Agricultural Trade Impacts of RCEP: an Integrated Partial Equilibrium and General Equilibrium Assessment

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Abstract: Multilateral trade-policy evaluation and policymaking depends on our continuing efforts to better model economic impacts. Recent innovations link general-equilibrium (GE) and partial-equilibrium (PE) models to capture both economy-wide and product-specific impacts. In this paper we highlight tariff aggregation issues in the context of the Regional Comprehensive Economic Partnership (RCEP). We find that product-specific information on tariffs within the PE-GE structure is superior to either trade weighting or simple averaging techniques applied in pure GE studies.

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1. Introduction

Multilateral trade-policy evaluation and policymaking depends on our continuing efforts to better model economic impacts. For example, it is important to assess the impacts on various countries of large-scale trade agreements, like the Regional Comprehensive Economic Partnership (RCEP). The 15 members in the RCEP consist of around a third of world GDP and would significantly impact the world economy and trade (Petri and Plummer, 2020). China's agricultural trade

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has been through significant changes in recent years, and it has been a significant importer of feed grains, including corn, barley, and sorghum, and meat products (GACC, 2020). In particular, China's corn imports increased from 4.79 million tons in 2019 to 9.04 million tons in the first eleven months of 2020, exceeding its tariff rate quota of 7.2 million tons for the first time since 1994 (GACC, 2020). With the newly signed RCEP and the continuing uncertainties in world agricultural trade, it's crucial to evaluate RCEP's impacts on global agricultural trade patterns and whether it can counteract the negative impacts of the recent trade war (Mahadevan and Nugroho, 2019).

While partial equilibrium (PE) trade models, like the Food and Agricultural Policy Research Institute (FAPRI) and the Common Agricultural Policy Regionalized Impact (CAPRI) Modeling System, can be used to explore the impacts of trade policies on disaggregated commodities. PE models cannot capture economy-wide impacts of large-scale trade policies that would have broader trade impacts beyond the commodities and countries directly targeted by the policies. On the other hand, general equilibrium (GE) models such as those based on the Global Trade Analysis Project (GTAP) can capture broad economy-wide and cross-commodity impacts but are constrained in analysis of specific commodities. For example, in the most recent GTAP10 dataset, critical agricultural commodities, like soybeans, are aggregated into "Oilseeds," while corn and pork are aggregated into "Other cereal grains" and "other meat products,"; therefore, GE models based on GTAP10 database cannot provide insights on the impacts of policies target on disaggregated commodities.

In this paper, we first develop a novel modeling system that links partial-equilibrium (PE) components of individual agricultural commodities with general equilibrium (GE) model calibrated using GTAP10 accounts, and then use the newly developed model to simulate the economic and trade impacts of the RCEP without and with India and U.S. as additional members. Specifically, we first develop PE modules for eight agricultural commodities, including corn, wheat, soybeans,pork, beef, ethanol, distiller grains (DDGS), and sorghum, by establishing regional input supplies and regional demand for each commodity, and then link the PE modules with a GE model based on GTAP database to solve for a consistent solution that meets the new trade equilibrium in both the PE modules and the GE model (Balistreri and Rutherford, 2013). The integration of PE models for specific disaggregated commodities with GE models based on the GTAP10 accounts better captures the impacts of large policy shocks that could result in the creation and destruction of trade links. We collect policy changes in the RCEP from the RCEP legal text, including detailed tariffs and non-tariff schedules.

We intend an evaluation of RECP's affects on agricultural trade patterns on the eight disaggregated commodities and compare the global agricultural trade patterns with and without India's participation. We also pay special attention to RCEP's impacts on US-China agricultural trade given that it's highly likely that

China will diversify away from US for agricultural exports due to the political tensions.

