and the Philippines for 2019; and the People's Democratic Republic of Lao (Lao PDR) for 2017. The female participation rate is lower than that of the male's for all age groups in all countries, but the size of the gap is diverse across the ASEAN Member States.

For our simulation experiment under Scenario 3, we assume that the gender gap in labour participation rates is gradually reduced to half of the size in 2026–2050. As compared to the baseline, more labour force becomes available, thereby leading to more production activities.

Figure 2.8. Labour Force Participation Rate for the ASEAN (%)



BRN = Brunei Darussalam, IDN = Indonesia, KHM = Cambodia, LAO = People's Democratic Republic of Lao, MMR = the Republic of the Union of Myanmar, MYS = Malaysia, PHL = the Philippines, SGP = Singapore, THA = Thailand, VNM = Viet Nam.

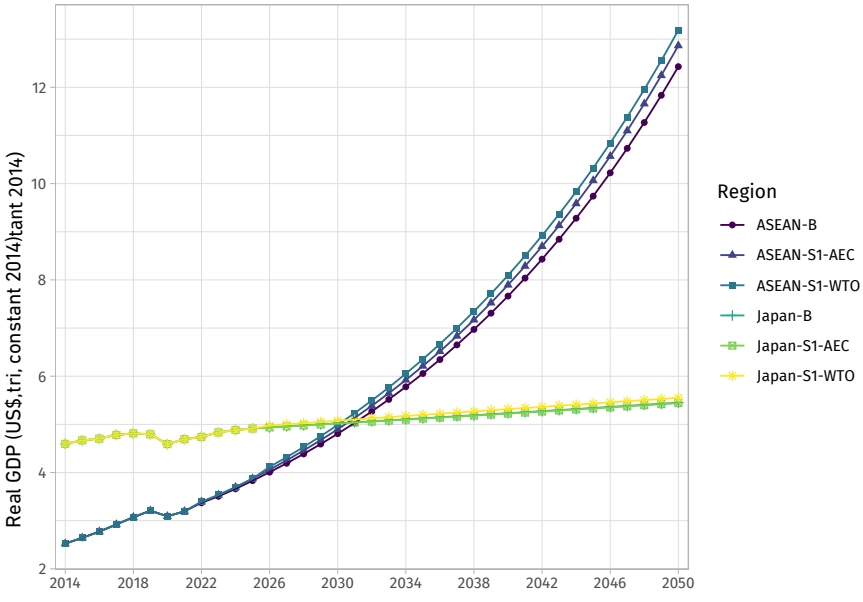
Note: Due to the data availability, figures for Indonesia, Singapore, Thailand, and Viet Nam are based on 2022 annual data; figures for Brunei Darussalam, Cambodia, Malaysia, the Republic of the Union of Myanmar, and the Philippines are based on 2019 annual data; and figures for Lao PDR are based on 2017 annual data.

Source: Author's computation based on ILO (2023).

4. Results of the Future Scenarios for the ASEAN Economic Community

We simulate the AEC's future scenarios and compute the difference from the baseline by using the General Equilibrium Modelling Package software (Harrison and Pearson,1996; Horridge et al., 2018). Figure 2.9 shows the impact of e-commerce agreements on the level of real GDP for ASEAN. We include the results in Japan for comparison. The e-commerce agreement brings down the trade cost for ASEAN in 2022 and for the member countries in the WTO Joint Initiative in 2026, stimulating trade and investment for the member countries. The ASEAN Agreement on E-Commerce raises the real GDP in 2050 to $12.9 trillion from a $12.4 trillion baseline, whilst the WTO Joint Initiative results in $13.2 trillion for ASEAN. The difference from the baseline amounts to $437 billion and $756 billion, respectively. Although the impact of the WTO Joint Initiative is larger than the ASEAN Agreement in absolute size, additional gain from the WTO Joint Initiative is limited because some ASEAN countries are excluded from the accord.

