BATModel

better agri-food trade modelling for policy analysis

Deliverable 7.4

Report on the results of the policy relevant test case.

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1 EXECUTIVE SUMMARY

BATModel aimed to improve general and partial equilibrium models for use in (ex-ante) impact assessments of trade policies. Four teams dealing with the partial equilibrium model CAPRI and the three computable general equilibrium (CGE) models CGEBOX, MAGNET, and MIRAGE performed a test case scenario for the EU-Canada Comprehensive Economic and Trade Agreement (CETA). To evaluate the success of BATModel, the test case compared the models results of assessing the Free Trade Agreement (FTA) simulated with two versions of each model, namely with improvements implemented at the end of BATModel and without.

During the life of the project, the models were developed looking at new data, new module to improve the model behaviour and newly developed indicators.

The test case has been useful to see how behaviour of each model changes when newly developed modules are added providing first insight on how the project developments may enhance and/or alter ex-ante trade policy analyses. Specifically, the project developments may alter already used indicators to assess trade agreements (like GDP, trade flows etc,) or provide new indicators offering a broader view on the implications of trade agreements.

The exercise of running the same simulation with different model versions showed that, in most cases, the newly developed modules did not trigger visible changes in terms of impacts of the CETA on the involved countries while the new additions caused visible impacts on the model baseline. The development of the new indicators on jobs, wages and wage-income distribution helps to broaden the model assessments of upcoming FTAs and adding product details (products & GVCs) increases expected response from FTA. Finally, the case of Spatial Price Equilibrium for selected products shows that transferring modules from CGE to PE is a real possibility acting as a proof of principle of transferring module between models which are very different in terms of structure.

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2 INTRODUCTION

BATModel aimed to improve general and partial equilibrium models for use in (ex-ante) impact assessments of trade policies. To evaluate the success of BATModel, the test case compared the model results of assessing the same Free Trade Agreement (FTA) simulated with two versions of each model, namely with improvements implemented at the end of BATModel and without. The four teams involved are those dealing with the partial equilibrium model CAPRI (Britz and Witzke, 2014), and the three computable general equilibrium (CGE) models CGEBOX (Britz and van der Mensbrugghe, 2018), MAGNET (Woltjer and Kuiper, 2014), and MIRAGE (Fontagné et al., 2013). The results of the first simulation with the models before the improvement were presented during a project workshop that took place on 17th of September 2021 and are reported in the project Deliverable D7.1, "Definition test case and application in existing models". The workshop, opened to all BATModel partners and colleagues from the EU Commission, showed and discussed results from the first application round presenting the state-of-the-art to assess an FTA in the different models before the start of the project. Teams handling the simulation models in BATModel explained how they implement the FTA in their models, showed main results across models, and highlighted some selected complementary results from each model. The initial exchange among teams highlighted that Partial (PE) and General Equilibrium (GE) models used for ex-ante assessments of trade agreements have many identical building blocks (e.g., Armington bilateral trade, nested-CES production functions), but the implementation in the different models differs (model equations, integration of extensions with existing code, benchmarking, and documentation). The test case scenario is the EU-Canada Comprehensive Economic and Trade Agreement (CETA). As explained in the BATModel Milestone "MS4 - Agreed upon definition of test cases for first round", getting data on planned changes in an FTA currently under negotiation is an extremely cumbersome activity. These data focus on the exemptions, i.e., sensitive agri-food products, in which TRQs may be expanded, GIs registered, NTM harmonized, tariffs partly liberalised in multiple steps over a longer implementation period etc... Together with EU Commission services, we selected an existing FTA such that final legal texts could be used to define the ex-ante shock.

During the life of the project, the models were developed looking at new data, new module to improve the model behaviour and newly developed indicators (Table 1). The four BATModel modelling teams simulated the CETA agreement before and after the project improvements. The aim of this deliverable is to present the comparison between the two runs to highlight to what extent the new modules change the results of the same simulation. It should be highlighted that the aim of the exercise was not to compare results across models, but across versions of the same model. The test case has been useful to see how behaviour of each model changes when newly developed modules are added providing first insight on how the project developments may enhance and/or alter ex-ante trade policy analyses. Specifically, the project developments may alter already used indicators to assess trade agreements (like GDP, trade flows etc.,) or provide new indicators offering a broader view on the implications of trade agreements. To zoom in on the impact of the project developments on model behaviour this

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deliverable shows model-specific comparisons and not cross-model comparison of the ex-ante assessment of CETA.

Table 1: WP7 compiles advances in data, model behaviour and indicators

DATA	MODEL	INDICATORS
i. **Production**: 40 additional agricultural sectors, GI products, NUTS2 (GI & non-GI) ii. **Trade flow detail**: HS6 trade margins, tariff line for selected products, MRIO (agent-specific imports) iii. **Trade barriers**: NTMs iv. **Consistent material flows** for footprints v. **Self-trade removal** (for aggregated regions)	i. **Producer behaviour**: Melitz module with quality extension ii. **Demand system:** nesting for GI iii. **Trade details**: tariff-line trade flows, agent-specific import composition (GVCs) iv. **Bilateral trade** : spatial price equilibrium (SPE), Armington with commitment terms, flexible nested Armington v. **Employment**: number of workers by sector consistent with labour force vi. **Material balances**: input for footprints vii. **Link between CGE and PE** for regional environmental analyses	i. **Global value chains** indicators (agent-specific detail) ii. **Wage income distribution**: working poverty (headcount & gap index), wage-based Palma ratio iii. **Footprint calculations** using Leontief Inverse

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3 MODELLING TRADE IN BATMODEL MODELS

Typically, CGE models tend to use Ad-Valorem Equivalents (AVEs) to summarize all trade policy instruments. In contrast, CAPRI differentiates specific and/or ad-valorem rates in combination with an explicit TRQ mechanism. Usually, these models do not yet reflect non-tariff measures (NTMs) such as standards or protected geographical indications (GIs).

The initial version of the ex-ante simulation models depict international trade in a rather standard way. All models use (at least) a 2-stage Armington approach with Constant-Elasticity-of-Substitution (CES) functions. These functions allocate, for each good of the model, budget to domestic versus imported origins. Once the budget has been allocated to imported goods, the function allocates this amount to different import regions, usually with higher substitution elasticity than the previous nest. All models assume that quality differentiation depends solely on where something is produced. Within a region (which can be also an aggregation of different countries), each product has the same price, the same quality and the same characteristics.

Within the analysed models, there is a difference related to the differentiation of the Armington function. Within the GTAP based models (MAGNET, CGEBox default) the domestic/import shares are differentiated for each industry, private, government and investment demand, but not by bilateral import composition. On the contrary, CAPRI does not differentiate by demand category. This implies that for any given good, such as wheat, any two agents, such as the animal feed industry and the human consumers, demand products of different origins in the same proportions.

It is interesting to understand what drives the main results after a reduction in a bi-lateral tariff. First, we expect an increase in the related import share (due to the fall in prices) and a decrease in imports from all other sources. This first order effect of the Armington function is hence a trade diversion effect. The strength of this effect depends on the substitution elasticity (the key parameter in this function) and the absolute size of the bi-lateral import share. There are also second order effects e.g., changes in production cost and marginal production costs due to changes in import costs. When one import flow becomes cheaper, the importing bundle as a whole becomes cheaper. The overall decrease of the average import price depends on the cost share of the shocked import flow and the substitution elasticity. When imports become cheaper, the CES function reacts by increasing imported quantities of the good and reducing domestic sales. This is the trade creation effect, whose strength depends again on the substitution elasticity, the absolute size of import share and second order effects such as marginal impacts on production costs among others.

The application of the Armington approach in CGE models is limited by the data availability. The GTAP-based model can count on up to 65 sectors of which 23 relate to agri-food, and 141 regions. Additionally, computational limits to solve a CGE model with full resolution, i.e., including 65 sectors and 141 regions, prove at least challenging. This means that CGE modellers have to aggregate the GTAP database by region and/or product, using observed trade values to weight AVEs and Armington elasticities. The PE model CAPRI has a fixed regional and commodity aggregation with different resolutions in the trade model and the agricultural supply models: The trade model contains 44 trading partners trading in 65 agricultural, food and bioenergy products, whereas supply is modelled in 310 regions worldwide, with greater resolution in the EU and some surrounding countries.

The main advantage of the Armington approach is its ability to capture obvious effects such as trade diversion and trade creation effects and cost savings from any trade liberalization shock. The approach is in line with the economic theory adopting a cost minimization for industries and

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a utility maximization approach for households, depicting a logical direction of trade changes after a shock. In addition, it only needs a substitution elasticity necessary for benchmarking of the CES function and is therefore relatively easy to implement.

There are also a few cons associated with this approach. It still suffers from a low empirical base for the estimation of the elasticities e.g., the GTAP database offers a quite old estimation, identical for all regions and available only for groups of products. Another issue related to the CES function is its property where "small shares stay small", making the trading system rigid. In its default version, it cannot handle emerging (or vanishing) trade flows. Another point that may be confusing is its non-linearity. Adding over bi-lateral import quantities to total imports gives results different from the non-linear CES aggregator, which assumes that bi-lateral imports are not homogenous. The BATModel WP2 is taking care of improving this approach, especially concerning the "small shares stay small" problem.

Recently, many modellers are offering several options to go beyond the mainstream Armington approach. Among these options offered by the new trade theory, we can mention the monopolistic competition where fixed costs imply Non-Constant Returns-To-Scale and the inclusion of mark-ups over marginal production costs to cover fixed costs. Another interesting and available extension is the use of Multi-Regional Input-Output (MRIO) tables to trace bilateral trade sourcing by agent differentiating imports by intermediate, investment and other final demand. Finally, the disaggregation of parts of the model to the tariff line provides additional options to overcome one of the Armington limitations.

4 IMPLEMENTING A FREE TRADE AGREEMENT - CETA

To model the trade agreement between the EU and Canada with BATModel ex-ante models, we start from the official legal text, which is already in force since 2017. The agreement provides the tariff liberalization schedule, defined by products (tariff lines) and across time.

To implement the FTA within this quantitative evaluation, we adopted some simplifications:

1. We do not consider the time dimension; we only consider the **initial** and **final** tariffs.
2. We only consider TRQs for **beef** and **cheese** while we exclude other existing TRQS, particularly those for pork and sweetcorn, except for CAPRI where pork TRQs are included. Further transitional TRQs are not taken into account as they are removed before the end of the implementation period.
3. We only consider a single beef TRQ and a single cheese TRQ even though that in reality different types of beef and cheese are included within these TRQs.
4. In the current simulation, we did not account for any Non-Tariff Measures (NTMs).
5. In the current simulation, UK is still an EU member state,

The first basic step to model FTA is gathering tariff information both for bilateral relationships between the EU and Canada and for all the rest of global bilateral flows. The global tariff database is based on either TASTE (Horridge and Laborde 2008) or MAcMap-HS6 (Guimbard et al., 2012). For the FTA tariffs, the official legal text has to be converted into quantified tariff information at the tariff line level. An alternative would be to use a stylized i.e., removing all tariffs for all products. This approach is losing much of the details lying in a FTA and it is certainly

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not the favourite option to provide precise policy analysis. The tariff lines information is then aggregated up to the sectoral and geographical level that depends on each model.

The different models performed the first set of simulations employing their typical approach. CAPRI, CGEBox, and MAGNET adopted a comparative static approach against some future time point while MIRAGE solved using a recursive dynamic approach over a future period. The counterfactual analysis simulated a new equilibrium against a baseline in or up to 2030 which is based on macroeconomic projections (GDP, education and population) coming from EconMap (Fouré et al., 2013). The simulations, which cover CETA's, tariff changes, kept these exogenous variables constant. The results, showed for the year 2030, depicted the difference between the future baseline scenario and the policy simulation (which includes CETA tariff shocks). MAGNET and MIRAGE converted all tariffs (TL/HS6 level) into ad-valorem equivalent (AVEs), including TRQs (using quantities and information on inside/outside rates). The tariffs were then aggregated to their pre and post CETA scenario's AVEs from HS6 level to MAGNET/MIRAGE sectors using either aggregation trade weighted in MAGNET or reference groups weighted MIRAGE. The pre-CETA AVEs were applied, in the model's baseline, on the Cost, insurance, and freight (CIF) price of a given bilateral relationship. The post-CETA AVEs were then applied in the simulation. This difference constitutes the exogenous trade policy shock.

CAPRI is a comparative-static model. The baseline to 2030 was implemented based on the EU Agricultural Outlook. The CETA tariffs of the EU, but not those of Canada, were already included in CAPRI, thus a manual modification of the existing forecast was made. CAPRI models the TRQs for the sensitive products beef, pork and cheese with a smooth approximation to the real step function. The focus was on getting the TRQs right for those products. It was assumed that in the baseline, the quotas for beef and pork would not be filled, while the Canadian cheese quota would be filled.

