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Advanced tariff aggregation in global trade models: dismantling tariffs on the Swiss beef market

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Advanced tariff aggregation in global trade models: the case of tariff dismantling on the Swiss beef market

Abstract

Two tariff aggregation extensions to global trade models are proposed, taking advantage of international trade data at the tariff line level. The proposed methods correct for typical biases in tariff aggregation. Firstly, they take into account the substitution effects in an optimal consumption bundle at the tariff line level. Secondly, they also deal with the “water” in tariffs, i.e. the imperfect transmission of tariff cuts to domestic prices. Finally, they model Tariff Rate Quotas explicitly. The aggregators are tested for Swiss tariff dismantling scenarios towards imported EU beef products, after implementing them in a partial equilibrium model of the agricultural sector.

Keywords: tariff aggregation, tariff rate quotas, CAPRI, Switzerland, beef market

1. Introduction

Market access policies are typically defined at the detailed tariff line level¹. The “tariff schedule” of a country normally includes thousands of tariff lines, and trade statistics are also recorded at this fine level of disaggregation. As negotiation offers (tariff cuts, exceptions to tariff cuts, sensitive products etc.) are made at the tariff line level both in bi- and multilateral trade talks, the disaggregated tariff data (tariff distributions) should be taken into account when assessing the economic impacts of trade policy reforms. Most empirical models of international trade, however, cannot fully take advantage of such disaggregated available data when working with aggregated commodities, each of them often covering a wider array of tariff lines.

The straightforward way for better exploiting existing datasets at the tariff line level would be to extend trade models to the tariff line. There are indeed some attempts in the literature in this direction (Grant et al., 2007, Narayan et al. 2010). Still computational and data issues force practitioners to stick to more aggregated commodity and regional groups in applied trade modelling. Statistics on both demand and supply are still lacking at the tariff line level and, when extending import demand systems to the tariff line, the number of possible bilateral trade flows quickly becomes computationally unmanageable. Practitioners are, therefore, confronted with the choice for a tariff aggregation method that fits both their modelling tools and the objective of their modelling exercise.

Unfortunately, tariff aggregation introduces several biases in simulated impacts of trade policy reforms. Techniques have been proposed to reduce such biases. In fact, Anderson (2009) developed a consistent aggregation approach that fully eliminates aggregation bias with respect to selected economic variables. More precisely it is consistent with respect to changes in a proxy variable for welfare changes. However, this method might increase the aggregation bias for other model variables, and it is therefore not a multi-purpose alternative to traditional approaches. Consistent aggregation also requires strong assumptions on demand and supply structures and therefore their implementation might require structural changes in existing applied trade models.

¹ The Nomenclature of the Convention on the Harmonized Commodity Description and Coding System, or “HS Nomenclature”, elaborated under the auspices of the World Customs Organization, comprises about 5,000 commodity groups identified by a 6-digit code and arranged according to a legal and logical structure. The Swiss tariff schedule comprises additional 8-digit subdivisions, which is the level of disaggregation considered in this paper.

In this paper, we propose and compare two tariff aggregation techniques that perform well in correcting for some important aggregation biases in a wider range of economic variables (multi-purpose) and that can be implemented as pre-model aggregation modules, therefore not requiring structural adjustments in existing trade models. We cover three relevant sources of aggregation biases: changes in the composition of the imported mix, “water” in tariff and Tariff Rate Quotas (TRQs) (Table 1). We test their application by analyzing alternative Swiss beef tariff dismantling scenarios.

Firstly, with heterogeneous commodity groups, the change in the composition of the group cannot usually be duly taken into account: the relative shares of the tariff lines in the corresponding traded commodity group are assumed not to change in simulations. This is a strong assumption since, if some tariff lines are subject to significantly lower/higher tariffs, or tariff lines are liberalized to a different extent, the shares are expected to change. In fact, tariff cuts are typically introduced in applied trade models as average tariff reductions for aggregated commodity groups, which means that already the change in tariffs due to the liberalization is introduced with a large degree of approximation.

Secondly, tariff cuts are often not transmitted perfectly to reductions in domestic prices. We refer to the part of the import tariff that needs to be eroded before tariff cuts have a direct impact on the domestic price as the “water” in tariffs. Conventional tariff aggregation is based on applied tariffs and does not explicitly take the “water” into account. This introduces a second source of aggregation bias.