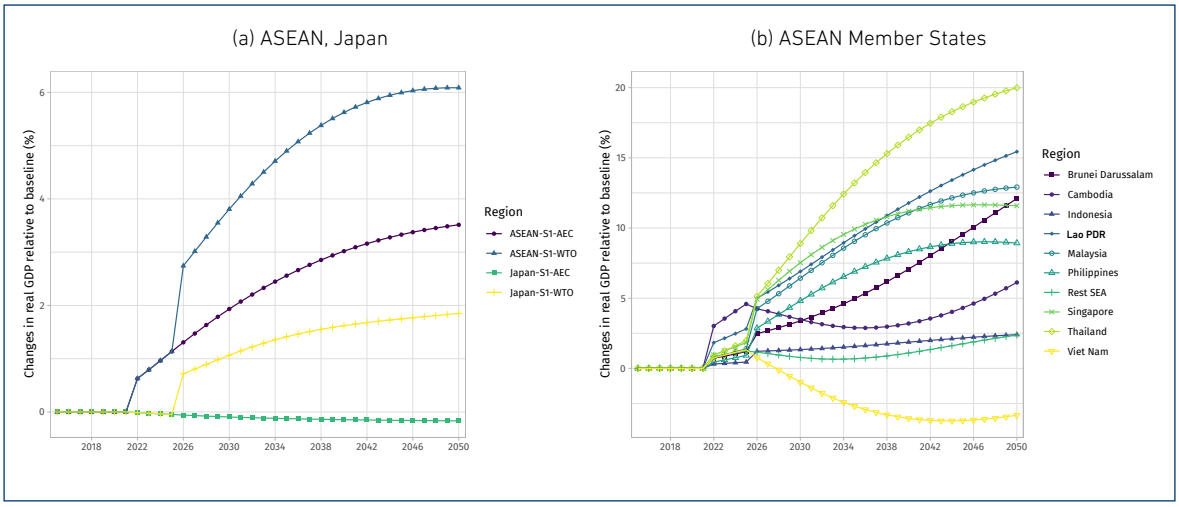
Figure 2.9. Impact of the E-Commerce Agreement on Real Gross Domestic Product



US$ tri, constant 2014 = US $ trillion, constant 2014 prices; AEC = ASEAN Agreement on E-Commerce; B = baseline; GDP = gross domestic product; S1 = Scenario 1; WTO = World Trade Organization Joint Initiative.

Source: Author's simulation results.

Figure 2.10. Impact of the E-Commerce Agreement on Real Gross Domestic Product (%)



AEC = ASEAN Agreement on E-Commerce, ASEAN = Association for Southeast Asian Nations, GDP = gross domestic product, Lao PDR = People's Democratic Republic of Lao, S1 = Scenario 1, SEA = Southeast Asia, WTO = Joint Initiative.

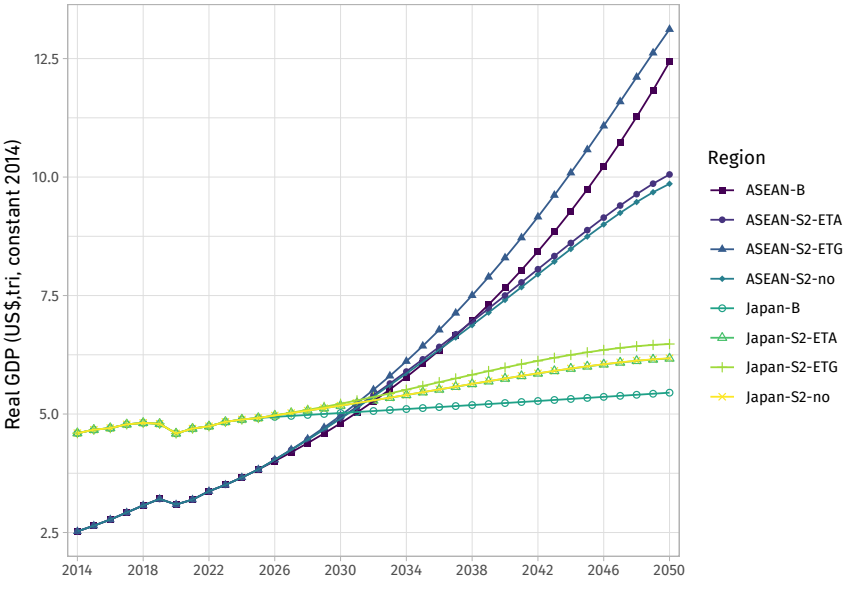
Source: Author's simulation result.