CGEBox employs a special version GTAP database with 39 additional agri-food products derived from GTAP V10, 104 products and 96 activities called GTAP-AGROFOOD. The results are then aggregated following the minimum common denominator agreed with other modelling teams. CGEBox runs as a comparative-static counterfactual, using as the benchmark the final year 2030 from the baseline generated with G-RDEM (Britz and Roson, 2019), replacing IASSA SSP projections by CEPII projections. The HS6 to GTAP-AGROFOOD mapping is used to aggregate pre- and post-CETA AVEs from MacMap (Guimbard et al., 2012) to the GTAP-AGROFOOD product level, using a trade-weighted average. The resulting relative changes in AVEs are applied to bi-literal import taxes, as found in GTAP-Data base. This is derived from TASTE (Horridge and Laborde 2008). Explicit TRQs (depicted by sigmoid function) are modelled for Canadian cheese imports into the EU and Canadian beef imports into EU. Table 2 summarises the shocks simulated by the four described models.

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Table 2: The tariff scenario

Importer	Sector	AVE Initial	AVE Final
Canada	All	5.9	2.3
Canada	Agriculture	38.2	21.8
Canada	Industry	2.0	0.0
European Union	All	3.5	0.3
European Union	Agriculture	12.9	4.0
European Union	Industry	2.6	0.0

Source: Tariff schedule from CETA, weighted by MAcMap-HS6's weights

The second run of the BATModel models included the newly developed module, additional data and indicators developed during the life of the BATModel project (Table 1 and Figure 1).
Firstly, some of the included models captured more product details. In particular, MIRAGE included the NTM database in ad-valorem equivalents suitable for aggregate global CGE. CGEBox included a set of equations to model tariff line trade (not for production & demand) to zoom in on (sensitive) dairy trade & model TRQs at tariff line level. CGEBox and MAGNET also implemented a Global Value Chain (GVC) module based on MRIO data to differentiate import sourcing by intermediate and final demand and be able to differentiate trade barriers faced by agents.
In terms of modelling, the CGE model CGEBox and the PE model CAPRI, implemented a Spatial Price Equilibrium (SPE) function. This function assumes perfect homogeneity for selected commodities and price of commodities differentiation only due to trade costs. Under this assumption, there is bilateral trade between two countries only if trade costs are equal or less than price in destination region while if price plus trade costs exceeds price in destination region, there will be no bilateral trade.

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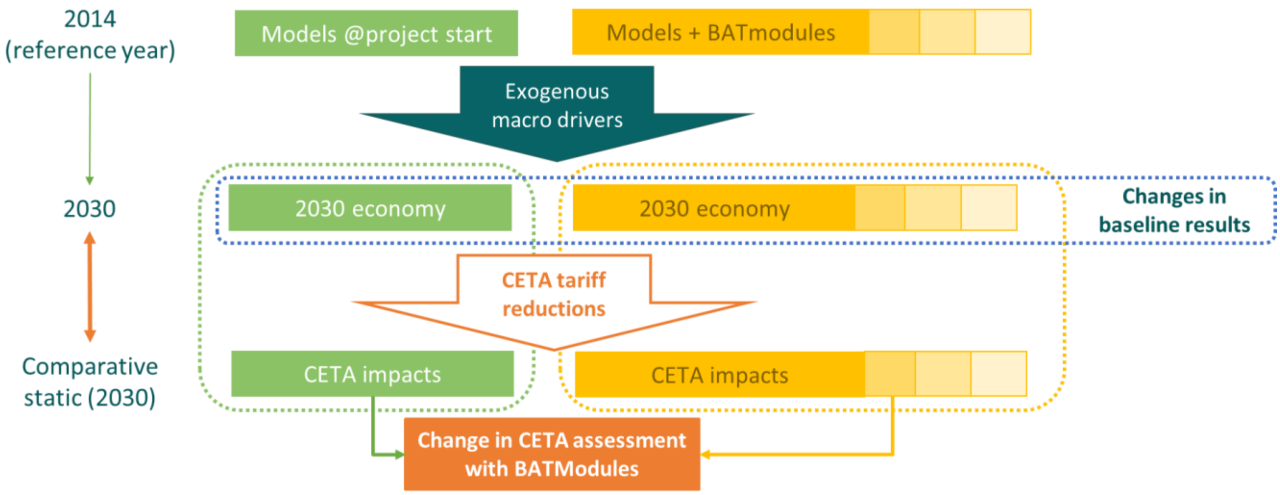
Figure 1: impact of new modules on CETA assessment



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5 RESULTS BY MODEL

5.1 Results from CAPRI

5.1.1 Scenario set-up

The updated simulations with CAPRI utilized the same base data and scenario set-up as the initial simulations carried out at the start of the project. However, the trade model was augmented by an alternative theory explaining the observed patterns of trade, based on spatial price equilibrium (SPE) that replaces the CES based Armington assumption. In the SPE model, all goods on each market, regardless of origin, are treated as homogeneous, and the law of one price applies. In order to allow for the model to reproduce the observed bilateral patterns of trade, where a given pair of countries may indeed export the same commodity to one another simultaneously, the SPE model introduces increasing marginal trade costs. The extension with the SPE model is described in detail in Deliverable 2.3.

One open question in the implementation of the SPE model is how to parameterize the trade cost functions. Estimations based on observed trade flows and observed price differences did not yield plausible or stable estimates. For this reason, we tried two alternative assumptions that are certain to give parameters that are not in conflict with the model theory, i.e. that give increasing marginal trade costs of plausible magnitude. The first assumption, which is now the default implementation, is that the observed marginal trade cost is the average trade cost (tc_ave) and that it would go to zero if trade (x) would go to zero. Since the marginal trade costs are linear, this means that the slope of the marginal trade cost is tc_slope=tc_ave/(2x). In order to avoid that this assumption gives very steeply increasing marginal trade costs for small quantities, or even division by zero in case that there is no trade in the baseline situation, we added a constant quantity C to the denominator, so that the marginal trade cost becomes tc_slope=tc_ave/(2x+C). We tried setting C to different values as reported below.

The second assumption that we used to define the marginal trade cost is that the SPE model should behave in approximately the same way as the Armington-CES system. This could be motivated if the CES elasticities are indeed the result of a robust estimation based on observed prices and quantity changes. To implement this assumption, we carried out simulation experiments with the Armington-CES model, where in each experiments, we increased the trade cost of one trade flow and observed the change in traded quantity on that flow (Table 3). Those results were used to compute the marginal change in trade flow that results from a change in trade cost, which we assumed to equal 1/tc_slope in the equation above.

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Table 3: Overview of scenarios and assumptions

Scenario name	Trade theory	Assumptions
REF_CES	CES	Reference scenario without CETA, using the CES model
FTA_CES	CES	Simulating CETA with the CES model
REF_SPE	SPE	Reference scenario without CETA, using the SPE model
FTA_SPE100	SPE	Simulating CETA with the SPE model, C = 100
FTA_SPE10	SPE	Simulating CETA with the SPE model, C = 10
FTA_SPE1	SPE	Simulating CETA with the SPE model, C = 1
FTA_SPEJAC	SPE	Simulating CETA with the SPE model, marginal trade costs set to replicate the marginal (Jacobian) behaviour of the CES model.

The CAPRI model has been set-up in such a way that that one can select trade theory (CES or SPE) for each commodity individually. To be able to examine the impact of the trade theory and parameters in isolation, we chose to implement the SPE model for only one commodity, beef meat. In the baseline situation, there is a tariff rate quota (TRQ) for EU imports of beef from Canada of 5.31 kt (thousand metric tons), with a preferential tariff rate of 16.22% and an MFN rate of 59.41%. In CETA, the TRQ is expanded to 54.15 kt, and the preferential tariff rate is reduced to zero.

5.1.2 Results

In the baseline situation, REF_CES, i.e. the CAPRI projection for 2030 without CETA, the EU imports 0.80 kt of beef from Canada – the TRQ is not filled – and the EU exports no beef at all to Canada. The scenario REF_SPE tests the ability of the SPE model to reproduce the behaviour of the CES model. This calibration is almost perfect, resulting in simulated EU imports of 0.69 kt from Canada. The results of all scenarios are given in Table 4 below.

Table 4: Tariff information and imports in the simulations

	TRQ (kt)	Imports (kt)	Import price (EUR/t)	Pref. tariff (%)	MFN tariff (%)	Trade cost (EUR/t)
REF_CES	5.31	0.8	4004	16.22	59.41	186.07
FTA_CES	54.15	3.62	3440	0	59.41	186.24
REF_SPE	5.31	0.69	4007	16.22	59.41	189.33
FTA_SPE100	54.15	52.22	3994	0	59.41	228.81
FTA_SPE10	54.15	51.62	3979	0	59.41	632.48
FTA_SPE1	54.15	8.2	3992	0	59.41	737.16
FTA_SPEJAC	54.15	2.07	4002	0	59.41	745.62

We find that the CES model predicts that the expanded TRQ will not be filled – the imports resulting from the reduction of the preferential rate are 3.62 kt. The SPE model with assumption C=100 (FTA_SPE100) in contrast predicts that the new TRQ is almost filled, and the same holds

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true also in FTA_SPE10. In FTA_SPE1, the increase in imports is more moderate, predicting 8.2 kt of imports under the TRQ. Finally, the scenario FTA_SPEJAC gives imports of 2.07 kt, which is somewhat smaller than with the original CES model.

The column "Import price" shows the price of beef imported from Canada on the EU market. With the CES model, the CETA scenario implies a reduction of the import price from 4004 to 3440 EUR/t, corresponding to the removal of the preferential tariff. In the SPE scenarios, in contrast, the import price barely changes, because it is tied to the market price of beef in the EU. Instead, the increased import result in rising trade costs, shown in the last column. In FTA_SPE100, where the slope of the marginal trade cost function is smallest, there is a moderate increase in trade costs from 189 EUR/t in the reference scenario to 229 in the simulation. The applied tariff (16.22% times the CIF price, about 650 EUR/t) that is removed is larger than that increase in trade cost. The remaining part of the shock is absorbed by the TRQ, which is modelled by a sigmoid function that gradually increases the TRQ rent already before the TRQ is entirely filled. In the scenarios FTA_SPE1 and FTA_SPEJAC, where the marginal trade cost increases steeply, the trade cost instead increases to 737 and 745 EUR/t respectively in order to absorb most of the reduced tariff.

5.1.3 Conclusions

Which model formulation is the best, and what parameters should one use? One way to approach that question is to compare the model predictions with reality. According to the UN COMTRADE database, the total three-year average imports of chilled or frozen beef (HS codes 201 and 202) from Canada to the EU countries increased from 0.16 kt in 2015-2017 to 1.23 kt in 2021-2023. Both pre- and post CETA observations are smaller than in our baseline (which is based on 2012 data). The scenarios that come the closest to these numbers are FTA_CES and FTA_SPEJAC. However, in reality, there are non-tariff measures (NTMs) relating to the use of growth hormones in beef production in Canada that prevent a larger import increase. These NTMs are not included in the model, and so one might say that "the CES model is right but for the wrong reason". However, the motivation for the increasing trade costs in the SPE model includes the cost conversion or adaptation of products for foreign markets. Interpreted this way, one could argue that the steeply increasing trade cost SPE model (i.e. FTA_SPE1) is also a good approximation. For the hypothetical scenarios that either the import restrictions for hormone treated beef are lifted, or of a convergence of production regulations in Canada towards EU standards, implying the removal of the NTM, the formulations with less steeply increasing trade costs might well be realistic models. Lacking firm empirical evidence, the parameterization and choice of theoretical model are still open issues.

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5.2 Results from CGEBox

Five extensions developed and incorporated to CGEBox throughout the course of BATModel are applied here to the CETA case. In the following, they are compared to the standard CETA results without any of the extensions being active. The standard CETA case in turn is compared to a no shock scenario. Thus, results of the BATModel extensions shown here do not provide the total CETA effect but the difference to the standard setting, while all model solves except for the standard case also implement the MRIO extension.

As each module can be applied for different sectors, for each extension an agri-food product is chosen that fits the assumptions and features of the trade representation. The Armington-CES module is for example activated for cereal products such as wheat, rye and oats since they are often traded in relatively small shares. As the dairy sector is a sensitive sector, where a Tariff Rate Quota (TRQ) applies, here the Tariff line module is used to depict the TRQ and model trade of these products at a more disaggregated level (HS6 and HS8). For the Spatial Price Equilibrium module, which allows for emerging trade and assumes homogeneity of products sugar is chosen here, because it has a relatively high Armington elasticity in the GTAP database especially for Canada. Finally, the Melitz module is applied for other food processing as it is a rather divers industry with small and larger firms. The results shown in the following give an overview of observed effects and are selected for sectors and countries with large effects, without describing all induced impacts per country. The EU region represents a post-model aggregation of the effects at member state level.

Apart from these extensions, a module that depicts Geographical Indications was developed which is detailed in Deliverable 6.4 and thus not shown here.

5.2.1 GDP per capita

Figure 2 compares the results of the implementation of the different modules to the standard CETA implementation, such that the red bar shows the total CETA effects in the standard representation and the other bars represent the change to the CETA results. Especially, for Canada, the absolute change due to the CETA are around twice as large with the different modules than with the CETA case alone (red bar), mostly induced by the MRIO module (yellow bar) as included also in the other model runs. The Melitz module results in the strongest outliers (light green bar) due to effects in the ‘other food processing’ trade market, depicted below (Figure 9). Mostly, the standard Armington representation of trade shows the lowest effect for the countries depicted here due to its functional form and underlying assumptions. Nevertheless, the impacts of CETA on GDP per capita remain muted in all trade configurations.

