Properly Capturing the Impact of Trade Liberalization: Impacts of CETA

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Abstract

Commutable general equilibrium (CGE) is a widely used approach to analyze the economy-wide impact of free trade agreements (FTAs). The majority of CGE models do not explicitly consider Tariff Rate Quota (TRQ) due to both data and modeling deficiencies. Among those that do model them explicitly, TRQs are implemented at the aggregate sectoral level. We propose an approach based on the Mixed Complementary Problem (MCP), which allows regime shifts in TRQs, where TRQs are implemented at the tariff line level. We use the Comprehensive Economic and Trade Agreement (CETA) as an example and compare our simulation results with the proposed approach with the standard approaches where TRQs are converted to AVEs and/or are explicitly modelled at the aggregate sectoral level. Our result suggest that standard approaches might substantially overestimate possible trade and welfare gains of bilateral trade between the trading partners.

Keywords: free trade agreements, policy analysis, TRQs, tariff line analysis, computable general equilibrium

Introduction

Computable general equilibrium models are often employed to estimate the impacts of regional trade agreements, due to their ability to take into account inter-sectoral and global linkages. The majority of CGE models do not explicitly consider TRQs due to both data and modeling deficiencies. These TRQs are a two-tier tariff scheme—a lower tariff charged upon imports under a defined quota and a higher tariff charged on goods above the quota. An important challenge with particular relevance to agri-food trade, and CETA analysis, is the impact of variable tariff rates under TRQ regimes. Applied tariff rates under a TRQ endogenously depend on the quota fill rate and thus imported volumes. As the quota fill rate is expected to change after liberalization, the applied tariff rate, and the aggregate protection level depending on it, cannot be correctly
determined ex-ante using fixed aggregation weights. Specific methods have been developed to address the issue. Traditional approaches convert TRQs into ad-valorem tariff equivalents (AVE) - due to data and modeling limitations-, but as the conversion is based on observed quota fill rates, it is vulnerable to endogenously changing applied rates under TRQs. As such, trade liberalization will be different if the researcher considers if a commodity has a tariff of a TRQ. This is mainly because a commodity with a TRQ will often have a very high AVE compared to a commodity that just has a tariff in place. Removing a large AVE would likely lead to large trade gains, gains which might be limited if a TRQ remains—depending on the quota. More recent approaches (e.g. Beckman, J., and S. Arita. 2017) consider the explicit implementation of TRQs often using the mixed complementarity problem (MCP) approach that allows the regime shift in TRQs. Nonetheless, these approaches still consider the implementation of TRQs at the aggregate sectoral level, which generates an aggregation bias in results (Jafari et al., 2019).

The approach we propose here builds upon the precedent work of Jafari et al. (2019) who extends the GTAP model to the tariff line module. Jafari et al (2019) split the bilateral sectoral export and import to the detailed tariff lines using a Constant Elasticity of Substitution (CES) and Constant Elasticity of Transformation (CET) functions. Using this framework, instead of modeling TRQs at the sectoral level, we rather model TRQs at the tariff line level. Since the quotas are often determined at the commodity level that comprises of several tariff lines, we do not know ex-ante how much of the quota is filled by the underlying tariff line commodities. This is a modeling challenge and we address this by using two approaches. First, we simply allocate quota to different tariff lines based on the observed trade shares. Second, we introduce a framework that allows the quota allocation endogenously. In this framework, a virtual export distributor allocate quotas endogenously to different tariff lines to maximise its profit. Our approach for implementing TRQs at tariff line is first introduced in a CGE framework to evaluate the trade and welfare impacts of CETA, and then systematically compared to simulated results with the standard approaches.