The difference from the baseline can be measured in percentage deviation, and Figure 2.10 shows the results for ASEAN as well as each member state. When the ASEAN Agreement on E-Commerce takes effect in 2022 (Figure 2.10a) the time path increases by about 0.6% and continues to rise to 3.5% by 2050. Because Japan is not a member of ASEAN, its real GDP becomes slightly lower than the baseline. Moreover, the WTO Joint Initiative in 2026 raises ASEAN's real GDP to 2.7% which becomes 6% by 2050. Figure 2.10b shows the impact for each ASEAN Member State in which diverse time paths are observed. The impact of the ASEAN Agreement on E-Commerce is dominated in magnitude by the WTO's Joint Initiative implemented in 2026 thereafter. Cambodia gains most from ASEAN's Agreement on E-Commerce, but the gain falls with the WTO Joint Initiative and recovers later in the simulation period. This reflects the fact that Cambodia is not in the WTO Joint Initiative. Thailand shows a significant positive impact reaching 20% higher real GDP in 2050 due to both agreements. Viet Nam, not in the WTO Joint Initiative agreement, experiences a negative impact (-3%) as compared to the baseline. This wide range of impacts can be attributed to the fact that there are 90 countries in the WTO Joint Initiatives so the impact can be magnified for the larger economies.

These results indicate that the AEC's push to establish the e-commerce agreement can benefit the Member States and that mega-regional agreements such as the WTO's Joint Initiative may contribute further to the Member States. Although it may not be realistic to assume the WTO's Joint Initiative will be realised in 2026, the result can highlight the potential gains from being a member of a mega-regional agreement. Also, there would be a considerable negative effect for the non-member countries.

Figure 2.11 outlines the results from Scenario 2, the impact of global net zero of CO_2 emissions and emissions trade on real GDP. When the global net zero of CO_2 emissions has been gradually attained by 2050 through the introduction of carbon pricing, ASEAN's real GDP continues to grow but the level of real GDP in 2050 becomes $2.6 trillion smaller than the baseline. In contrast, the real GDP of Japan is $0.7 trillion larger than the baseline because of the relatively smaller amount of CO_2 emissions to be mitigated by carbon pricing. Allowing for emissions trading amongst ASEAN Member States, ASEAN's real GDP gain becomes larger than the no-emission-trading case by about $200 billion. If the emissions trading is implemented at a global scale, ASEAN's real GDP exceeds the baseline at $13.1 trillion.