Finally, we cover the endogenous determination of tariffs under TRQ. This issue is especially relevant to the empirical application in this paper since the Swiss beef market is characterized by a complex TRQ system. A substantial proportion of agricultural production in developed countries is protected by TRQs (see for example de Gorter and Kliaugu, 2006). As the applied tariff rate depends on the quota fill rate (and therefore on imports), it becomes model-endogenous. Traditional aggregation techniques do not always take that into account, or at least not at the tariff line level.

The proposed tariff aggregation approaches are (1) the trade expenditure aggregator (TE) and (2) the Tariff Reduction Impact Model for Agriculture (TRIMAG) aggregator. The TE aggregator is an equivalence measure, defined as the uniform tariff rate that is equivalent with a set of individual tariffs in terms of its impact on trade expenditures. Equivalence measures, pioneered by Anderson and Neary (2005), are equivalent in terms of their impact on selected economic indicators, e.g. welfare (Trade Restrictiveness Index, TRI) or total traded volumes (Mercantilist Trade Restrictiveness Index, MTRI). The TE aggregator is restricted to responses in consumer expenditure only, and does not take into account the impacts of foregone (or increasing) tariff revenues on consumer demand (through an income effect). Full welfare consistency is not respected for the sake of reduced numerical complexity and to achieve a multi-purpose aggregator. In a landmark paper, Anderson (2009) provides a welfare consistent aggregation for the general equilibrium by combining an equivalence measure (termed “true average tariff”) and a weighted average tariff in an extended balance of trade constraint. In this way, we increase the complexity of typical outcome measures (such as weighted averages) to a level that enables us to mimic more realistic demand adjustments. Outcome measures are calculated based on policy variables and associated weights, which are typically related to trade statistics but can also be extended to production or consumption data, GDP, etc. (e.g. the reference group method of Bouet et al., 2008). TRIMAG includes endogenous aggregation weights based on an explicit import demand system at the tariff line level,

which takes into account substitution effects in the imported mix. In this context, as for the TE aggregator, only responses in consumer expenditure are considered. This characteristic allows also for a more straightforward assessment of the two aggregation approaches.

Both the TE and TRIMAG aggregators are implemented as pre-model aggregation modules in the same large-scale global PE modelling framework, the Common Agricultural Policy Regionalized Impact (CAPRI) model (e.g. Britz and Witzke 2014), which renders systematic direct comparison possible. Assuming different test tariff liberalization scenarios for the EU beef exports to Switzerland, both pre- and post-reform aggregated tariffs are calculated with the TE and TRIMAG approaches. In order to evaluate the proposed aggregators and their use in equilibrium models, the aggregated tariffs are plugged into CAPRI and the economic impacts of the liberalization scenarios are simulated.

The paper is structured as follow. Section 2 and 3 formally introduce the TE and TRIMAG tariff aggregation approaches, respectively. Section 4 defines the application to the Swiss beef market as well as the test tariff dismantling scenarios. Data and simulation results are presented and discussed in Section 5. Concluding remarks are reported in Section 6.

2. The trade expenditure (TE) tariff aggregator

The TE aggregator is conceptually equivalent to the expenditure aggregator of Bach and Martin, (2001) and to the true average tariff of Anderson (2009). Nevertheless, we introduce here an extended version following the regionally explicit aggregator of Himics and Britz, (2016), following mostly their notation and sometimes referring back to that paper for further references. The TE aggregator aims to derive a uniform tariff that is equivalent to the set of individual tariffs in terms of their impact on trade expenditures. In order to quantify the impact we need to construct a demand system based on the following trade expenditure function:

$$E(p, v, u) = e(p, u) - r(p, v) \quad (1)$$

where p denotes the domestic price vector, including both a domestically produced and imported goods. v is the vector of input prices, u denotes consumer utility, $e(p, u)$ and $r(p, v)$ are the expenditure and GDP (revenue) functions respectively. The trade expenditure function is concave and homogenous of degree one in p and convex in v . The domestic price vector is wedged away from world prices by an (ad valorem) tariff vector τ (“price gap approach”):

$$p = (1 + \tau)p^w \quad (2)$$

The TE aggregator is defined by an implicit function of the domestic price vector:

$$\phi: \mathbb{R}^n \rightarrow \mathbb{R} \mid E(\phi(p), v, u) = E(p, v, u) \quad (3)$$

where n is the number of imported goods. We follow a compensation variation approach and keep utility fixed at the initial level. Furthermore, the input price vector is assumed not to be affected by changes in output prices, allowing us to drop u and v below for the sake of brevity. The TE aggregator represents the aggregate price wedge relative to an average world price:

$$t^{TE} = \frac{\phi(p) - \phi(p^w)}{\phi(p^w)} \quad (4)$$

Following Himics and Britz, (2016) we extend the above implicit function to cover explicitly each exporter region $1 \dots m$:

$$\varphi_1, \dots, \varphi_m: \mathbb{R}^{n \times m} \rightarrow \mathbb{R}^m \mid E[\varphi_1(p), \dots, \varphi_m(p), u] = E(p, u) \quad (5)$$