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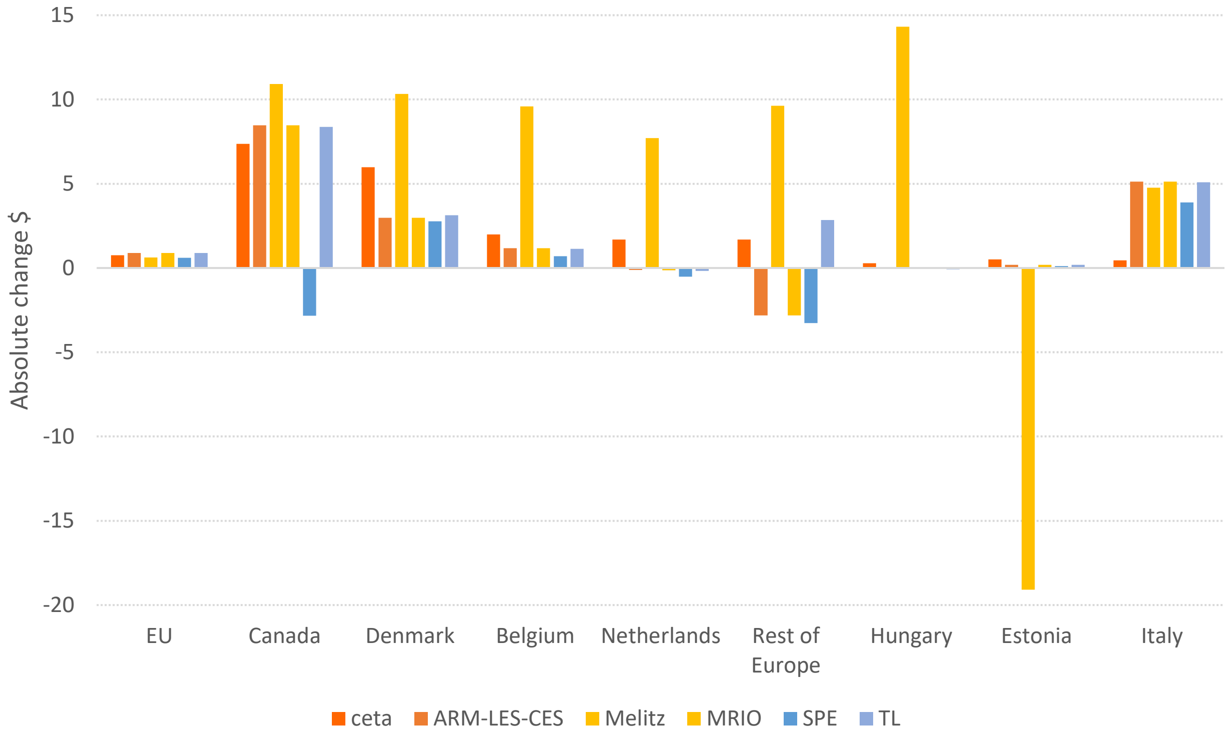
Figure 2: real GDP per capita



5.2.2 Agricultural land

Effects on Canada's land use is similar to the single EU Member State shown in Figure 3, while in the Melitz run, they are partly larger where some production increase land use by about 3% or decrease it by about 5% compared to the standard CETA .

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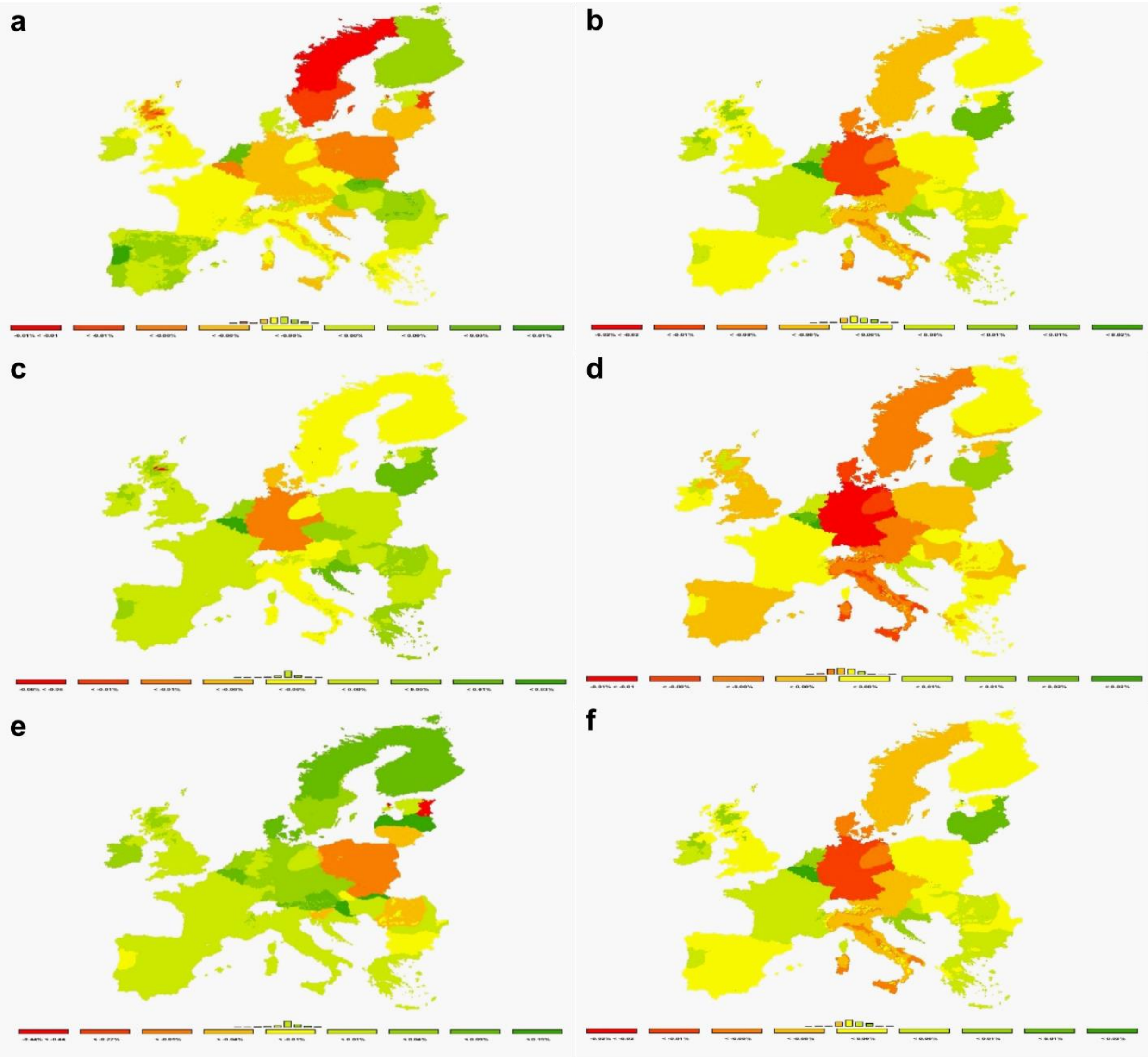
Figure 3: Pasture + cropland change in (a) CETA (b) MRIO (c) SPE (d) TL (e) Melitz (f) ARM-LES-CES



5.2.3 Emissions

The change in total GHG emissions induced by the CETA agreement as implemented in the standard case is small, especially in the EU (Figure 4Figure 4). However, also the other trade module shows small changes compared to the standard simulation for EU and Canada.
At product level, however, some changes are observed in the SPE and the Melitz configurations for the targeted products sugar and other food processing (Figure 5 and Figure 6), with partly strong increases in GHG emissions.

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Figure 4: % change in total GHG emissions in EU and Canada for all trade modules

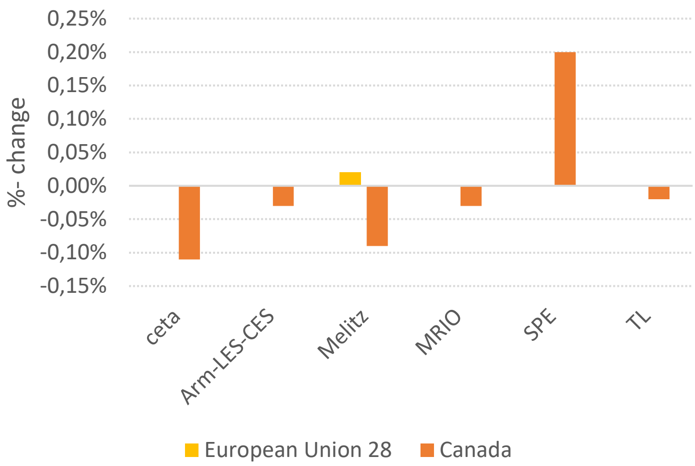

Figure 5: % change in GHG of sugar for the standard and SPE solves

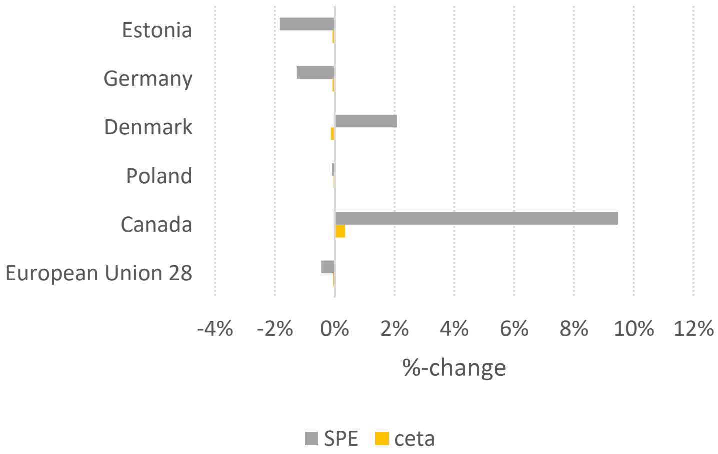

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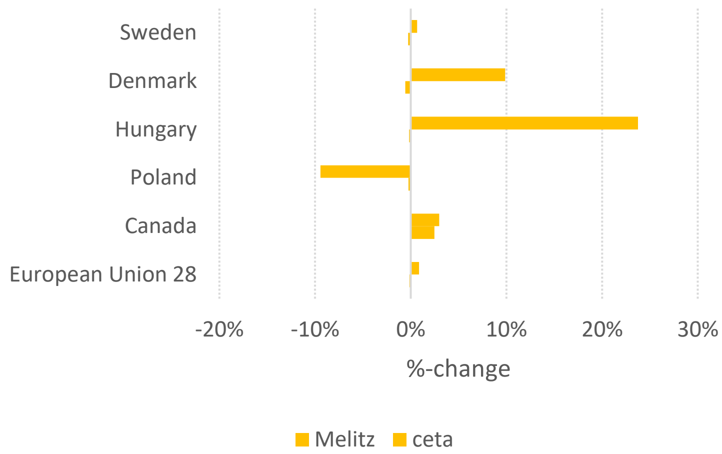
Figure 6: % change in emissions for other food processing in the standard and Melitz solve



5.2.4 Import EU and MS and Canada

The CETA trade agreement results in a total increase of trade at EU and Canada level also for non-agricultural products. In terms of relative change, some products show larger changes than the average. Especially, the imports of fishing from Canada increase due to the FTA.