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1 MAcMap (the institution that provides the tariff information used in many RTA analysis) notes the AVE calculation method for TRQs takes into account the inside quota tariff rate (IQTR), outside quota tariff rate (OQTR) and the quota volume. The choice between the IQTR and the OQTR depends on the quota fill rate. If the quantity imported is smaller than 80% of the quota volume, the AVE is calculated based upon the IQTR. Once the import quantity exceeds 98% of the quota volume, the AVE is calculated based upon the OQTR. Finally, if bilateral imports in the preceding year fall between 80 and 98% of the quota volume, the AVE of the tariff rate quota is calculated as the simple average of the IQTR and OQTR AVEs.
We take CETA as an example and focus on dairy and meat sector, to inform on potential changes in this notoriously sensitive sector in trade liberalization. For example, in the Trans-Pacific Partnership (TPP), dairy was the main sticking point in negotiations (Schott et al. 2016) and in the Transatlantic Trade and Investment Partnership (TTIP), the meat sector was a very important part of negotiations (Jafari et al. 2019). In terms of the producer support estimate from the Organisation for Economic Co-operation and Development (OECD), support and protection for milk producers is more widespread than for any of the other commodities. Moreover, the meat sector is among the most intensively protected sectors against free trade based on GTAP database. The Uruguay Round of multilateral trade liberalization forced countries to replace their very restrictive import quotas with tariffs. However, the tariffs on dairy and meat products are high enough to leave each countries complex milk and meat marketing system largely intact. But a highly protected dairy and meat sector is not specific to just developed countries. Knips (2005) notes that tariff and non-tariff barriers are erected both by developed and developing countries to protect their meat and dairy sector from ‘unfair’ competition. As such, reforming meat and dairy in trade agreements is usually done through TRQ access, at best.

We introduce the TRQs explicitly in the flexible and modular platform for CGE modeling CGEBOX (Britz and Van Der Mensbrugghe 2018) which also include the tariff line module in Jafari et al. (2019) and also offers the choice between different approaches to depict bi-lateral trade including a Melitz implementation (Jafari and Britz 2018). We use the latest GTAP10 database providing a snapshot of the global economy 2014 in combination with detailed data at the tariff line as well as changes in bi-lateral tariff and TRQs between EU and Canada according to the CETA agreement. We keep the full resolution of the GTAP database at 57 sectors but aggregate globally to important trading partners of the EU and Canada.

CETA

The Comprehensive Economic and Trade Agreement (CETA) is a free-trade agreement between Canada, and the European Union, provisionally applied since autumn 2017. When fully phased in, it will remove tariffs for 98% of all goods between the two regions, including for agricultural products where 94% of EU tariffs will be duty-free and 91% for Canada. For agriculture, several

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2 Canada, all EU Member countries and the European parliament have approved, but ratification of some EU Member states is pending along with a positive opinion by the European Court of Justice.
sectors considered sensitive and protected by high trade barriers will be reformed—either through lower tariffs or through an increase in tariff-rate quotas (TRQs). As expected, recent literature finds trade gains due to CETA.\(^3\) A study by the European Commission estimates that CETA could increase bilateral trade by 8%. Devadoss and Luckstead (2018) find even larger gains with Canadian exports of processed food to the EU expanding by 56% and that of EU exports to Canada by 50%.\(^4\) Both of these studies, however, assume complete tariff elimination and abstract from exemptions for some sensitive sectors, particularly in agriculture. For example, under CETA, EU cheese exports will still be subject to a TRQ with a prohibitive out-of-quota rate. Here, a partial liberalization concept is based on an increase of that TRQ from 13,500 tons to 32,000 tons reflecting that Canada controls dairy production by supply management.

**Explicit representation of TRQs at the Tariff line module**

We provide here a summary of the extension of the GTAP model to a tariff line module in Jafari et al. (2019), which allows the analysis of (potential) FTAs at the tariff line level for selected bilateral trade links. The authors propose an approach that only requires the split of bilateral trade data to the detailed tariff lines without further information on domestic supply and demand. We extend this module for an explicit representation of bi-lateral TRQs where the applied tariff rates become endogenous due to the switch between in-quota and out-of-quota market regimes. The proposed structure provides a fully consistent aggregation from the tariff line to the commodity level.