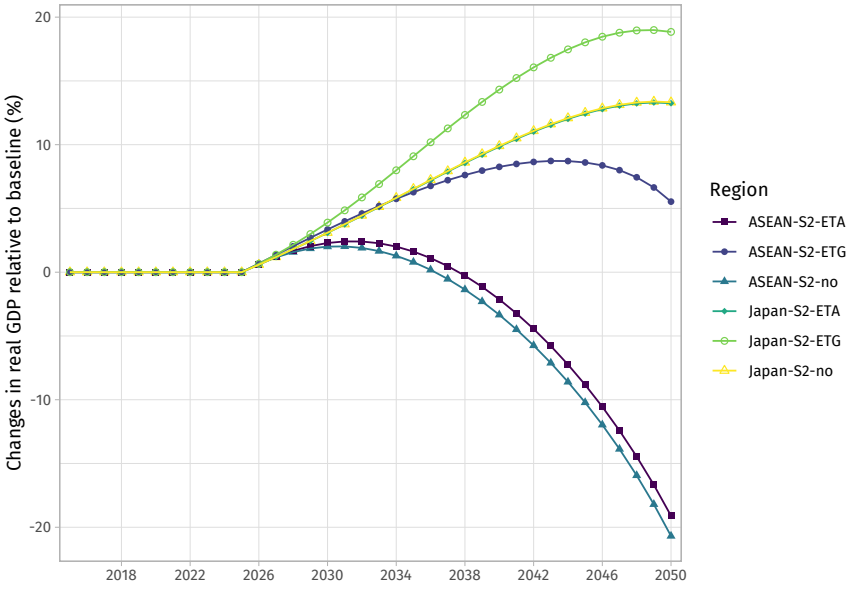
Figure 2.11. Impact of Global Net Zero and Emission Trade on Real Gross Domestic Product



US$ tri, constant 2014 = US dollar $ trillion, constant 2014 prices; ASEAN = Association of Southeast Asian Nations; B = baseline; ETA = emission trade in ASEAN; ETG = global emission trade; GDP =gross domestic product; no = no emission trade; S2 = Scenario 2; tri = trillion,

Source: Author's simulation results.

Figure 2.12. Impact of Global Net Zero and Emissions Trading on Real Gross Domestic Product (%)



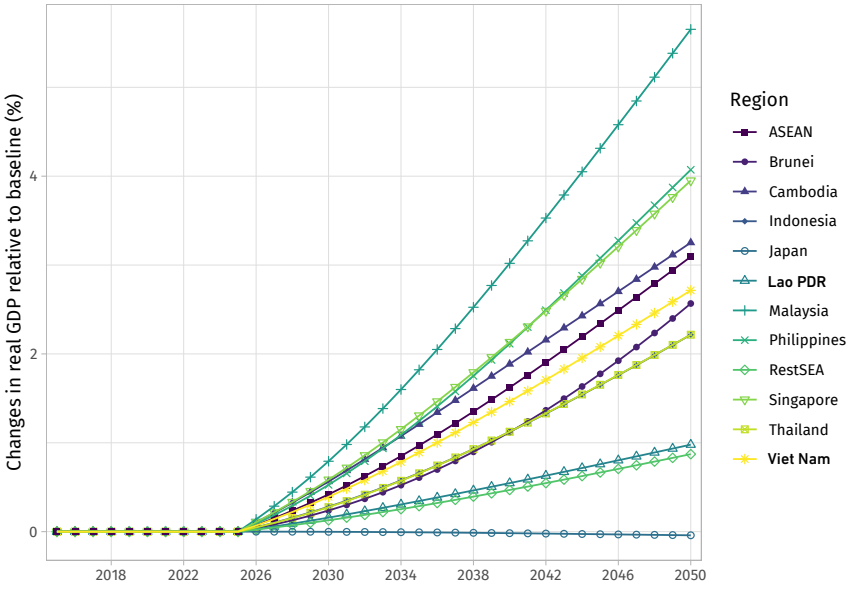
ASEAN = Association of Southeast Asian Nations, B = baseline, ETA = emission trade in ASEAN, ETG = global emission trade, GDP = gross domestic product, no = no emission trade, S2 = Scenario 2.

Source: Source: Author's simulation results.

The deviation from the baseline drawn in Figure 2.12 confirms these points. The imposition of carbon pricing to meet the global net zero of CO_2 emissions lowers ASEAN's real GDP below the baseline level by 20% for the no-emission-trading case and 19% for emissions trading within ASEAN. It should be noted that ASEAN's real GDP keeps growing under these scenarios (Figure 2.11). Global emissions trading leads to ASEAN's real GDP being higher than the baseline by 6% in 2050. These results suggest that under the global net-zero scenario, emissions trading amends the limiting effect of carbon pricing on ASEAN's real GDP and that it can be possible to reach a higher real GDP under the global emissions trading.

Lastly, for Scenario 3, we report the impact of narrowing the gender gap in the labour force participation rate in ASEAN Member States on real GDP. Figure 2.13 illustrates the impact in terms of change in real GDP relative to the baseline. In the simulation, we assume that the gender gap in the labour force participation rate is gradually closing from 2026, and the gap is eventually halved by 2050. Malaysia shows the largest impact in real GDP which amounts to 5.7% higher than the baseline in 2050. For the Philippines (4%), Singapore (3.9%), and Cambodia (3.3%), the impact is larger than the ASEAN average (3.1%). The impact on Lao PDR (1%) is smaller than the other ASEAN Member States because the gender gap is narrower whilst the overall labour participation rate is relatively low in the baseline. These positive impacts are attributed to the increasing labour supply as more females participate in the labour force, thereby leading to higher economic activity.

Figure 2.13. The Impact of Narrowing the Gender Gap in the Labour Participation Rate



ASEAN = Association for Southeast Asian Nations, GDP = gross domestic product, Lao PDR = People's Democratic Republic of Lao, SEA = Southeast Asia.

Source: Author's simulation results.

5. Conclusion

This study explores the future scenarios for the AEC beyond the year 2025 under three themes: digitalisation, sustainability, and inclusiveness. We evaluate these future scenarios through a general equilibrium framework, particularly focusing on the specific events under each theme. For digitalisation, we examine the impact of the ASEAN Agreement on E-Commerce and the WTO's Joint Initiative. For sustainability, we consider the effects of achieving global net zero of CO emissions and emissions trading. For inclusiveness, we simulate the potential economic benefits of narrowing the gender gap in the labour force participation rate.

Simulation results indicate the potential economic benefit in terms of the real GDP for ASEAN as compared to the baseline. The ASEAN Agreement on E-Commerce results in real GDP that is 2.7% higher by 2050, and for the WTO Joint Initiative, real GDP is 6% higher by the same year. Whilst the global net zero of CO_2 emissions without emissions trading lowers ASEAN's real GDP below the baseline level, the global emissions trading raises it over the baseline by 6%. Halving the gender gap in the labour force participation rate in ASEAN contributes to a 3% higher real GDP in 2050. These results may involve far-reaching assumptions, but the implication for the AEC's future direction is to extend deeper economic integration of the ASEAN Member States to the global partners.

References

Aguiar, A., M. Chepeliev, E. Corong, R. McDougall, and D. van der Mensbrugghe (2019), 'The GTAP Data Base: Version 10', *Journal of Global Economic Analysis,* 4(1), pp1–27. https://jgea.org/ojs/index.php/jgea/article/view/77

Armington, P.S. (1969), 'A Theory of Demand for Products Distinguished by Place of Production', *IMF Staff Papers,* 16(1), pp.159–78. https://www.elibrary.imf.org/view/journals/024/1969/001/article-A007-en.xml

Association of Southeast Asian Nations (ASEAN) (2021), *Mid-Term Review: ASEAN Economic Community Blueprint 2025*. Jakarta: ASEAN Secretariat. https://asean.org/book/mid-term-review-report-of-the-aec-blueprint-2025/

Burniaux, J-M. and T.P. Truong (2002), 'GTAP-E: An Energy-Environmental Version of the GTAP Model', *Global Trade Analysis Project (GTAP) Technical Paper,* 16, West Lafayette: Purdue University. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=923

Burri, M., M.V. Callo-Müller, and K. Kugler (2022), TAPED: *Trade Agreement Provisions on Electronic Commerce and Data*. Lucerne: University of Lucerne. https://unilu.ch/taped (accessed 12 May 2023)