The regionally explicit version of the TE aggregator then can be defined as:

$$t_i^{TE} = \frac{\varphi_i(p) - \varphi_i(p^w)}{\varphi_i(p^w)}, \quad \forall i \in \{1 \dots m\} \quad (6)$$

The equation system of (5) has no unique solution in general, but by exploiting separable homotheticity the problem can be rewritten using composite price indexes. As shown by Himics and Britz, (2016) the TE aggregators can then be derived independently, in a sequence, and a unique solution does exist:

$$\varphi_1, \dots, \varphi_m: \mathbb{R}^{n \times m} \rightarrow \mathbb{R}^m \mid p_c[\varphi_i(p), p^{-i}] = p_c(p), \quad \forall i = 1 \dots m \quad (7)$$

where p^{-i} is the domestic price vector of imported goods other than those originated in exporter region i and p_c denotes the composite price index. Using a constant elasticity of substitution (CES) form for the utility function with one domestically produced and n imported goods this can be expressed as:

$$p_c = [\beta_d p_d^{1-\sigma} + \sum_{i=1}^m \sum_{j=1}^n \beta_{i,j} p_{i,j}^{1-\sigma}]^{1/(1-\sigma)} \quad (8)$$

where β denotes calibrated share parameters, σ is the substitution elasticity and p_d denotes the price of the domestically produced good.

We further extend the above framework in order to endogenously model the shifts from in-quota to out-of-quota market regimes under TRQs. Explicit TRQ functions are introduced in the price transmission equation (2) linking the applied tariffs to the imported quantities, in the form of complementarity slackness conditions:

$$q - I_{in} \geq 0 \quad \perp \quad t_s \geq 0 \quad (9)$$

$$t_{out} - t_{in} \geq t_s \quad \perp \quad I_{out} \geq 0 \quad (10)$$

$$t_a = t_{in} + t_s \quad (11)$$

$$I = I_{in} + I_{out} \quad (12)$$

Equation (9) drives the regime switch; if in-quota imports I_{in} reach the quota limit q then the unit quota rent t_s (shadow tariff) becomes non-zero, representing an out-of-quota market regime. Equation (10) 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 (11) defines the endogenously determined applied tariff rates t_a based on the in-quota rate and the shadow rate, and finally equation (12) is the import balance defining total imports I . The equation system (9)-(12) is defined for all tariff lines that are subject to TRQs assuming that TRQs are bilateral. In case they are defined on a multilateral basis then quota limits are distributed a-priori.

3. The TRIMAG tariff aggregator

The TRIMAG model, developed by the Swiss Federal Office for Agriculture (FOAG) (Listorti et al., 2013), aggregates both current tariffs (reference mode) and tariffs modified according to possible trade scenarios (simulation mode). In the Swiss tariff schedule, in-quota and out-of-quota tariffs are registered under different tariff lines. All Swiss tariff lines are specific (expressed as a fixed charge per physical unit of imports) so, in order to perform the aggregation, they are first converted into ad-valorem (shares of the value of the imported good) using the c.i.f. price. This is necessary since various 8-digits tariff lines corresponding to the same CAPRI product could have different levels of product transformation (e.g., fresh meat and meat preparations), but conversion factors from processed to base products are not available. For a given commodity, the aggregation is repeated separately for in-quota and out-of-quota tariffs, and for the main importing regions (EU and RW; see section 5).

In the *reference mode*, three weighting methods are combined, each having an advantage from a particular point of view: (i) an import weighted average accounts for the source of origin of imports (EU or RW); (ii) a total imports weighted average focuses on the importance of the specific tariff line in the aggregated commodity (iii) a simple arithmetic average is free of the endogeneity bias associated with import weights, and that can also take into account tariffs without trade observations. The weights for the import weighted average (i) can be expressed as follows:

$$w_{ts,i,r}^1 = \frac{V_{ts,i,r}}{\sum_{i=1}^N V_{ts,i,r}}, \quad \forall ts, i, r \quad (13)$$