Jafari et al. (2019) split selected bi-lateral trade flows from commodity level to tariff line level, see extensions in figures 1 and 2. Their approach does not require disaggregated data on domestic sales and consumption. The new demand nest at the tariff line decomposes the bilateral import demand for each individual commodity \(i\) by tariff lines, \(tl \ (XWTL^{d}_{s,tl(i)})\) using a CES preference structure. The subscript \(tl(i)\) refers to the tariff line, \(tl\), belonging to the aggregate commodity level, \(t\). Equally, a new CET nest is used to allocate the bilateral export supply of each individual commodity across the various tariff lines associated with that aggregate

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\(^3\) Many studies exist before CETA was actually finalized. We focus only on those that consider the more recent trade negotiations.

\(^4\) Note that a part of large increase in this study could be explained by the employed PE structure and the value of the model parameters.
commodity \((XWT_{d,tl(i)}^s)\). Henceforth we skip the notation \(tl(i)\) and simply refer to it as \(tl\) for the sake of readability. The proposed approach dramatically reduces data needs, as it requires tariff line information on trade flows and protection data only for some bi-lateral links, namely those in the focus of the analysis. Hence, it keeps the model at a manageable size even if some bi-lateral trade flows are depicted with rich dis-aggregated tariff line information.

**Figure 1:** Nested Armington demand

*Source:* Jafari et al. (2019)
In this modelling framework, there are four bilateral trade prices corresponding to three price wedges, see figure 3.

Producers in region $r$ receive the price PETL for delivering goods at tariff line $tl$ to region $d$. A bilateral export tax or subsidy at tariff line ($\tau^e$) is applied to the producer price, PETL, and determines the export border price (or the free on board—FOB price), $PETL^{fob}$ as represented in
The price for international trade and transport services for each trade node $\zeta^{mg}$ is added to the FOB price to determine the cost-insurance–freight–CIF price, $PMTL_{clf}$ as in equation (2). In order to obtain the transport margin at tariff line for each mode of transport, we split the transport margin for each mode and for each individual commodity into their related tariff lines using benchmark trade values as weights. Equation (3) determines the purchaser’s import price at tariff line where the import tax or subsidy at tariff line ($\tau^m$) is applied to the CIF price.

\[
P_{ETL_{r,tl,d}}^{f} = P_{ETL_{r,tl,d}} (1 + \tau_{r,tl,d}^{e} + \tau_{r,tl}^{e}) \tag{1}
\]

\[
PMTL_{s,tl,r}^{clf} = P_{ETL_{r,tl,d}}^{f} + \zeta^{mg}_{s,tl,r} PWMG_{s,tl,r} \tag{2}
\]

\[
PMTL_{s,tl,r} = PMTL_{s,tl,r}^{clf} (1 + \tau_{s,tl,r}^{m} + \tau_{s,tl}^{m}) \tag{3}
\]

Above three equations indicate the bilateral price relationships in the extended framework and thus replace those at commodity level. Accordingly, the purchaser’s price of bilateral imports at commodity level, $PM$, in equation 1 and 2 depicts the CES weighted aggregate of bilateral import prices at tariff lines belonging to that commodity land.

In this paper, we define the bilateral import tax at tariff line level in Equation 3, $\tau_{s,tl,r}^{m}$, as a variable to render it endogenous under TRQs. For this purpose, we use a Mixed Complementarity Problem (Rutherford, 1995) approach to allow for tariff regime shifts under TRQs in the form of complementary slackness conditions:

\[
Quota - I^{in} \geq 0 \perp t^{s} \geq 0 \tag{4}
\]

\[
t^{out} - t^{in} \geq t^{s} \perp l^{out} \geq 0 \tag{5}
\]

\[
\tau^{m} = t^{in} + t^{s} \tag{6}
\]

\[
l = l^{out} + t^{in} \tag{7}
\]

This the usual approach found e.g. in the LINKAGE model (van der Mensbrugghe 2005), in the GLOBE model (Burrell et al. 2011) or Himics and Britz (2013) and Himics et al. (2017).