Corong, E., T. Hertel, R. McDougall, M. Tsigas, and D. van der Mensbrugghe (2017), 'The Standard GTAP Model, Version 7', *Journal of Global Economic Analysis,* 2(1), pp.1–119. https://doi.org/10.21642/JGEA.020101AF

Global Carbon Project (2022), *Global Carbon Budget 2022.* https://www.globalcarbonproject.org

Global Trade Analysis Project (GTAP) (2024), *Global Trade Analysis Project.* West Lafayette: Purdue University. https://www.gtap.agecon.purdue.edu

Golub, A. (2013),'Analysis of Climate Policies with GDyn-e', *GTAP Technical Paper*, 32 (September), pp.1–31. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=4292

Harrison, W.J. and K.R. Pearson (1996),'Computing Solutions for Large General Equilibrium Modeling Using GEMPACK', Computational Economics, 9, pp.83–127. https://doi.org/10.1007/BF00123638

Hertel, T.W. (ed) (1997), *Global Trade Analysis: Modeling and Applications.* New York: Cambridge University Press.

Horridge, M.J., M. Jerie, D. Mustakinov, and F. Schiffmann (2018), *GEMPACK Manual*. GEMPCK Software. https://www.copsmodels.com/gpmanual.pdf

Ianchovichina, E. and R. McDougall (2001), 'Theoretical Structure of Dynamic GTAP', *GTAP Technical Paper,* 17, West Lafayette: Purdue University. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=480

Ianchovichina, E. and T. Walmsley (eds) (2012), *Dynamic Modeling and Applications for Global Economic Analysis*. New York, NY: Cambridge University Press. https://assets.cambridge.org/97811070/11694/frontmatter/9781107011694_frontmatter.pdf

International Labour Organization (ILO) (2023), *ILO Modelled Estimates Database,* Geneva: ILO. https://ilostat.ilo.org/data/ (accessed 23 October 2023).

International Monetary Fund (IMF) (2023) *World Economic Outlook Database,* Washington, DC: IMF (accessed 14 October 2023).

McDougall, R. (2003), 'A New Regional Household Demand System for GTAP', *GTAP Technical Paper*, 20 (September): pp.1–57, West Lafayette: Purdue University. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=942

McDougall, R. and A. Golub (2007), 'GTAP-E: A Revised Energy-Environmental Version of the GTAP Model', *GTAP Research Memorandum*, 15. West Lafayette: Purdue University. https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=2959

United Nations (UN) (2022), *World Population Prospects: The 2022 Revision*. New York: UN. https://population.un.org/wpp/ (accessed 1 October 2022).

UN (2023), *UN Comtrade Database*. New York, NY: UN. https://comtradeplus.un.org (accessed 22 June 2023).