Where V is the import value; ts is the subscript indicating the tariff scheme (in- or out-of-quota tariff); i indicates the tariff lines, and N is the number of 8-digits tariff lines corresponding to the selected aggregate commodity; r ($r = 1 \dots R$) is the regional subscript for the sources of origin. The weights of the total imports weighted average (ii) are as follows:

$$w_{ts,i}^2 = \frac{\sum_{r=1}^R V_{ts,i,r}}{\sum_{i=1}^N \sum_{r=1}^R V_{ts,i,r}}. \quad (14)$$

The weights for the arithmetic average (iii) take the form of:

$$w_{ts,i,r}^3 = \frac{I_{ts,i,r}}{\sum_{i=1}^N I_{ts,i,r}}, \quad (15)$$

where I is a binary variable indicating whether a tariff line i is covered by the aggregate commodity that is subject to the tariff aggregation. For each tariff line, the final aggregation weight under the reference mode $w_{ts,i,r}^{REF}$ is then simply defined as an arithmetic average of the above three:

$$w_{ts,i,r}^{REF} = (w_{ts,i,r}^1 + w_{ts,i}^2 + w_{ts,i,r}^3) \cdot \frac{1}{3} \quad (16)$$

The aggregate tariff for the commodity XX is then a weighted average using the above weights:

$$t_{ts,XX,r}^{REF} = \sum_{i=1}^N w_{ts,i,r}^{REF} \cdot t_{ts,i,r}, \quad (17)$$

where $t_{ts,XX,r}^{REF}$ is the aggregated applied ad valorem equivalent rate for the commodity XX in the *reference mode* for a given tariff scheme ts and source of origin r . $t_{ts,i,r}$ are the respective ad-valorem tariffs of all tariff lines i assigned to commodity XX .

In the *simulation mode*, TRIMAG provides the ultimate impact of tariff dismantling defined at the 8-digits level on the aggregated applied tariff rates. Aggregation weights change in respect to the

reference mode. Indeed, the substitution effects in the consumption bundle are endogenously calculated, based on a CES demand system that mimics, under a fix utility assumption, the adjustments in the composition of the consumption mix triggered by relative price changes at the tariff line level. This is also similar to what the TE aggregator does. The CES demand system is calibrated to the weights of the *reference mode* as derived from above. Intuitively, if the relative price of a certain tariff line decreases due to tariff cuts, then its relative consumption, and therefore weight, within the aggregate commodity increases. The *simulation mode* is formally defined by the following set of equations,

$$U_{ts,XX,r} = \left[\sum_{i=1}^n \delta_i \cdot (w_{ts,i,r}^{SIM})^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \quad (18)$$

$$w_{ts,i,r}^{SIM} = w_{ts,NUM,r}^{SIM} \left[\frac{\delta_{ts,i,r}}{\delta_{ts,NUM,r}} \frac{p_{ts,NUM,r}}{p_{ts,i,r}} \right]^{\sigma}, \quad (19)$$

$$\sum_{i=1}^n \delta_{ts,i,r} = 1 \quad (20)$$

Where, for a given tariff scheme ts and source of origin r , $w_{ts,i,r}^{SIM}$ is the aggregation weight of tariff line i ; $U_{ts,XX,r}$ denotes consumers' utility; $\delta_{ts,i,r}$ is the share parameter calibrated to the reference weights $w_{ts,i,r}^{REF}$; $p_{ts,i,r}$ is the expected domestic wholesale price after tariff cuts; $\sigma > 0$ is the elasticity of substitution; NUM indicates the numéraire tariff line. The aggregate tariff is then calculated as:

$$t_{ts,XX,r}^{SIM} = \frac{\sum_{i=1}^N t_{ts,i,r} \cdot w_{ts,i,r}^{SIM}}{\sum_{i=1}^N w_{ts,i,r}^{SIM}}. \quad (21)$$