Equation (4) represents the regime switch between in-quota to out-of-quota market regimes under TRQs. If in-quota imports, $I^{in}$, reach or exceed the quota level, Quota, then the unit quota

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5 Although our formulation allows for export tax and subsidies, in our application export taxes/subsidies are not differentiated at tariff line level and that the trade margins are assumed identical for all tariff lines belonging to the same commodity.
rent, $t^s$ (the shadow tariff that defines the quota rent per unit of imports), becomes non-zero, representing an out-of-quota market regime. Equation (5) defines bounds for the shadow tariff that should be equal to the difference of in- and out-of-quota rates ($t^{in}$ and $t^{out}$, respectively) in case out-of-quota imports $I^{out}$ occur. Equation (6) defines the endogenously determined applied tariff rates $\tau^m$ based on the in-quota rate and the shadow rate, and finally equation (7) is the import balance defining total imports $I$. This system of equations is defined for all tariff lines that are subject to bilateral TRQs.

Trade negotiations often determine a ‘collective’ quota for each of the product categories that have some similarities. For example, CETA determines three types of quota for different classifications of meats: bison, fresh, frozen, and high-quality meat and a single quota for the dairy sector. Each of the categories comprises numbers of products at finer details and their share in the collective quota is not predetermined. The shares depend on the number of variables (e.g. price) and parameters (e.g. substitution elasticities at the tariff line) that affect the profit of exporters. Given this background, modeling TRQs for ex-ante policy analysis is challenging. An alternative approach to model TRQs at the aggregate commodity level is to model it at the disaggregate bilateral trade to the detailed tariff line. The challenge here is to allocate the collective quota to each tariff line. While once could simply allocate the quota equally or based on observed trade data to the detailed tariff line commodities we present approach that allows for the endogenous allocation of the shares.

Let $q$ denote a given tariff rate quota own by an exporting firm which can be filled by $i$ different tariff lines. The firm ships given amounts $x$ of these different products to the export destination at given cif cost $c$ and receive related prices $p$ by selling at the export destination. The out-of-quota rates $t$ differ across the tariff lines while the in-quota rate is zero. The problem is to determine which amounts of the different $x$ are formally declared to fall under the quota and if the firm shall sell the rest or not. The problem is hence:
\[
\max \pi = \sum_{i} x_{i,eq} \left[ p_{t} - \bar{t}_{i} \bar{c}_{i} \right] + x_{i,iq} \bar{p}_{t} - \bar{x}_{i} \bar{c}_{i}
\]

s.t. \[ x_{i,eq} + x_{i,iq} \leq x_{i} \quad [\lambda_{i}] \]

\[ \sum_{i} x_{i,iq} \leq q \quad [\lambda_{q}] \]

Where the profit $\pi$ to maximize depicts the difference between the revenues received by selling the product at the export destination and the cost which include the paid to tariff. The first constraints states for each of the different product that the bough quantity must be declared as in-quota $iq$ or out-of-quota $oq$ potentially in shares. The second constraint ensures that the quota is filled. This is simple linear problem which we can solve via Lagrange:

\[
\frac{\partial L}{\partial x_{i,eq}} = p_{t} - \bar{t}_{i} \bar{c}_{i} - \lambda_{i} \perp x_{i,eq}
\]

\[
\frac{\partial L}{\partial x_{i,iq}} = p_{t} - \lambda_{i} - \lambda_{q} \perp x_{i,iq}
\]

We have two expressions for the $\lambda_{i}$ which can be combined to get:

\[
\lambda_{i} = p_{t} - \bar{t}_{i} \bar{c}_{i} = p_{t} - \lambda_{q}
\]

Rearrange to find the optimal quota rent gives:

\[
\lambda_{q} = \bar{t}_{i} \bar{c}_{i} \perp x_{i,eq}
\]

That implies that the uniform quota rent is defined by the per unit tariff costs which must be equalized across the different products falling under the same quota. Let’s imagine that we have only two products. We would only export over-quota quantities of a product if the difference between the price received $\bar{p}_{t}$ and the cost $(1 + \bar{t}_{i})\bar{c}_{i}$ are positive. The product which the smallest positive difference defines the quota rent $\lambda_{q}$, its $\lambda_{i}$ is exactly zero. Products with higher positive differences have an extra value of $\lambda_{i}$ which can be interpreted as an additional economic rent. Clearly, the firm would rather like to export these products over quota, either because they have a lower ad-valorem rate or lower cost. As we assumed above the firms has already shipped the products to the destination and then realizes the quota to be filled, such in case of a first-come-
first-serve quota, this includes the case to actually dispose quantities instead of selling them. That is case if the \( \frac{t}{c_i} > \frac{p_i - c}{c_i} \), i.e. if the difference between the per unit revenues from selling minus the sunk c.i.f. cost are smaller from the tariff to pay to be allowed to sell.