This paper proceeds as follows. In Section 2 we introduce related literature on PE-GE linked modelling and tariff aggregation bias. In Section 3 we outline the PE-GE modelling approach used in the analysis. Section 4 describes the tariff schedules specified in RCEP and the simulation scenarios. Section 5 provides a set of results for all countries and regions and discusses the aggregation bias arising from using trade-weighted tariffs. Finally, in section 6 we provide concluding comments and highlight follow-up research needed to better evaluate the trade and welfare impacts of regional trade agreements.

2. Literature

2.1 PE-GE linked model

While Computable General Equilibrium (CGE) Models are widely used to evaluate and simulate the impacts of trade policies, the aggregation levels in these models are often too coarse for informative policy evaluation and simulations. Too aggregated policy evaluations might not be illuminating and maybe even harmful for policy debates. Given that PE models can capture the impacts of the more disaggregated level, several studies have employed a hybrid PE-GE framework to overcome such limitations (Grant, Hertel, and Rutherford, 2009; Narayana, Hertel, and Horridge, 2010; Aguiar et al., 2021).

Grant, Hertel, and Rutherford (2009) develop a HS-6 digit tariff-line and export-differentiated policy model to investigate bilateral and multilateral Tariff Rate Quota (TRQ) reform options in the heavily protected U.S. specialty cheese import market. Narayana, Hertel, and Horridge (2010) develop a PE model that captures international trade, domestic consumption and output that are nested within the standard GTAP model. They use this model to investigate the impacts of multi-lateral tariff liberalization on Indian economy, with a focus on the auto sector. They find that the linked model is superior to both the GE and PE counterparts: the PE model cannot predict the economy-wide changes, and the GE model underestimates the aggregate welfare gain due to tariff averaging and also fails to account for changing in industry composition resulting from trade reform. Aguiar et al. (2021) provide an automated data and model workflow that allows GTAP-based analysis at the HS level. They illustrate the model using automotive sector, where tariffs are highly differentiated across HS components, and their framework and code facilitates trade policy simulations at the HS level and allow researchers to capture more nuances on the trade side. Balistreri and Rutherford (2013) offered and PE-GE linked approach to calibration and computation of models that include the Melitz (2003) monopolistic competition and heterogeneous-firms structure. Balistreri and Rutherford (2013) find that heterogeneous firm structure matters for CGE analysis.

2.2 Tariff aggregation bias

Another well-known bias in CGE modelling is tariff aggregation bias. Using simple or trade-weighed average tariffs up to a level consistent with the data used for analysis of production and consumption is common in trade policy evaluation. While empirical work requires policy aggregation, a notable disadvantage with trade-weighted average tariff is that its weight on any tariff declines as it rises, and therefore it underestimates the overall tariff protection. There are many studies showing that aggregation bias is substantial(Laborde, Martin, and Van der Mensbrugghe, 2011; Pelikan and Brockmeier, 2008; Britz and van der Mensbrugghe, 2016; Himics, Listorti, and Tonini, 2020). Laborde, Martin, and Van der Mensbrugghe (2011) use detailed tariff data provided by the MAcMapHS6 database in a modified LINKAGE global general equilibrium model. They find the aggregation procedure with a conservative estimate of elasticity of substitution between six-digit tariff lines results in a close to doubling estimated welfare gains from complete liberalization. Pelikan and Brockmeier (2008) also find that traditional trade-weighted average tariffs largely underestimate welfare gains from trade liberalization. However, there are also studies. Britz and van der Mensbrugghe (2016) discuss how to avoid aggregation bias in large-scale global CGE models by reducing the need of pre-model aggregation. Himics, Listorti, and Tonini (2020) show that standard tariff aggregation overestimates trade quantity impacts and the aggregation bias increases with greater dispersion in tariffs or tariff cuts. Specifically, Himics, Listorti, and Tonini (2020) focus on three bias: substitution effects on import demand, TRQ, existing overprotective buffers of tariff protection, and simulate the impacts of two aggregators: the trade expenditure aggregator which is the uniform tariff rate that is equivalent to a set of individual tariffs in terms of its impacts on trade expenditures; and the Tariff Reduction Impact Model for Agriculture (TRIMAG) aggregator which adjusts aggregation weights based on a CES function defined at the tariff line and provides an explicit representation of overprotective tariffs.

