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HOW TO IMPLEMENT WTO SCENARIOS IN SIMULATION MODELS: LINKING THE TRIMAG TARIFF AGGREGATION TOOL TO CAPRI

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Abstract: Import tariffs are typically defined at a very detailed level, which is then used in trade negotiations. The WTO Framework Agreement of July 2004 proposes the use of a "tiered" formula where tariff lines classified in higher 'bands' are subject to proportionally higher cuts. Exceptions to the general rule, like sensitive products, are also defined at the tariff line level. Despite the relevance of tariff structure on trade liberalization, computable partial or general equilibrium models usually represent more aggregated products. In this respect, the literature suggests that market models can be combined with detailed tariff modules. We propose a new methodology to more accurately aggregate tariffs from the tariff line level to the one required by computable equilibrium models. The Tariff Reduction Impact Model for Agriculture (TRIMAG) uses the highest possible level of disaggregation (8 digits) and allows implementing tariff cuts and deriving the domestic price drops foreseen by alternative trade policy scenarios. Aggregated tariffs are derived by considering the substitutability effects in consumption between the tariff lines corresponding to the same aggregate product. We incorporate the tariff aggregates of TRIMAG resulting from a WTO agreement into the Common Agricultural Policy Regionalized Impact (CAPRI) partial equilibrium model. Differences between the standard tariff aggregation of CAPRI and the newly implemented methodology are illustrated. Results show that, when tariff cuts are applied at the 8 digit level, whether the substitution in consumption between tariff lines will result in a lower or higher aggregate tariff cut than the one that should directly be applied to the aggregate product is an empirical question. The selection of a limited number of sensitive tariff lines, if their share in the consumption bundle is high, might significantly raise the tariff for the corresponding aggregated product.

Keywords: WTO agricultural negotiations, tariff aggregation, linking models

INTRODUCTION

A necessary step for trade policy analyses at global level is to rely on a consistent, harmonized and reliable database of border protection. Market access policies (tariffs and non-tariff measures) are typically defined at a very detailed level. The agricultural "schedule of concessions" of a country normally includes thousands of tariff lines, each associated to a specific imported good. The relevance of representing a highly disaggregated "tariff schedule" is both economic and political: on the one side, it is well known that tariffs display a high variability; on the other, negotiations typically involve choices at the tariff line level.

Notably, the WTO Framework Agreement of July 2004 (WTO, 2004) proposes the use of a "tiered" formula where tariffs classified in higher "bands" are subject to proportionally higher cuts. In addition, WTO members have the flexibility to self-select a limited number of tariff lines defined as "sensitive" where lower tariff cuts are implemented but must be accompanied by an expansion of import tariff rate quotas (TRQs). The impact on trade liberalization of the selection of sensitive tariff lines is highly debated. In particular, given the typically highly skewed distributions of protection, even allowing for a small number of sensitive products can lead to have overall strong effects (Gouel et al., 2011).

Most ex-ante economic analyses are typically carried out using a rather aggregate tariff structure because of data availability and computational problems. Computable partial or general equilibrium (henceforth PE and CGE) models usually distinguish only a limited number of aggregate commodities, requiring to aggregate individual tariff lines up to the level characterizing the model at hand (Cipollina and Salvatici, 2008).

This paper focuses on tariff measures. The aim is to develop and propose a new methodology to more accurately aggregate tariffs to a level typically required by equilibrium models. This is particularly relevant since both multilateral and bilateral trade negotiations usually refer to specific tariff lines, highlighting the importance of considering an appropriate level at which tariff cuts should take place depending on the purpose of the analysis. The empirical literature is rich in examples showing the importance and influence of different weighting schemes while aggregating tariffs. In this paper, we propose a tariff aggregation methodology applied to the Swiss agricultural sector that 1) makes use of the highest possible level of disaggregation (8-digits in the Harmonized System[1]), 2) is applied horizontally to the whole agricultural sector, and 3) utilizes information on domestic price drops so as to considers consumer's utility while calculating the aggregation weights. The Tariff Reduction Impact Model for Agriculture (TRIMAG) model, built on this methodology, allows representing more exactly the economic impact of tariff cuts, which are normally determined at the tariff line level, on the markets of aggregate agricultural products. It also allows to test with high precision various market access negotiating options, capturing more accurately the economic effect of a number of issues, such as "water in the tariffs" or "binding overhang" as well as tariff peaks.