Appendixes

Table 2.A1. Regional Aggregation

No.	Country	GTAP 141 regions
1	**Brunei Darussalam**	Brunei Darussalam.
2	**Cambodia**	Cambodia.
3	**Indonesia**	Indonesia.
4	**Lao PDR**	Lao PDR.
5	**Malaysia**	Malaysia.
6	**Philippines**	Philippines.
7	**Singapore**	Singapore.
8	**Thailand**	Thailand.
9	**Viet Nam**	Viet Nam.
10	**Rest SEA**	Rest of South East Asia.
11	**Japan**	Japan.
12	**China**	China; Hong Kong.
13	**Korea**	Korea.
14	**Australia**	Australia.
15	**New Zealand**	New Zealand.
16	**India**	India.
17	**Taiwan**	Taiwan.
18	**US**	United States of America.
19	**Canada**	Canada.
20	**Mexico**	Mexico.
21	**Chile**	Chile.
22	**Peru**	Peru.
23	**EU**	Austria; Belgium; Bulgaria; Croatia; Cyprus; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Latvia; Lithuania; Luxembourg; Malta; Netherlands; Poland; Portugal; Romania; Slovakia; Slovenia; Spain; Sweden.
24	**UK**	United Kingdom.
25	**Rest of World**	Rest of Oceania; Mongolia; Rest of East Asia; Bangladest; Nepal; Pakistan; Sri Lanka; Rest of South Asia; Rest of North America; Argentina; Bolivia; Brazil; Colombia; Ecuador; Paraguay; Uruguay; Vebezuela; Rest of South America; Costa Rica; Guatemala; Honduras; Nicaragua; Panama; El Savador; Rest of Central America; Dominican Republic; Jamaica; Puerto Rico; Trinidad and Tobago; Caribbean; Switzerland; Norway; Rest of EFTA; Albania; Belarus; Russian Federation; Ukraine; Rest of Eastern Europe; Rest of Europe; Kazakhstan; Kyrgyzstan; Tajikistan; Rest of Former Soviet Union; Armenia; Azerbaijan; Georgia; Bahrain; Iran Islamic Republic of; Israel; Jordan, Kuwait; Oman; Qatar; Saudi Arabia; Turkey; United Arab Emirates; Rest of Western Asia; Egypt; Morocco; Tunisia; Rest of North Africa; Benin; Burkina Faso; Cameroon; Cote d'Ivoire; Ghana; Guinea; Nigeria; Senegal; Togo; Rest of Western Africa; Central Africa; South Central Africa; Ethiopia; Kenya; Madagascar; Malawi; Mauritius; Mozambique; Rwanda; Tanzania; Uganda; Zambia; Zimbabwe; Rest of Eastern Africa; Botswana; Namibia; South Africa; Rest of South African Customs; Rest of the World.

EFTA = European Free Trade Association, GTAP = Global Trade Analysis Project, Lao PDR = People's Democratic Republic of Lao.

Source: Author's aggregation based on Aguiar et al. (2019).

Table 2.A2. Sector Aggregation

No.	Sector	GTAP 65 sectors
1	**Primary**	Paddy rice; Wheat; Cereal grains nec; Vegetables, fruit, nuts; Oil seeds; Sugar cane, sugar beet; Plant-based fibers; Crops nec; Bovine cattle, sheep and goats; Animal products nec; Raw milk; Wool, silk-worm cocoons; Forestry; Fishing; Bovine meat products; Meat products nec; Vegetable oils and fats; Dairy products; Processed rice; Sugar; Food products nec; Beverages and tobacco products.
2	**Coal**	Coal.
3	**Oil**	Oil.
4	**Gas**	Gas; Gas manufacture, distribution.
5	**Oil-pcts**	Petroleum, coal products.
6	**Electricity**	Electricity.
7	**TextWapp**	Textiles; Wearing apparel; Leather products.
8	**WoodPaper**	Wood products; Paper products; publishing.
9	**Chemical**	Chemical products.
10	**Pharma**	Basic pharmaceutical products.
11	**RubberPlstic**	Rubber and plastic product.
12	**Minerals**	Mineral products nec.
13	**BasicMetal**	Ferrous metals; Metals nec
14	**MetalProduct**	Metal products.
15	**CmpEletrncs**	Computer, electronic and optic.
16	**ElectrelEquip**	Electrical equipment.
17	**Machinery**	Machinery and equipment nec.
18	**Motorvehicle**	Motor vehicles and parts.
19	**TrnsprtEquip**	Transport equipment nec.
20	**OthMnfct**	Minerals nec; Manufactures nec.
21	**Utilities**	Water.
22	**Construction**	Construction.
23	**Trade**	Trade.
24	**Transports**	Transport nec; Water transport; Air transport; Warehousing and support activi.
25	**Comm**	Communication.
26	**FinsBusi**	Financial services nec; Insurance; Real estate activities; Business services nec.
27	**OthServices**	Accommodation, Food and service; Recreational and other service; Public administration and defe; Education; Human health and social work a; Dwellings.

GTAP = Global Trade Analysis Project, nec = not elsewhere classified.

Source: Author's aggregation based on Aguiar et al. (2019).