3. Structural Model

3.1 Partial equilibrium component

The first step in the integrated modeling system is to establish a PE module for each agricultural commodity of interest. Each PE module will be formulated as a Mixed Complementarity Problem (MCP) using the General Algebraic Modeling System (GAMS) programming language. The PE model's trade structure is flexible and is set to the theory that best represents a commodity's trading system. Each PE module's solution uses commodity-specific input supply functions that reflect differences in input demand for production of a given commodity. Considering that each commodity's input supply and demand will be different across regions, we also establish regional input supplies and regional demand for each commodity and then solve a new set of prices and quantities for the inputs and production across regions to establish the new trade equilibrium. We calibrate the PE models using the GTAP10 dataset and external data sources like UN Comtrade data and disaggregated input-output tables when necessary.

3.2 Linking partial equilibrium and general equilibrium model

We use the CGE model based on the GTAP10 database utilizing GTAPinGAMS (Lanz and Rutherford, 2016) data management tools to link with the PE modules for disaggregated agricultural commodities. In the CGE-PE linkages, the regional values used of aggregate-commodity demands and the inputs used to produce them are disaggregated into separate demand for the specific commodities of interest and other commodities. The PE model then uses the disaggregated information to solve new production, consumption, and trade equilibrium based on a trade structure tailored to each commodity. These commodity-specific solutions are then inserted back to the aggregate sectors in GTAP accounts, which will generate a new equilibrium with different input and output prices. This iteration process between GE and PE models continues until a consistent solution for both the GE and PE models is found.

4. Policy Simulations

4.1 RCEP

On November 15, 2020, 10 members of the Association of Southeast Asian Nations (ASEAN) and five Asia-Pacific countries, including Australia, China, Japan, New Zealand, and South Korea, signed the RECP, seven years after the negotiation started in 2013. India and the U.S. exit the mega trade deal after negotiating the deal for seven years. With its 15 members accounting for about a third of the global GDP, RECP will be the largest free trade agreement in history. Petri and Plummer (2020) utilized a CGE model based on the GTAP dataset that consists of 24 regions and 18 sectors to simulate the impacts of RCEP by adjusting annual baseline values of tariffs, utilization rates of tariff preferences, non-tariff barriers, and costs associated with meeting rules of origin. However, Petri and Plummer conducted the study when the RCEP text was not yet available and made assumptions about member countries' tariff schedules based on the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP).

The chapters and annexes comprise the RCEP text are released on November 15, 2020 and contains each member country's detailed schedules of tariff and non-tariff commitments and the labor movement. We collect the detailed policy changes, adjust these baseline values in the GTAP10 dataset, and then use the developed integrated model to simulate the impacts of RCEP. Therefore, this study improves the analysis in Petri and Plummer (2020) by incorporating PE models on disaggregated commodities with a GE model and also uses the actual tariff and non-tariff schedules in RCEP. Other than simulating the impacts of RCEP with 15 members, we simulate the impacts of RCEP with India and the U.S. in the agreement.

4.2 Tariff reduction scenarios in RCEP

RCEP covers about 90 percent of tariff lines, and the exact extent and timing of RCEP's tariffs cuts requires lengthy country schedules. RCEP also includes extensive exclusions for import-sensitive agricultural products and 20-year to 35-year transition periods for certain tariff cuts to go into full effect. Several countries, including Australia, Brunei, Cambodia, Malaysia, Myanmar, New Zealand, Singapore, and Thailand, will apply a single tariff schedule to all other RCEP members, the remaining members will phase out their tariffs at different rates for different RCEP members. To account for the different tariff reduction timing of different RCEP members and compare the estimation bias from tariff aggregations, we present both simple average tariff reduction scenarios and trade-value weighted tariff reduction scenarios specified in RCEP. We use bilateral trade data in 2019 as the weights.[1]