In doing so, Section 2 presents and discusses some of the most popular aggregation methods encountered in the empirical literature. Section 3 describes the TRIMAG modeling tool as well as how its information is processed in order to be used by the Common Agricultural Policy Regionalized Impact (CAPRI) model (Britz and Witzke, 2012). In Section 4, a WTO agreement scenario is implemented based on the last version of the draft modalities agreed in December 2008 (WTO, 2008). More specifically, two scenarios are considered, described and analyzed. The first one implements the draft modalities based on a tiered formula where the CAPRI standard tariff aggregation methodology is applied horizontally to all countries. The second one also implements the draft modalities but for Switzerland the CAPRI standard aggregation methodology is complemented by the tariff aggregation performed with TRIMAG. The impact on the aggregated tariffs of the two different tariff aggregation schemes applied to Switzerland is analyzed. The paper ends with concluding remarks in Section 5.

[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.

1. LITERATURE REVIEW

In the measurement of trade protection, the main distortions can arise from the conversion of different import tariffs (ad-valorem, specific and compound[2]) into a common metric and during the aggregation of tariffs (Pelikan and Brockmeier, 2008). In this section, we will consider the most important tariff aggregation methods encountered in the literature highlighting their main characteristics and potential drawbacks. Several methodologies have been proposed (see Anderson 2009 for a comprehensive overview), and the empirical literature shows that they might yield differences in the estimation of the aggregate protection and as a consequence influence final model results (Bureau and Salvatici 2003; Martin et al., 2003; Brockmeier et al.,2006; Guimbard et al., 2012).

At present, most tariff aggregation methods rely on simple or trade weighted averages since consumption and production data are in most cases not available at the desired tariff line level[3]. Leamer, (1974) proposed to use import values[4]. The simplest approach is the *simple average* where all tariffs receive the same weight. The drawback is that it does not take into account the importance of the products and it is prone to manipulation bias[5] (Manole and Martin, 2005). In addition, tariff schedules are in most cases characterized by highly skewed distributions. The use of *medians* instead of *simple averages* can help in this respect.

Another commonly used tariff aggregation approach is to rely on *weighted averages* where the weights are given by the respective shares on imports valued at border prices. However it is well known that this method is often subject to an endogeneity bias since highly taxed goods tend not to be imported; it will then tend to bias downwards the evaluation of trade restrictiveness. This issue can be partly avoided by relying on weighting schemes based on “reference

[2] Specific tariffs are expressed as a fixed charge per physical unit of imports; ad valorem tariffs as shares of the value of the imported good; compound tariffs are a combination of both

[3] The use of production and consumption data is still subject to a bias. Many factors different from tariffs can affect production; for consumption, the bias is related to which extent high tariffs tend to reduce it.

[4] More precisely Leamer, (1974) proposes to use duty free import values, which are anyway difficult to measure.

[5] For example, policy makers could create many tariff lines with small tariffs and aggregate all the sensitive products into a single and very high tariff line, which leads to underestimating the effective trade protection.

groups" of countries[6] (Bouet et al., 2004; Guimbard et al., 2012). For bilateral comparisons it is also possible to use weights capturing the relevance of sensitive products taking into account the trade composition of the exporting country (Gehlhar and Wainio, 2002). Martin et al. (2003), by analyzing the effects of trade-weighted tariff averages in measuring the welfare impact of trade reform, found that the standard trade-weighted tariff aggregation schemes are subject to an "averaging error" (tendency to underestimate the welfare gains expected after trade reform) and a "weighting error" (smoothing of tariff peaks). Martin et al. (2003) also found that tariff aggregators based on standard weighted average approaches appear to be lower than those based on the consumer expenditure, while the comparison with tariff revenue aggregators seems more ambiguous because of the different cross-price effects.

The bias inherent aggregating tariffs to a level which is too high to properly capture the trade composition effects has been analyzed by several authors (among which Hallak, 2006; Hertel et al., 2007).

Another approach is the so-called *trade restrictiveness index* (TRI) proposed by Anderson and Neary (1994, 1996). The TRI (Anderson and Neary, 1994) estimates what is the uniform tariff that would be equivalent, in terms of welfare, to a given pattern of trade distortions. This index has been applied for CGE applications; its strength lies on its theoretical consistency. In most applications, the tariff aggregation still takes place using standard methods and then the welfare equivalent protection is derived using the TRI. Bach and Martin, (2001) extend the TRI approach to measure the impact of tariffs at sectoral level. They define aggregators for expenditure, profits, and tariff revenues. Other sectoral applications of the TRI are in Bureau and Salvatici, 2004,and Kee et al., 2009).

An index similar to the TRI is the so-called *mercantilist trade restrictiveness index* (MTRI) introduced by Anderson and Neary (2003). It is defined as an aggregate uniform tariff able to keep the import volume at world market prices constant as in the case of non-aggregated tariffs. The MTRI, like the TRI, has been applied mostly for GE, but also for PE applications (Bureau and Salvatici, 2004). Both TRI and MTRI indicators are not suited for aggregation at the product level involving a large number of countries given that their calculation is based on CGE analysis (Guimbard et al., 2012).

[6] It is assumed that the import structure of a group of similar countries can approximate the free trade structure of a given country. "Reference groups" can be defined using clustering procedures taking into account GDP per capita and trade openness. The composition of the clusters affects the aggregation (Guimbard et al., 2012). Normalization factors can be used to render the results not sensitive to the size of the reference group (Pelikan and Brockmeier, 2008)

In addition, a growing body of the literature suggests that economic simulation models can be enriched with tariff modules to form a combined model system (see for example Brockmeier and Urban, 2008). For example, Brockmeier et al., (2006) use the Global Trade Analysis Project (GTAP) model and apply the tariff cuts at the 6 digit level and then aggregate them by using import weighted averages. Afterwards, the cuts are implemented directly on the aggregates. Although the comparison of results across the two different scenarios does not reveal a systematic pattern, the first method better captures tariff peaks, although they are always underestimated. Furthermore, tariffs cuts at the 6 digits level are more adequate when tariff reductions are based on a tiered formula as it is the case in the current WTO negotiations. Gouel et al. (2011), modify the MIRAGE CGE model accommodating for trade at the 6 digits level for the agricultural sector of the European Union and Japan. Results show that a Doha agreement without sensitive products would lead to half of the welfare gains obtained under full liberalization. The selection of 4% of sensitive products considerably limits this impact. Welfare gains are concentrated on a limited number of 6 digits codes. Some studies also focus on specific products. Grant et al. (2007) develop a 6 digits import source differentiated PE model for the US dairy sector embedded in the GTAP framework.

Keeping all these considerations in mind, we here aim at developing a tariff aggregation tool which starting from the 8 digits level can be used in combination with standard PE or CGE models. Our model is applied horizontally to the whole agricultural schedule. It tries to overcome the lack of data by integrating consumer's utility theory accounting for substitution between tariff lines corresponding to the same aggregate product. Whereas by far less ambitious than a global equilibrium model at the tariff line level, our tariff module is computationally less demanding, and nonetheless constitutes a powerful tool to test the various negotiating options at a disaggregated level, which can then be directly used by policy makers.

2. METHODOLOGY

In this section we present a new tariff aggregation methodology, based on the TRIMAG model, and its use in combination with the PE model CAPRI. We start by describing the standard aggregation methodology currently in use in CAPRI. CAPRI is a spatial, PE model designed to analyse CAP measures and trade policies for agricultural products (Britz and Witzke, 2012). In 2011, Switzerland has been integrated as a separate trade block in the CAPRI market model. The latter simulates production, consumption and trade flows for 47 products in 77 countries aggregated in 40 trade blocks. Bilateral trade flows are determined by the Armington assumption, where the composition of demand from domestic sales and different import origins depends on the relation of domestic market prices and import prices.

The import prices are determined from market prices in the exporting country minus export subsidies plus transport cost and tariffs (ad valorem or specific). Data on tariffs are available in the Agricultural Market Access Database[7] (AMAD) for the 475 6 digits codes related to the agricultural products covered by CAPRI, to which they have to be aggregated. For each country the tariff is calculated as the mean of three different weighting schemes: 1) share of the import value for the specific country; 2) share of the world wide import value; 3) simple average. As discussed in the previous section, all three weighting schemes on their own are biased. In absence of data on domestic consumption at the 6 digits level, option 1) might be seen as the best way of aggregating tariffs, but it only gives weight to tariffs when imports are occurring. Even if assigning a weight of zero to certain tariff lines might be justified if there is no domestic demand, it is misleading if imports are prohibited by high tariffs. In order to account for prohibitive tariffs, the aggregation schemes 2) and 3) are additionally applied, and then the average of the three options is taken in the model.

For specific tariffs, ad valorem equivalents are calculated at the 6 digits level and then aggregated up to the CAPRI product level. If needed, the aggregate ad valorem equivalent is once again converted in a specific tariff by multiplying it by the average import unit value of the CAPRI product. When tariff reduction scenarios are simulated by the CAPRI model, the tariff cut is directly applied at the level of the 47 CAPRI products. This ignores that the various tariffs at the 6 digits level might be subject to different tariff reduction formulas, and that the aggregation weights (import values) might change subject to the tariff reduction. In this respect, the TRIMAG model can constitute a valid complement.

TRIMAG has originally been developed to optimise the selection of sensitive tariff lines in WTO negotiations (Listorti et al., 2011a, 2011b), but can also be used as a detached pre-model tool to derive tariffs aggregated to the CAPRI products level. The aggregate effect is driven by the tariff reductions at the 8 digits level and by expected changes in the consumption pattern, i.e. the weight of each tariff in the aggregation is adjusted according to expected changes in consumption. These are in turn driven by the estimated price effects at the 8 digits level.

TRIMAG is so far only operational for Switzerland, where highly disaggregated data are available. The database consists of information for the 2302 8 digits tariff lines of the Swiss tariff schedule (source: Swiss Federal Office for Agriculture). The Swiss schedule consists of specific tariffs, and TRQs. Applied duties might be below the bound duties. For every tariff line, the data on bound, applied and, where applicable, preferential tariffs are included in the database (source: Swiss Federal Customs Administration), as well as the

[7] For more information visit http://r0.unctad.org/ditc/tab/amad.shtm

corresponding ad valorem equivalents (AVE) agreed in Paris in 2005[8]. Imports values and quantities are differentiated by origin (EU and rest of the world, RW). In addition, import prices by origin and domestic prices are available.

The data allows estimating the price drop caused by the reduction of import tariffs at the 8 digit level by a simple approach. We assume that the applied tariff after reduction is equal to the minimum between the reduced bound rate and the currently applied rate[9], and that reductions of the bound tariffs will have an effect only when the "water" contained both in the bound and in the applied tariffs is completely eroded. We make the simplistic assumption that the ratio between the domestic and import price plus applied tariff stays constant over time[10]e[10]. Secondly, the resulting effect on the domestic price is calculated by an import value weighted average between EU and RW price drops. For every tariff line, these calculations are repeated applying the relevant tariff reduction formulas. Since tariff reductions and consequently price drops are determined at the 8 digits level, a number of issues such as tariff peaks or binding overhang are directly accounted for, without incurring in any aggregation bias.

In the reference mode, the tariff aggregation is done similarly to what done in the CAPRI model, but starting from 8 digits data. The aggregation is repeated for in quota, over quota and single tariffs separately, and over two regions (EU or RW). The aggregated tariff is determined as a weighted average of three components: simple averages; weighted averages over total imports; import weighted averages accounting of the respective source of origin (EU or RW). In the scenarios, thanks to the availability of information on domestic price drops at the 8 digits level, the TRIMAG aggregation methodology considers substitution effects in the consumption of tariff lines corresponding to the same aggregate product. Unfortunately, reliable data on consumption shares at the 8 digits level are not available[11]. For this reason, as a proxy for consumption shares we rely on the weighted averages calculated in the reference mode (henceforth, for the sake of simplicity we will refer to them as consumption shares).

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[8] For specific duties, the corresponding AVE have been agreed with a political compromise in Paris in 2005 by calculating the reference world prices for each country. These equivalents are used by the model to apply the WTO tiered formula.

[9] This is a widely used assumption. However, the initial applied rate is not the only possible counterfactual, since applied tariffs could be raised up to the new bound rate (Bchir et al., 2006).

[10] This ratio reaches its lower value of one when there is water in the applied tariff.

[11] Consumption values have been calculated in the context of WTO negotiations to calculate the TRQ extension for sensitive products. However, due to the non-harmonization of trade data below the 6 digit level, consumption values at the 8 digit level are highly correlated with import flows.

The Constant Elasticity of Substitution (CES) framework allows predicting changes in consumption subject to changes in the price relation of products. The utility is calculated and fixed based on the consumption shares and on the price indices in the reference mode. Then, the model is solved with fixed utility and price indices after applying a tariff reduction. This results in new shares of consumption, which are then used as weights when aggregating 8 digits lines to the CAPRI product level. In a nutshell, if the price drop associated to the reduction of a certain tariff line is relatively higher than the others corresponding to the same aggregate product, then its consumption would relatively increase, and, consequently, also its weight in the aggregation. All tariffs are converted in ad valorem before entering the weighting process. The ad valorem tariffs are obtained by dividing the Swiss specific tariffs by *cif* prices. This operation 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.

The aggregation scheme is described in equations (1) to (3),

$$t_{XX} = \frac{\sum_i t_i w_i}{\sum_i w_i} \quad (1)$$

$$U_{XX} = \left[\sum_{i=1\ldots n} \delta_i * (w_i)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \quad (2)$$

$$w_i = w_{NUM} \left[\frac{\delta_i}{\delta_{NUM}} \frac{p_{NUM}}{p_i}\right]^{\sigma} \quad (3)$$

where i=1…n is the tariff line, and n is the number of 8 digits tariff lines corresponding to CAPRI product XX; t_{XX} is the aggregated ad valorem tariff for product XX; t_i is the ad valorem tariff of tariff line i; w_i is the aggregation weight of tariff line i; U_{XX} is the utility associated to the consumption of XX; δ_i is the share parameter used to calibrate the function to observed values; p_i is the expected price after applying a certain tariff cut to tariff i; $\sigma > 0$ is the elasticity of substitution[12]; *NUM* is the numeraire. An aggregate applied tariff for each CAPRI product is then calculated by applying equations (1) to (3) separately to EU and RW regions (if there is a TRQ, this scheme is applied separately to all in quota and over quota tariffs). The question then arises of how to derive the Swiss most favorite nation (MFN) protection for a given CAPRI product. In a straightforward way, we just take the tariff from the region from which most of imports come from (with a few exceptions, the EU). For all

[12] The elasticity of substitution is currently set at 4.

products (excluding those submitted to an entry price system[13]), TRIMAG then provides us with the aggregated applied tariffs for a given policy scenario.

3. RESULTS

In this section, we aim at comparing the TRIMAG aggregation methodology with the one currently applied in CAPRI. The tiered formula included in the last draft of the WTO modalities (WTO, 2008) prescribes different cuts according to the height of the tariffs, and is defined at the 8 digits level. This makes this WTO policy scenario particularly interesting for this exercise. We proceed as follows. Three scenarios are simulated: the reference (baseline) scenario ("Ref."), the WTO scenario without sensitive products and exceptions to capping ("WTO no sens") and the WTO scenario including candidate sensitive products and exceptions to capping ("WTO sens"). All three scenarios are implemented using first the standard CAPRI aggregation and then the standard CAPRI aggregation completed for Switzerland by the TRIMAG aggregation.

3.1. Definition of the WTO scenario in CAPRI

We assume that the Doha Round is fully phased in by 2020. Provided that the focus of this paper is purely to compare alternative aggregation methodologies for Switzerland, we adopt a pragmatic approach and follow Burrel et al., (2011). In order to apply the tiered formula, product specific AVEs for all countries and trade blocks are calculated as a weighted average of the import price in that specific trade block and the average world market import price.

Three country groups are identified: for countries that identify themselves as developed at the WTO, the standard tiered formula[14]a[14] is applied with the exception of the sensitive products, for which a reduction of 2/3 of the tariff cut is allowed. Following Burrel at al., 2011, for sensitive products we consider an increase in TRQs equal to 3% of domestic consumption. This is a trade-off between the 4% to be accounted for sensitive products at 8 digits level and the

[13] Here the TRIMAG tariff aggregation methodology is not advantageous. For comparison and consistency with the rest of the CAPRI model we apply the entry price mechanism at the CAPRI product level. However, even for the entry prices the aggregated cut in the notified tariffs is calculated by TRIMAG.

[14] If $0<AVE\leq 20\%$, the reduction shall be 50 per cent; if $20\%<AVE\leq 50\%$, the reduction shall be 57 per cent; if
$50\%<AVE\leq 75\%$, the reduction shall be 64 per cent; if $AVE>75\%$, the reduction shall be 70 per cent.

minimum access of 2% that must be reached at the *product category*. This percentage can be reduced if current TRQs are sufficiently large (Paragraph 77 of the modalities). For the purposes of this exercise, we just select the sensitive products according to the criteria presented in Listorti et al. (2011a; 2011b). We assume that all the sensitive products are exempted from capping, and that countries can also select some standard tariff lines as exceptions to cappin[15].

As far as in quota tariffs are concerned, if the AVE is lower than 5% the tariff is removed, while if it is greater than 5% it is reduced by 50% of the initial value or to a threshold of 10 %, whichever result is lower[16]r[16]. Least developed countries (according to the UN definition) are exempt from tariff cuts. For the other countries (developing countries, recently acceded members to the WTO, Small, vulnerable economies and non-members) for the sake of simplicity, following Burrel et al., (2011), we assume no tariff cuts. Finally, we assume that export subsidies will be eliminated.

3.2. Definition of the WTO scenario in TRIMAG

In this case, a detailed application of the WTO modalities to the Swiss tariff schedule is allowed. Since CAPRI is a comparative static model, we here simply use the results of 2020, when the modalities are fully phased in (although TRIMAG includes a time dimension; in fact, the modalities prescribe stepwise cuts).

Contrary to what described for CAPRI, we here can implement the "tiered" formula at the 8 digit level[17]. The sensitive products are selected at the 8 digit level according to the criteria of Listorti et al. (2011a; 2011b), for testing purposes only. We ensure conformity to the detailed provisions set out in Annex A of the modalities. For sensitive products, we assume that the tariff cut will be 1/3 of the otherwise applicable tiered reduction formula, and that the TRQ expansion which has to be granted shall be equal to 4.5% of the quantity of domestic consumption of the tariff line concerned[18]. The aggregated

[15] In general, no AVE > 100% will be allowed at the end of the implementation period, although some exceptions are possible both for standard tariff lines, and for sensitive lines (see paragraph 76 of the modalities, and attached working paper W5).
[16] According to WTO, 2008, Switzerland shall be allowed not to reduce to zero the in-quota tariff for 2 tariff lines of wine in bottles, and not to reduce to 10 per cent the in-quota tariffs for two tariff lines of bread cereals. Switzerland shall compensate with new market access opportunities (1 per cent of domestic consumption).
[17] The band for tariff reduction is assigned based on the AVEs available at the 8 digits level; see note 8.
[18] In accordance with Paragraph 76 of the modalities.

coefficient for TRQ extension at the CAPRI product level is 4.5% weighted by the ratio of the aggregation weights of the tariff lines selected as sensitive over the total. This coefficient is then multiplied by the total consumption of the aggregated product. We also consider that applied TRQs might already be above the volumes notified at the WTO. We also allow for the presence of exceptions to capping, non-sensitive tariff lines, and account for tariff escalation and tropical products at the 8 digit level.

We here focus on possible differences that can emerge from the use of the CAPRI and TRIMAG aggregation methodologies, and compare the three scenarios: "Ref.", "WTO no sens" and "WTO sens" (Table 1)[19]. Two general considerations hold. First of all, we note that the aggregated tariffs calculated by TRIMAG can in principle be higher or lower than those of the standard CAPRI methodology[20]. However, in most cases the corresponding band of the tiered formula remains unchanged. Secondly, as far as the tariff cuts are concerned, whereas for the standard aggregation methodology they just reflect what prescribed by the respective band of the tiered formula for the aggregate product (multiplied by 1/3 if the product is selected as sensitive, or higher than 70% if it is subject to capping), the aggregated tariff cuts calculated by TRIMAG display a higher variability. This happens simply since the scenario is implemented at the 8 digits level; in addition to this, tariff lines which suffer a relatively stronger (weaker) price drops can get a higher (lower) consumption weight. The picture is further complicated by the fact that these tariff lines might be both higher or lower than the other tariff lines corresponding to the same aggregate product, which results in a higher or lower aggregate tariff. Indeed, even when no exceptions from the standard "tiered" formula are allowed (columns "WTO no sens"), we note that the tariff reductions calculated by TRIMAG can be higher, lower or equal than those found by the standard CAPRI aggregation methodology. No standard pattern emerges. Whether higher domestic price drops, and consequently higher shares in the consumption bundle, are associated to higher or lower tariffs, is an empirical question.

[19] Tariffs are specific for all products in the standard aggregation methodology and, for products submitted to the entry price system, also when TRIMAG is used. All specific tariffs are here converted in ad valorem using the *cif* import prices of the reference scenario (note that these ad valorem tariffs might then differ from the AVE computed for assigning the band of the tiered formula). Due to space limitations, we present only some products which are particularly interesting for the discussion which follows. The complete table is available upon request.

[20] In TRIMAG applied tariffs are accounted for, while for Switzerland only the notified tariffs are inserted in the CAPRI database. However, in the majority of cases there are actually no differences between the two (with the exception, of course, of products with entry prices, for which the applied tariffs are calculated by CAPRI).

Table 1: Ad valorem MFN tariffs and tariff cuts according to CAPRI and TRIMAG aggregation methodologies. In the case of TRQ regimes, only the over quota tariff is shown.

Aggregate CAPRI products	Entry prices	Sensitive products candidates	CAPRI standard aggregation			TRIMAG aggregation		
			Ref.	% var., WTO no sens.	% var. WTO sens	Ref.	% var., WTO no sens.	% var. WTO sens
Apples pears and peaches		X	84%	-70%	-23%	155%	-69%	-22%
Barley	X		116%	-70%	-70%	116%	-69%	-69%
Beef		X	423%	-70%	-23%	145%	-70%	-35%
Butter			503%	-83%	-70%	341%	-85%	-75%
Eggs		X	273%	-70%	-23%	136%	-69%	-40%
Pork meat		X	226%	-70%	-23%	143%	-78%	-33%
Potatoes		X	192%	-70%	-23%	226%	-72%	-23%
Poultry meat		X	261%	-70%	-23%	240%	-85%	-49%
Sheep and goat meat		X	224%	-70%	-23%	63%	-59%	-41%
Skimmed milk powder			86%	-70%	-70%	97%	-70%	-70%
Sugar	X	X	65%	-70%	-23%	65%	-64%	-22%
Tomatoes		X	463%	-70%	-23%	355%	-73%	-22%
Wheat	X		218%	-70%	-70%	218%	-70%	-70%
Whole milk powder			156%	-70%	-70%	171%	-70%	-70%

Source: Own calculations

If we look at the “WTO sens” case for meat (beef, pork, poultry, sheep and goat), the selection of a few tariff lines results in a final tariff cut for the aggregated CAPRI product which is stronger than what we would see if the reduced tariff cut would directly be applied to it (i.e., respectively, -35%, -33%, -49% and -41% are lower than -23%). At the same, time, the selection of some tariff lines, if they are “relevant” for the consumption bundle, can substantially lower the tariff cuts associated to the product aggregate. However, some lower tariffs might bring downwards the tariff for the product aggregate (see for example poultry meat, where the tariff cut is -49%, halfway between the sensitive and standard tariff reduction of the product aggregate).

For apples, pears and peaches, potatoes and tomatoes, the selection of sensitive tariff lines allows to get a tariff reduction which is even weaker than if the formula was directly applied to the product aggregate, due to the fact that the tariffs which suffer the highest price drops, and then whose weight increases in the aggregation, have generally higher tariffs. While there are no differences for skimmed and whole milk powder (in the first case it is just one 6 digits product; in the second case there are two 6 digits with very similar tariffs and price drops), the cuts found by TRIMAG for butter and eggs are higher than those of the standard methodology, since products with lower tariffs gain a higher share of consumption. For products submitted to the entry price system (barley, sugar, wheat), the tariff levels are the same in both cases, and only the tariff cuts of the notified tariffs are calculated by TRIMAG. The differences tend however to be quite small. As far as the TRQ extension is concerned, we note that what calculated by TRIMAG are normally lower than by CAPRI (we account for the fact that not all tariff lines are selected as sensitive, and that applied TRQs could already be above the notified ones). Results are available upon request.

CONCLUDING REMARKS

The objective of this paper is to present an alternative methodology to aggregate tariffs more accurately to the level typically required by equilibrium models and display the likely impacts of different tariff aggregation methodologies on simulation results. The TRIMAG model allows using the highest possible level of disaggregation (8 digits), is applied to the whole agricultural sector, and uses information on domestic price drops so as to consider consumer's utility while calculating the aggregation weights. In a nutshell, if the domestic price drop associated to the reduction of a certain tariff line is relatively higher than the others corresponding to the same aggregate product, then its consumption would relatively increase, and, consequently, also its aggregation weight. TRIMAG can be used in combination with simulations model that operate at a higher level of aggregation.

Currently, TRIMAG is used for the definition of tariff changes for Switzerland in the CAPRI model, a spatial, PE model designed to analyse CAP measures and trade policies for agricultural products (Britz and Witzke, 2012). In t his way, it is possible to combine a high level of precision in applying tariff reduction formulas (as needed by policy makers in trade negotiations) with the opportunity of assessing the impact of trade liberalization on aggregated agricultural markets. Whereas it is clear that TRIMAG could be expanded to a PE model at the 8 digits level which could be sequentially linked to CAPRI, the current structure is more flexible and computationally less demanding, though keeping the advantages of representing tariff changes at a detailed level.

This is particularly evident in the case of WTO scenarios, for which tariff cuts (and exceptions) are defined at the 8 digits level. Results show that even a small number of sensitive tariff lines could increase the import tariff associated to a certain aggregate product. Depending on relative price drops, shares in consumption and tariff heights, tariff cuts obtained by TRIMAG can range from those that would occur if the status of sensitive product was granted to the whole product aggregate, up to halfway between the sensitive and standard tariff cut applied to the product aggregate. Even when products are not selected as sensitive, the high variability of tariff lines and of their relevance in the consumption bundle could explain aggregated tariff cuts which are higher or lower than those that would be obtained by applying the tariff reduction formula directly on the product aggregate. Different tariffs corresponding to different aggregation methodologies might in turn yield different results in the simulated scenarios.

However, a number of methodological improvements can be envisaged. Firstly, using shares of domestic consumption instead of import values might be appreciable, but even for a single, small country this data are not available. Sensitivity analysis could be helpful in assessing to which extent results are driven by the selected weights, and should concern also the value of the elasticity of substitution between the 8 digits tariff lines. Secondly, there is currently no substitution allowed between tariff lines corresponding to different CAPRI products. Thirdly, recalculating MFN specific tariffs in CAPRI by using average unit import values would also be advisable. Fourthly, in CAPRI the tariff cuts could be applied at the 6 digits level rather than on product aggregates. Results could then be compared with those obtained by using TRIMAG.

Finally, remembering that the original use of TRIMAG is to assist in the selection of sensitive products in the context of WTO negotiations, our model could be used in a two-step procedure. First, to support the policy makers for the identification of the "sensitivities" following the application of any tariff reduction patterns, in combination with other economic criteria (Listorti et al. 2011a, 2011b). Secondly, once a given tariff reduction is assigned to each 8 digit tariff line, TRIMAG can be used to determine the aggregate tariffs for the CAPRI product aggregates (or, in GE and PE models). The impact on the domestic agricultural sector resulting from trade scenarios applied at the 8 digits level (that is, as discussed in practice by negotiators), can then conveniently be analyzed at the aggregate level.

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