Figure 7: % change in imports due to the CETA standard implementation

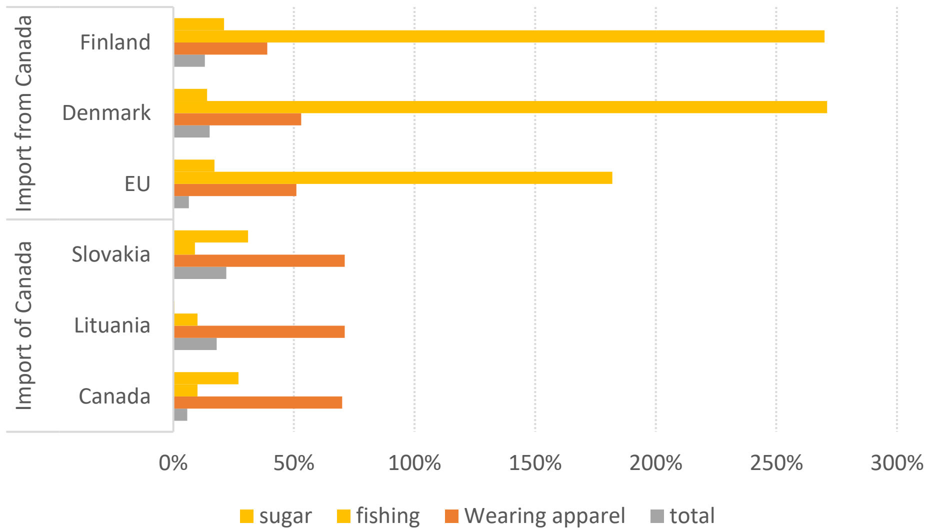


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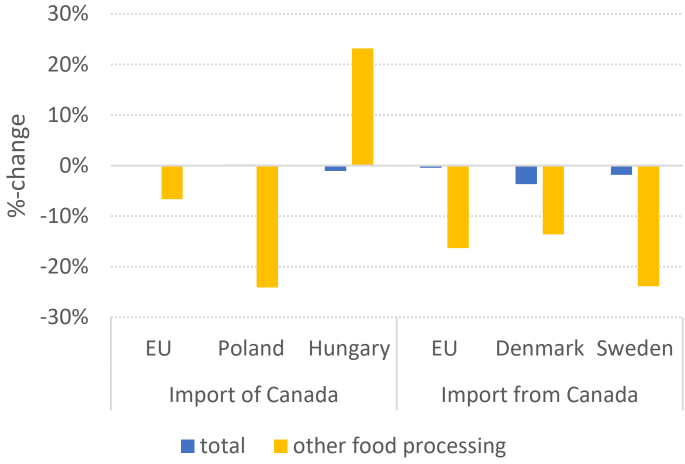
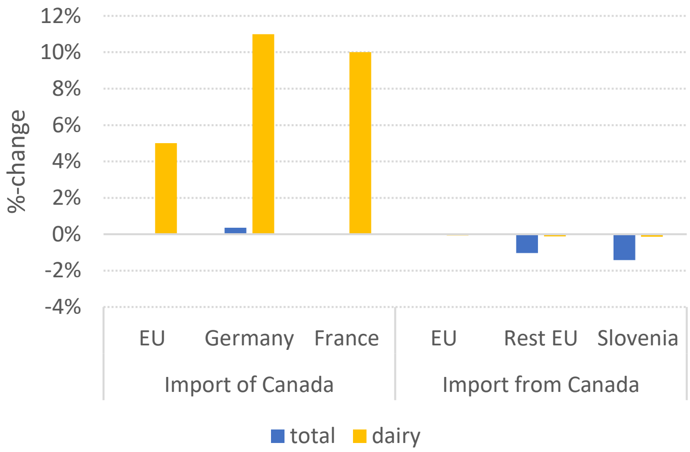
Figure 8: % change in imports with the Melitz module relative to the standard CETA case



When incorporating the Melitz module for other food processing changes in trade are observed, which are mostly smaller than observed with the standard trade representation for imports from and to Canada, except for some countries, like Hungary shown in Figure 8.
Again, the effect on total trade, remains small also reducing the effect observed in the standard CETA.

Figure 9: % change in imports with the Tariff line module relative to the standard CETA case



The explicit modelling of the Canadian cheese TRQ and the tariff lines of dairy products shows an effect on trade between Canada and EU (Figure 9). As the increase in dairy trade is much higher than in the standard CETA case. This is especially the case for Germany and France within the EU. The EU does not implement a TRQ for dairy products, therefore, no changes are observed for dairy imports.

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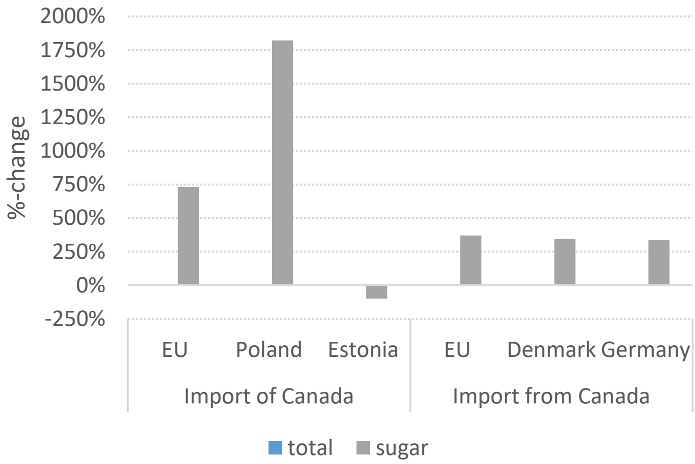
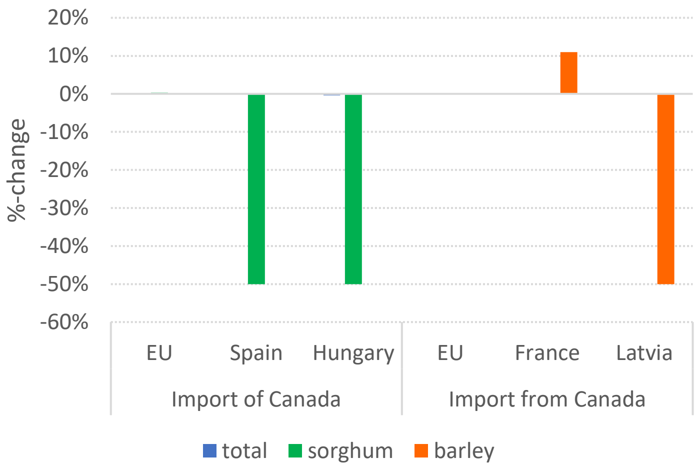
Figure 10: % change in imports with the SPE module relative to the standard CETA case



As summarized in Figure 10, total trade between EU and Canada remains largely unaffected from the incorporation of the SPE-module for sugar. For the product in particular, however, strong changes are observed. Especially the imports of Canada from the EU and member states increases strongly in relative terms.

Figure 11: % change in imports with the Arm-LES-CES module relative to the standard CETA case



Applying the Armington with commitment term module to different cereals shows partly large reductions in trade for both import and exports of Canada and the EU. As Figure 11 shows, decreases are for example observed for sorghum and barley. However, also positive changes in trade, such as stronger increases in import of Canada from Slovakia (+1951%, Sorghum) or Lithuania (11227% Rye from Canada) are induced by the implementation of the Arm-LES-CES module.

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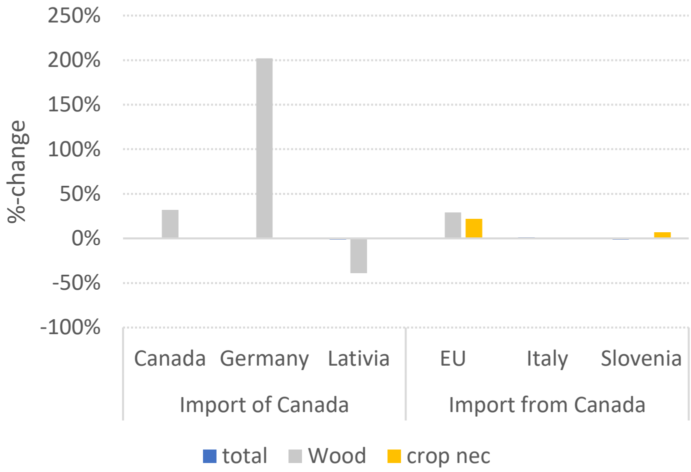
Figure 12: % change in imports with the MRIO module relative to the standard CETA case



The MRIO, implemented in all additional CETA runs, is shown here also as a single model run, which shows that implementing a GVC module has an effect on trade results between Canada and the EU in the CETA setting. Especially, as depicted in Figure 12, wood products but also partly crops not else classified (nec) show changes in trade.

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5.3 Results from MAGNET

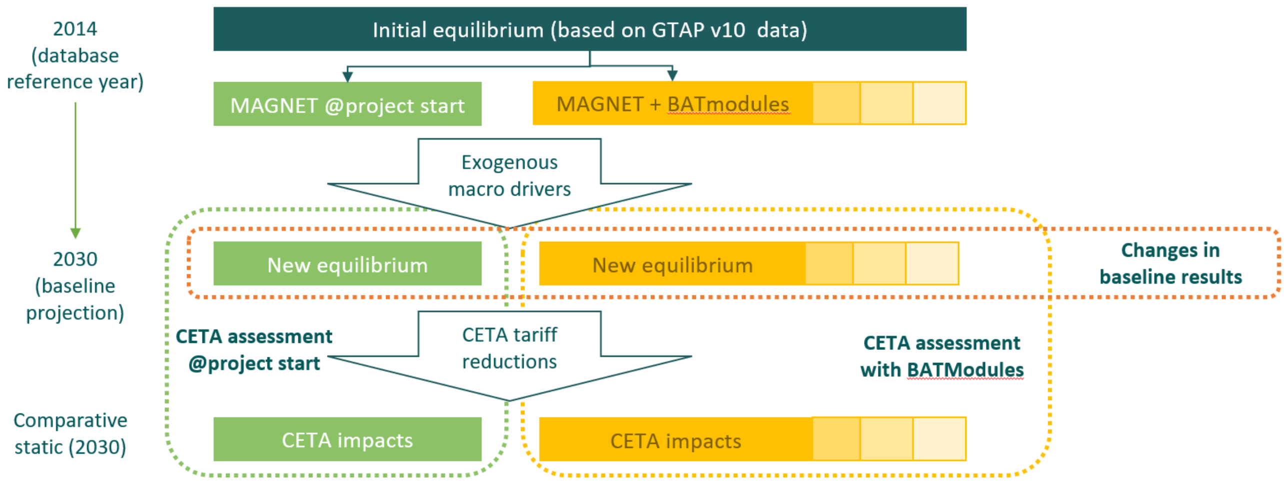
5.3.1 Workflow for decomposing the impact of combining BATModules

This section shows how modules developed in BATModel project, so called BATModules, impact MAGNET simulations. Note that we do not discuss how the modules were implemented or show how the individual modules work. This has already been reported in the respective work packages and documentation is available at the BATModel GitHub[1] (see names of Wiki pages links behind each module). Our focus here is on how the combination of different BATModules may affect trade policy analysis.
The modules taken into account are:

1) Self-trade removal (WP1 – RST module- Remove self-trade from database)
2) Improved labour modelling (WP1 – EMP module – Employment-based indicators)
3) Global Value Chains (WP4 – GVC module – Global value chains)
4) Armington-Krugman-Melitz module (WP7 – AKM module – Armington-Krugman-Melitz)

To analyse the impact of the different BATModel modules in MAGNET, we will follow the workflow presented in Figure 13. The Baseline projection from the GTAPv10 reference year (2014) to 2030 as presented in deliverable D7.1 (Definition test case and application in existing models) has been rerun with the various modules turned on in a step-wise fashion. We thus keep the source data and exogenous macro drivers identical to those used in D7.1 while using different versions of the MAGNET model to explore how these affect baseline results in 2030. Just as in D7.1 the CETA tariffs reduction shocks are implemented in a comparative static manner using the 2030 baseline of each model version as a basis. Again, the shocks are identical as those used in D7.1 and differences in CETA assessment are due to the impact of including different combinations of BATModules in MAGNET on the 2030 baseline projection and the response to the CETA tariff shocks.

Figure 13: Analysing the impact of BATModel extensions in MAGNET



[1] The BATModule Wiki is available at: https://github.com/BATModules/BATModules/wiki

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5.3.2 Scenario implementation

To analyse the impact of including each module, we implemented four different scenarios (Table 5). Scenario 1 "No BATModules" is the original starting position without any BATModel improvements added to MAGNET. Scenario 2 "Labour force" includes the modules developed in work package 1 (self-trade removal and improved labour modelling). Scenario 3 "Labour force and GVC" includes the labour market improvements and the global value chains. Scenario 4 "Labour force and Melitz" includes the labour market improvements and the Armington-Krugman-Melitz module. The GVC module and the Armington-Krugman-Melitz module have not been turned on at the same time, as there is an inherent conflict between the two modules. Thus, at the moment, either one can be chosen but not both simultaneously.

Table 5 BATModules included in each scenario

	No BATModules	Labour force	Labour force & GVC	Labour force & Melitz
MAGNET@start project	✓	✓	✓	✓
Self-trade removal	-	✓	✓	✓
Labour supply projection	-	✓	✓	✓
Labour force closure	-	✓	✓	✓
GVC module	-	-	✓	-
Melitz module	-	-	-	✓

The NoBATModules run replicates the results reported in D7.1 to the extent that BATModel extensions are not activated. This model version is however slightly different from the MAGNET version used in D7.1 as we integrated the BATModules in the current production version of MAGNET to assure future availability of the BATModules to researchers working with MAGNET. There have been bug fixes in the years since BATModel started which are thus included in our NoBATModules scenario.