5. Results

5.1 Regional and sectoral trade impacts

We anticipate having three sets of results. First, we expect to see the global agricultural trade impacts of RCEP. In particular, we expect to see how RECP would affect the agricultural trade patterns on the eight disaggregated commodities, including corn, wheat, soybeans, pork, beef, ethanol, distiller grains (DDGS), and sorghum. Second, we expect to compare global agricultural trade patterns were India and the U.S. joined the RCEP with the current scenario when there are 15 members in RCEP. Finally, we pay special attention to RCEP's impacts on the US and China's agricultural trade, given that China has been consistently developing an import diversification strategy to reduce its agricultural reliance on the US.

5.2 Regional welfare impacts

5.3 Tariff aggregation bias

We also compare the trade and welfare impacts when we use simple average tariff reductions and trade-value weighted average tariff reductions in the simulation.

[1] We obtain bilateral trade data from CEPII (2021).

6. Conclusion

This paper contributes to the current literature by developing a novel modeling system that integrates the advantages of partial equilibrium models in their coverage of disaggregated commodities that have significant policy implications and the advantages of general equilibrium models in analyzing economy-wide and cross-commodity impacts. Future studies can follow or extend this method and expand the PE modules to other commodities to study the impacts of large-scale trade and economic policies. We anticipate developing a modeling system that is able to accommodate advanced partial equilibrium modules for manufacturing and service sectors that include firm-selection and variety impacts consistent with advanced monopolistic competition models of trade.

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References

Aguiar, A., E. Corong, D. van der Mensbrugghe, et al. 2021. "Detailed Trade Policy Simulations Using a Global General Equilibrium Model." Report.

Balistreri, E.J., and T.F. Rutherford. 2013. "Computing general equilibrium theories of monopolistic competition and heterogeneous firms." In *Handbook of computable general equilibrium modeling*. Elsevier, vol. 1, pp. 1513–1570.

Britz, W., and D. van der Mensbrugghe. 2016. "Reducing unwanted consequences of aggregation in large-scale economic models-A systematic empirical evaluation with the GTAP model." *Economic Modelling*, 59: 463–472.

GACC. 2020. "Monthly Statistics of Main Imported Products." (General Administration of Customs of China), Report. http://www.customs.gov.cn/customs/302249/302274/302277/index.html/.

Grant, J.H., T.W. Hertel, and T.F. Rutherford. 2009. "Dairy tariff-quota liberalization: Contrasting bilateral and most favored nation reform options." *American Journal of Agricultural Economics*, 91(3): 673–684.

Himics, M., G. Listorti, and A. Tonini. 2020. "Simulated economic impacts in applied trade modelling: A comparison of tariff aggregation approaches." *Economic Modelling*, 87: 344–357.

Laborde, D., W. Martin, and D. Van der Mensbrugghe. 2011. *Measuring the impacts of global trade reform with optimal aggregators of distortions*. The World Bank.

Lanz, B., and T.F. Rutherford. 2016. "GTAPinGAMS: Multiregional and Small Open Economy Models." *Journal of Global Economic Analysis*, 1(2): 1–77.

Mahadevan, R., and A. Nugroho. 2019. "Can the Regional Comprehensive Economic Partnership minimise the harm from the United States–China trade war?" *The World Economy*, 42(11): 3148–3167.

Melitz, M.J. 2003. "The impact of trade on intra-industry reallocations and aggregate industry productivity." *Econometrica*, 71(6): 1695–1725.

Narayana, B.G., T.W. Hertel, and J.M. Horridge. 2010. "Linking partial and general equilibrium models: a GTAP application Using TASTE." Report.

Pelikan, J., and M. Brockmeier. 2008. "Methods to aggregate import tariffs and their impacts on modeling results." *Journal of Economic Integration*, pp. 685–708.

Petri, P.A., and M.G. Plummer. 2020. "20-9 East Asia Decouples from the United States: Trade War, COVID-19, and East Asia's New Trade Blocs." Report.