The adjustment in the import mix is therefore driven by the relative domestic price changes at the tariff line level in the equation system (18)-(20). The impact of cutting notified tariffs on domestic prices is calculated thanks to a unique database (see section 5) and can be explained as follows. For each importing region, the import price is calculated as c.i.f. price plus applied tariff. If, and only if, after tariff cuts the import price falls below the domestic price level, then the domestic price is linearly reduced (in other words, the ratio between the domestic and import price plus applied tariff stays constant over time). This rule implies that tariff reductions only have an impact on domestic prices if the “water” in the applied tariffs is completely eroded. A unique database that includes domestic and c.i.f. prices at the 8-digits level enables TRIMAG to take into account the “water” in applied tariffs explicitly. The water in tariff is calculated as the difference between the c.i.f. import price plus the applied duty and the Swiss price. Assuming a lower Swiss domestic price then the tariff inclusive import price, the water indicates the “overprotective” part of the applied duty, i.e. the part that is in excess of what would be needed to maintain the difference between the domestic and the c.i.f. price. Under TRQ the water in tariff corresponds to the difference between the applied out-of-quota quota duty and the unit quota rent. Being able to estimate the “water” in tariffs is a significant advantage of TRIMAG over the TE aggregator where the domestic price is assumed to wedge away from world prices by the tariff height only. The expected impact on the domestic price are first calculated for both importing regions (EU and RW), and then aggregated according to the following possibilities: 1) import weighted average of the two regional import price reductions (no substitution is assumed between the import sources), 2) minimum regional import price reduction (perfect substitution between import sources, where cheaper imports are assumed to fully replace all other imports), or 3) a weighted combination of the previous two options. By considering that the EU is by far the biggest exporter of agricultural products to Switzerland, and that tariff reductions will be applied to EU imports only, option 2) is selected for our analysis.

4. Application and scenario definitions

The meat sector is of great importance for the Swiss agriculture. In 2015, with about CHF 2 600 million, the beef production value represented slightly more than a quarter of the total Swiss agricultural production (BLW, 2016). The self-sufficiency rate for this product is around 80% rendering Switzerland a net importer. The meat sector in Switzerland is currently subject to a multilateral TRQ. Out-of-quota tariffs are very high. Given the extremely detailed definition of sub-quotas within the global TRQ, and also for the presence of a mixed method for their administration, the beef import regime is one of the most complex ones amongst Swiss products (Loi et al., 2016).

Both proposed tariff aggregation methodologies are implemented at the 8-digits level, therefore considering explicitly all registered transactions in the trade statistics and the full detail of the Swiss tariff schedule. Aggregating applied tariff rates under TRQs in an equilibrium framework faces the challenge that applied tariff rates and imported quantities are interdependent. Furthermore, assumptions on the unit quota rents are still unavoidable. Assuming a TRQ fill rate of 100%, which is typical for Swiss beef imports, the unit quota rent can be set theoretically to anywhere between the in-quota (preferential) and out-of-quota rates. However, the span between the in- and out-of-quota rates can be quite large especially when considering the beef commodity group in Switzerland. The TE aggregator determines the unit quota rent endogenously, relying on complementarity slackness conditions that mimic regime shifts between in- and out-of-quota tariffs at the tariff line level. Quota rents in the initial point still need to be assumed in order to perform the calibration of the TRQ equations. Instead, TRIMAG takes advantage of its detailed database and defines the unit quota rent as the difference between the domestic and the c.i.f. prices at the 8-digits level. The difference between the out-of-quota quota duty and this unit quota rent gives information on the amount of the overprotective part of the duty, or “water”.

For the aggregate product “beef” there are 22 in-quota and 23 out-of-quota quota tariff lines (in the Swiss tariff schedule, in- and out-of-quota tariff lines do not necessarily have a one-to-one correspondence). This product group is very heterogeneous ranging from live animals to fresh or frozen carcasses, fresh or frozen meat boneless or with bones in, and offal. The multilateral TRQ No. 05 for red meat includes beef, horsemeat, sheep and goat meat. The total volume notified at the WTO is of 22.500 t. The biggest in-quota imports occur for beef that is further subdivided into various sub quotas. Out-of-quota quota tariffs are extremely high, and therefore imports mostly occur within the quota limit. For more details see also Loi et al., (2016).

We opt for a simple scenario setup in order to keep the comparison between the two proposed methodologies tractable. Note that, as the aggregate tariffs for the reference scenario are already different using the two aggregation approaches, two reference scenarios (REF) have been developed as well. Trade liberalization impacts of the two tariff aggregation approaches are calculated and presented always compared to their respective reference scenarios (baselines). The following two liberalization scenarios are implemented: SCEN_1, where a 50% tariff cut applies on all notified tariff lines at the 8-digits level (in-quota and out-of-quota) for the beef imports originating from the EU; SCEN_2, similar to SCEN_1, but where two out-of-quota tariff lines (0201.3099, fresh boneless beef meat and 0202.3099, frozen boneless beef meat) are exempted from the tariff cut. These two out-of-quota tariff lines are characterized by comparable specific tariff heights but different aggregation weights in the reference scenario, as well as different levels of “water” in the applied duties. They are therefore particularly useful for our application comparing different multi-purpose tariff aggregators.

We expect that the three aggregation biases we discuss in this paper will be relevant for our scenarios. Firstly, aggregation weights for a product group are not uniformly distributed already in the reference scenario (for a distribution of tariff heights, “water” and aggregation weights see Figure 1). Therefore, the substitution effect at the tariff line level is expected to be significant. Secondly, although SCEN_1 assumes a homogenous (50%) tariff cut for all tariff lines, the changes in relative import prices is expected to be heterogeneous due to different “water” levels (see Figure 1). Results sheds light on the importance of different levels of “water” in tariffs. Note here that, while TRIMAG takes into account “water” in both notified and applied tariffs explicitly, the TE aggregator follows a “price gap” approach and therefore is not able to explicitly consider the impact of the “water” in tariff on domestic price adjustments. Thirdly, explicitly considering the TRQ mechanism in the tariff aggregators is also crucial for the analysis on the beef sector.

5. Data and simulation results

This section discusses first the input data and then the simulation results for the two tariff aggregators. In the TE tariff aggregator, import values and quantities are from the Swiss-Impex database (Swiss-Impex, 2015) at 8-digits level; for the analysis we used average import volumes in 2009-2014. Exporter countries are mapped and potentially aggregated to the CAPRI regional list before setting up the equation system of the TE aggregator. Therefore the exporter-specific aggregate tariffs of equation (7) can be plugged in CAPRI directly. In the Swiss tariff schedule, in-quota/out-of-quota tariffs are registered under different tariff lines. The out of quota tariffs are paired with their corresponding in-quota tariff lines. The implementation of the TRQ equation system (9)-(12) is therefore defined for the merged (in total 22) TRQ lines.

For the TRIMAG aggregator, the base year is defined as an average of the 2004-09 years for all 8-digits tariff lines of the Swiss tariff schedule. The data on bound and applied tariffs are included in the database. Imports values and quantities, as well as c.i.f. prices are differentiated by main origins (EU and RW²). Domestic Swiss prices (wholesale level) are also included at this very detailed level. For the simulation year, exogenous assumptions (exchange rate and medium term projections on agricultural markets) are also explicitly taken into account and further validated by the market experts.

A 50% uniform tariff cut on all in-quota and out-of-quota tariffs (SCEN_1) results in a somewhat similar cut for the aggregate ad valorem equivalent tariff applied to the EU, which is -48% in the TE aggregator and -51% in the TRIMAG aggregator. The slight difference in the results can be explained by the substitution effect that favours tariff lines with relatively higher or lower duties after the cut. In TRIMAG, the aggregation weight of tariff line 0201.3099 is very high, while for tariff line 0202.3099 it is very low (Figure 2). Note that the aggregation weights are concentrated among only few relevant tariff lines.

In SCEN_2, making the two tariff lines exempt from tariff cuts reduces even further the aggregate cut for the EU in the TE aggregator (-19%), hinting on the high value shares of these two tariff lines in the reference scenario (Table 2). In TRIMAG, the average cut is reduced to only -39%. This is due to the fact that, as said, while tariff line 0201.3099 has a very high aggregation weight, the aggregation weight of tariff line 0202.3099 is much lower, then with no substantial impact on the results (Figure 2).

² The aggregation of all non-EU partners into RW is due to the fact that more than 70% of the Swiss agricultural trade takes place with the EU (see www.agrarbericht.ch).

The EU, the main player on the Swiss beef market, increases exports by 132% in SCEN_1 and by 85% in SCEN_2 when using the TE aggregator whereas using TRIMAG imports from the EU increase by 65% in SCEN_1 and by 46% in SCEN_2 (Table 2). Despite the lower impact on the aggregated tariff, the larger simulated trade impacts in the TE aggregator compared to the TRIMAG results are due to the applied ad valorem equivalent representation of TRQs, which generates a larger shock on relative import prices than representing TRQs explicitly.

Looking at net welfare figures, the consumer welfare increases in SCEN_1 and SCEN_2 under both methodologies given that consumers start to have access to beef meat at lower consumer prices once imports increase. Conversely, a decrease in the producer surplus, driven by lower producer prices, is observed (Table 3). The tariff revenue is increased under both methodologies (the quantity effect due to the increased imports outweighs the impact of the tariff reduction). The variation of tariff rate quota rents is negative according to the TRIMAG aggregator and positive according to the TE aggregator. This can be explained by the explicit representation of TRQs in CAPRI when using the TRIMAG methodology. Overall the net welfare impact of both scenarios remains positive, although the use of the TE aggregator suggests a higher net welfare compared to the use of the TRIMAG aggregator.

6. Conclusions

In this paper we develop and compare two multi-purpose tariff aggregation techniques, the TE and TRIMAG aggregators that address important sources of biases in applied trade modelling: substitution effects at the tariff line, “water” in tariffs and TRQs. Both aggregators are applied and compared relying on a common set of beef tariff dismantling scenarios in Switzerland. The beef sector is particularly suited to assess these tariff aggregators since: a) the number of beef tariff lines is sufficiently large to render substitution effects among the different lines meaningful; b) the beef tariff lines are characterized by different levels of “water” in the applied duty; c) beef is in Switzerland regulated by a complex system of import TRQs. The proposed aggregators can be implemented as pre-model aggregation routines in large-scale trade models, and are found to perform well in a PE setup presented above.

Simulated impacts on imports and welfare indicate that advanced tariff aggregation methodologies can significantly improve the quality of ex-ante policy impact assessments. Finally, the fact that both the TE and the TRIMAG aggregators can be implemented as pre-model aggregation modules without significantly altering existing model structures represents a clear potential for their more wide-spread use in applied trade modelling.

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8. Appendix

Table 1 Properties of tariff aggregators in respect to selected aggregation biases

	Traditional (fixed weight) aggregators	Trade Expenditure (TE) aggregator	TRIMAG aggregator
Substitution effect at the tariff line level	Not taken into account	via CES import demand system	via CES demand system for aggregation weights
Water in tariffs	Not taken into account	Not taken into account	Explicitly taken into account thanks to information on domestic and c.i.f. prices
Tariff Rate Quotas (TRQs)	via tariff equivalent, fix applied rate	via tariff equivalent, variable applied rate with explicit TRQ functions	calculates both aggregated in-quota and out-of-quota rates

Source: Own comparison.

Table 2 Impacts on Swiss beef imports and AVE tariffs

	TRIMAG			TE Aggregator		
	REF	SCEN_1	SCEN_2	REF	SCEN_1	SCEN_2
Absolute level						
(Relative difference w.r.t. reference scenario, %)						
Aggregated ad-valorem tariff (% c.i.f.)	142.1	70.0 (-51.0%)	86.0 (-39.5%)	80.5	41.46 (-48.0%)	65.6 (-19.0%)
Imports (1000 t)	15.9	26.4 (+65.0%)	23.3 (+46.0%)	15.7	36.4 (132.0%)	29.1 (85.0%)

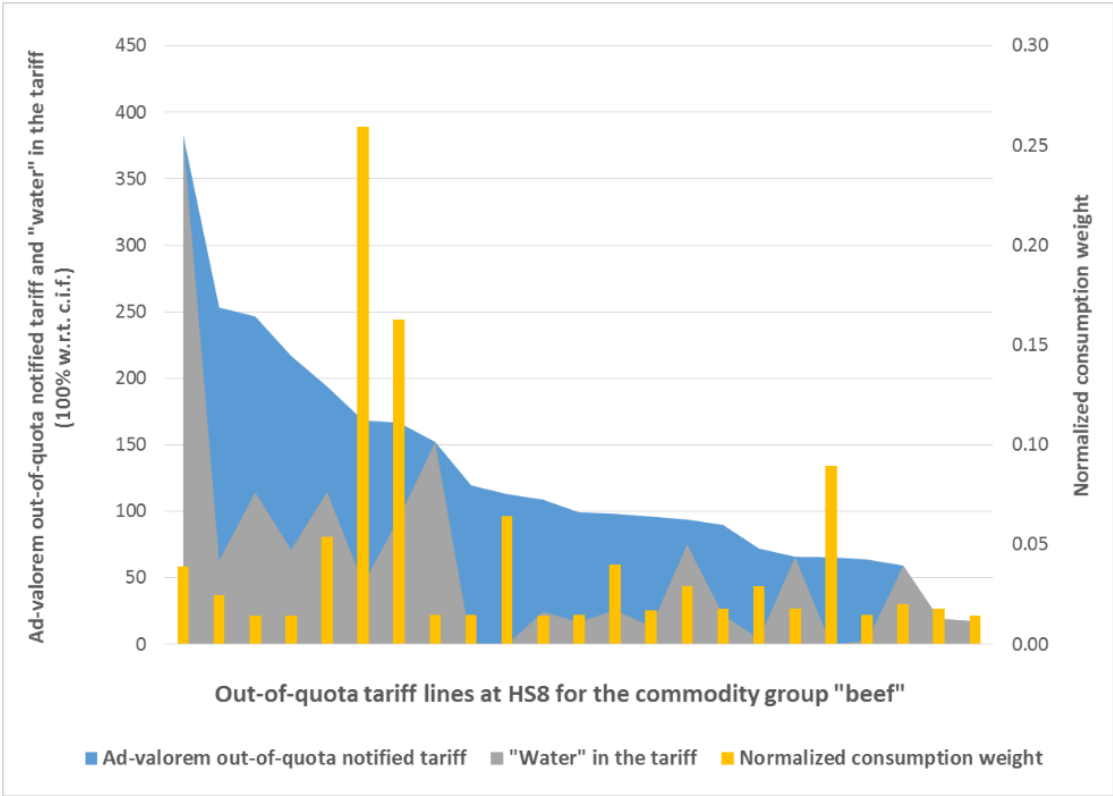
Source: CAPRI simulation results.

Table 3 Welfare impacts for the beef sector in Switzerland.

	TRIMAG		TE Aggregator	
	SCEN_1	SCEN_2	SCEN_1	SCEN_2
Absolute difference from reference scenario, Mio Euro				
Consumer surplus	232	177	369	281
Producer surplus	-150	-116	-208	-156
Tariff rev. + Dom. support	30	25	128	85
Tariff rate quota rents	-23	-18	13	19
Net Welfare	89	68	302	229

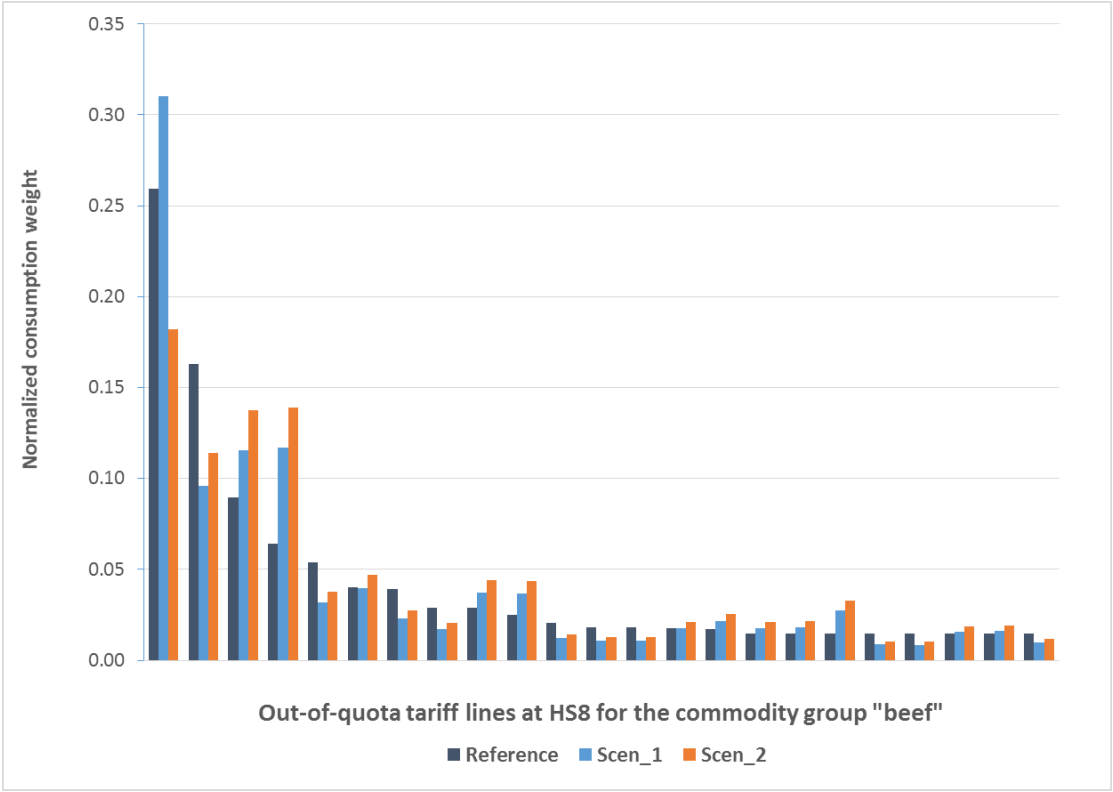
Source: CAPRI simulation results.

Figure 1 TRIMAG calculated ad-valorem out-of-quota notified tariffs, “water”, and aggregation weights for the reference mode in TRIMAG



Source: TRIMAG. Note: tariff lines are ordered according to tariff height.

Figure 2 TRIMAG calculated aggregation weights for the reference mode and the two scenarios



Source: TRIMAG. Note: aggregation weights are ordered according to their height in the reference mode.