The second detail to note is that the Employment module provides indicators on wage distribution, which are computed post-simulation, i.e., they do not affect the model results. We can thus provide these indicators for the NoBATModules scenario as well. The Labour force scenario then differs from the NoBATModules in three manners: (i) self-trade, defined as trade of aggregated regions with itself, is removed, (ii) labour supply projections are worker specific and (iii) a change in endogenous and exogenous variables of the model (a so-called closure swap). The equilibrium on the labour market is now defined through physically consistent aggregation of the number of workers instead of a value-based labour market equilibrium as described in more detail in deliverable D1.3[2]. On top of this closure swap, this scenario uses labour supply projections, which are specific for each labour type, in contrast to equal changes, derived from working age projections in the NoBATModules scenario. We ran separate versions

[2] Available at the BATModel website: https://www.batmodel.eu/wp-content/uploads/2024/03/BATModel_Deliverable_D1.3.pdf

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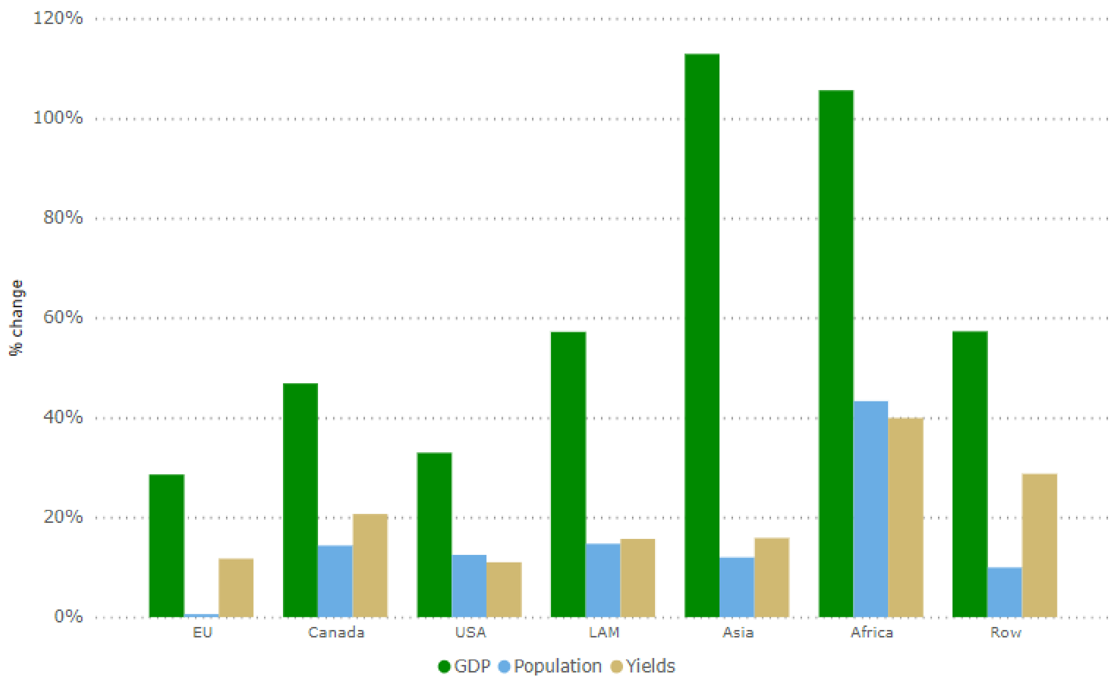
where we first added self-trade removal and then the labour supply projections to deduce their impact. The results showed that removing self-trade has no impact on the model results, whereas of the two components of the employment module (worker-specific supply shocks and the closure swap) the labour supply shock dominates the change in model response. For conciseness, we show only the impact of the combined implementation, as indicated in Table 5. Using the four MAGNET set-ups described in Table 5, we run a baseline using the same macro-economic developments as used in D7.1. The shocks implemented in each of these four baselines are shown in Figure 14. Real GDP increases between 30% (EU) and 115% (Asia) in the period 2014-2030. Population growth is more modest with values between 1% (EU) and 45% (Africa) in the period 2014-2030. Yields will increase due to improvements in varieties (genetic improvements) and more optimal use of inputs and other management practices, which is a continuing improvement of observed historic yield trends.

Figure 14 Macro economic shocks (% change 2014-2030)



Source: MAGNET results

With the implementation of the labour force module, we also switched from labour shocks derived from working age projections to labour shocks derived from labour supply projections, which are specific for each labour type. Figure 15 shows the labour shocks implemented in the NoBATmodule (top figure) and the shock implemented in the other scenarios (bottom figure). The labour shocks changed quite a bit. Especially in Latin America, Asia and Africa, agricultural labour moves out of agriculture toward office managers and professionals. It should however be noted that these large percentage changes operate on small to modest initial shares in the labour force which moderates the impact on the total labour force composition.

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Figure 15 Labour shocks 2014-2030

Source: MAGNET results

5.3.3 Baseline comparison

At global level, only the Melitz modules alters key economic indicators. The macro-economic shocks have an impact on the economy as shown in Figure 16 by the expected growth in some key indicators is shown at global level. Production is expected to increase. Agricultural food production is expected to increase by about 20% and non-food production is expected to grow by 45%, following Engel's Law with rising incomes. Increased production and a fast growing population in some regions in the world leads to more trade in both food and non-food commodities in all scenarios. Including the Labour force module with the worker-specific supply shocks reverses the negative agri-food price trend. Due to the new labour shocks, labour moves out of agriculture thus leading to increased wages and slightly rising food prices. Introducing GVC and Melitz does not change this impact on food prices, although introducing the Melitz module in the model decreases exports of both food and non-food commodities and decreases worldwide production of agri-food and non-food commodities. With the Melitz module turned on, firms that are more productive will export more and less productive firms will be forced out of the market leading to overall less but more efficient production, exports and leading to thus a lower but still increasing price.

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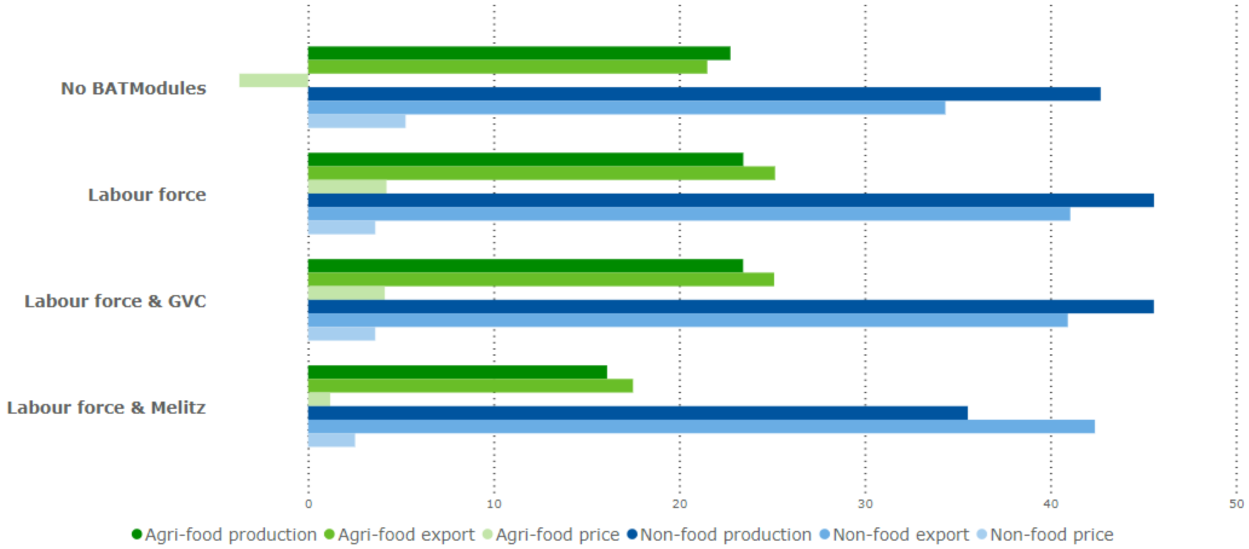
Figure 16 Changes production, trade and prices by scenario (% change 2014-2030)



Source: MAGNET results

While at world level the various BATModules seem to have only a limited impact on the simulation results, at regional level the impact is far larger. Figure 17 shows the change in agri-food production in each of the regions in the model. In all model regions, agri-food production reduces when the Melitz module is turned on in line with the global pattern from Figure 16. Although the difference between NoBATModules and Melitz varies across regions (between 1% and 10%).

Switching on modules may also reverse baseline developments compared to the NoBATModules scenario. These cases are highlighted in Figure 17 by boxplots stretching across the x-axis. Japan, for example is projected to (modestly) decrease its agri-food production in the Labour force and Melitz scenario, while all other scenarios project a (modest) increase. Thus while the spread in results is comparable across the model regions there can be sign reversals for regions with modest growth rates.

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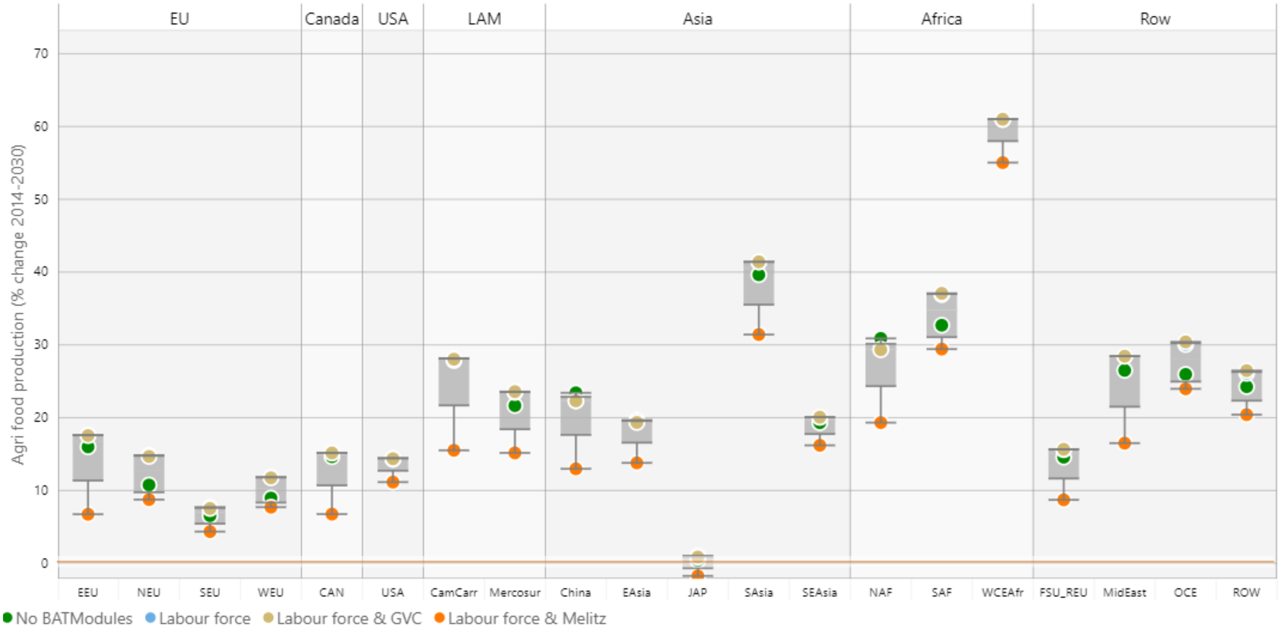
Figure 17 Agri-food production changes by region and scenario (% 2014-2030)



Source: MAGNET results

Regional agri-food prices are affected more strongly than production by the different modules and may change direction in a substantial manner for some regions. The food prices changes can have 30% difference depending on which module is included (Figure 18). Compared to production, the spread in food prices due to the activation of different modules is larger than for agri-food production. For most regions, food prices are the lowest when NoBATModules are included which is in line with the global pattern of Figure 16. Including the labour force module with the improved labour projections causes the largest increase in food prices due to labour moving out of the agricultural sectors. Introducing Melitz on top of the labour force module lowers the food price increase because it moves less efficient firms out of the market. In some regions, the development of the food prices is even reversed when the BATModules are included. For example, Japan (JAP) food prices decline without any modules turned on but increase when we include any of the new modules. The minimal impact in Figure 16 thus hides important regional variation as food prices are a key policy concern.

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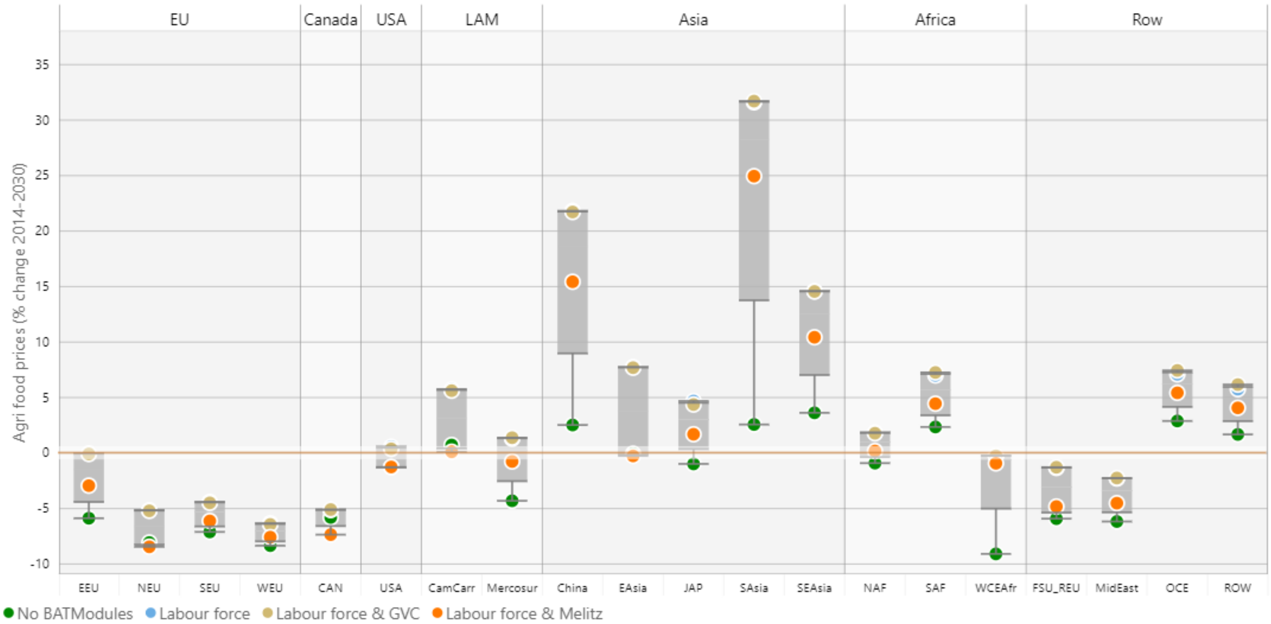
Figure 18 Agri-food price changes (% change 2014-2030)



Source: MAGNET results

Figure 19 shows the regional impact on exports of food commodities again showing a substantial spread across modules with region-specific impacts of module activation. In some regions including the Melitz module will lead to more exports (EU, Japan, SAF, OCE) however this is not the case for other regions indicating that there may be less variance in highly efficient and less efficient producers in this regions. Including the labour force module increases exports in most regions however in Asia (especially in China, SAsia and SEAsia) the labour shocks lead to less exports. Capturing more detail in the regional sourcing of commodities may thus have a substantial impact on the projections of agri-food exports.

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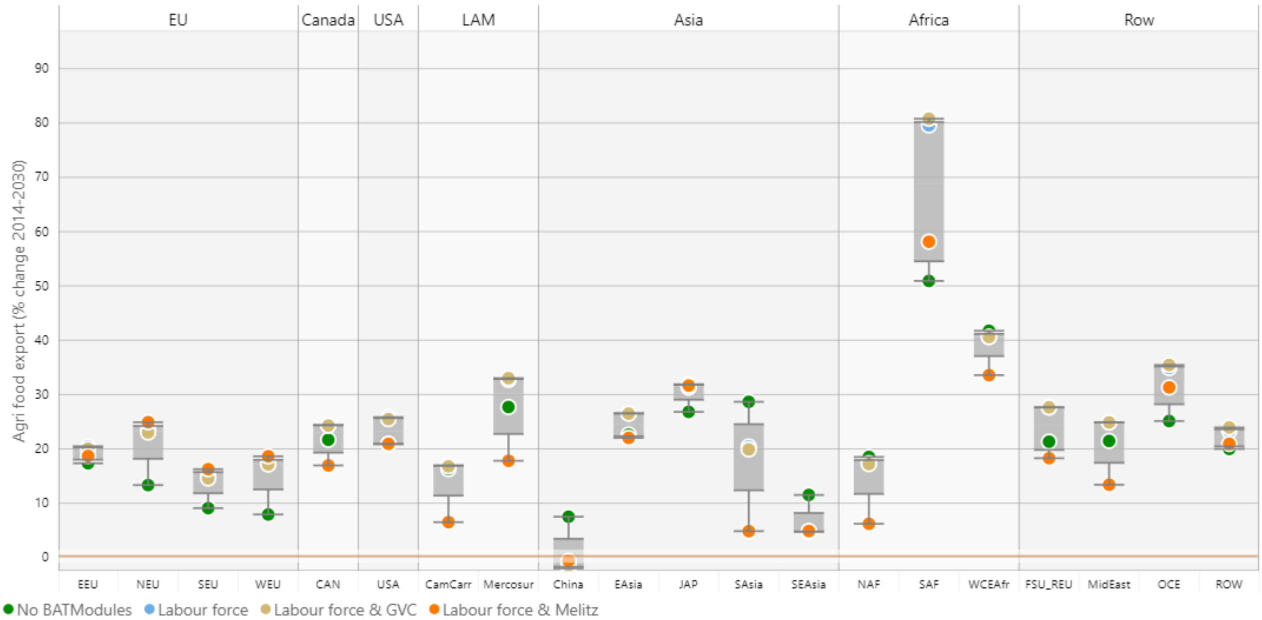
Figure 19 Agri-food export changes (% change 2014-2030)



Source: MAGNET results

Activating the modules generally strengthens developments in the trade balance (Figure 20). In general, regions with a positive trade balance get more positive in 2030. Regions with a negative trade balance get more negative in 2030. The BATModules all show a similar pattern with the change in trade balance driven by the imporoved labour shocks.

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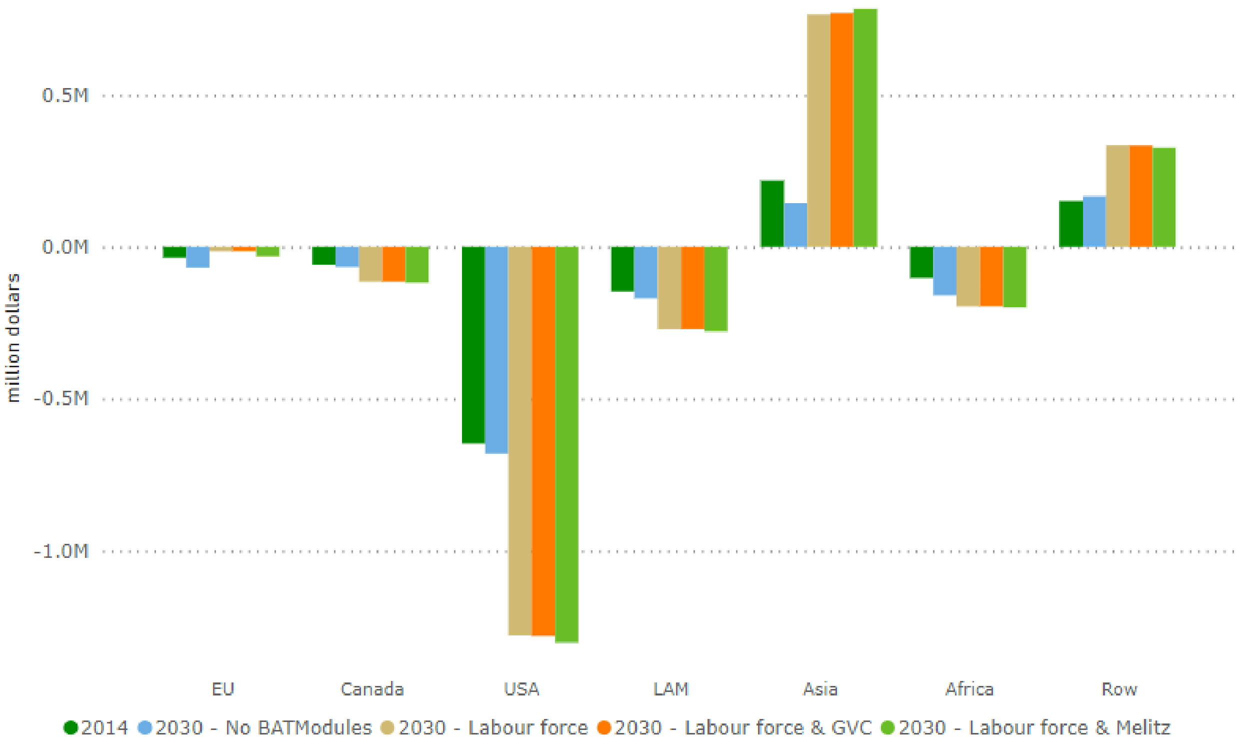
Figure 20 Changes trade balance (absolute change in million dollars 2014-2030)



Source: MAGNET results

Changing to labour force specific projections, activating the employment modules has a significant impact on the projected labour supply in the economy. Figure 21 shows the development of skilled and unskilled labour in the economy. Activating the employment modules makes two changes to the labour supply projections: basing them on the physical number of workers and making them labour type-specific. As the labour projections are exogenous and we add modules in a step-wise fashion, they are identical for all scenarios where BATModules are activated.

When no BATModules are activated, we adjust the labour force in measured in dollar quantities as in the standard GTAP model. The total labour force then endogenously adjusts following as the percentage change in labour demand by sector weighed with the initial number of workers in each sector. This affects projections as can be seen for the Asia aggregate. While the NoBATmodules scenario shocks skilled and unskilled labour types in dollar values all with the same growth rate the labour force in terms of workers shows opposing developments: skilled workers increase and unskilled workers decrease.

Due to the new labour module, the number of workers are projected to change in line with structural change accompanying GDP growth, also taking into account changes in labour force participation rates, which are kept constant in the NoBATModules projections of labour using changes in working age. This implies that all scenarios with BATModules have a different total size of labour force as well as change in composition. This translates to the number of skilled workers hardly increasing (or decreasing) in the EU, Canada, USA and ROW and increasing in Latin America, Asia and Africa. In Asia, the number of workers greatly increase for skilled labour types; the unskilled labour force however decreases in the period 2014-2030. The changes to

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the wage rate show a opposite trend, including the labour module overall leads to mostly higher wages except in Asia and Africa where wages decline for skilled labour due to the increase in skilled labour supply (Figure 21).

Figure 21 Changes number of workers and wages (% change 2014-2030)

Source: MAGNET results

5.3.4 Scenario comparison

Similar to the findings in D7.1, implementing the CETA trade agreement has only a limited impact on the economy in Canada and the EU. Figure 22 shows the impact on real GDP for the different scenarios. Note that, in this and all following figures, the CETA results are compared to the corresponding reference scenario including the same BATModules as included in the CETA run (denoted by BAU) (see Figure 13 for MAGNET workflow). Overall, there is hardly any change to GDP, the maximum impact is when Melitz is included, however then the impact is still only 0.009%. The impact on GDP is larger in Canada than the EU reflecting the differences in economic size.

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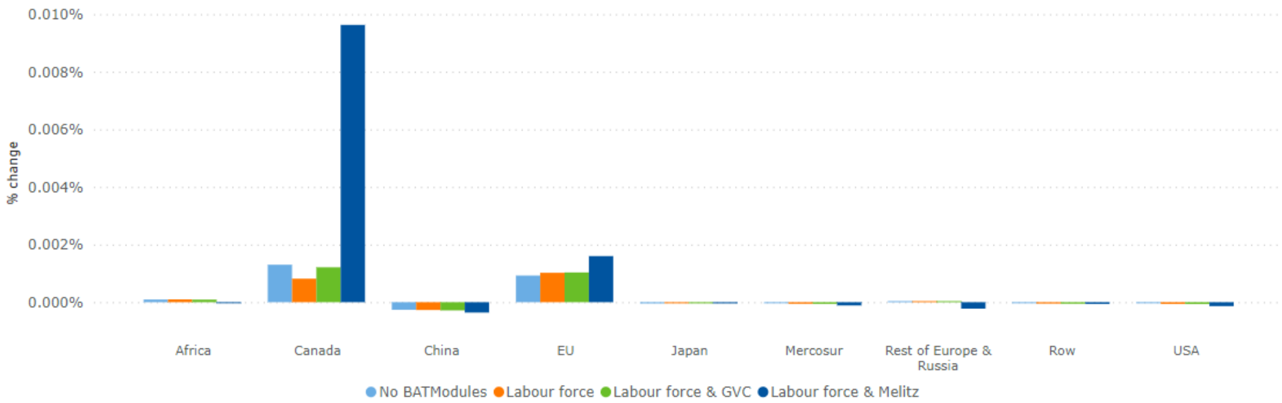
Figure 22 Real GDP change CETA by scenario (% change compared to BAU)



Source: MAGNET results

As in the baseline comparison, including Melitz has the highest impact on the results. If Melitz is included, the impact on production volume in Canada is the highest (Figure 23). Especially the sectors “meat and livestock” and “food products” increase production after introducing the CETA tariff shocks. These have the highest initial levels of protection given their sensitive nature and hence experience the largest shock. Primary agriculture and forestry decrease due to the CETA shocks in a model including Melitz.

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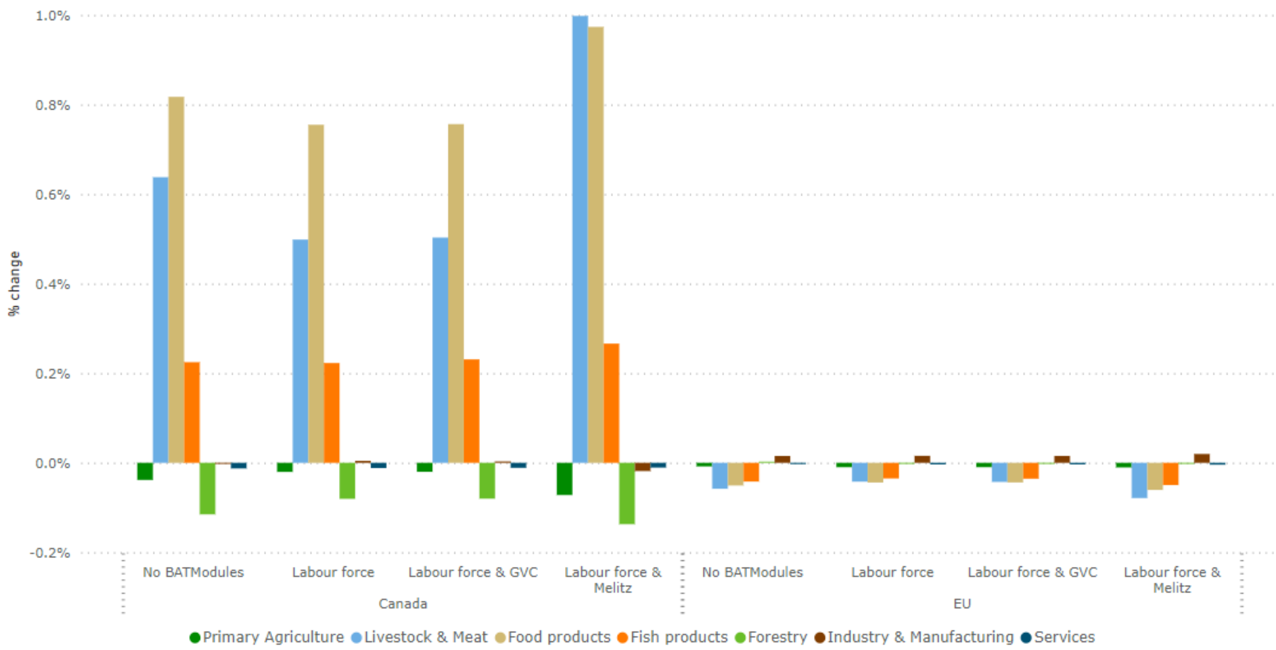
Figure 23 Production volume (% change versus BAU)



Source: MAGNET results

There is some trade displacement going on (Figure 24). Canada starts importing more from the EU and less from Asia and the USA. The EU increase imports from Canada and mostly reduces intra-European trade. As seen in Figure 23, the EU hardly increases its production; therefore, other countries reduce their imports from the EU. Only the Melitz module changes the trade displacement slightly. Due to including the Melitz module in the model, trade between the EU and Canada increases a bit more. Figure 25 shows that the increased trade is mainly in the sectors "Industry and manufacturing" and "Livestock and meat" sectors.

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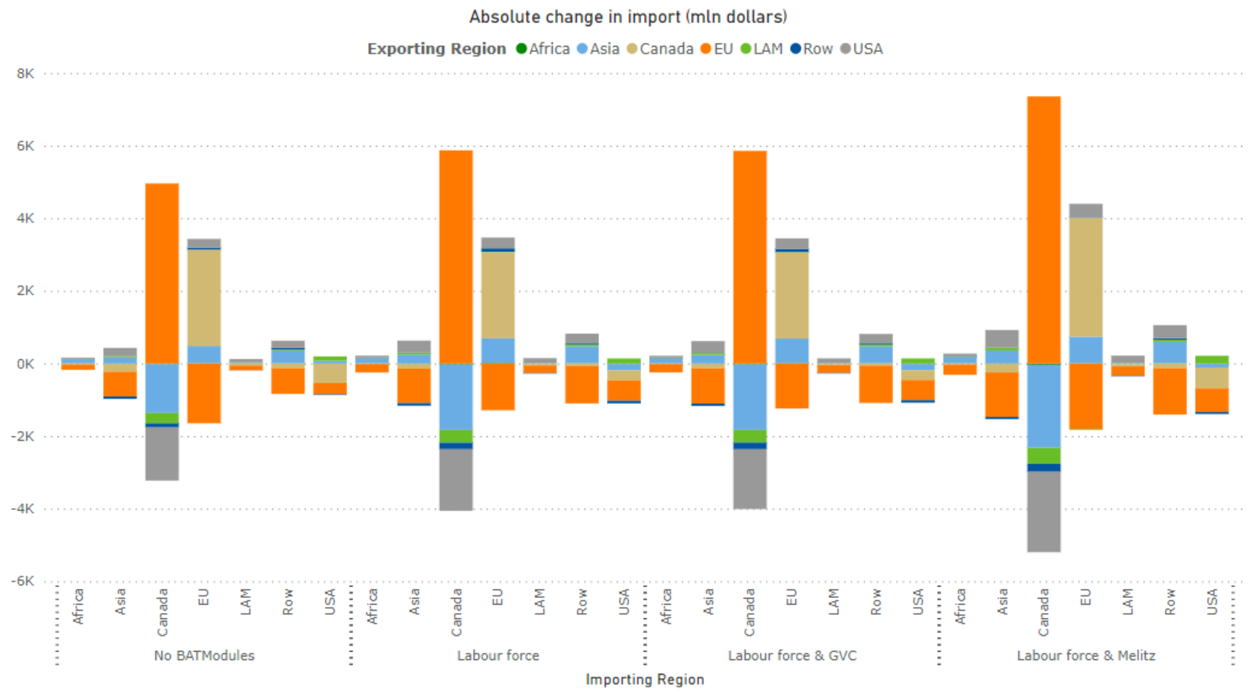
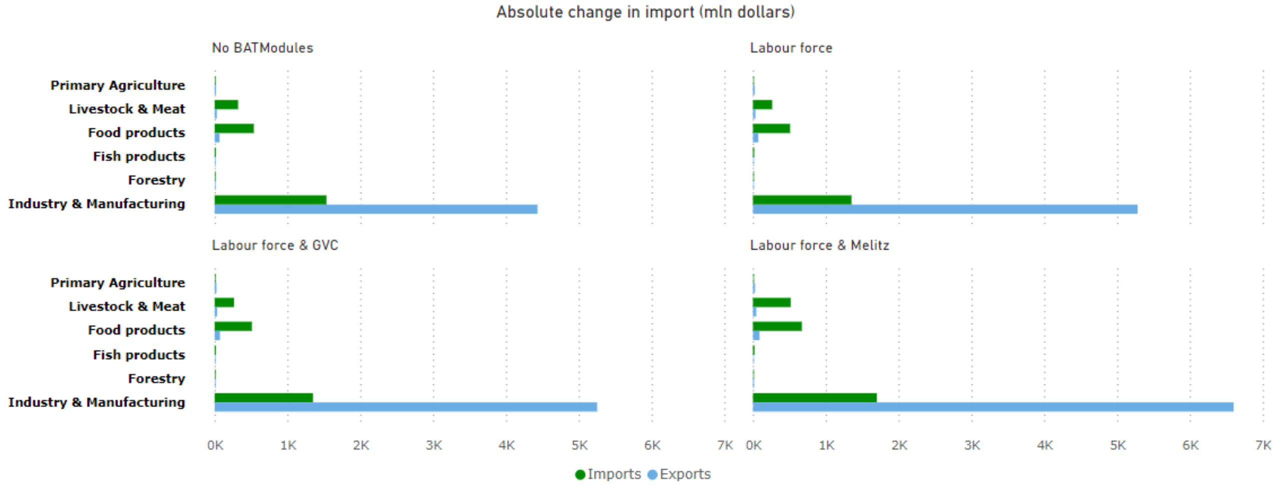
Figure 24 Imports (absolute change vs BAU)



Source: MAGNET results

Figure 25 Trade between EU and Canada by sector (absolute change in million dollars)



Source: MAGNET results

The increased trade between the EU and Canada and the subsequent trade displacement has a small impact on the trade balance of other regions in the world. The USA decreases its imports of the EU and replaces this with domestic consumption, thus leading to a small increase in its trade balance. China decreases its exports to Canada thus leading to a small decrease in its trade balance (Figure 26).

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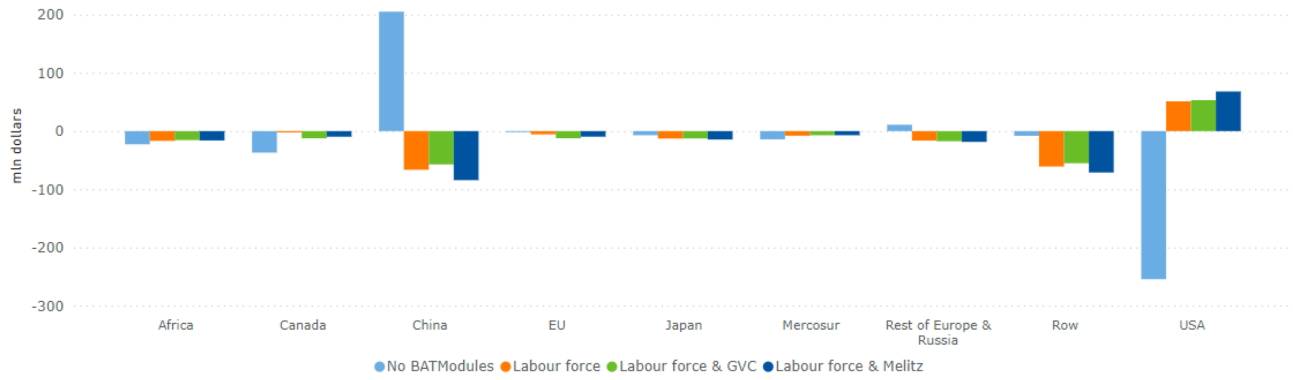
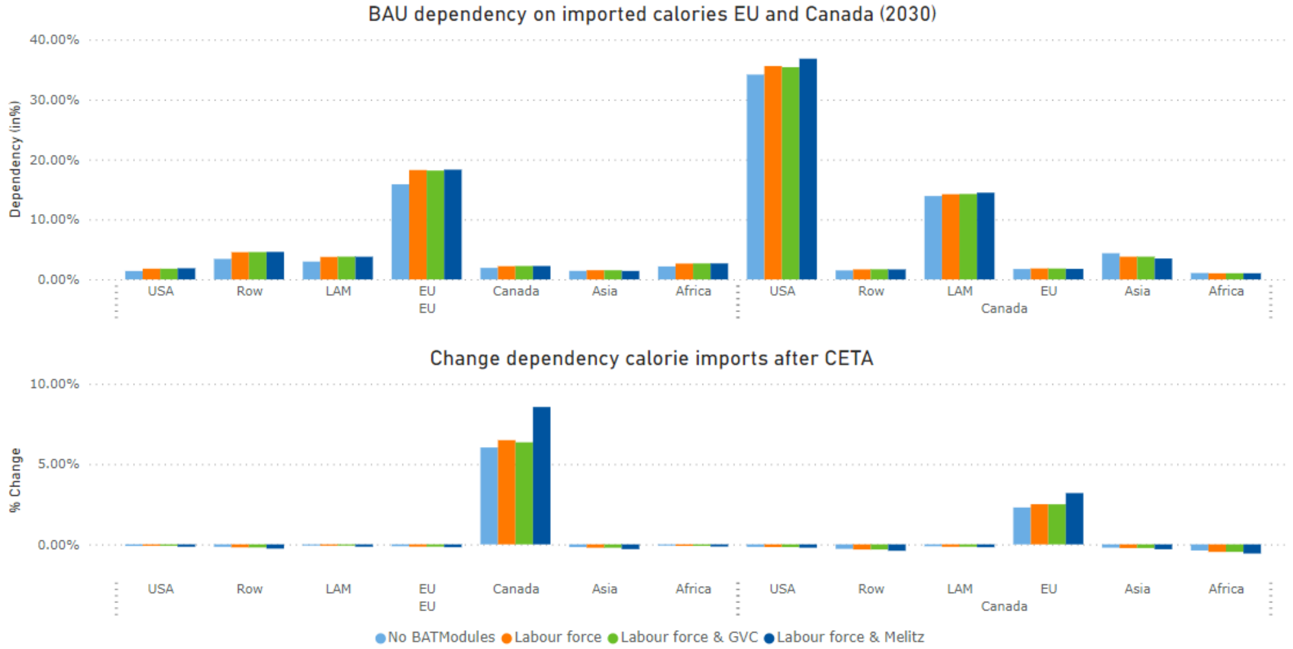
Figure 26: Balance of Trade (absolute change in million dollars, compared to BAU)



Source: MAGNET results

Due to the increased trade between Canada and the EU, both regions become slightly more dependent on imported calories from each other (Figure 27). However, both Canada and the EU were not that dependant on each other for food imports in the baseline. Again, including Melitz in the model has the largest impact increasing trade more than for the other model versions.

Figure 27: Calorie import dependency (% change compared to BAU)



Source: MAGNET results

The CETA tariff shock has a negative impact on the diet in Canada. Due to the shock, certain food commodities already consumed in excess e.g., meat, milk and sugar, become cheaper (Figure

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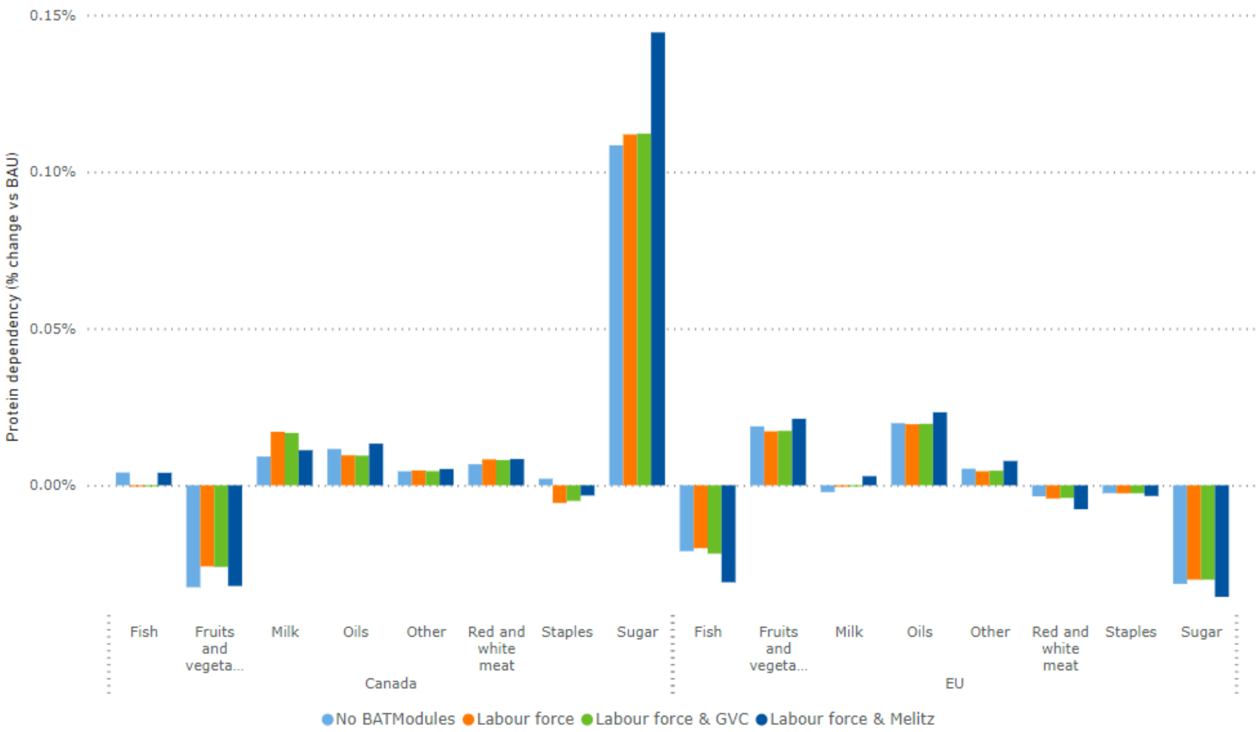
28). The EU shows an opposite trend: fruit, vegetables, and oils become cheaper and are therefore consumed more.

Figure 28 Protein dependency (% change versus BAU)



Source: MAGNET results

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5.4 Results from MIRAGE

The final (end-of-project) simulation of CETA in MIRAGE includes a change in NTMs, to account for a number of provisions on this aspect provided by the agreement (mainly chapters 4 and 5). The comparison is done between the simulation with only tariffs and the one that includes a change in NTMs. To have results easy to compare, each table presenting MIRAGE's results contains variations in percentage as compare to the baseline in 2030 for three different scenarios (in some cases the value of the simulation is added). Hence, regarding MIRAGE, the three scenarios simulated are:

1. A full tariff liberalization between EU and Canada. This scenario gives an upper bound of the results given by the model. It allows to disentangle the impacts of sensitive products excluded from tariff removal and to evaluate the role of NTMs as compared to the ones of sensitive products.
2. To ensure that the version used of the model as well as the data are the same as at the beginning of the project, the official tariff schedule has been re-simulated. The average initial values of tariff between EU and Canada and the final ones are given in Table 2.
3. Finally, this official tariff scenario is associated to an across-the-board decrease (-25%) of the AVEs of NTMs in goods to evaluate the impacts of changes in NTMs. The data comes from Kee et al. (2009) which has been filled for missing values; both the EU and Canada are included in the original database.

In terms of additional descriptive evidence, AVEs of NTMs, before and after the implemented shock, are reported in Table 6. Averages are computed using a trade weighted aggregation (as for tariffs, those averages depict lower figures than ref group weighted/Simple average weighted).

Table 6: Average level of the AVEs of NTMs, between EU and Canada (baseline and scenario, in %).

Agr. Sectors	Eu as importer		Canada as importer	
	Baseline	Simulation	Baseline	Simulation
Cereals	6,8	5,1	9,5	7,1
VegFruits	26,4	19,8	35,2	26,4
OthCrops	14,0	10,5	13,1	9,8
Cattle	41,5	31,1	35,9	27,0
OthAnim	23,1	17,3	4,7	3,6
Dairy	76,6	57,4	72,3	54,2
Forestry	0,5	0,4	7,3	5,5
Fishing	13,0	9,7	22,7	17,0
Meat	25,8	19,4	13,5	10,1
OthFood	60,7	45,5	6,8	5,1

Source: Kee et al. (2009), author's computation

Both countries depict a high level of AVEs for NTMs. However, in some cases, AVEs of NTMs can be lower that the corresponding applied tariffs (in the dairy sector for Canada as importer, for example). The EU shows higher average level for AVEs of NTMS. However, globally both

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countries seem to have « similar » NTMs (not necessary the same ones in terms of measures, but leading similar computed AVEs).
The results of this new set of CETA simulations are in line with what is expected. The results on value added are commented in the previous paragraphs (for the initial scenario). Hence, in the following paragraphs we focus on classic indicators coming from MIRAGE (GDP, Welfare, Trade…) to show the impact of the inclusion and reduction of the AVEs of NTMs of the CETA (Table 7).
At the world level, the impact of CETA, whatever the simulation, remains marginal. Both GDP in volume and economic welfare marginally change in the simulations as compared to the baseline in 2030: between +0% and +0.01%. The lowest impact is expected from the "Only Tariff" scenario, i.e. when sensitive sectors are excluded from the tariff liberalisation as in the official text of the agreement. Both "Full Lib" and "Tariff + 25% NTMs" shows similar results in terms of GDP and welfare. The reduction in trade cost however increases (with a factor 3) world trade a little bit more than the full removal of tariffs (+0.09% vs +0.06%). Hence, the reduction of the economic inefficiencies linked to the trade costs eases more trade than only reducing tariffs.

Table 7: Macroeconomic results (world level), as compared to the baseline in 2030.

Variable	Scenario (var. in %)		
	Full Lib	Only Tariff	Tariff + 25% NTMs
Exports (vol - Fisher index)	0,06	0,03	0,09
Imports (vol - Fisher index)	0,06	0,03	0,09
World GDP (vol - Fisher index)	0,01	0,00	0,01
World Welfare	0,01	0,00	0,01

Source: MIRAGE model, author's computation.

Regarding the impacts on the EU and Canada (Table 8), results keep their initial "structure": They are rather low, but heterogeneous across countries. Canada benefits the more from the agreement as the country can trade more with the EU than the opposite, the European market being much larger than the Canadian one. Consequently, whereas the welfare of Canada increases by 0.12% in the initial scenario, the inclusion of changes in NTMs almost doubles the effect of the agreement for this country. For the EU, the relative change is higher (multiplied by 3), but the expected variations regarding welfare are much lower: +0.01% in the "Only Tariff" scenario whereas it becomes +0.03% in the "Tariff + 25% NTMs" scenario.
All scenarios present positive impacts on unilateral trade flows, showing the positive impact of the agreement whatever the level of ambition in terms of trade liberalisation. Again, the agreement is particularly positive for Canada: unilateral exports for Canada increases by +1% in the initial scenario and jumps to +2.1% when including NTMs.

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Table 8: Macroeconomic results (country level), as compared to the baseline in 2030.

Region	Variable	Full Lib		Only Tariff		Tariff + 25% NTMs	
		Var %	Value Sim	Var %	Value Sim	Var %	Value Sim
Canada	Exports (vol - Fisher index)	1,8	814,9	1,0	808,2	2,1	816,8
	Exports (vol _ no intra)	1,9	857,1	1,0	850,2	2,2	859,6
	GDP (vol - Fisher index)	0,4	2752,1	0,1	2743,4	0,2	2746,4
	Imports (vol _ no intra)	1,6	910,8	1,0	905,1	2,1	914,9
	Terms of trade	-0,1		0,0		-0,0	
	Welfare	0,27	219,8	0,12	219,4	0,21	219,6
EU28	Exports (vol - Fisher index)	0,1	9117,3	0,1	9114,3	0,1	9120,7
	Exports (vol _ no intra)	0,3	4208,6	0,2	4204,0	0,5	4217,1
	GDP (vol - Fisher index)	0,0	25805,3	0,0	25802,9	0,0	25808,2
	Imports (vol _ no intra)	0,3	5109,3	0,2	5103,3	0,5	5116,3
	Imports (vol)	0,1	10314,7	0,1	10310,5	0,1	10317,8
	Terms of trade	0,0		0,0		0,0	
	Welfare	0,02	2085,8	0,01	2085,5	0,03	2086,0

Source: MIRAGE model, author's computation. Values are expressed in billions of 2014 USD.

In all scenarios, bilateral trade is greatly impacted by the agreement (Table 9). Both agriculture and industry benefit from the agreement in terms of exports, whereas services are only impacted through GE effects (the basic assumption used in this test case is that nothing has been done in the services sectors).

Table 9: bilateral trade impacts, as compared to the baseline in 2030.

Exporter	Importer	Sector	Full Lib		Only Tariff		Tariff + 25% NTMs	
			Var %	Value Sim	Var %	Value Sim	Var %	Value Sim
Canada	EU28	Agriculture	37,1	12 621,2	16,0	10 677,3	23,2	11 339,5
		Industry	21,8	55 475,4	20,7	54 959,3	26,2	57 450,4
		Services	0,2	29 026,4	-0,6	28 803,7	-0,9	28 708,4
EU28	Canada	Agriculture	497,3	11 125,3	70,2	3 169,7	75,4	3 267,4
		Industry	17,2	76 018,7	14,6	74 316,2	20,6	78 210,9
		Services	-0,2	48 430,8	0,4	48 725,3	0,7	48 854,6

Source: MIRAGE model, author's computation. Values are expressed in millions of 2014 USD.

EU is the biggest winner in agriculture, in terms of exports. The "Full Lib" scenario shows very high impacts, mainly due to the changes in the dairy sector. Comparing "Only Tariff" and "Tariff + 25% NTMs" shows that most of the impact for EU exports in agriculture is due to tariff reduction (75.2% vs 75.4%): the decrease in the AVEs of NTMs show s limited impacts for agricultural exports. For the industry, adding a 25% decrease of AVEs of NTMs increases the positive variations more for all concerned sectors, both for the EU and Canada, but those increases remain moderate.

In conclusion, accounting for NTMs is key in evaluating the economic consequences of any trade agreement that goes beyond tariff removal. However, the CETA case shows that MFN tariffs remain of importance between developed economies as an important share of the results come from tariffs reduction. The NTM scenario simulated in this section is an *ad hoc* scenario that considers an impact on NTMs in goods only. Additional simulations including variations in NTMs in the services sector may also be included and interesting to study, even if the uncertainty about the changes may be even higher than the ones on goods.

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6 CONCLUSION

The main lessons learnt from the exercise of running the same simulation with different model versions are the following:

1. By testing model extensions one-by-one, the modelling teams concluded that adding product details (products & GVCs) increases expected response from FTA.
2. On the other hand, NTM details are very likely to get lost in global CGE models, particularly if not combined with tariff line modelling that would help to capture details on specific products or tariff lines.
3. In all tested variants of CGEBox, one of the few consistent result show a slight decrease for land use compared to the initial version of the models.
4. The case of Spatial Price Equilibrium (SPE) for selected products shows that transferring modules from CGE to PE is a real possibility acting as a proof of principle of transferring module between models which are very different in terms of structure.
5. The SPE test leads to an extremely (probably unrealistic) strong increase in trade with CETA in both PE and CGE models.
6. Testing the combination of different modules developed throughout the BATModel project in MAGNET showed that some modules might not work together. This might be a data issue that could appear only for some specific type of aggregation of the GTAP database or could signal a deeper inconsistency between modular enhancements.
7. Step-wise addition of new modules in MAGNET shows modules may change both size and direction of change at regional level, but without a clear pattern. The impact also varies considerably across indicators, agri-food prices for example show a larger spread than agri-food production when modules are added.
8. In most cases, the newly developed modules did not trigger visible changes in terms of impacts of the CETA on the involved countries. On the other hand, the new additions caused visible impacts on the model baseline while CETA results comparable across model versions. Hence, while conclusions on the relative impact of the CETA are not changed, the reference point to which the expected impacts are compared may differ when modules are added.
9. The development of the new indicators on jobs, wages and wage-income distribution could help to broaden the model assessments of upcoming FTAs.

6.1 More details on revisiting the CETA test case

The first results of CETA test case (and results from other work packages) are presented at the BATModel Summer School (https://www.batmodel.eu/summer-school-agenda/)
Newly developed BATModel modules & documentation are available on GitHub: https://github.com/BATModules/BATModules/wiki

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