In order to use the results in the context to define appropriate ad-valorem rates, this suggest to use the highest ad-valorem rate which at given c.i.f. price would still be able to be sold in the export market. Unfortunately, that is no information to get by easily as it requires information in the marginal willingness to pay at tariff line level by export partner.

**Scenario specifications**

Trade negotiations often determine a ‘collective’ quota for each of the product categories that have some similarities. For example, CETA determines three types of quota for different classifications of meats: bison, fresh, frozen, and high-quality meat and a single quota for the dairy sector. Each of the categories comprises numbers of products at higher details and their share in the collective quota is not predetermined. The shares depend on the number of variables (e.g. price) and parameters (e.g. substitution elasticities at the tariff line) that affect the profit of exporters. Given this background, modelling TRQs for ex-ante policy analysis is challenging.

We consider three scenarios to highlight the importance of modelling TRQs at the detailed tariff line (HS8 digit in our example)). First, we disaggregate the bilateral meat trade to different product categories as negotiated in the agreement. We use the number of HS8 tariff lines under product category as split factors to disaggregate the GTAP meat sector to the product categories in this study. In this scenario, we keep the dairy sector as represented by the GTAP database. In the second scenario, we disaggregate each bilateral trade link for the dairy sector and meat commodities to the detailed HS8 digit tariff line and allocate the collective quota to each HS8 level based on observed trade data. Third, we use similar product disaggregation as in the second scenario but we do not pre-allocate quotas at the HS8 level. Instead, we introduce in the model a virtual “export agent” that maximizes its profit to determine the share of each HS8 level in the collective quota endogenously such that the sum of quantities will not exceed the collective quota that is permitted in the agreement (See the section below Endogenous quota allocation). Finally, to shed light on the importance of explicitly modeling TRQs, as mentioned above, we repeat the above three scenarios but convert the TRQs to their Ad-Valorem Equivalents (AVEs).
In this respect, the fourth scenario uses the same modelling structure as the first scenario but the AVEs of TRQs are considered. The fifth scenario uses the tariff lie structure and its result will be comparable to the second and third scenarios.

**Table 1: Scenario layout**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Product level quota</th>
<th>HS8 level trade</th>
<th>Allocation of product level quota to comprising HS8 tariff lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>TRQs modelled explicitly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario 2</td>
<td>Bilateral trade at product level is disaggregated to the HS8 tariff lines</td>
<td>TRQs modelled explicitly</td>
<td>Exogenously determined</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>Bilateral trade at product level is disaggregated to the HS8 tariff lines</td>
<td>TRQs modelled explicitly</td>
<td>Endogenously determined by profit maximization behaviour of a virtual exporting agent</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>TRQs converted to AVEs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario 5</td>
<td>Bilateral trade at product level is disaggregated to the HS8 tariff lines</td>
<td>TRQs converted to AVEs</td>
<td></td>
</tr>
</tbody>
</table>

**Data and software**

We introduce the model-endogenous tariff line aggregator in the flexible and modular platform for CGE modeling CGEBOX (Britz and Van Der Mensbrugghe, 2016) which also offers the
choice between different approaches to depict bi-lateral trade. We use the latest GTAP database in combination with detailed data at the tariff line; and simulate the impact of changes in bi-lateral tariff and TRQs between EU and Canada according to the CETA agreement. We keep the full resolution of the GTAP database at 57 sectors, but aggregate globally to important trading partners of the EU and Canada.

3. Results and discussions

[To be inserted later]

4. Summary and conclusion

[To be inserted later]

References:


