# Assessment of the potential environmental impacts and risks in Switzerland and the MERCOSUR States resulting from a Free Trade Agreement (FTA) between the EFTA States and MERCOSUR

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**Colophon**

Assessment of the potential environmental impacts and risks in Switzerland and the MERCOSUR States resulting from a Free Trade Agreement (FTA) between the EFTA States and MERCOSUR

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**List of abbreviations**

| | |
|---|---|
| CGE | Computable general equilibrium |
| DESTA | Design of Trade Agreements |
| EFTA | European Free Trade Association |
| EG | Environmental goods |
| EMFTA | EFTA MERCOSUR free trade agreement |
| FOEN | Swiss Federal Office for the Environment |
| GHG | Greenhouse gas emissions |
| GVCs | Global value chains |
| GSP | Generalized System of Preferences |
| GMRIO | Global multi-regional input-output |
| JRC | Joint Research Centre |
| LCA | Life cycle analysis |
| MFN | Most Favoured Nation |
| MT | Million tons |
| MERCOSUR countries | Argentina, Brazil, Paraguay, and Uruguay |
| NTMs | Non-tariff measures |
| PTAs | Preferential trade agreements |
| SECO | Swiss State Secretariat for Economic Affairs |
| SIA | Sustainability impact assessments |
| TRQs | Tariff rate quotas |
| ToR | Terms of reference |

# Executive summary

In August 2019, the European Free Trade Association (EFTA) announced that the EFTA Member States (Iceland, Liechtenstein, Norway and Switzerland) reached an agreement in principle with MERCOSUR on a comprehensive free trade agreement between the EFTA states and MERCOSUR (EMFTA). The last phase of negotiations had been running in parallel with EU-MERCOSUR negotiations on a comprehensive trade agreement, with the provisional EU-MERCOSUR deal concluded in June 2019. The Swiss announcement on the EMFTA references the EU agreement directly as a motivating factor. The EMFTA is an economic treaty focused on what are known as conditions of market access. In the present context, this means the treaty is focused on the rules governing access of MERCOSUR exports of goods and services to Switzerland, as well as the rules governing access of the respective Swiss exports to the MERCOSUR countries. In this report, we examine the possible environmental effects of the EMFTA. The task has involved a model-based assessment of the economic impact, alongside a mapping of economic outcomes into environmental outcomes. The follow-up analysis is both quantitative and qualitative.

## The Mandate

This study follows a mandate from the Swiss State Secretariat for Economic Affairs (SECO) in June 2019 to examine the environmental impacts of the EMFTA. Per the terms of mandate, the aim of this targeted impact assessment is to study the possible environmental consequences of the EMFTA both in Switzerland and in the MERCOSUR countries (Argentina, Brazil, Paraguay, and Uruguay), as well as globally, which are generated by changes in trade and economic activity in both regions that are likely to follow from implementation of the terms of the EMFTA. This is achieved by conducting a quantitative economic analysis of the agreement that emphasises on the associated environmental impacts.

## Methodology

This is one of the first studies formally conducted for the Swiss government on the environmental effects of a Swiss trade agreement across all industries. (There have been recent industry level studies, for example by the Federal Office for the Environment (FOEN) in 2019; Alig *et al.* 2019). The terms of reference for this study called for a top down assessment of the EMFTA. In particular, a computable general equilibrium (CGE) model has been used to estimate the macroeconomic and sector level economic effects. These in turn have been used to estimate changes in model-based environmental indicators. The CGE model computes changes in the allocation of activities, intermediate inputs, labour, and natural resources across sectors and regions resulting from a policy shock, in this case the entry into force of EFTA MERCOSUR Free Trade Agreement (EMFTA). Data on greenhouse gas (GHG) emissions, air pollutants, and resource use are used to compute changes environmental impacts from this set of allocation changes. The analysis also takes advantage of what is called multi-region input output (MRIO) analysis of the benchmark database, as well as the counterfactual database (meaning the post-EMFTA database) generated by the CGE analysis. MRIO analysis makes possible the tracing of resource and embodied emission flows across global value chains. The negotiated outcome in trade in goods of the EMFTA (tariff concessions) serves as the input into the CGE model to compute the changes in economic activity and environmental impact due to the EMFTA.

With all MERCOSUR States being classified as developing countries according to the Swiss Generalized System of Preferences (GSP), a comparison between the Swiss-MERCOSUR concessions of the EMFTA and Switzerland's preferential tariffs for goods originating in developing countries has shown that with the

EMFTA, Switzerland is in principle offering security of current market access (which is otherwise concessionary according to the GSP but not guaranteed since the status of the MERCOSUR countries could change in the future) under mostly unchanged conditions (with some further improvement for manufactured goods, especially for textiles and clothing). On the other hand, Swiss exports of goods to the MERCOSUR countries benefit from improved market access. What this means, for example, is that for many industrial products, Swiss tariffs applied to MERCOSUR goods change only a small amount, while there are substantial changes in MERCOSUR tariffs, especially as applied against Swiss industrial goods. Exceptions include Swiss tariff reductions for textiles. Critically, for agricultural products (including beef) we have found that market access conditions are largely unchanged by the EMFTA compared with the GSP. The relatively small changes in market access translate into relatively small economic effects and environmental impacts, as detailed below.

## Economic effects of the EMFTA

On a macroeconomic scale, the EMFTA would result in a positive, albeit minor change in real GDP for all partner countries, with an estimated 0.06% increase in Switzerland's real GDP, and a 0.01% increase for overall MERCOSUR real GDP. Trade changes are also minor, especially for MERCOSUR, with a 0.12-0.13% increase in both exports and imports, and a 0.31-0.33% increase in Switzerland's exports and imports.

## Environmental impacts and risks

An important factor feeding into the mapping from economic results to more specific sustainability issues addressed in the report is the sector profile for resource use. In particular, the magnitude of impacts on land and natural resources (water, forests, mineral and energy deposits) hinges on the extent to which sectors important in terms of land and natural resource use realize changes in output, and so economic activity that again will drive environmental impacts. Given that the conditions of market access for Mercosur countries to Switzerland remains largely unchanged (again with notable exceptions like textiles), this leads to small estimated changes in trade and production levels in Mercosur. This in turn implies muted environmental impacts across a broad range of environmental indicators.

Table E-1 below summarizes economic changes reported in the study for sectors identified in recent previous studies as being of particular environmental importance. For all these sectors the expected economic changes are very small, with all changes in exports and output being below one percent (while for diary and vegetables, fruits, nuts, exports are estimated to increase slightly, this is accompanied by generally even smaller changes in output in these sectors).

**Table E-1** Estimated economic changes in Mercosur in some of the sectors identified in previous studies (LSE Consulting 2018,19; Alig *et al.* 2019; Frischknecht *et al.* 2018)

| Sector/Product | % Change in Mercosur exports due to EMFTA | % Change in Mercosur output due to EMFTA |
|---|---|---|
| Bovine cattle, sheep and goats | 0.03 | 0.03 |
| Dairy products | 0.48 | -0.06 |
| Oilseeds (incl. soybeans) | 0.03 | 0.02 |
| Processed rice and sugar | 0.11 | 0.01 |
| Textiles | 0.61 | 0.02 |
| Vegetables, fruits, nuts | 0.12 | -0.06 |

Source: Own calculations.

The relatively limited economic effects of the EMFTA reported are the main reason for differences in the magnitude of environmental impacts compared with other recent studies. Alig *et al.* (2019), for instance, applied a much more ambitious trade liberalisation scenario. We have benefitted from hindsight, and

have been able to work with the set of actual negotiated market access commitments. Earlier studies did not have this information. We summarize the main environmental findings in the report below.

- Greenhouse gas (GHG) emissions and air pollution

Table E-2 below summarizes estimated changes in GHG emissions from the EMFTA, reported both on the basis of the sectors in which they are generated (labelled "sources by activity" in the table) as well as where they are demanded by downstream firms or final demand, so either embodied as intermediate inputs (or in household and government use in the case of energy). These latter values are labelled "sources by use" in the table.[1] The breakdown is provided as changes in MT $CO_2$-eq (with further detail in the full report). While emissions by activity reflect direct emissions by the sector undertaking the activity, the use classification takes account of intermediate linkages necessary in producing final goods and services. In effect the use classification reassigns emissions to the final stages of production of goods and services. For example, emissions from fertilizer production that is then used in agriculture to produce food is assigned to manufacturing on an activity basis (i.e. the sector that makes the fertilizer) and processed food on a use basis (as the fertilizer feeds into agricultural production that then feeds into processed foods). As trade in goods (and services) embodies emissions from upstream sectors, the use classification provides a more direct mapping from traded goods to the emissions that result from production of those goods (both from direct activity in the sector and indirect activity from upstream suppliers), while avoiding double counting by construction.

Importantly, estimated global changes in emissions reflect the mixture of both direct effects from changes in production in Switzerland and the MERCOSUR countries, as well as from indirect changes that are realized in other countries. For example, if machinery demand in Brazil shifts away from imports from a country with a relatively higher carbon content for production with respect to Swiss production, and toward Swiss suppliers with lower emissions profiles relative to that third country, then this would contribute to a drop in emissions from global machinery production. The net effects depend on the full combination of direct effects in the EMFTA partner countries, as well as induced effects, linked in part to trade diversion, across all third countries that are not part of the agreement, and across all sectors. The actual effects from the complex reallocation of production globally following the implementation of the EMFTA are captured in the model. Indeed, this is an important reason to use a global, multi sector model allowing to capture these effects.

Following the pattern for GHG emissions, estimates indicate that air pollution also will not change significantly in the MERCOSUR countries (generally ±0.0%), while percentage changes in air pollution indicators for Switzerland are between 0.1% and 0.3%, with $NH_3$ (ammonia) increasing by 0.13%, NMVF (Non-methane volatile organic compounds (long cycle carbon) by 0.2%, $SO_2$ by 0.3%, and $PM_{10}$ by 0.17%. These changes are driven by a small estimated increase in overall Swiss manufacturing activities, as discussed in the main body of the report. For the world as a whole, and for the rest of the world, the changes are negligible for all air pollutants (consistently ±0.0%).

[1] Yet a further breakdown involves the resources and emissions embodied in final consumption, as distinguished from final production. This includes, for example, Fernandez Amador et al (2017, 2020).

**Table E-2** Greenhouse gas emissions changes as MT $CO_2$-eq

| | source by activity sector | | | |
|---|---|---|---|---|
| | MER | CHE | RoW | World |
| Agriculture, food, beverages | 0.14 | 0.00 | -0.07 | 0.08 |
| Energy (extraction based) | -0.04 | 0.02 | -0.09 | -0.11 |
| Other primary | 0.04 | 0.00 | -0.01 | 0.03 |
| Manufacturing | 0.00 | 0.01 | -0.01 | 0.00 |
| Transport | 0.04 | 0.00 | -0.04 | 0.00 |
| Other Services, Utilities | 0.03 | 0.02 | 0.09 | 0.13 |
| Final consumption (Govt, Households) | | | | |
| Total, MT $CO_2$-eq | 0.21 | 0.04 | -0.13 | 0.13 |
| Total, percent | 0.02 | 0.10 | 0.00 | 0.00 |
| | source by use (intermediate or final use) | | | |
| | MER | CHE | RoW | World |
| Agriculture, food, beverages | 0.20 | 0.00 | -0.10 | 0.10 |
| Energy (extraction based) | 0.01 | 0.00 | -0.01 | 0.00 |
| Other primary | 0.04 | 0.00 | -0.01 | 0.03 |
| Manufacturing | -0.02 | 0.01 | 0.00 | -0.01 |
| Transport | 0.03 | 0.00 | -0.06 | -0.04 |
| Other Services, Utilities | 0.01 | 0.00 | 0.06 | 0.07 |
| Final consumption (Govt, Households) | -0.05 | 0.03 | 0.00 | -0.03 |
| Total, MT $CO_2$-eq | 0.21 | 0.04 | -0.13 | 0.13 |
| Total, percent | 0.02 | 0.10 | 0.00 | 0.00 |

Source: Own calculations.

Note: Column sums do not always match the totals shown in the table because of rounding.

- Biodiversity and water risks

This study further examines risks posed by two main activities highlighted by previous SIAs, with respect to biodiversity and water resources – forestry and cattle. The EMFTA creates very limited incentives for expansion in agricultural and food trade between Switzerland and MERCOSUR, and this explains why the consequent deforestation risks are muted. While the estimated changes in forestry activities are judged to be minor, there is a small expected increase in bovine cattle, sheep, and goat production, with the highest increase estimated to take place in Uruguay, equivalent to a 0.05% increase in overall production. This is driven by an increase in non-bovine ruminant meats supporting the estimated increase in exports in these products. Keeping in mind the relative magnitudes involved, this change may result in a negative impact on biodiversity in the long run, most importantly in Uruguay, albeit a small one.

Another environmental risk relates to water quality, which intersects with concerns about the general health of ecosystems (biodiversity). An important market access concession in the EMFTA is the elimination of Swiss textile tariffs. Textile production is associated with high volume water usage, as well as toxic metals pollution (Cardoso de Oliveira Neto *et al*., 2019; San *et al*., 2018). While there is an increase in MERCOSUR textile exports, there is basically no corresponding increase in output, meaning increased trade under the EMFTA involves diversion of trade from other destinations. As such, in this case we do not identify dangers to water quality from expanded textile production.

- Land use risks due to agriculture and deforestation

According to the 2009 Trade Sustainability Impact Assessment (SIA) of the Association Agreement under negotiation between the European Community and MERCOSUR (Kirkpatrick and George, 2009), there was an expected increase in agricultural production. According to the report, this increase in production would

increase demand for resources, most importantly land and water, but also potentially increasing deforestation, contributing to deterioration in biodiversity and climate change.

It is important to note that most of the historically large increases in land demand for commodity crops in MERCOSUR have indeed been generated by increased international trade, in particular from China. For example, soybean exports from Brazil to China expanded almost 17 times in the last 15 years. Moreover, if the EU-MERCOSUR FTA does increase trade in agricultural goods (mainly of meats), then this can be expected to substantially expand land use demand, and hence, deforestation risks in the MERCOSUR countries. However, as explained above, the EMFTA creates very limited incentives for expansion in agricultural and food trade between Switzerland and MERCOSUR, and this explains why the consequent deforestation risks are muted. This also contrasts sharply with possible impacts from the EU-MERCOSUR agreement. The key difference is the importance of largely unchanged import quotas for agricultural products in the case of the EMFTA. Our results indicate a minor change in agricultural activity due to the trade agreement with the EMFTA, which is then linked to minor changes in the intensity if land use.

We also report the results for an alternative specification of our core economic model, wherein supply of agricultural land expands as a result of a larger demand for land as a production factor for agricultural and food activities. This provides an estimate of potential (upper bound) risk for repurposing forests for agricultural purposes. Here again we find minor changes in agricultural land use (see Table E-3). We find that land use increases by 0.02% for MERCOSUR as a whole. This result is driven mainly by increases in Argentina and Brazil. Assuming that all the new agricultural land is taken through deforestation – instead of repurposing existing land – this implies potential deforestation effects of the EMFTA of around 901 square kilometres ($km^2$) until the agreement has been fully implemented, when the full economic impacts should be in effect. This implies a yearly deforestation rate of 43 $km^2$, which represents 0.1% of the current yearly deforestation of more than 40,000 $km^2$. This estimate of potential deforestation should be viewed in the context of historical land use patterns. Historically around 20% of agricultural land expansion is realized through deforestation (Zalles et al., 2019). On this basis, EMFTA-related deforestation would be closer to 0.02% of the historic yearly average deforestation rate.

**Table E-3** MERCOSUR: Estimated upper bound land use changes and comparison to current deforestation

| | Agricultural land area in 2017, $km^2$ | Estimated % change in land use from CGE model, percent | Potential deforestation until 2040, $km^2$ | Potential deforestation yearly average 2020-40, $km^2$ | Deforestation yearly average 1990-2015, $km^2$ | Share of potential against current deforestation |
|---|---|---|---|---|---|---|
| Argentina | 1,487,000 | 0.02 | 297 | 14 | 4,801 | 0.30% |
| Brazil | 2,835,460 | 0.02 | 567 | 27 | 33,229 | 0.08% |
| Paraguay | 218,850 | 0.01 | 22 | 1 | 3,646 | 0.03% |
| Uruguay | 144,496 | 0.01 | 14 | 1 | -655 | -- |
| MERCOSUR | 4,685,806 | 0.02 | 901 | 43 | 41,022 | 0.10%[1/] |

Sources: Own estimates using GTAP-10 database, with additional data from the World Development Indicators, UNSD Environmental Indicators and Tabeau et al. (2017).

[1/] See text with reference to Zalles (2019). Historically, around 20% of agricultural land expansion involves deforestation, so the 0.10% potential would imply 0.02% if realized at the historical rate of land repurposing versus expansion.

## Final Observations

Overall, we find that the EMFTA results in a limited change in trade flows between Switzerland and the MERCOSUR countries, and so also in underlying production patterns. This is because in most sectors the EMFTA involves commitment to maintain existing preferences that Switzerland grants to the MERCOSUR countries under the Generalized System for Preferences for developing countries, while quotas under the agreement reflect current levels of imports. As a consequence, the environmental impacts of the agreement are relatively minor as well. Estimated changes in GHG emissions for the world as a whole are insignificant, with adjustments in the rest of the world serving to offset roughly half of the Swiss-MERCOSUR increases that follow from the agreement. At the same time, there are some sectors (for example textiles) where changes in market access conditions are more substantial. However, even in these cases the environmental impacts prove to be limited. Earlier concerns, especially related to meat production and trade, have essentially been addressed under the terms of the EMFTA by limiting the concessions to the consolidation of current market access for these products.[2] The fact that output changes in resource intensive sectors generally range at well below +/- 0.2 percent means that we identify little pressure on resource-based sustainability issues. Because Swiss exports benefit from expanded market access to MERCOSUR, in particular for manufactured goods, this translates into increased manufacturing production in Switzerland that generates relatively minor overall environmental effects linked to Swiss economic activity, as detailed in the report.

The combination of CGE modelling and complementary MRIO-based value chain analysis provides a top-down assessment of the impact of the EMFTA. However, it does not in itself identify flanking measures that might be taken, nor does it provide a more micro or detailed (bottom-up) picture for specific products. In the present context, such an analysis should be sufficient. This is because in most sectors the EMFTA involves commitment to maintain existing preferences, including agri-food quotas. The consequent trade and output effects are therefore quite limited, which translates into equally limited potential environmental impacts. Had the EMFTA led to more substantial changes vis-à-vis current market access conditions and consequently generated substantial changes to trade and production patterns, this sector-specific environmental impact and risk assessment could have been followed up by more detailed product-specific analysis to better identify risks and potential flanking measures.

[2] This contrasts with valid concerns about more substantial changes in market access for food and agriculture in the case of the EU and MERCOSUR, which does have serious implications for greenhouse gas emissions, deforestation, biodiversity, and a range of related sustainability impacts (cf. LSE 2019). It is the more limited changes in market access for these same sectors in the EMFTA case that limits the effects to being relatively minor.

# 1 Introduction

## 1.1 Overview of the Mandate

In August 2019, the European Free Trade Association (EFTA) made an announcement that the EFTA Member States had reached an agreement in substance with MERCOSUR on a relatively comprehensive EFTA MERCOSUR free trade agreement (EMFTA). Negotiations had been running in parallel with EU-MERCOSUR negotiations on a comprehensive trade agreement, with the provisional EU-MERCOSUR deal concluded in June 2019. Indeed, the Swiss announcement on the EMFTA references the EU agreement directly as a motivating factor.[3]

Neither the EMFTA nor the EU MERCOSUR agreements are without controversy. In both the EU and Switzerland, concerns raised by civil society involve a range of issues linked to both agricultural policy and sustainability.[4] In the case of the EMFTA, to some extent this reflects expectations that the agreement could have been more of an environmental agreement and less of an economic agreement.[5] Reflecting concerns about the sustainability impact of the actual agreement, per the underlying mandate, this study examines the potential environmental impacts of the actual EMFTA. Emphasis is placed on both the environmental impact of changes in Swiss economic activity, and changes in economic activity in the MERCOSUR countries (Argentina, Brazil, Paraguay, and Uruguay) following directly from implementation of the EMFTA. While there are very real and valid concerns about environmental conditions and protections in the MERCOSUR countries (as discussed in this report), these are not the primary focus of the treaty itself. Because the EMFTA is an economic treaty focused on what are known as *conditions of market access*, this means the treaty is focused on the rules governing access of MERCOSUR exports of goods and services to Switzerland, as well as the rules governing access of Swiss exports to the MERCOSUR countries. We examine the environmental effects of these changes in market access.

The present study, mandated by the Swiss State Secretariat for Economic Affairs (SECO) in June 2019, combines quantitative economic analysis of the EMFTA with an analysis of possible environmental impacts building on the economic analysis. Per the terms of reference (ToR) from SECO, this targeted environmental impact assessment is based on measure 7(a) of the reference framework of measures of the Report to the Swiss Federal Council “Green Economy - Federal

[3] See Freihandelsabkommen EFTA-MERCOSUR: Einigung in der Substanz, Der Bundesrat, https://www.admin.ch/gov/de/start/dokumentation/medienmitteilungen.msg-id-76159.html. The announcement notes: “The agreement also prevents trade relations with the EU to deteriorate, which concluded a free trade agreement with the MERCOSUR countries in the summer.” It also stresses the deep nature of the agreement with respect to market access and legal certainty, non-tariff barriers, trade facilitation, and trade and sustainable development.

[4] For example, see “Amazon burning: Petition handed in opposing Switzerland-MERCOSUR trade deal.” https://www.swissinfo.ch/eng/amazon-burning_petition-handed-in-opposing-switzerland-mercosur-trade-deal/45194216, August 2019. According to the Norwegian Economy Minister, "An important theme of the negotiations was the sustainable management of forests. Both sides committed themselves to fight illegal deforestation and protect the rights of the indigenous people" in the context of EMFTA negotiations.

[5] For example “Norway says EFTA-MERCOSUR pact has guarantees on Amazon forests,” the local.no, August 2019, https://www.thelocal.no/20190825/norway-says-efta-mercosur-pact-has-guarantees-on-amazon-forests.

measures for a resource-conserving, future-proof Switzerland" of 20 April 2016. The aim of this study is to assess the possible environmental consequences of the EMFTA both in Switzerland and in the MERCOSUR countries - as well as globally.

The mandate calls for a three-stage process. The first stage involves economic modelling of possible changes in trade flows and economic activity resulting from the EMFTA. To this end, we employ a computable general equilibrium (CGE) model of the world economy to quantitatively analyse the economic effects of the actual agreement.[6] Building on the modelling exercise, the second stage involves the mapping of the economic effects to environmental indictors for the identification of products and economic sectors of particular environmental relevance with respect to the modelled trade flows between Switzerland and the MERCOSUR countries. In the third and last stage, we conduct the environmental assessment based on the first stage modelling. This is based on the detailed analysis of environmentally sensitivity products and sectors identified in the previous stages, in combination with an analysis of how these map to a range of environmental concerns.[7] The analysis is based on available environmental indicators, tracked through estimates of cross border production linkages based on global value chain structures within a CGE model, combined with reference to parallel assessment from the ongoing EU study of the EU-MERCOSUR agreement (LSE, 2019). In addition to strict quantitative analysis, the mandate also calls for qualitative analysis where appropriate.

The report starts with an overview of how preferential trade agreements can impact the environment. This includes a short description of what FTAs are, how they directly affect bilateral trade and economic activity in the partner countries, and how these changes in economic activity are linked to environmental impacts. This is followed by a description of the model and data used for the analysis, followed in turn by a discussion of likely environmental effects.

[6] See Rojas-Romagosa (2020) on the use of modelling in EU SIAs, as well as Laedre *et al.* (2015), the European Economic and Social (2011), European Commission (2016), and LSE (2019).

[7] These environmental indicators follow both the terms of reference and the approaches followed in the ongoing EU-MERCOSUR assessment (LSE, 2019).

# 2 Linking FTAs to the environment

Free trade agreements (FTAs) are pacts between two or more countries binding them to commitments to remove or reduce barriers to trade (and often to investment) between each other. An FTA can apply to all traded goods and services or just to a subset. There is a requirement, however, that FTAs for trade in goods between WTO Member States cover "substantially all trade."[8]

FTAs can and do vary substantially in terms of the sectors and policies they cover. While removal or reduction of tariffs on goods has traditionally been a core element of FTAs, more recent agreements tend to be deeper, covering non-tariff measures (NTMs) as well. Where NTMs impede trade and investment flows, the provisions of deeper FTAs are meant to reduce the costs of NTMs. Such measures can be both technical (for example heterogeneity in the application of sanitary or phytosanitary requirements, or in certification of technical requirements), and non-technical (such as import quotas, export subsidies, public procurement preferences, and differential treatment of intellectual property rights). Critically, FTAs can also include provisions linked to NTMs that are as much public policy as trade policy. For example, the EMFTA includes *inter alia* specific commitments with respect to domestic environmental laws, policies and practices. They are meant to preclude the weakening of environmental protection provided by domestic law and regulation to take advantage of market access under the agreement. These provisions are found in every trade agreement concluded by EFTA since the FTA with Hong Kong in 2011.

Notwithstanding explicit environmental provisions that may be found in FTAs, their main effects are driven by changes in conditions for market access (or changes in costs linked to barriers to selling goods in a foreign market). With an FTA, barriers to market access are reduced across a range of sectors by all signatory countries. These reductions trigger what are called general equilibrium effects, whereby in some sectors competition from the partner country implies a reduction of output in the sector, while in other sectors there will be an expansion of production supported either by more exports to the partner country, or by the supplying of inputs to other sectors that expand because of the FTA.

Important *scale effects* can also arise with changes in market access conditions (tariffs and regulatory barriers) under an FTA as resulting changes in trade costs drive changes in levels of economic activity across all industrial sectors. These are reflected in both changes in trade flows and changes in production volumes. The direct environmental effects of an FTA depend on how the resulting set of changes in economic activities across sectors (for example rising and falling output, and changes in demand for raw materials and energy) translate into environmental impacts. These include changes in energy use by industry (and so consequent emissions changes), changes in polluting activities, and changes in resource use (such as mining and land use). Changes in the composition of production, as opposed to the overall level, are discussed below.

[8] Because FTAs are generally discriminatory against third countries, they are also called preferential trade agreements (PTAs). In addition to FTAs, another form of preferential agreement is a customs union. Customs unions go beyond FTAs, in that the member countries agree to apply a common external tariff against outside countries. The European Union is an example of a customs union, while the European Free Trade Area is an example of an FTA.

FTAs can also lead to *composition effects*. The initial (first order) changes in trade and production generated by the trade-cost reductions in the agreement are then translated into general equilibrium (second order) effects. These include among others, domestic factor employment and production readjustments, as well as trade diversion effects with respect to third countries. These composition effects imply that economic activities that are not directly affected by the agreement, can nevertheless, be indirectly affected. From a global perspective, the indirect (trade diversion) effects also imply that increased bilateral trade between Mercosur and Switzerland will also change underlying multilateral trade flows (and supporting production patterns), and thus the net environmental effect of the agreement is conditional on how the new trade flows and associated production complement or substitute each other.[9] The quantitative general equilibrium analysis we use in this study provides a full picture of both these direct and indirect effects, both at the domestic as well as the global level. In particular, the quantitative computable general equilibrium (CGE) model is extensively discussed in the following section.

The increase in bilateral trade flows between two relatively far-away regions can also generate larger *transportation costs*, and hence, a larger environmental impact. These effects will also be determined by the overall trade diversion effects associated with the agreement. The CGE model we employ directly includes transportation margins and their associated emissions, by mode of transport (land, water and air) for all countries analysed. As such, the model also captures the transport-related emission changes from the agreement.[10]

Trade agreements can lower prices for cleaner technologies, and can also foster the diffusion and adoption of other *technologies* that can increase overall or sector-specific productivity. These effects are harder to assess quantitatively, and moreover, they also have direct and general equilibrium (indirect) effects. In the CGE model used here, we do not account for these technological effects. However, the analysis does take into account how the tariffs of environmental goods change with the agreement, and hence, we illustrate the potential increase of bilateral trade in these goods.

One example of particular importance in the public policy debate surrounding the EMFTA is the potential impact of the trade agreement on deforestation in the Amazon basin. If the agreement were to lead to a substantive expansion in beef production for example, without appropriate accompanying measures, there would be risk of increased deforestation. Whether this can be expected to actually happen depends on the changes in market access contained in the EMFTA for beef. On the other hand, the expansion of sugarcane could have a more indirect effect, by taking land from products that might otherwise move into forested areas (Kirkpatrick and George, 2009).

The next sections of this report are based on an empirical CGE model of global production and trade. The model is used to estimate economic effects from the EMFTA, and to map these economic effects into consequent environmental ones.

[9] For instance, there can be environmental benefits if the agreement enables consumers and producers to switch to relatively cleaner international suppliers.

[10] Transportation, however, has been shown to have a very limited climate impact (Frischknecht *et al*. 2018, Poore and Nemecek 2018).

# 3 Methodology

In this chapter we outline the methodology employed to conduct the environmental impact assessment (EIA) of the EMFTA.

## 3.1 General description of the three-step process

We follow closely current practice as followed in the trade sustainability impact assessments (SIA) for the European Commission (EC, 2016b). The trade SIA methodology itself has evolved over 20 years of EC SIA studies.[11] The core of the more quantitative stage of the trade SIA methodology is a three-stage approach that combines: i) a large-scale economic model of the global economy; ii) the estimation of the economic effects of the agreements together with the identification of the most relevant products and sectors; and iii) a detailed environmental assessment that is based on the estimated economic impacts and identified relevant sectors.[12] This approach is grounded in the fact that, by definition, FTAs are themselves large trade-enhancing mechanisms that primarily affect economic variables, and the primary environmental impacts of the FTA are directly and indirectly related to these changes in economic activity. In other words, the environmental effects are a consequence of the scope and force of the economic effects of the FTA on trade and economic activity.[13]

In the first step of the analysis, we employ a large-scale computable general equilibrium (CGE) model of the global economy to estimate the overall economic impact of the EMFTA, including sectoral and macroeconomic effects, on the different countries involved in the agreement, as well as third countries. The model itself is described below in the next subsection, with a more technical overview in the technical annex (Annex I). In the second step of the process, we identify products and sectors that are relevant for the analysis based on expected environmental impacts, combined with information on initial bilateral trade volumes and changes in trade costs. In the third and final step of the analysis, the CGE sectoral and macroeconomic effects are translated into environmental impacts along various dimensions. In a first dimension, the CGE model directly estimates changes in sectoral output driven greenhouse gas (GHG) emissions and air pollutants for the countries involved and for the global economy as a whole. Second, the output and trade changes for particular activities that are environmentally sensitive —such as land use in agriculture, forestry, fishing and mining activities— are analysed to assess possible

[11] This SIA methodology has been updated and revised since the initial SIA studies started in 1999, there have been around 30 SIA studies conducted by the EC to date and the EC has written two editions of the SIA methodological handbooks (EC 2006, 2016b). For a critical overview of the methodology and its evolution over time, see Rojas-Romagosa (2019). See for example, LSE (2019) for the ongoing SIA for the EU-MERCOSUR agreement.

[12] In contrast to the sustainability impact assessments from the European Commission, per the mandate for this study this report does not address broader issues of the potential social and political impacts of the FTA, nor has there been a wide-ranging consultation process. This analytical delimitation was clearly established in the scope of the public tender. See the discussion of the project mandate in the introduction. As such, the current report falls into a category between an EC inception report and an interim report, where the economic and environmental effects of the trade agreement are analysed, but are not complemented by an extensive public consultation process nor by offering suggestions regarding flanking institutional measures or changes to the core text of the agreement based on such consultations.

[13] In contrast, the Paris Climate Agreement, for example, deals directly with greenhouse gas emissions and other climate issues, and these climate policies will in turn, affect economic activity.

environmental impacts linked to changes in these particular activities. The third and last dimension of the environmental impact assessment is more qualitative flanking analysis of how economic and legal provisions in the FTA may lead to environmental effects. This includes, for example, the reduction of tariffs for goods classified as environmentally relevant goods during negotiations for an Environmental Goods Agreement.

In the next section, we provide an overview of the CGE model used on our analysis, the identification of environmentally sensitive products, and the specific trade costs reductions associated with the EMFTA. An extended explanation of the model and the FTA scenario, together with more technical details of the analysis are presented in Annex I of this report.

## 3.2 The CGE model

In the first step of the impact assessment, we use a CGE model of global world trade to estimate the economic effects of the FTA.[14] The CGE model is a large-scale economic model that translates the expected trade costs reductions from the FTA (i.e. tariffs, costs related to non-tariff measures, and quotas) into economic effects at the national and global levels. The estimated economic effects include detailed information regarding changes in values, quantities and prices for domestic activities and associated trade flows. Given the general equilibrium nature of these models (meaning that sectors interact through both supply linkages and factor markets), complex interactions are captured in the model. In particular, the model simulates the changes in specific economic activities (sectors) that result from the trade cost reductions resulting from the FTA. This is important, as the combined impact of all policy changes from an FTA will not be the same as if we examined each set of sector policies in isolation.

In general, a CGE model consists of three main elements. The underlying general equilibrium economic model, the multi-regional input-output data, and a set of exogenous parameters and variables (i.e. elasticities that determine the endogenous reactions, as well as policy variables). The combination of these three elements yields a general equilibrium (calibrated) baseline in which all the accounting and market clearing conditions are met. Policy experiments consist of a shock to one or more exogenous variables (e.g. tariffs or quotas) that generate changes in the prices and quantities of the endogenous variables such that a new general equilibrium is reached (the counterfactual scenario). The behavioural equations in the economic model determine how the endogenous variables react, while the underlying baseline data and the exogenous parameters (i.e. the various elasticities in the model) determine the size and scope of the adjustments. To evaluate trade policy changes, such as the implementation of a free trade agreement the baseline (business as usual) scenario with no policy effects is compared to the counterfactual scenario that includes the changes in trade policy. The effect of the policy change is then quantified as the difference between the two. For the CGE modelling framework to allow for economy-wide analysis across all sectors, it employs a balanced and internally consistent global database (in this case GTAP version 10 database) of all trade and production across countries and industries, including trade in intermediate goods. The GTAP database is a global multi-regional input-output (GMRIO) database that has extensive and comprehensive economic data for 140 countries/regions and 65 production sectors. The GTAP database provides disaggregated data for sectoral production, consumption, taxes and subsidies, trade,

[14] See the Annex I for more technical and a detailed description of the CGE model employed in the study.

government finances, labour variables for different skill levels, and data on other production factors. For documentation on the current version of the database see Aguiar *et al*. (2019). These data feed into the computational model that describes the economic activity for the sectors and agents in the dataset.

Our model has a micro-founded theoretical trade model based on the Eaton and Kortum (2002) model. It is a structurally-estimated model, which means the trade elasticities and non-tariff measures are taken from econometric estimations based on the underlying data that are later used in the model.[15] The model directly estimates changes in several greenhouse gas emissions –and not only $CO_2$ emissions as in standard CGE models—together with changes in other air pollutants. This allows us to directly quantify the effects of the EMFTA on all potential GHG emissions.[16] The atmospheric pollution indicators in the model include both greenhouse gas (GHG) and non-greenhouse gas (NGHG) emissions. These are listed in Table 1. Benchmark GHG emissions data cover $CO_2$, $CH_4$, $N_2O$, and fluorinated gases. They are derived from IEA and FAO data (various releases), the methane and $CO_2$accounts data from Fernandez-Amador et al (2017, 2019), and GTAPv10 satellite accounts data, and are reported as $CO_2$metric ton equivalents for non- $CO_2$ GHG emissions. (See Fernandez-Amador for discussion on conversion rates). The NGHG data cover atmospheric emissions of black and organic carbon compounds, carbon monoxide, atmospheric ammonia, non-methane volatile organic compounds (short and long cycle), nitrogen oxides, $SO_2$, and particulate matter 10 micrometers or less in diameter and 2.5 micrometers or less in diameter. The NGHG indicators cover important contributors to smog and acid rain, tropospheric ozone depletion, degradation of human health, and damage to sustainability of agricultural and ecosystems. They are derived from GTAP satellite accounts data (Ahmed et al. 2014; Burcu Irfanoglu and van der Mensbrugghe 2015; Baldos 2017; and Chepeliev 2018).

The CGE model computes changes in the allocation of activities, intermediate inputs, labour, and natural resources across sectors and regions resulting from a policy shock, here the entry into force of EMFTA. Our data about GHG emissions and pollutants are used to compute changes in emissions resulting from this set of allocation changes, assuming that emissions are proportional to the level of the associated activities. Benchmark data are updated alongside core economic baseline projections, with projections (and with some technical progress included for baseline GHG volumes) based on the IPCC SSP2 baseline and the technology coefficients of the CGE model (O'Neill et al. 2017, Riahi et al. 2017, Samir and Lutz 2017, Bekkers et al. 2018). This modelling of changes in emissions is based on an explicit functional mapping from our emissions and pollution data to specific aspects of production such as energy use, land use, and intensity of value added by sector, which in turn are tied to levels of emissions and resource use. The mapping between the economic model and quantitative model-based environmental indicators is summarised in Table 1. In the table, the third column labelled "model drivers" indicates the economic variables in the model linked to environmental outcomes (for example changes in GHG emissions are linked to changes in energy use by firms and households, as well as production and resource use).

[15] For further technical details regarding the CGE model and the structural estimation of trade elasticities and NTMs, see Annex I.

[16] Hence, the CGE model employed in this report is more advanced and richer than the standard CGE models used in recent SIA's conducted by the EC that only report CO2 changes. For example, with respect to the CGE model employed in past and current EU-MERCOSUR reports (Kirkpatrick and George, 2009; Copenhagen Economics, 2011; Joint Research Center, 2011; LSE Consulting, 2018, 2019). For technical details beyond the annex, see Bekkers *et al*., 2019).

For each of these, functional equations in the model directly link relevant activity changes with associated emissions changes.

To illustrate how the results of the modelling exercise are generated and reported, Figure 1 shows how the simulation results (i.e. the counterfactual) compare with the simulated baseline values. In the right-side panel in the figure, curved line $A$ represents the baseline trend for economic activity indicator Q (for example production of steel in Brazil), while line $B$ represents the evolution of that same economic activity following a trade policy shock (for example from the EMFTA). The left-side panel then provides a mapping from the same economic activity (in our example, production of steel in Brazil) to environmental impact (for example $CO_2$ emissions associated with different levels of steel production in Brazil), represented by curved line *C*. Our modelling results are reported as the numerical difference or percentage change represented by moving to $B$ with respect to the baseline values $A$. In Figure 1, the full economic effects from implementation of the FTA are realized along the baseline between the year of signature and the year of analysis (in our case 2040).

*Table 1 Model Based Environmental Indicators*

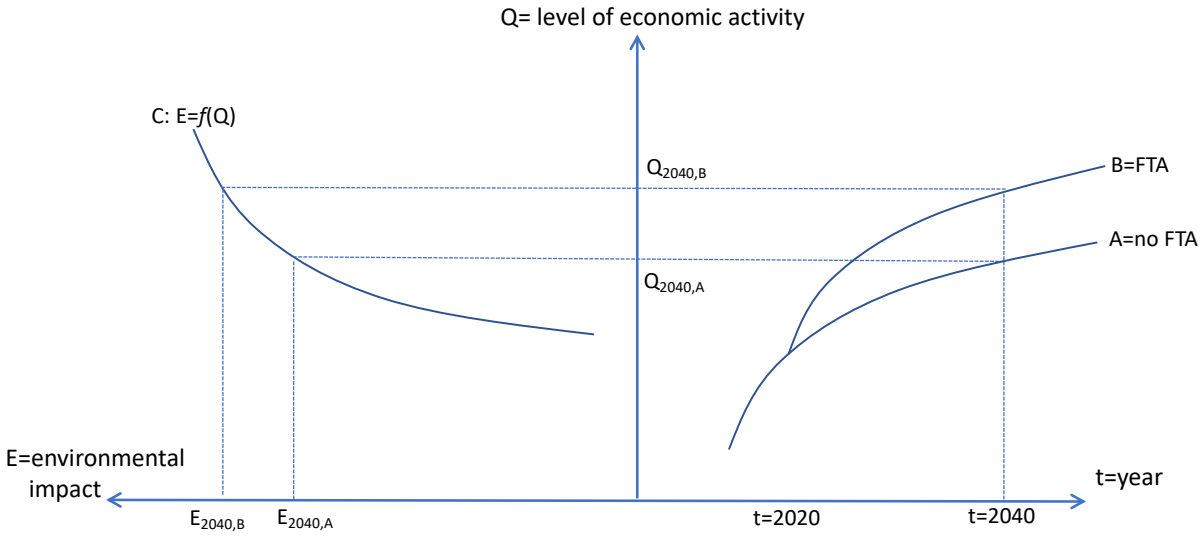
| category | | model drivers (changes) | units | outcomes |
|---|---|---|---|---|
| Greenhouse gas emissions | | | | |
| $CO_2$ | carbon dioxide | firm energy use, production, primary factor use, household energy use, transport | MT $CO_2$ | A |
| $N_2O$ | nitrous oxide | | MT $CO_2$-eq | A |
| $CH_4$ | methane | | MT $CO_2$-eq | A |
| FGAS | fluorinated gases | | MT $CO_2$-eq | A |
| Air pollution | | | | |
| BC | Black carbon | firm energy use, production, primary factor use, household energy use | Gg | D |
| CO | Carbon monoxide | | Gg | D |
| $NH_3$ | Ammonia | | Gg | D |
| NMVB | Non-methane volatile organic compounds (short cycle carbon) | | Gg | D |
| NMVF | Non-methane volatile organic compounds (long cycle carbon) | | Gg | D |
| NOx | Nitrogen oxides | | Gg | D |
| OC | Organic carbon | | Gg | D |
| $PM_{10}$ | Particulate matter 10 | | Gg | D |
| $PM_{2.5}$ | Particulate matter 2.5 | | Gg | D |
| $SO_2$ | Sulphur dioxide | | Gg | D |
| Resource use | | | | |
| FLAND | Forest land, use intensity | primary factor use, changes in production intensity | %, (inputs per ha) | B,C,H |
| GLAND | Grazing land, use intensity | | %, (inputs per ha) | B,C,F |
| ALAND | Agricultural land, use intensity | | %, (inputs per ha) | B,F |
| MNG | Mining intensity | | %, (inputs per ha) | B,E,F,G,H |

Note: A atmospheric pollution (greenhouse gas emissions); B land use and protection of forests; C wildlife and biodiversity; D air pollution; E water pollution; F soil fertility and contamination; G toxic chemicals; H mineral and other natural resources.

Sources: Ahmed *et al*. (2014), Burcu Irfanoglu and van der Mensbrugghe (2015), Baldos (2017), Chepeliev (2018), Fernández-Amador *et al*. (2017, 2019); Schwietzke *et al*. (2016); GTAPv10; various IEA releases. Projections and updates based on SSP2 and the technology coefficients of the CGE model (O'Neill *et al.* 2017, Riahi *et al.* 2017, Samir and Lutz 2017, Bekkers *et al*. 2018). Note: MT stands for million tons.

Between the time of signature and full implementation, there is an adjustment period where different sectors are expanding/contracting reflecting the new relative prices (and comparative advantages) resulting from the trade cost changes in the FTA. Labour (jobs) also shifts between sectors accordingly. Our estimates are "long-run," meaning implementation and its effects are fully built into new (post-FTA) trend values. The changes in environmental indicators are based on the mapping (from our data and the model) of changes in economic activity into changes in associated environmental impacts (represented in the figure by the change from point $E_{2040,A}$ to $E_{2040,B}$ along line *C*. We report the values as changes with respect to the reference year (2040). While we have shown and discussed impact in a particular sector here with respect to Figure 1, for a particular indicator, in reality the same type of changes in economic activity map to changes in environmental indicators, not only for the countries in the EMFTA, but in other countries as well affected by the agreement. In some cases, the environmental impact will run in one direction (e.g. a rise in $CO_2$ emissions in a sector in one country), while in others it will run in the other direction. We work with a multi-country, multi-sector to model to capture this range effects across countries and sectors. The net effects are then the combination (the sum) of these changes across sectors and countries.

*Figure 1 Changes in Environmental Indicators Following from Changes in Economic Activity*




## 3.3 Alternative modelling with endogenous land use

Our main model specification assumes that land use (and other endowments in the economy) are fixed, and hence an increase in the demand for land (as a production factor) can only be met by a more intensive use of existing agricultural and arable land. However, in the case of MERCOSUR and in particular Brazil, which has large forests areas, it could be the case that increased demand for land is met by cutting down existing forests to increase the agricultural land area. The resulting deforestation can thus create serious environmental impacts that should be considered. Therefore, as an alternative to our main model specification, we also run a version

of the model modified such that the amount of land used in production is endogenously determined by changes in the demand for land. In this modified version of the model, the economic rent earned by land (its price) is fixed, demand for new land use is met by an increase in agricultural land area instead of the intensity of existing land use. As such, our main model has one extreme possibility (land area is fixed and land rental prices absorb all demand changes), while this alternative model presents the other extreme (all increased demand for land is met by an expansion of land use while land rental prices remain fixed). In reality, the expected effect should be between these two extremes: increased demand for land use can be met by a combination of more intense and/or specialised use of existing land, and an expansion of the agricultural and arable land areas.

This alternative model relies on a land supply curve defined over a price-elasticity. To parameterize this modified model, we rely on the overview on estimated land supply elasticities from a recent study by the Joint Research Centre (JRC) of the European Commission (Tabeau *et al.*, 2017). The study reviews existing elasticities from a large number of studies for different countries and regions, using different data sources and methodologies. For the MERCOSUR countries, the elasticities they chose for their CGE modelling range from 0.12 for Brazil to 0.68 for Argentina. We use a land supply elasticity that weights these country-specific elasticities by the agricultural land area (taken from the World Development Indicators of the World Bank), resulting in a land supply elasticity of 0.319 for the region.[17] This value is above the world average and reflects the increased land expansion possibilities in these countries —in particular, Brazil and Argentina— when compared to the rest of the World.[18]

The survey by Tabeau *et al.* (2017) also finds that statistical data on agricultural areas show very limited increases in land areas for the majority of countries (or even reductions after 2000), while agricultural value added per unit of agricultural area have increased significantly. The large increases in land use in Argentina and Brazil due to increase production of commodity crops (i.e. soybean, sugarcane, cotton, and corn) in response to international demand (mainly from China) are a special case. Zalles *et al.* (2019) is the most recent and scientifically sound study of agricultural land use in Brazil to date. They use Landsat data to create a comprehensive and national-scale record of yearly land cover changes related to cropland expansion in Brazil.[19] Zalles *et al.* (2019) find that land use for crops in Brazil almost doubled between 2000 and 2014. However, this same study also finds that 80% of this increase was achieved by switching of agricultural land, changing land use from previous pastures to new crops (through land intensification of beef production). The remaining 20% of the agricultural expansion was done through deforestation, when taking three or fewer years of pasture transition period into account. Similar results were found by Elobeid *et al.* (2011), where the increase in ethanol demand expanded the production of sugar cane in Brazil and the increased production was also

[17] For sensitivity analysis, we have also used a higher elasticity of 0.5.

[18] On the other hand, this elasticity values are much higher than those employed for Brazil in previous studies. For instance, Al-Riffai *et al*. (2010) employ an elasticity of 0.035 for Brazil, while the MIRAGE model by CEPII employed elasticities between 0.01 and 0.05 (Laborde and Valin, 2012). Note that we assume that land use can only expand in the MERCOSUR countries and land use is fixed for all other regions in our model.

[19] Previous studies, for instance, Boerema *et al.* (2016), find that deforestation has accounted for more than half of land use expansion in Brazil and 20% in Argentina. However, they do not have nation-wide coverage for either country and their methodology has important limitations and inaccuracies.

largely met by changes and intensification of use of exiting land. This finding that increased land use in Brazil is primarily achieved through repurposing of existing agricultural land, instead of deforestation, suggests that our main model – with fixed agricultural land and higher land intensity use – is closer to reality than the alternative model where land use is expanded and land intensity is fixed. Nevertheless, we also report on this alternative specification of land use in our core model as it provides complementary information on how the EMFTA can potentially affect future land use and deforestation for the MERCOSUR countries. We map changes in land use that are obtained from this alternative model to data on agricultural and arable land areas taken from the World Bank's World Development Indicators,[20] while annual deforestation rates for MERCOSUR countries are taken from the UNSD Environmental Indicators.[21]

## 3.4 Identifying and benchmarking relevant model sectors

One final step in model construction is the definition of the sectoral aggregation to be employed. By this, we mean the specification of sectors and regions for the analysis. The underlying multi-regional input-output (MRIO) data used in the CGE model is taken from the GTAP database,[22] which has 140 countries (or regions) and 65 sectors. The aggregation process identifies those sectors that will receive detailed analysis (within the limits of the global dataset). In other words, this stage of model construction determines those sectors (starting from the underlying 65 sectors) that are to be analysed independently, and those that are instead aggregated into broader sectors. This selection is based on the current bilateral trade values between Switzerland and MERCOSUR, the trade cost reductions for particular products (and their respective economic sectors), the emissions profiles of individual sectors, and other aspects of environmentally sensitive products (for example from the ongoing EU SIA, see LSE 2019). In this section we describe this process, and provide some environmental benchmarking of the resulting sectors in terms of GHG emissions and their relationship to Swiss-MERCOSUR trade flows. We then examine changes in these GHG emissions, in relation to trade flows, as part of the analysis of the EMFTA itself.

The end result of the sector selection process is that we keep 35 of the original 65 GTAP sectors while the remaining 30 sectors are aggregated into 8 additional sectors.[23] These are listed in Table 2. In total we work with 43 sectors in our CGE model and in the resulting economic analysis. In general, we focus on detailed manufacturing sectors, mining activities, and in particular on agri-food sectors (e.g. bovine cattle, meats, oil seeds, dairy products and other food products that represent high deforestation risks). Most services sectors, on the other hand, are aggregated, since these sectors are not expected to have large environmental impacts.

[20] http://datatopics.worldbank.org/world-development-indicators

[21] https://unstats.un.org/unsd/envstats/qindicators.cshtml. The most recent version of these data cover deforestation for the period 1990 to 2015.

[22] Version 10 with base year 2014 (see Aguiar *et al.*, 2019).

[23] See Annex I for a list of the particular sectors and further details on the selection process.

Table 2 Model Sectors for CGE-based Analysis

| no | short name | name | no | short name | name |
|---|---|---|---|---|---|
| 1 | wht | Wheat | 23 | rpp | Rubber and plastic products |
| 2 | v_f | Vegetables, fruit, nuts | 24 | nmm | Other non-metallic minerals |
| 3 | osd | Oil seeds | 25 | i_s | Ferrous metals |
| 4 | ctl | Bovine cattle, sheep and goats | 26 | nfm | Non-ferrous metals |
| 5 | frs | Forestry | 27 | fmp | Fabricated metal products |
| 6 | pry | Other primary | 28 | ele | Computer, electronic and optic |
| 7 | oxt | Other mining extraction | 29 | eeq | Electrical equipment |
| 8 | eny | Energy (extraction based) | 30 | ome | Machinery and equipment nec |
| 9 | cmt | Bovine meat products | 31 | mvh | Motor vehicles and parts |
| 10 | omt | Meat products nec | 32 | otn | Transport equipment nec |
| 11 | mil | Dairy products | 33 | omf | Other manufactures |
| 12 | vol | Vegetable oils and fats | 34 | uty | Utilities |
| 13 | prs | Processed rice and sugar | 35 | trw | Trade and warehousing |
| 14 | ofd | Food products nec | 36 | otp | Land transport |
| 15 | b_t | Beverages and tobacco products | 37 | wtp | Water transport |
| 16 | tex | Textiles | 38 | atp | Air transport |
| 17 | wap | Wearing apparel | 39 | cmn | Communication |
| 18 | lea | Leather products | 40 | fir | Finance, insurance & real estate |
| 19 | lum | Wood products | 41 | obs | Other business services |
| 20 | ppp | Paper products, publishing | 42 | raf | Recreation, accommodation, food |
| 21 | chm | Chemical products | 43 | osv | Public Administration and defense |
| 22 | bph | Basic pharmaceutical products | | | |

The selection and identification of the sectors in the model is based on three characteristics: i.) the initial (current) bilateral trade flows between Switzerland and the MERCOSUR countries; ii.) the trade costs reductions (regarding tariffs, tariff-rate quotas and/or NTMs) that where negotiated in the trade agreement; and iii.) the environmental relevance of these products/sectors throughout their value chain, which is based on embodied emissions generated by these products through their production, use as intermediate inputs, and final production and consumption, in addition to other environmental sensitivities. The last point means we also pay special attention to those activities that represent high deforestation risks related to agriculture, mining and/or energy operations.[24]

These characteristics determine how likely the EMFTA is to affect the economic activities related to these sectors, and second, how changes in these economic activities may impact the environment in both Switzerland and/or the MERCOSUR countries. For instance, products that are environmentally sensitive and where we expect increases in bilateral trade due to the provisions in the EMFTA, will be linked with potential significant environmental effects. In these cases, increased trade is associated with increased economic activity (i.e. production and consumption) that may magnify the environmental impact of these products. On the contrary, a product is not considered to be sensitive if it is currently not traded bilaterally, or has very low

[24] Furthermore, other environmental dimensions are also considered. For example, those related to environmental regulations surrounding the products life-cycle, exchanges in green technology related to environmental goods, as well as other environmental risks related to air, water and/or land pollution, waste and chemical hazards, among others.

trading levels, and there are no substantial trade costs reductions for these products in the negotiated EMFTA that might increase the current traded volumes. In these cases, even though these products might have large potential environmental impacts in and of themselves, given that the EMFTA is not foreseen to create changes in the trade and production activities associated with these products, then accordingly, no environmental impact is expected from these products directly because of the EMFTA. The exception is that while output from some sectors is not directly traded (or is traded very little), it may be indirectly traded in that it provides domestic value added that is included in downstream export sectors. As such, we have examined both emissions linked to production direct trade, and emissions linked to indirect trade through downstream linkages. We explain this concept further in the box. In the model-based assessment that follows, it is important to remember that the general equilibrium nature of our economic model assures that we are considering both the direct effects of the agreement, but also the indirect effects through intermediate input demand (i.e. value chains) and consumption changes generated through changes in wages and other household incomes.

In the sector selection process, the initial bilateral trade values and volumes are taken from the GTAP database,[25] augmented with updates based on Swiss and MERCOSUR trade data. Potential trade costs reductions are based on product-line (HS-8) EMFTA tariff and TRQ reductions (provided by SECO), combined with GTAP level gravity model NTM-based trade cost reduction estimates. This information allows us to determine which products/sectors are likely to be most affected by the EMFTA and how large the expected trade effect might be based on current traded levels and the size of the trade cost reductions. In selecting sectors, we also considered other recent MERSOSUR-related studies (within the sector constraints of out CGE data). Table 3 presents the relevant sectors identified by these other Mercosur-related studies. Here we find that, with the exception of textiles, all the identified sectors are agricultural or food sectors. Indeed, all of the sectors identified in these studies can be mapped to our model sectors listed in Table 2, in particular to: wheat; Vegetables, fruit, nuts; Oil seeds; Dairy products; Bovine meat products; Meat products nec; textiles; and Processed rice and sugar.[26]

*Table 3 Relevant sectors/products in other recent studies*

| **EU SIA (LSE Consulting 2018,19)** | **Frischknecht *et al.,* 2018** | **Alig *et al.,* 2019** |
|---|---|---|
| Bovine meat | Soybeans | Bovine meat |
| Other meat | Rice | Sugar |
| Vegetables, fruits, nuts | Coffee | Cereals |
| Oil seeds | | Oil seeds |
| Cereals | | |
| Dairy | | |
| Textiles | | |

[25] We complement these data with Swiss import data from MERCOSUR taken from the Swiss Federal Customs Administration (FCA) and with Swiss export data taken from COMTRADE. Both data are from 2014 so it matches the base-year of the GTAP-10 database.

[26] All processed coffee (including roasted and/or decaffeinated) is in the sector Other food products (ofp), while strictly raw beans under HS 090111 (beans that are unprocessed, so neither roasted nor decaffeinated), are in other primary products (pry), which includes the GTAP sector other agricultural products.

To determine the greenhouse gas impact of changes in the different sectors, we first establish GHG emission benchmarks based on the currently embodied carbon in trade flows between Switzerland and the MERCOSUR countries. These are calculated for $CO_2$, methane and other GHG emissions that originate in Switzerland or MERCOSUR countries, and which are embodied in both intermediate input and final production, as well as intermediate and final consumption. This general equilibrium analysis enables us to assess the impacts at different points in the life-cycle of each sector and its underlying products. This methodology is built upon a multi-region and multi-sector input-output analysis, which traces GHG emissions through national and cross-border value chains.[27] Box 1 presents a non-technical explanation of this type of analysis. The benchmarking was done for the latest GTAP database, and for the benchmark 2040 database.[28] The benchmark GHG emission serves two purposes. First, they flag sectors with potential environmental effects and second, they provide the emission data used in the CGE model. Moreover, we also flag environmental sensitive products identified in existing SIA studies for the EU-MERCOSUR FTA (Kirkpatrick and George, 2009; Copenhagen Economics, 2011; Joint Research Center, 2011; LSE Consulting, 2018, 2019).

Based on the GVC calculations of embodied resource flows (again see Box 1), Figure 2, Figure 3, Figure 4 and Figure 5 present the relative importance of our model sectors for $CO_2$ and $CH_4$ emissions. Two sets of calculations are reported in the figures. In the first, in Figure 2 and Figure 3, we show the relative importance of sectors in terms of the emissions embodied in direct flows. For example, from Figure 2, we can see that model sector 9, "CMT: Bovine cattle, sheep and goats" (essentially processed beef) is the most important in terms of $CH_4$ emissions contained in MERCOSUR exports to Switzerland, while model sector 26 "NFM: non-ferrous metals" is the most important in terms of $CO_2$ emissions contained in MERCOSUR exports to Switzerland. These measures of emissions embodied in exports include not only those generated directly by activity in a given sector when producing for export, but also the emissions from upstream suppliers that feed into downstream production for export. In the second set of calculations, in Figure 4 and Figure 5, we report instead on the full flow of emissions across global supply chains, including not only for example Swiss emissions embodied in direct exports to MERCOSUR, but also emissions to third countries that are then embodied in exports to MERCOSUR from those countries, after further processing of the associated intermediate goods. This second view of the data captures the full flow of resources from production through further processing to final production and consumption.

[27] In particular, we use the input-output methodology detailed in Francois *et al.* (2015b) and Fernández-Amador *et al.* (2016a, 2016b, 2017 and 2019) to map cross border embodied carbon flows by sector.

[28] The decision to make comparisons relative to a 2040 baseline was made because we can expect both the EMFTA and the EU-MERCOSUR agreement to be in place by that time. We can also expect associated environmental effects to be realized by that time. See the Annex I for further details on how these projections are modelled.

**Box 1: Measuring resource flows embodied in global value chains (GVCs)**

In recent decades, firms have developed increasingly complex supply chains that cross international borders. In the case of Switzerland, the global shift from strictly national suppliers to a mix of regional and global production networks means that production and consumption in Switzerland both embody resources that were extracted in other countries, while some of the emissions used to produce intermediate and final goods abroad are also embodied in the production of Swiss firms and the consumption basket of Swiss consumers. At the same time, firms and consumers abroad use both intermediate and final goods and services produced in Switzerland, meaning for example that some share of Swiss greenhouse gas emissions is ultimately embodied in the goods and services bought by Brazilian consumers. The fact that a significant part of global industrial production involves supply networks that cross borders means that when we quantify the relationship between national consumption and production patterns, on the one hand, and global emissions and resource use on the other, we need to take these linkages into account. Typically, this involves either firm level detailed supply chain analysis, or industry level analysis with what are called multi-region input-output (MRIO) data. MRIO analysis employs data on how, for example, German vehicle production uses machinery parts from Spain made with steel from Poland. The advantage of MRIO analysis is that the methodology avoids double counting of resource flows, while also following the flow of resources through complex value chains (across industries and borders) to final production and consumption.

In this study, we use MRIO methods to trace the emissions associated with economic activity in MERCOSUR that ultimately end up embodied in both Swiss production and consumption, as well as Swiss emissions embodied in production and consumption in MERCOSUR. The methods employed in MRIO analysis ensure that this is done without double counting. Because the analysis is done across industries, we are also able to both identify the sectors where those emissions originate (for example MERCOSUR emissions from metals production embodied in Swiss consumption), and to decompose emissions embodied in traded goods and services across sectors (for example Swiss emissions embodied in Swiss exports of chemicals to Brazil). The MRIO accounting is based on the same data and consistent with the CGE analysis used to assess the impact of the EMFTA.

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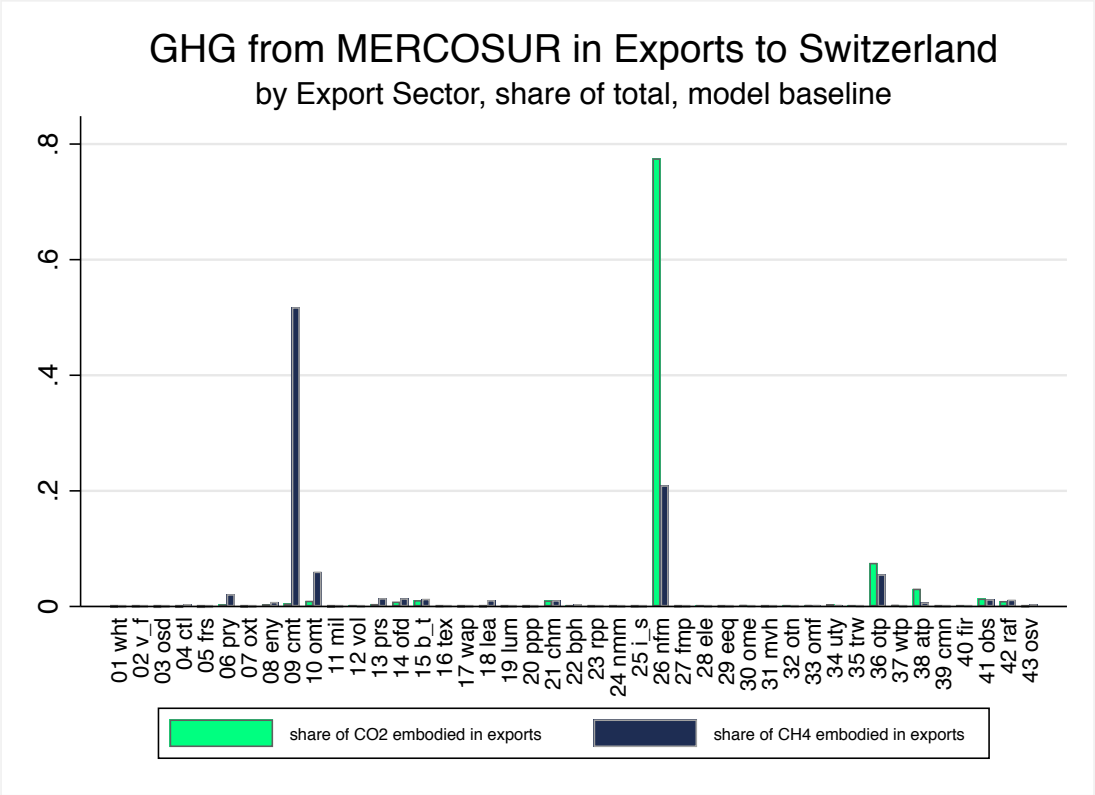
For further reading, see Fernandez-Amador *et al.* (2016, 2019) on global patterns of embodied $CO_2$ and methane emissions, Fernandez-Amador *et al.* (2014) on Swiss patterns of trade in embodied emissions, and Bems and Kikkawa (2020) and Timmer *et al.* (2014) on trade in value added along GVCs.

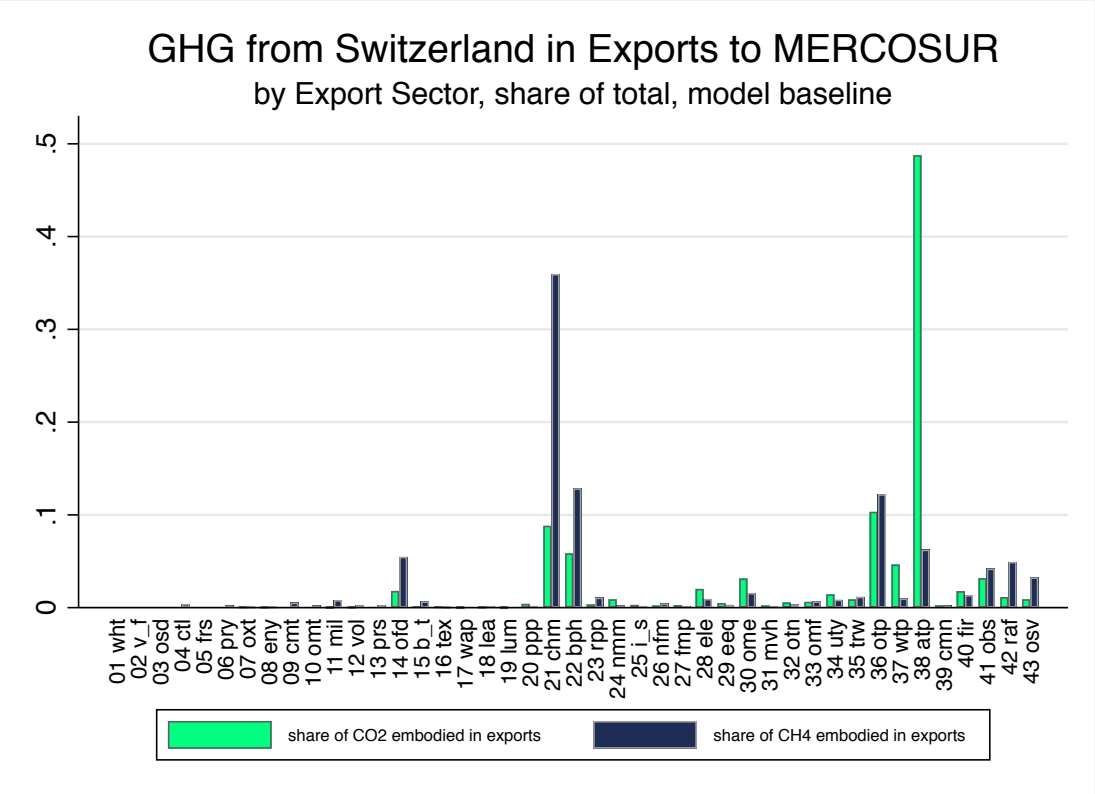
It provides an important perspective, involving the flow of activity-based sources of emissions, that both avoids double counting while also capturing, in the model-based analysis below, the potential cases where changes in resource use and emissions between EMFTA partners involve diversion from third countries to the EMFTA partners, rather than increased overall resource use or emissions. As an example of interpretation, from Figure 4, we see a major source of $CH_4$ from MERCOSUR contained in Swiss final production and consumption is the model sector 4 “CTL: Bovine cattle, sheep and goats” (essentially cattle), while relatively little $CH_4$ comes from direct activity in the meat processing sector itself. Taken together with Figure 2, this means that while model sector 9 "CMT: Bovine meat products” is a major channel for $CH_4$ emissions embodied in trade flows, these emissions originate in large part upstream in other sectors like the cattle sector. We will return to these GVC-based views of emissions patterns (and also pollution and resource use) when we examine the impact of the EMFTA below.

Figure 2: GHG emissions embodied in MERCOSUR exports to Switzerland, MRIO based



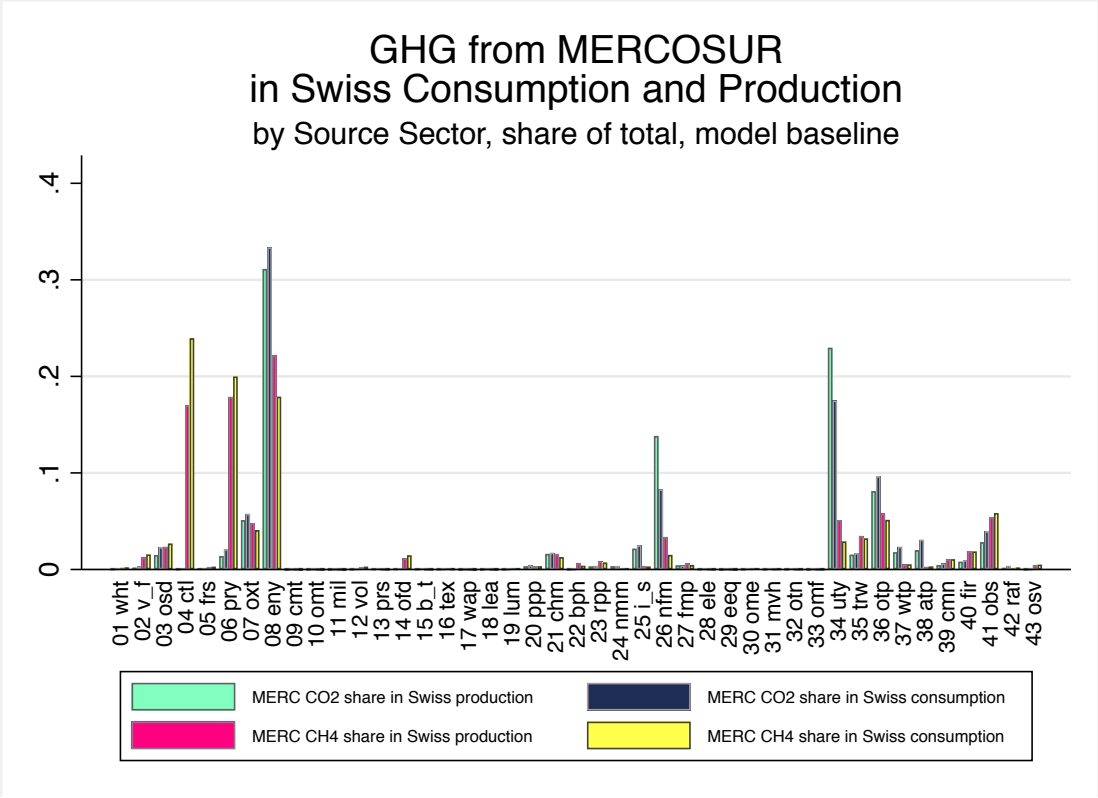

Source: Own calculations using GTAP.

*Figure 3 GHG emissions embodied in Swiss exports to MERCOSUR, MRIO based*



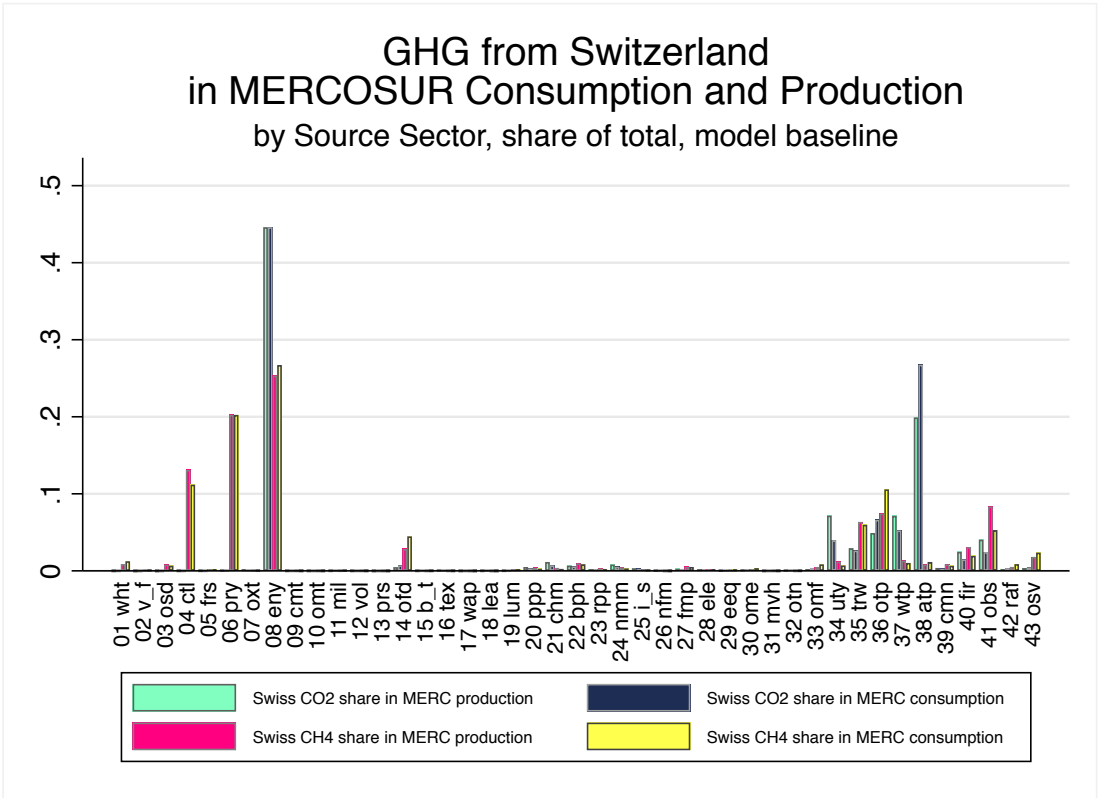

Source: Own calculations using GTAP.

Figure 4 MERCOSUR GHG emissions embodied in Swiss Output and Consumption, MRIO based




Source: Own calculations using GTAP.

*Figure 5 Swiss GHG emissions embodied in MERCOSUR Output and Consumption, MRIO based*




Source: Own calculations using GTAP.

## 3.5 Modelling the EMFTA agreement

The CGE framework, using the trade costs reductions associated with the negotiated EMFTA, estimates how these reductions are mapped to changes in bilateral trade flows, while at the same time estimating associated changes in economic activity. The general equilibrium nature of the CGE model, moreover, also provides the changes in multilateral trade (i.e. trade diversion effects), and how the initial changes in economic activity by sector affects demand for primary factors of production (i.e. the demand for different labour types, capital, land and natural resources) and the demand for intermediate inputs from other sectors. These changes in sectoral trade, output and factor demand are then translated into macroeconomic income, production and consumer demand changes. All of these are estimated simultaneously to capture the combined impact of changes in market access conditions across multiple sectors.

To define changes in market access for the modelling exercise, we start with product-line (HS-8) information on preferential tariffs and TRQs from the negotiated agreement (provided by SECO). This information details the Most Favoured Nation (MFN) or Generalized System of Preferences (GSP) tariffs currently in place, and the preferential tariffs to be implemented within the EMFTA. Mapping these to detailed HS-6 based trade data, the tariff concessions are then aggregated from the product-line information to trade-weighted tariff changes at the model sector level. This provides us with the tariff margins under the EMFTA (the difference between current and negotiated tariffs), which are then implemented in the CGE model.[29]

It is important to recall that for many agricultural and food products, the main binding element in the negotiated agreement are the TRQs and not the tariffs. In particular, for Swiss imports of these products from MERCOSUR, the increases in the quotas are what is actually binding (i.e. changes in the tariff margin are not translated into changes in bilateral trade because volumes are governed by quotas). Furthermore, many of the TRQs in the agreement are consolidating (or formalizing) current access under MFN quotas currently in place. Most notably, the negotiated FTA does not increase the actual market access for bovine meats (i.e. beef), and entails only relatively minor export increases in sheep, lamb, chicken and pork meats. In total, the new quotas are just expected to increase the trade value of cattle and related ruminant meat products (sheep and lamb) by 3.9% overall, and the value of other meat products (chicken and pork) by 9.5%. In Annex I we detail how these values were obtained and we present the specific quota and tariff changes generated by the negotiated agreement. Other quota expansions provide increased trade opportunities for MERCOSUR exports to Switzerland, but these are usually from a low initial trade value (e.g. wheat, fruits and nuts, other agricultural products, dairy products and vegetable oils).

In the case of MERCOSUR imports from Switzerland, the EMFTA primarily provides tariff reductions on Swiss manufacturing goods. The tariff margin decreases are around 10 percentage points (see Annex I for the sector-specific decreases). In addition, we have estimated the potential decrease in trade costs associated with non-tariff measures (NTMs) implicit in the general provisions of the agreement. Such reductions in trade costs apply to trade in both directions. These reductions are associated with the institutional setting embedded in the EMFTA, which is a relatively deep agreement. The non-tariff provisions of the EMFTA can be

[29] The resulting sector-specific tariff changes are shown in Table 13 and Table 14 in Annex I.

expected to reduce market access uncertainties, and clarify and streamline trade-related procedures for different sectors and the firms trading in these sectors. This includes a mix of trade facilitation measures, behind the border mechanisms that ease trade flows or reduce current complying costs,[30] provisions that assure better or improved market access, property right protection, competition and investment opportunities, access to public procurement, and measures to liberalise trade in services. It also reflects provisions related to trade defence and dispute settlement mechanisms that reduce uncertainties for trading firms and investors.[31]

To measure the NTM-related trade-cost reductions expected from this particular FTA, we have employed what is called a top-down gravity-based econometric model to estimate these changes in trade costs, based on the trade impacts of previous FTAs, which are country- and sector-specific (i.e. we identify how similar FTAs signed by Switzerland and each MERCOSUR country have affected the trade volumes of the sectors we use in our CGE model). A detailed technical explanation and presentation of the estimates is provided in the Annex I. It is important to note, however, that even in sectors where we have estimated positive trade cost reductions from the agreement, if the negotiated quotas are binding in those sectors (i.e. trade volumes are effectively constrained by the quotas), then like tariff reductions, NTM-related cost reductions will not have an effect on bilateral trade volumes. In particular, this is important for Swiss imports of agricultural and food products, where all TRQs are binding.

Overall, given the nature of underlying tariffs and commitments, while the EMFTA does provide greater access in some specific sectors (like MERCOSUR exports of textiles and Swiss machinery exports), it is expected to have a minor overall impact on MERCOSUR exports to Switzerland. Critically, the negotiated TRQs in the agreement effectively constrain (or in some cases completely neutralise) any potential substantive overall increase in agricultural and food imports into Switzerland. However, the agreement does assure uninterrupted and certain market access for MERCOSUR exports, which are currently granted on a voluntary basis by Switzerland through the unilateral Generalized System of Preferences (GSP). Given that, for instance, the EU recently retired (withdrew) its GSP concessions to MERCOSUR (as they are considered to be middle-income countries), the lock-in of current Swiss GSP concessions as part of the EMFTA is an important achievement. On the other side, Swiss exporters will benefit from substantial reductions in the current tariffs for manufacturing products, while bilateral trade in services should benefit from moderate trade cost reductions associated with the NTMs provisions implicit in the terms of the EMFTA. Where they do apply, estimated reductions in NTM related costs (for example in services) apply to trade flows in both directions. The sector by sector estimates of changes in market access conditions under the EMFTA are presented in the Annex I.

[30] For example, the paperwork and administrative time required to comply with technical barriers to trade, and sanitary and phytosanitary measures.

[31] There is a large and growing literature that analyses the evolution, impact and measurement of NTMs in FTAs and how they affect trade overall. For a recent survey, see Francois and Hoekman (2019).

# 4 The estimated impact of the agreement

This section presents estimated results from general equilibrium modelling of the EMFTA. We first discuss the economic effects which is followed by discussion of the environmental effects. The results presented as estimated changes relative to projected baseline values in the year 2040 (see Figure 1 and related discussion above). While some of the estimated changes are presented in value terms and/or in million tons (MT), other changes are in percentage changes.

## 4.1 Economic effects

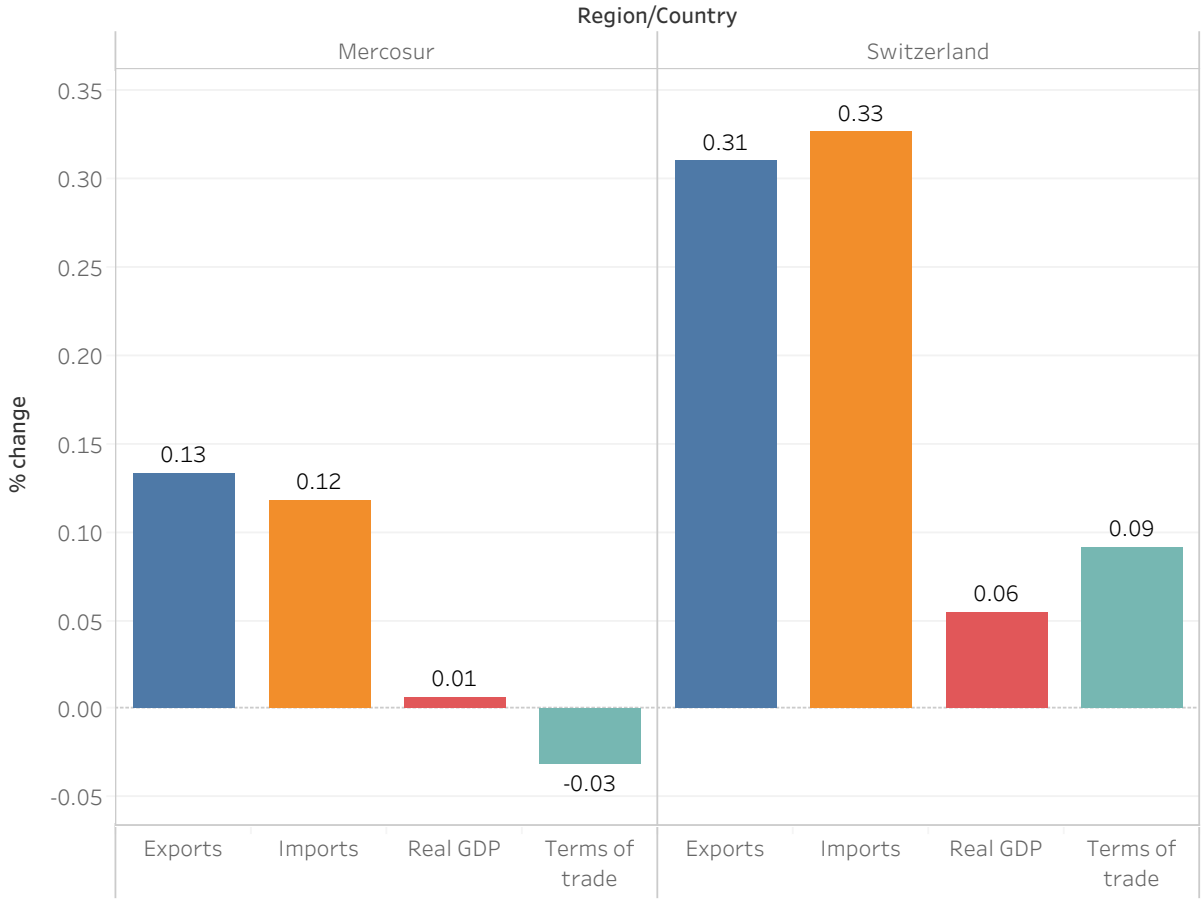
In this section, we provide an overview of the estimated macro-economic impact of the EMFTA. In particular, we present estimated changes stemming from the agreement compared to the baseline. First the economic effects at aggregate level (in terms of GDP, exports, imports, terms of trade, and real wages) are discussed, followed by sectoral level economic results (exports and value added). Figure 6 depicts the estimated percentage changes in MERCOSUR's and Switzerland's aggregated exports and imports, real GDP, and terms of trade changes. The overall impact of the agreement is minor for both Switzerland and MERCOSUR.[32] The FTA would result in a positive, albeit minor change in real GDP for all partner countries, with an estimated 0.06% increase in Switzerland's real GDP, and a 0.01% increase for overall MERCOSUR real GDP. Trade changes are also minor, especially for MERCOSUR, with a 0.12-0.13% increase in both exports and imports, and a 0.31-0.33% increase in Switzerland's exports and imports. The terms of trade for a country reflects how much the exports are worth in terms of imports. As such, an expected improvement (i.e. positive change) in a country's terms of trade implies that for each unit of exports sold, the country can afford to buy more imports. The PTA is estimated to marginally deteriorate Mercosur's terms of trade, while improve Switzerland's terms of trade, with both changes being very small.

Real wages are not expected to change significantly as a result of the agreement in MERCOSUR. The estimated changes in real wages are also minor in Switzerland, with the highest increase in agricultural and lower skilled workers' wages, equivalent to a 0.17% real wage gain. Real wages in other sectors are expected to rise by 0.07-0.08%. These results can be explained by a high intensity use of the lower skilled workers in the sectors that benefit the most from the agreement, which increases the relative demand for these workers, and thus, their real wages with respect to those of other worker types.

Table 4 presents the estimated impact in sectoral exports and Table 5 in sectoral value-added both in MERCOSUR and Switzerland. Again, most changes are minimal, with both exports and output expected to change above 1% in only very few sectors. In MERCOSUR, the only sector with a more substantive increase in exports in terms of percentage change is wearing apparel (due to the largest reduction in tariff barriers in the sector), amounting to 3.6% rise which is equivalent to a 38.23 million US$ increase. In terms of changes in value, this represents a lower increase than what is estimated to take place in several other sectors, reflecting low baseline flows.

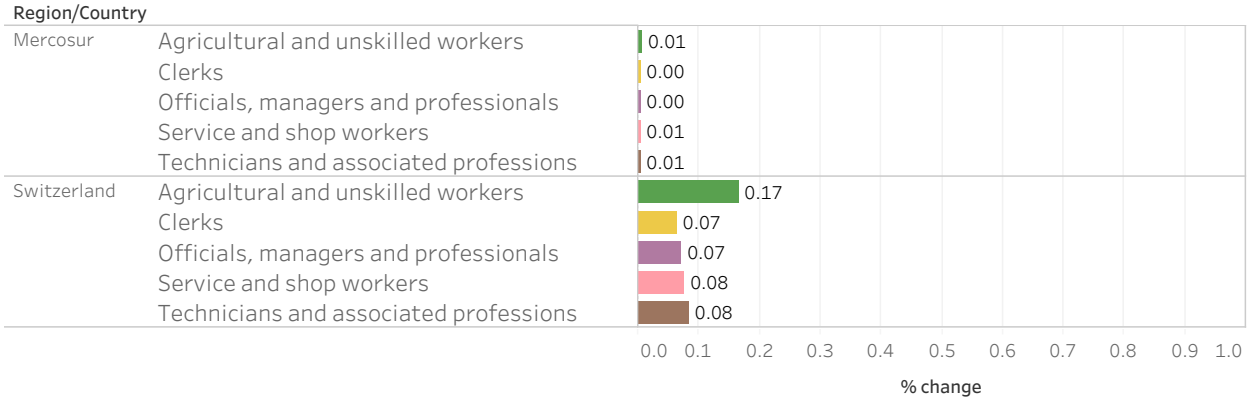
[32] The other members of EFTA: Iceland, Liechtenstein and Norway, are also expected to have moderate gains from the agreement: real GDP is expected to increase by 0.03% and total trade by about 0.25% for these countries. See Table 21 in the Annex II.

Figure 6 Changes in trade and real GDP (in %)[33]




Source: Own calculations using GTAP. Exports, imports, terms of trade is value based, real GDP is volume based.

*Figure 7 Changes in real wages (in %)[34]*




Source: Own calculations using GTAP.

[33] See underlying data in Table 21 in the Annex II.

[34] See underlying data in Table 21 in the Annex II.

The sectors with the highest increases in exports in value are meat products (this is driven by non-bovine meat, so excluding beef, due to improved market access to the Swiss markets as a result of the trade agreement), other primary products,[35] vegetable oils and fats (the sector includes soya). These sectors were important export sectors in the baseline, and thus the bigger increase in nominal value represents only minor increase in percentage terms (for the latter two sectors around 0.1%, and for meat products 0.3%). In the case of Switzerland the highest increase in exports in value terms is estimated to be in the machinery and equipment sectors (403 million US$), followed by basic pharmaceutical products (321 million US$), and chemical products (290 million US$). In terms of percentage changes, different sectors stand out, given the initial differences in the volume of exports across different sectors. More specifically, exports in the vegetable oil sector is estimated to rise most (3.65%), followed by motor vehicles and parts (2.43%) and dairy products (1.9%).

Table 5 shows estimated changes in sectoral output. In MERCOSUR, all sector level output changes remain under 0.2%, with the exception of basic pharmaceutical products, where the sector is projected to shrink by a relatively major -1.3% compared to the baseline. This corresponds to a 361 million US$ decrease on a value-added basis, which is among the highest changes in output in MERCOSUR. This is driven directly by increased competition from the Swiss pharmaceutical sector under the agreement. The most important output changes for Switzerland are in vegetable oils, motor vehicles and parts, chemicals, machinery and textiles (between 2.3-1%). Both machinery and chemical sector output also represent the most pronounced increases in terms of US$ on a value-added basis.

[35] Other primary sector includes rice: seed, paddy (not husked), other grains, cane & beet, fibres crops, other crops, other animal products, raw milk, wool, fishing.

*Table 4 Changes in sectoral exports*

| | | Changes in exports (in %) | | Changes in exports (in US$ million) | |
|---|---|---|---|---|---|
| Activity | Sectors | MERCOSUR | Switzerland | MERCOSUR | Switzerland |
| Primary | Bovine cattle, sheep and goats | 0.03 | -0.08 | 2.61 | -0.02 |
| | Energy (extraction based) | 0.11 | -0.10 | 58.17 | -1.76 |
| | Forestry | 0.19 | -0.20 | 2.67 | -0.49 |
| | Oil seeds | 0.03 | -1.04 | 41.86 | -0.35 |
| | Other mining extraction | 0.03 | -0.02 | 24.74 | -1.25 |
| | Other primary | 0.10 | -0.61 | 90.09 | -6.02 |
| | Vegetables, fruit, nuts | 0.36 | 0.07 | 28.97 | 0.12 |
| | Wheat | 0.00 | -0.86 | 0.07 | -0.73 |
| Manufacturing | Basic pharmaceutical products | 0.30 | 0.45 | 12.81 | 320.70 |
| | Beverages and tobacco products | 0.25 | 0.23 | 18.11 | 9.73 |
| | Bovine meat products | 0.22 | -0.76 | 27.82 | -0.60 |
| | Chemical products | 0.25 | 1.39 | 48.04 | 289.89 |
| | Computer, electronic and optic | 0.44 | 0.76 | 7.26 | 203.48 |
| | Dairy products | 0.48 | 1.90 | 20.62 | 52.37 |
| | Electrical equipment | 0.42 | 0.72 | 11.85 | 78.23 |
| | Ferrous metals | 0.28 | 0.65 | 33.66 | 10.76 |
| | Food products nec | 0.14 | 0.99 | 28.75 | 137.47 |
| | Leather products | 0.58 | -0.10 | 64.30 | -3.43 |
| | Machinery and equipment nec | 0.52 | 1.57 | 53.02 | 403.18 |
| | Meat products nec | 0.30 | -0.31 | 88.74 | -1.15 |
| | Metal products | 0.36 | 1.05 | 10.00 | 73.01 |
| | Metals nec | 0.45 | -0.34 | 55.22 | -298.11 |
| | Motor vehicles and parts | 0.19 | 2.43 | 56.28 | 68.37 |
| | Other manufactures | 0.56 | 0.40 | 14.05 | 103.01 |
| | Other non-metallic minerals | 0.22 | 0.46 | 6.46 | 8.89 |
| | Paper products, publishing | 0.29 | 0.58 | 27.63 | 17.25 |
| | Processed rice and sugar | 0.11 | 0.27 | 54.51 | 0.19 |
| | Rubber and plastic products | 0.18 | 0.60 | 8.12 | 29.23 |
| | Textiles | 0.61 | 1.38 | 10.90 | 33.64 |
| | Transport equipment nec | 0.38 | -0.52 | 22.98 | -32.38 |
| | Vegetable oils and fats | 0.12 | 3.65 | 78.90 | 29.82 |
| | Wearing apparel | 3.60 | 0.52 | 38.23 | 7.36 |
| | Wood products | 0.37 | -0.21 | 15.68 | -1.93 |
| Services | Air transport | 0.33 | 0.25 | 9.83 | 10.88 |
| | Communication | 0.33 | -0.36 | 12.52 | -11.21 |
| | Finance, insurance & real estate | 0.70 | -0.30 | 36.70 | -126.13 |
| | Land transport | 0.15 | -0.38 | 7.96 | -29.77 |
| | Other business services | 0.26 | -0.49 | 75.30 | -137.96 |
| | Public Administration and defence | 0.29 | -0.49 | 18.29 | -80.69 |
| | Recreation, accomodation, food | 0.25 | -0.49 | 19.56 | -46.48 |
| | Trade and warehousing | 0.26 | -0.58 | 13.58 | -73.23 |
| | Utilities | 0.18 | -0.20 | 3.78 | -6.27 |
| | Water transport | 0.49 | -0.08 | 23.87 | -0.35 |

Source: Own calculations using GTAP. Changes are calculated with respect to the 2040 baseline.

*Table 5 Changes in sectoral output*

| Activity | Sectors | Changes in value added (in %) | | Changes in value added (in US$ million) | |
|---|---|---|---|---|---|
| | | MERCOSUR | Switzerland | MERCOSUR | Switzerland |
| Primary | Bovine cattle, sheep and goats | 0.03 | 0.04 | 22.20 | 1.11 |
| | Energy (extraction based) | 0.02 | -0.03 | 64.91 | -2.54 |
| | Forestry | 0.00 | -0.02 | 0.88 | -0.48 |
| | Oil seeds | 0.02 | 0.19 | 45.54 | 0.45 |
| | Other mining extraction | 0.02 | -0.02 | 21.65 | -1.27 |
| | Other primary | 0.02 | 0.02 | 58.16 | 3.10 |
| | Vegetables, fruit, nuts | -0.06 | -0.11 | -47.56 | -4.57 |
| | Wheat | -0.07 | -0.10 | -7.77 | -0.87 |
| Manufacturing | Basic pharmaceutical products | -1.34 | 0.28 | -361.44 | 286.01 |
| | Beverages and tobacco products | 0.01 | 0.04 | 6.74 | 4.19 |
| | Bovine meat products | 0.03 | 0.09 | 33.32 | 4.64 |
| | Chemical products | -0.08 | 1.31 | -82.82 | 285.80 |
| | Computer, electronic and optic | -0.10 | 0.22 | 27.98 | 128.49 |
| | Dairy products | -0.06 | 0.41 | -66.37 | 79.52 |
| | Electrical equipment | 0.05 | 0.25 | 20.07 | 64.16 |
| | Ferrous metals | 0.08 | 0.22 | -7.75 | 12.45 |
| | Food products nec | -0.07 | 0.49 | -388.28 | 154.03 |
| | Leather products | 0.13 | -0.13 | 82.74 | -5.05 |
| | Machinery and equipment nec | 0.01 | 0.97 | -134.05 | 355.03 |
| | Meat products nec | 0.03 | -0.02 | 88.66 | -1.30 |
| | Metal products | -0.02 | 0.34 | -37.57 | 81.28 |
| | Metals nec | 0.02 | -0.34 | -17.41 | -302.29 |
| | Motor vehicles and parts | 0.07 | 1.58 | 100.48 | 61.51 |
| | Other manufactures | -0.10 | 0.14 | -124.13 | 53.57 |
| | Other non-metallic minerals | -0.02 | 0.05 | 5.65 | 5.38 |
| | Paper products, publishing | -0.04 | 0.06 | -4.35 | 6.99 |
| | Processed rice and sugar | 0.01 | -0.72 | 46.86 | -4.30 |
| | Rubber and plastic products | 0.02 | 0.21 | 12.48 | 19.33 |
| | Textiles | 0.02 | 1.21 | 33.63 | 32.28 |
| | Transport equipment nec | 0.20 | -0.52 | 52.96 | -41.55 |
| | Vegetable oils and fats | 0.06 | 2.29 | -3.10 | 29.40 |
| | Wearing apparel | 0.15 | 0.16 | 64.18 | 3.65 |
| | Wood products | -0.01 | -0.08 | 8.02 | -11.00 |
| Services | Air transport | 0.02 | 0.07 | 7.66 | 8.52 |
| | Communication | 0.01 | 0.00 | 52.96 | 1.88 |
| | Finance, insurance & real estate | 0.00 | -0.09 | -0.81 | -145.45 |
| | Land transport | 0.01 | -0.14 | 17.58 | -60.58 |
| | Other business services | 0.06 | -0.08 | 167.74 | -169.78 |
| | Public Administration and defence | 0.01 | 0.05 | 124.36 | 250.61 |
| | Recreation, accomodation, food | 0.01 | -0.04 | 45.40 | -37.78 |
| | Trade and warehousing | 0.01 | 0.04 | 46.80 | 99.42 |
| | Utilities | 0.00 | 0.01 | 0.57 | 1.19 |
| | Water transport | 0.13 | -0.09 | 33.94 | -2.12 |

Source: Own calculations using GTAP. Changes are calculated with respect to the 2040 baseline.

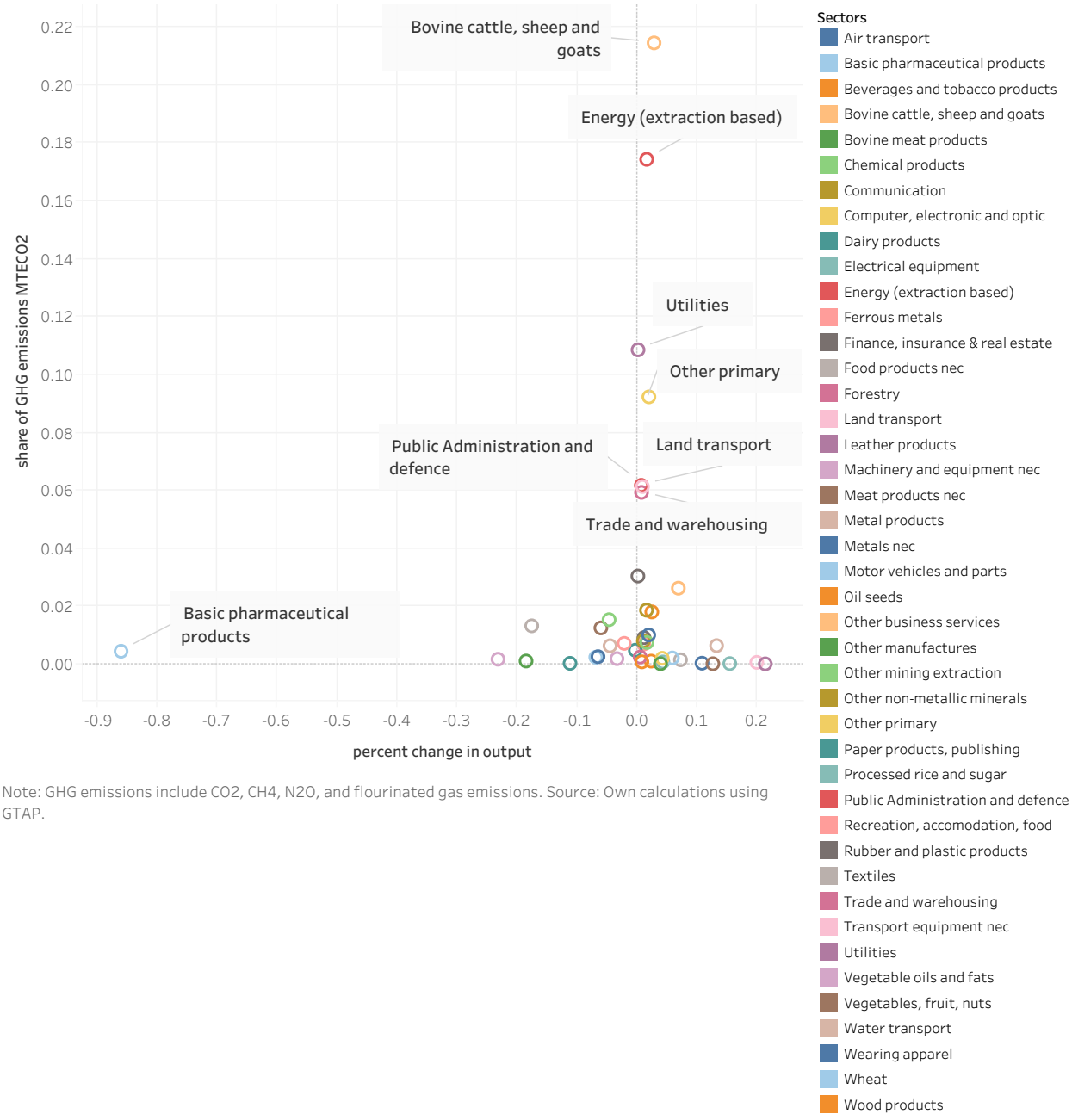
## 4.2 Environmental effects

### *4.2.1 Overall Impact: Assessment of relevant Sectors*

We start in this section with a mapping across sectors between changes in economic activity, as discussed above, and changes in environmental outcome indicators. This is followed by more focused discussion on specific sustainability issues in the next section, building on the sector results. Conceptually, in this section we describe the results feeding into the process described around Figure 1.

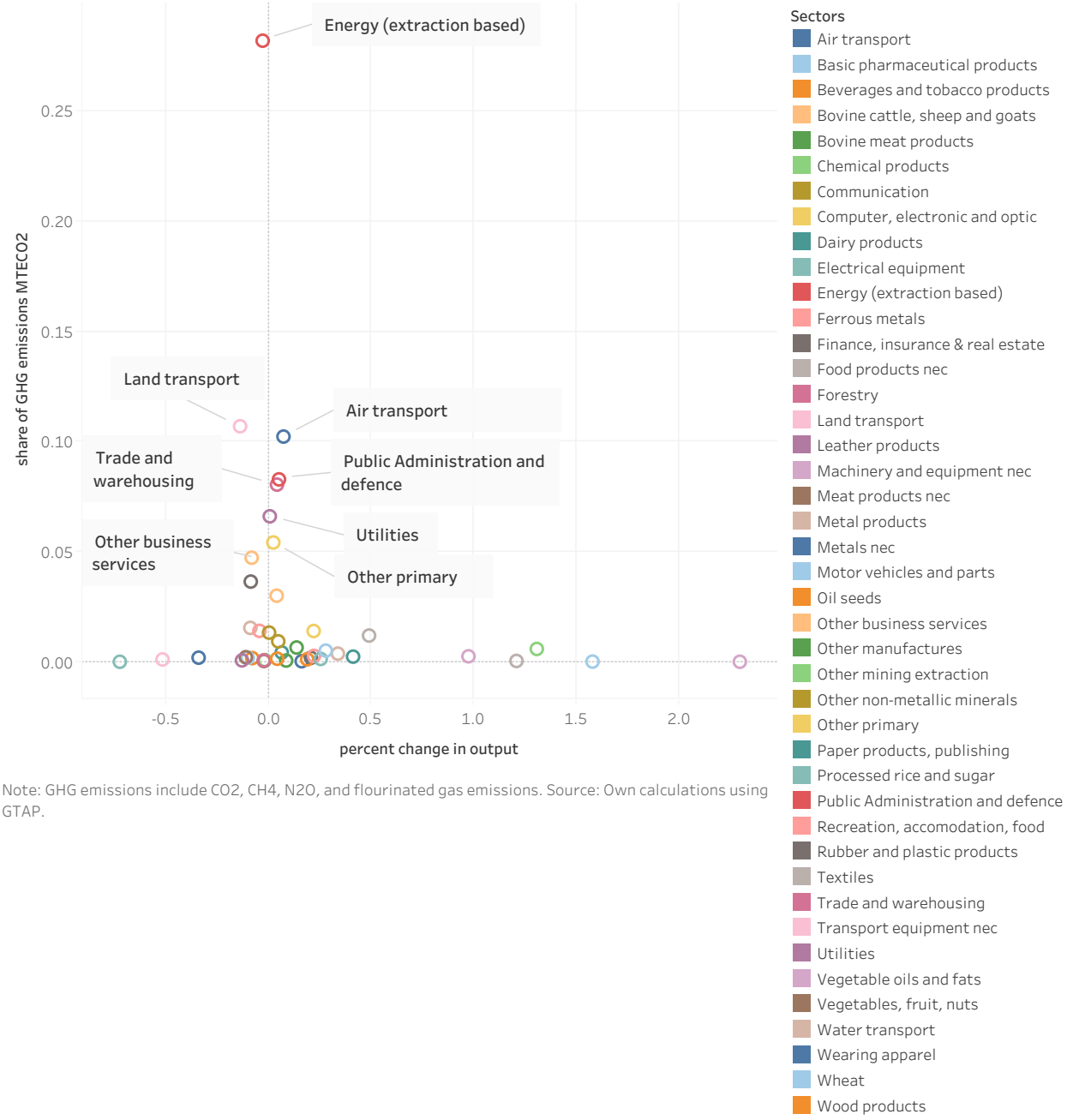
In the CGE model, emissions are linked to levels of activity at sector level, which in turn generally involve production with a mix of inputs. The changes in production activities drive changes in emissions. Figure 8, Figure 9, Figure 10, Figure 11 plot changes in output (on the horizontal axis) against sector shares of both GHG emissions and air pollutants. The pattern in the figures is important, and will drive the results covered in the next section. In particular, note that in general, for both MERCOSUR and Switzerland, sectors with the largest output changes account for small shares of benchmark emissions. The larger estimated changes (positive or negative) in output are in sectors with relatively small emission profiles. There are exceptions – water transport emissions of $SO_2$ and $NO_X$ in MERCOSUR, and the chemicals share of $N_20$ emissions in Switzerland, though even in these cases the shares are not so large. This means, with output changes of usually less than 1 percent for sectors most important for emissions, the overall change in emissions will also be small as reported in the next section.

*Figure 8 MERCOSUR sector shares of greenhouse gas emissions and output changes*



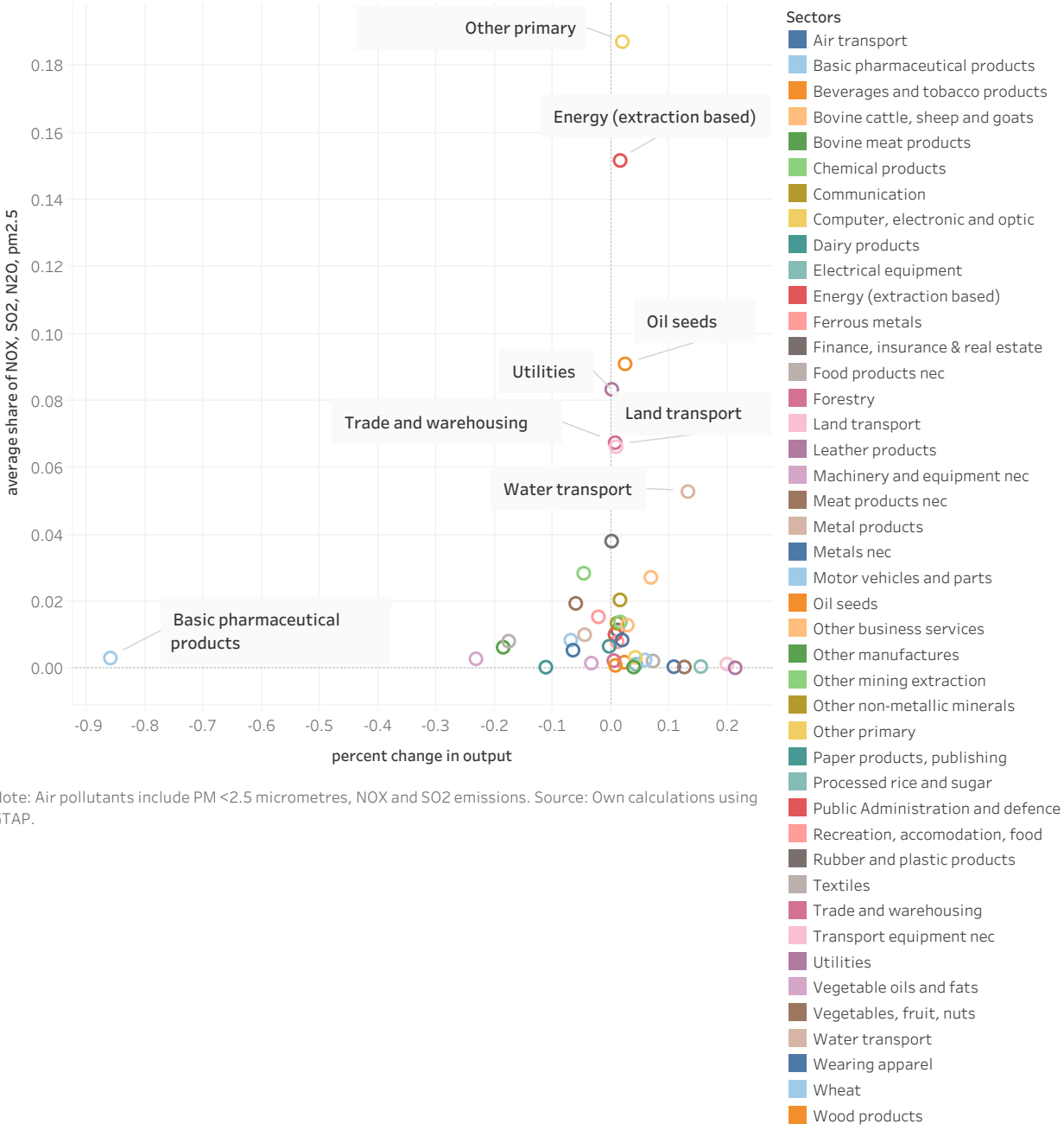

Note: GHG emissions include CO2, CH4, N2O, and flourinated gas emissions. Source: Own calculations using GTAP.

*Figure 9 Swiss sector shares of greenhouse gas emissions and output changes*



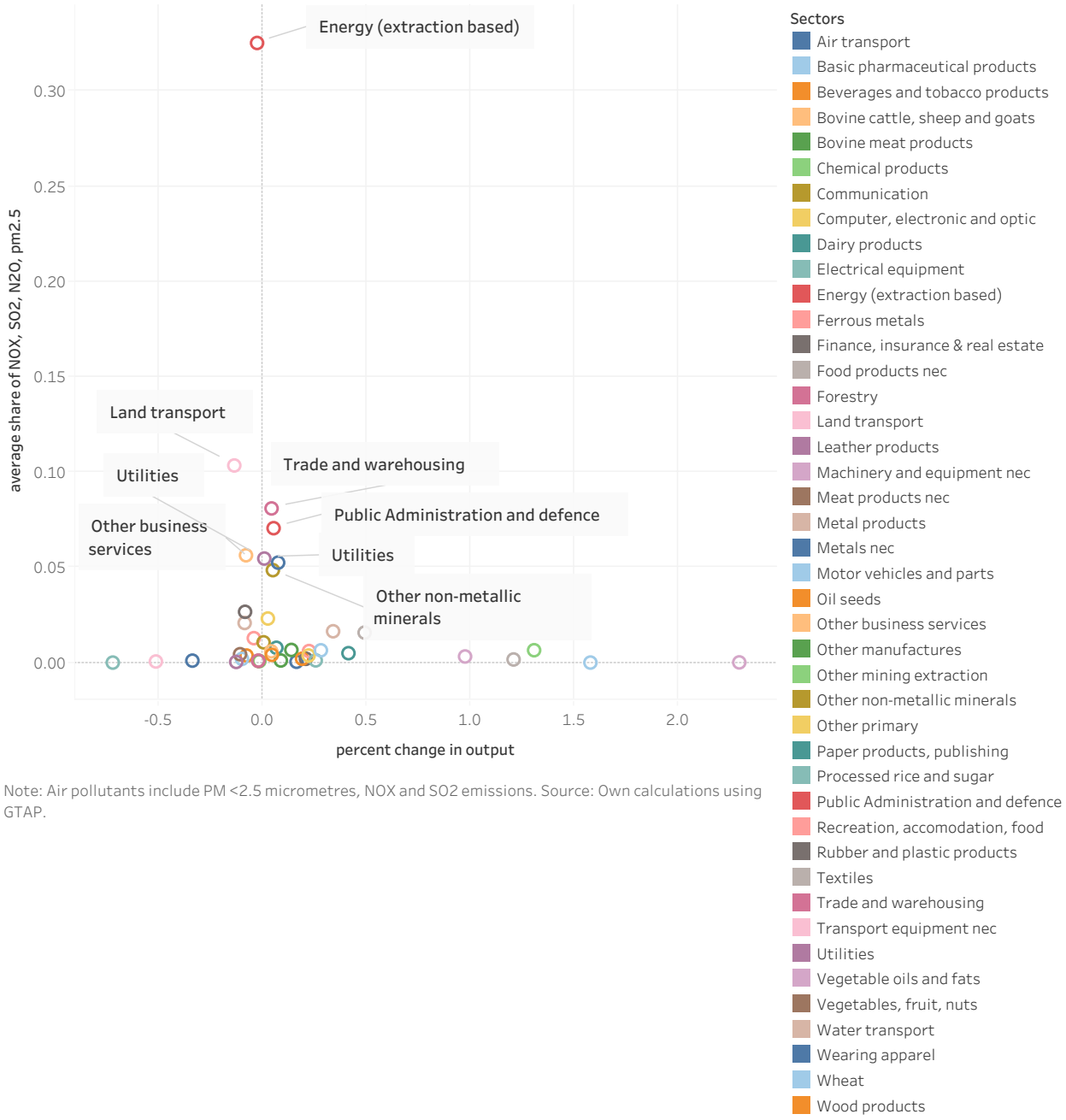

Note: GHG emissions include CO2, CH4, N2O, and flourinated gas emissions. Source: Own calculations using GTAP.

*Figure 10 MERCOSUR sector shares of air pollutants and output changes*




Note: Air pollutants include PM <2.5 micrometres, NOX and SO2 emissions. Source: Own calculations using GTAP.

*Figure 11 Swiss sector shares of air pollutants and output changes*

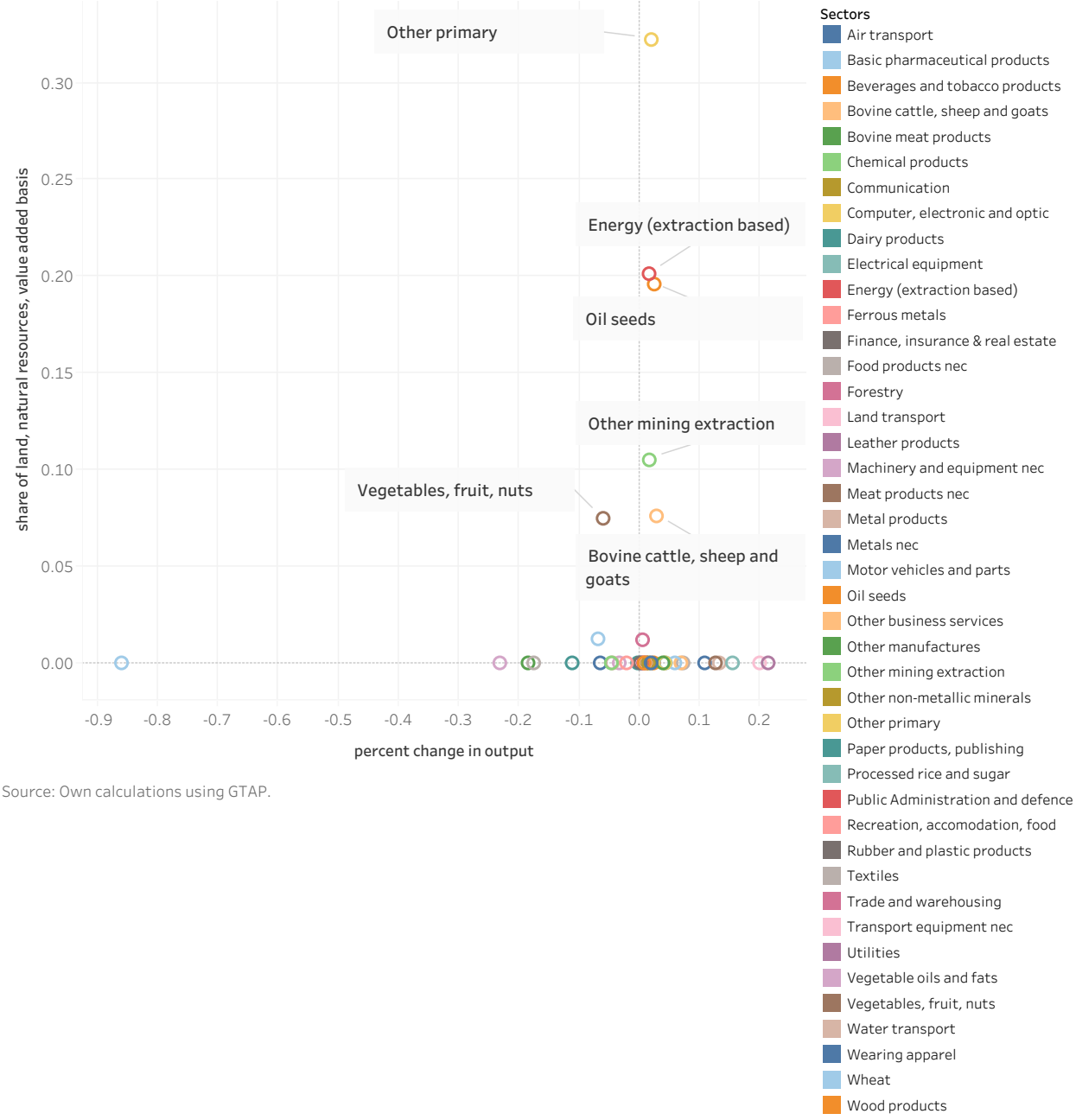



Note: Air pollutants include PM <2.5 micrometres, NOX and SO2 emissions. Source: Own calculations using GTAP.

Another factor feeding into the mapping of economic results reported above to the more specific sustainability issues addressed below is the sector profile for resource use. In particular, the magnitude of impacts on land and natural resources (water, forests, mineral and energy deposits) hinges on the extent to which sectors important in terms of land and natural resource use realize changes in output, and so economic activity that again will drive environmental impacts. Figure 12 and Figure 13 map changes in output at sector level against the resource intensity on a value-added basis (where resources include cropland, grazing land, forests, and mineral resources) of those same sectors. Like the case in Figure 8-Figure 11 above, for the most part there is little change in output intensive sectors. In part, this relates to the nature of EMFTA market access concessions discussed in Section 3.5. For example, trade in food and agricultural products is

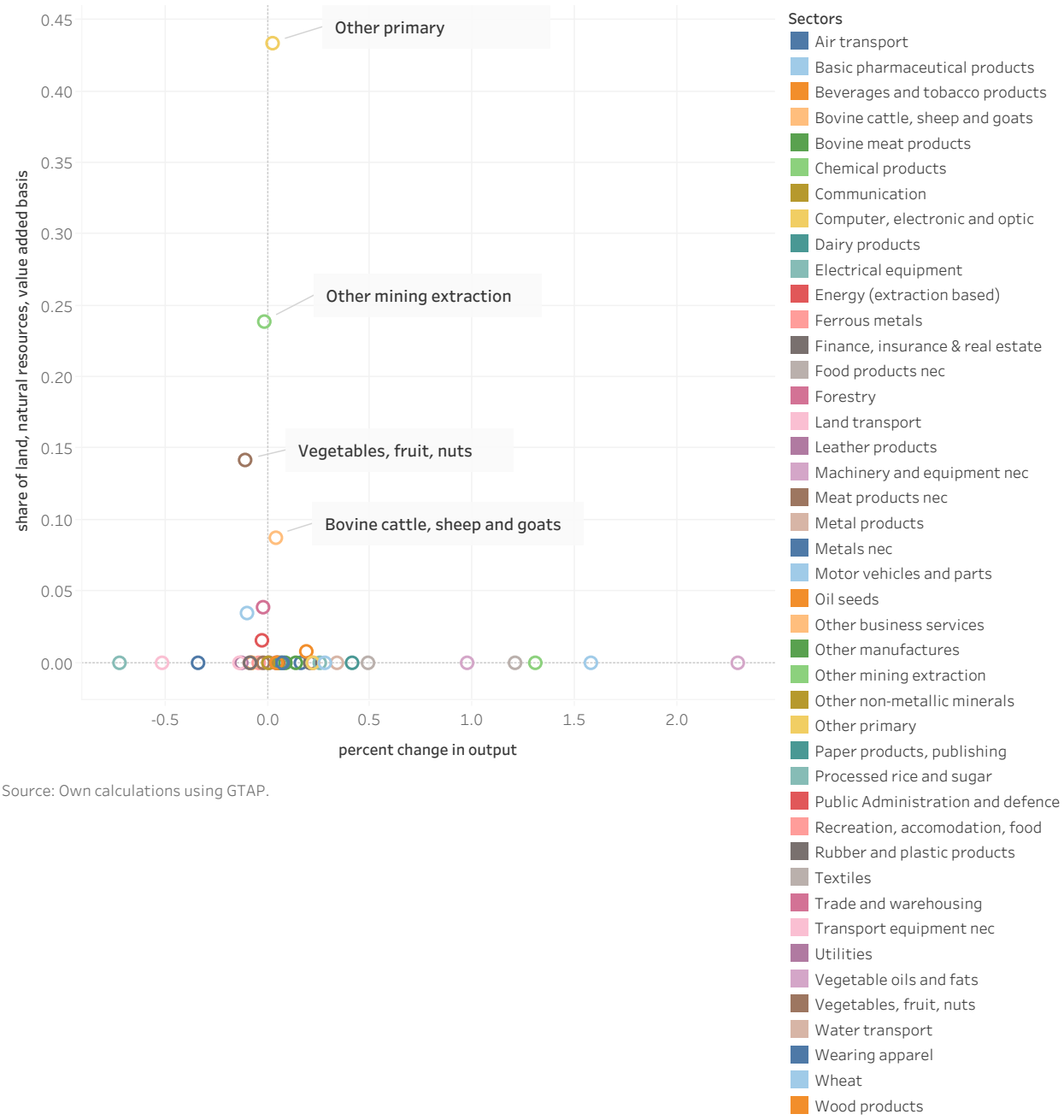
largely governed by quotas, and those quotas remain mostly unchanged (though with some exceptions). The fact that output changes in resource intensive sectors generally range at well below +/- 0.2 percent in absolute value means that we identify little pressure in what follows on resource-based sustainability issues. There is another aspect of resource use discussed below, as some expanding sectors (textiles) may be linked to degradation of water quality and so also to biodiversity.

*Figure 12 MERCOSUR sector resource intensity and output changes*




Source: Own calculations using GTAP.

*Figure 13 Swiss sector resource intensity and output changes*




Source: Own calculations using GTAP.

Table 6 summarizes estimated changes for the main sectors identified by previous studies. For all these sectors the expected changes are very small, with all changes in exports and output being below one percent (while for diary and vegetables, fruits, nuts, exports are estimated to increase slightly, this is accompanied by a very small drop in output in these sectors due to general equilibrium effects). The importance of these sectors in both the overall GHG emission levels and resource use is small, hence the impact of the assumed agreement in these sectors will be minimal.

*Table 6 Estimated changes in Mercosur in some of the sectors identified in previous studies*

| Sector/Product | Sector share of overall GHG emission levels | Sector share of resource use | % Change in Mercosur exports due to EMFTA | % Change in Mercosur output due to EMFTA |
|---|---|---|---|---|
| Bovine cattle, sheep and goats | 0.21 | 0.08 | 0.03 | 0.03 |
| Dairy products | 0.00 | 0.00 | 0.48 | -0.06 |
| Oilseeds (incl. soybeans) | 0.02 | 0.20 | 0.03 | 0.02 |
| Processed rice and sugar | 0.00 | 0.00 | 0.11 | 0.01 |
| Textiles | 0.00 | 0.00 | 0.61 | 0.02 |
| Vegetables, fruits, nuts | 0.01 | 0.07 | 0.12 | -0.06 |

Source: Own calculations. While some studies identified certain more specific products, our level of aggregations does not allow us to look at such specific products. It is possible, that looking at those specific products, the estimated changes would be more pronounced.

See Figures 8, 10, and 12 for information on the dominant sectors in terms of emissions and resource use.

### *4.2.2 Estimated impact for the different environmental sustainability categories*

We now turn to specific environmental sustainability impacts. While the quantitative estimates presented in this report compare the estimated outcome to our baseline, which is projected into 2040, it is still informative to briefly discuss the current, pre-baseline environmental performance of MERCOSUR and Switzerland. In this section we discuss each MERCOSUR country separately.

#### *4.2.2.1 Estimated changes in greenhouse gases*

In this section, we turn to our quantitative estimates of changes in GHG emissions, first presenting the overall results, and then discussing the main contributing factors to the overall results. Estimated changes in GHG emissions are reported both on the basis of the sectors in which they are generated (labelled "sources by activity" in the table) as well as where they are demanded by downstream firms or final demand, so either embodied as intermediate inputs (or in household and government use in the case of energy). These latter values are labelled "sources by use" in the table.[36] A breakdown is provided below in Table 8 presenting the estimated GHG emission changes in MT $CO_2$-eq (with further detail in Annex II). As discussed above, While emissions by activity reflect direct emissions by the sector undertaking the activity, the use classification takes account of intermediate linkages necessary in producing final goods and services. In effect the use classification reassigns emissions to the final stages of production of goods and services. For example, emissions from fertilizer production that is then used in agriculture to produce food is assigned to manufacturing on an activity basis (i.e. the sector that makes the fertilizer) and processed food on a use basis (as the fertilizer feeds into agricultural production that then feeds into processed foods). As trade in goods (and services) embodies emissions from upstream sectors, the use classification provides a more direct mapping from traded goods to the emissions that result from production of those goods (both from direct activity in the sector and indirect activity from upstream suppliers), while avoiding double counting by construction.

[36] Yet a further breakdown involves the resources and emissions embodied in final consumption, as distinguished from final production. This includes, for example, Fernandez Amador et al (2017, 2020).

Our estimates of global changes in emissions reflect the mixture of both direct effects from changes in production in Switzerland and the MERCOSUR countries, as well as from indirect changes that are realized in other countries. For example, if machinery demand in Brazil shifts away from imports from a country with a relatively higher carbon content for production with respect to Swiss production, and toward Swiss suppliers with lower emissions profiles relative to that third country, then this would contribute to a drop in emissions from global machinery production. The net effects depend on the full combination of direct effects in the EMFTA partner countries, as well as induced effects, linked in part to trade diversion, across all third countries that are not part of the agreement, and across all sectors. The actual effects from the complex reallocation of production globally following the implementation of the EMFTA are captured in the model. Indeed, this is an important reason to use a global, multi sector model allowing to capture these effects.[37]

Table 7 shows the baseline values (i.e. including projections) of the various GHG emissions for all Mercosur countries, Switzerland, the rest of the world (as an aggregate region), and the world (as an aggregate of all countries including Mercosur and Switzerland). In Switzerland, the most important contributor to total GHG emissions is $CO_2$, mainly driven by transport and energy sectors. There is an important heterogeneity among Mercosur countries, with the highest values of GHG emissions in Brazil, followed by Argentina. In Brazil, the most polluting sector is agriculture, food, and beverages, with $CH_4$ being the main pollutant in the sector.

[37] What we do not capture (and in general what comparable CGE estimates do not capture) is the effect if the Swiss machinery that is now imported has a more energy efficient profile than the third country machinery it replaces. This is linked to the potential for flanking policies that support transfer of greener technologies, which again are not modelled here as a core effect from the EMFTA.

*Table 7 Baseline values of GHG emissions MT $CO_2$-eq) by aggregate sectors*

| | | Countries/Regions | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sectors | | Argentina | Brazil | Paraguay | Uruguay | Switzerland | ROW | World |
| Agriculture, food, beverages | CH4 | 47 | 163 | 19 | 11 | 1 | 1,634 | 1,875 |
| | CO2 | 9 | 10 | 0 | 0 | 0 | 540 | 560 |
| | Fgas | 0 | 0 | 0 | 0 | 0 | 29 | 29 |
| | N2O | 24 | 75 | 8 | 5 | 1 | 1,299 | 1,411 |
| | GHG total | 80 | 248 | 28 | 16 | 2 | 3,502 | 3,875 |
| Energy (extraction based) | CH4 | 15 | 32 | 3 | 1 | 1 | 2,497 | 2,549 |
| | CO2 | 75 | 99 | 3 | 2 | 12 | 6,701 | 6,892 |
| | Fgas | 0 | 0 | 0 | 0 | 0 | 46 | 47 |
| | N2O | 4 | 8 | 0 | 0 | 0 | 329 | 341 |
| | GHG total | 95 | 139 | 6 | 3 | 13 | 9,573 | 9,830 |
| Manufacturing | CH4 | 3 | 26 | 1 | 0 | 0 | 602 | 632 |
| | CO2 | 18 | 33 | 0 | 0 | 2 | 3,162 | 3,216 |
| | Fgas | 0 | 2 | 0 | 0 | 1 | 369 | 373 |
| | N2O | 2 | 13 | 0 | 0 | 0 | 287 | 302 |
| | GHG total | 23 | 74 | 1 | 1 | 3 | 4,421 | 4,522 |
| Other primary | CH4 | 10 | 55 | 1 | 2 | 2 | 1,382 | 1,452 |
| | CO2 | 5 | 15 | 0 | 0 | 0 | 722 | 742 |
| | Fgas | 0 | 0 | 0 | 0 | 0 | 30 | 30 |
| | N2O | 7 | 46 | 1 | 1 | 1 | 860 | 915 |
| | GHG total | 22 | 116 | 2 | 3 | 3 | 2,993 | 3,139 |
| Other Services, Utilities | CH4 | 20 | 82 | 5 | 2 | 2 | 3,201 | 3,312 |
| | CO2 | 26 | 37 | 0 | 1 | 6 | 3,898 | 3,968 |
| | Fgas | 0 | 1 | 0 | 0 | 0 | 132 | 133 |
| | N2O | 7 | 19 | 1 | 1 | 1 | 759 | 788 |
| | GHG total | 53 | 138 | 7 | 4 | 9 | 7,991 | 8,202 |
| Transport | CH4 | 7 | 41 | 5 | 1 | 1 | 1,451 | 1,507 |
| | CO2 | 24 | 89 | 3 | 2 | 12 | 4,778 | 4,908 |
| | Fgas | 0 | 1 | 0 | 0 | 0 | 108 | 109 |
| | N2O | 2 | 15 | 2 | 0 | 0 | 355 | 374 |
| | GHG total | 33 | 145 | 10 | 3 | 14 | 6,692 | 6,898 |

Source: Own calculations using GTAP. ROW refers to the aggregate of all other countries, while World is the aggregate of all countries including Mercosur and Switzerland.

Table 8 sheds further details on the driving forces of estimated changes in GHG pollution by presenting aggregate sectors to highlight the main economic activities behind the patterns. Here we show the estimated changes in GHG emissions by country and by major sectors, based on activity and use accounting.[38] While in most countries the estimated changes are negligible, there would be a small increase in Brazil's emissions (with the exception of the energy sector), and very minor increases in Switzerland and at the World level. The table also presents the estimated

[38] When emissions are reported on the basis of the sectors in which they are generated, we refer to this as "by activity and when reported based on where they are demanded by downstream firms or final demand, so either embodied as intermediate inputs or in household and government use of energy we refer to "by use".

changes for the rest of the world (i.e. the aggregate for countries other than Mercosur and Switzerland). Most estimated changes in the rest of the world are offsetting those of Mercosur and Switzerland. The exception is the other services and utilities sector, where there is small an increase in emissions in the rest of the world, and also in the Mercosur and Switzerland. This is mainly driven by inputs going into production in the other countries.

There is a small reduction of energy related activities in most MERCOSUR countries, most notably in Brazil and also at the global level, as other sectors with less energy related activities expand. This is accompanied by a minor increase in greenhouse emissions in Switzerland in this sector. The only non-negligible increases in GHG emission comes from the agricultural sector in Brazil, amounting to an increase of 0.11 MT $CO_2$-eq when based on the activity in the sector, and 0.15 MT $CO_2$-eq when based on the "consumption" of the sector. This is driven by a small increase in exports and hence output in this sector, and the initial relatively higher value of emission volumes in these sectors already in the baseline. In the other MERCOSUR countries, the agreement would not lead to any significant change in GHG emissions. In Switzerland, there is an estimated minor increase in total GHG emissions mostly driven by an increase in final consumption. The estimated changes at the World level, most importantly in the agriculture sector, are partly driven by the changes taking place in Brazil.

## *Table 8 Changes in total GHG emissions (MT $CO_2$-eq) by aggregate sectors*

### Changes in total GHG emissions by activity, aggregated sectors

range of values (by activity): -0.11 to 0.13

| Aggregated Sectors | Countries: Argentina | Brazil | Paraguay | Uruguay | Switzerland | ROW | World |
|---|---|---|---|---|---|---|---|
| Agriculture, food, beverages | 0.01 | 0.11 | 0.01 | 0.01 | 0.00 | -0.07 | 0.08 |
| Energy | -0.01 | -0.03 | 0.00 | 0.00 | 0.02 | -0.09 | -0.11 |
| Manufacturing | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | -0.01 | 0.00 |
| Other primary | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | -0.01 | 0.03 |
| Other services, utilities | 0.00 | 0.03 | 0.00 | 0.00 | 0.02 | 0.09 | 0.13 |
| Transport | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | -0.04 | 0.00 |
| Grand Total | **0.01** | **0.18** | **0.01** | **0.01** | **0.04** | **-0.13** | **0.13** |

### Changes in total GHG emissions by use, aggregated sectors

range of values (by use): -0.10 to 0.15

| Aggregated Sectors | Countries: Argentina | Brazil | Paraguay | Uruguay | Switzerland | ROW | World |
|---|---|---|---|---|---|---|---|
| Agriculture, food, beverages | 0.02 | 0.15 | 0.01 | 0.01 | 0.00 | -0.10 | 0.10 |
| Energy | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | -0.01 | 0.00 |
| Final consumption (Govt, Households) | -0.01 | -0.04 | 0.00 | 0.00 | 0.03 | 0.00 | -0.03 |
| Manufacturing | 0.00 | -0.02 | 0.00 | 0.00 | 0.01 | 0.00 | -0.01 |
| Other primary | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | -0.01 | 0.03 |
| Other services, utilities | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.06 | 0.07 |
| Transport | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | -0.06 | -0.04 |
| Grand Total | **0.01** | **0.18** | **0.01** | **0.01** | **0.04** | **-0.13** | **0.13** |

Own calculations using GTAP. Changes are calculated with respect to the baseline. ROW stands for the aggregate of all other countries, while the World stand for the aggregate of all countries including the Mercosur and Switzerland.

Note: Column sums do not always match the totals shown in the table because of rounding.

## *Table 9 Changes in GHG emissions (MT $CO_2$-eq) by aggregate sectors, (in %)*

### *9.1 Individual GHG indicator % changes*

Changes in CO2 emissions by activity, aggregated sectors, in %

CO2 % changes, range of values: -0.07 0.40

| Sectors | Argentina | Brazil | Paraguay | Switzerland | Uruguay | World |
|---|---|---|---|---|---|---|
| Agriculture, food, beverages | 0.00 | -0.02 | 0.00 | 0.40 | 0.01 | 0.00 |
| Energy (extraction based) | -0.01 | -0.04 | -0.02 | 0.12 | 0.02 | 0.00 |
| Manufacturing | -0.01 | -0.01 | -0.01 | 0.30 | 0.03 | 0.00 |
| Other primary | -0.01 | 0.01 | 0.00 | 0.20 | -0.07 | 0.00 |
| Other Services, Utilities | 0.00 | 0.01 | 0.00 | 0.07 | 0.03 | 0.00 |
| Transport | 0.01 | 0.01 | 0.01 | 0.00 | 0.06 | 0.00 |

Changes in CH4 emissions by activity, aggregated sectors, in %

CH4 % changes, range of values: -0.05 0.11

| Sectors | Argentina | Brazil | Paraguay | Switzerland | Uruguay | World |
|---|---|---|---|---|---|---|
| Agriculture, food, beverages | 0.02 | 0.05 | 0.04 | 0.06 | 0.06 | 0.00 |
| Energy (extraction based) | 0.01 | 0.02 | 0.00 | 0.11 | 0.06 | 0.00 |
| Manufacturing | 0.01 | 0.03 | 0.02 | 0.08 | 0.03 | 0.00 |
| Other primary | 0.02 | 0.04 | 0.01 | 0.05 | -0.05 | 0.00 |
| Other Services, Utilities | 0.00 | 0.02 | 0.02 | 0.03 | 0.03 | 0.00 |
| Transport | 0.00 | 0.03 | 0.03 | -0.04 | 0.03 | 0.00 |

Changes in N2O emissions by activity, aggregated sectors, in %

N2O % changes, range of values: -0.05 0.67

| Sectors | Argentina | Brazil | Paraguay | Switzerland | Uruguay | World |
|---|---|---|---|---|---|---|
| Agriculture, food, beverages | 0.02 | 0.04 | 0.04 | 0.06 | 0.06 | 0.00 |
| Energy (extraction based) | 0.00 | 0.00 | -0.01 | 0.11 | 0.00 | 0.00 |
| Manufacturing | 0.00 | 0.02 | 0.02 | 0.67 | 0.02 | 0.00 |
| Other primary | 0.01 | 0.04 | 0.01 | 0.04 | -0.05 | 0.00 |
| Other Services, Utilities | 0.01 | 0.02 | 0.02 | 0.08 | 0.04 | 0.00 |
| Transport | 0.01 | 0.03 | 0.03 | 0.16 | 0.03 | 0.00 |

Changes in Fgas emissions by activity, aggregated sectors, in %

FGAS % changes, range of values: -0.09 0.48

| Sectors | Argentina | Brazil | Paraguay | Switzerland | Uruguay | World |
|---|---|---|---|---|---|---|
| Agriculture, food, beverages | -0.05 | -0.08 | 0.00 | 0.23 | 0.00 | 0.00 |
| Energy (extraction based) | -0.08 | -0.09 | 0.00 | 0.48 | 0.00 | 0.00 |
| Manufacturing | -0.07 | -0.06 | 0.00 | 0.23 | 0.03 | 0.00 |
| Other primary | -0.06 | -0.08 | 0.00 | 0.29 | 0.00 | 0.00 |
| Other Services, Utilities | -0.07 | -0.06 | 0.00 | 0.07 | 0.03 | 0.00 |
| Transport | -0.05 | -0.06 | 0.00 | 0.22 | 0.05 | 0.00 |

Own calculations using GTAP. Changes are calculated with respect to the baseline. Estimated percentage changes are 0.00 both for the rest of the world and the world.

### *9.2 Total MT $CO_2$-eq GHG indicator % changes*

Changes in total GHG emissions by activity, aggregated sectors, in %

| Sectors | Argentina | Brazil | Paraguay | Switzerland | Uruguay | WORLD |
|---|---|---|---|---|---|---|
| Agriculture, food, beverages | 0.02 | 0.04 | 0.04 | 0.13 | 0.06 | 0.00 |
| Energy (extraction based) | -0.01 | -0.02 | -0.01 | 0.12 | 0.03 | 0.00 |
| Manufacturing | -0.01 | 0.01 | 0.02 | 0.30 | 0.03 | 0.00 |
| Other primary | 0.01 | 0.04 | 0.01 | 0.05 | -0.05 | 0.00 |
| Other Services, Utilities | 0.00 | 0.02 | 0.02 | 0.06 | 0.03 | 0.00 |
| Transport | 0.01 | 0.02 | 0.02 | 0.00 | 0.04 | 0.00 |
| Total | 0.00 | 0.02 | 0.03 | 0.08 | 0.04 | 0.00 |

Own calculations using GTAP. Changes are calculated with respect to the baseline. Estimated percentage changes are 0.00 both for the rest of the world and the world.

Please Note: The total MT $CO_2$- eq values (the sum of the values shown here) are shown in the previous table. In percent changes, the Rest of World (not shown) and World totals are identical at 0.00 percent.
Note: Column sums do not always match the totals shown in the table because of rounding.

Table 9 shows the underlying changes in percentage changes for GHG emissions. Most increases take place in Switzerland, in terms of percentage changes. However, these changes reflect very small changes in actual value terms. The increase in the agriculture, food, beverages sectors in Brazil are mostly due to a small increase in $N_2O$ and $CH_4$ emissions (both between -0.04% and +0.5% change at sector level). Emissions from non-$CO_2$ greenhouse gases are not expected to change as a result of the agreement for most countries (see Figure 14). While most estimated changes are around or below +/-0.1%, in the case of Switzerland, fluorinated gases increase by about 0.2% while $N_2O$ increases by 0.56%.

If we break down the changes in total MT $CO_2$-eq for MERCOSUR and Switzerland into general expansion in economic activity (also called volume effects in the climate economics literature), and changes in the pattern of economic activity (also called composition effects) we find that 57.8 percent of the change in Swiss GHG emissions is due to volume effects, while in MERCOSUR the composition effects drive most of the change (53.8 percent of the total change). In other words, while both volume and composition effects are important, in MERCOSUR it is changes in production patterns that dominate. At the same time, we again note that the estimated overall changes at world level are at what we would characterize as negligible levels.

*Figure 14 Change in greenhouse gas emission (in %)*[39]


Source: Own calculations using GTAP. MTCO2 refers to million tons CO2 equivalents.

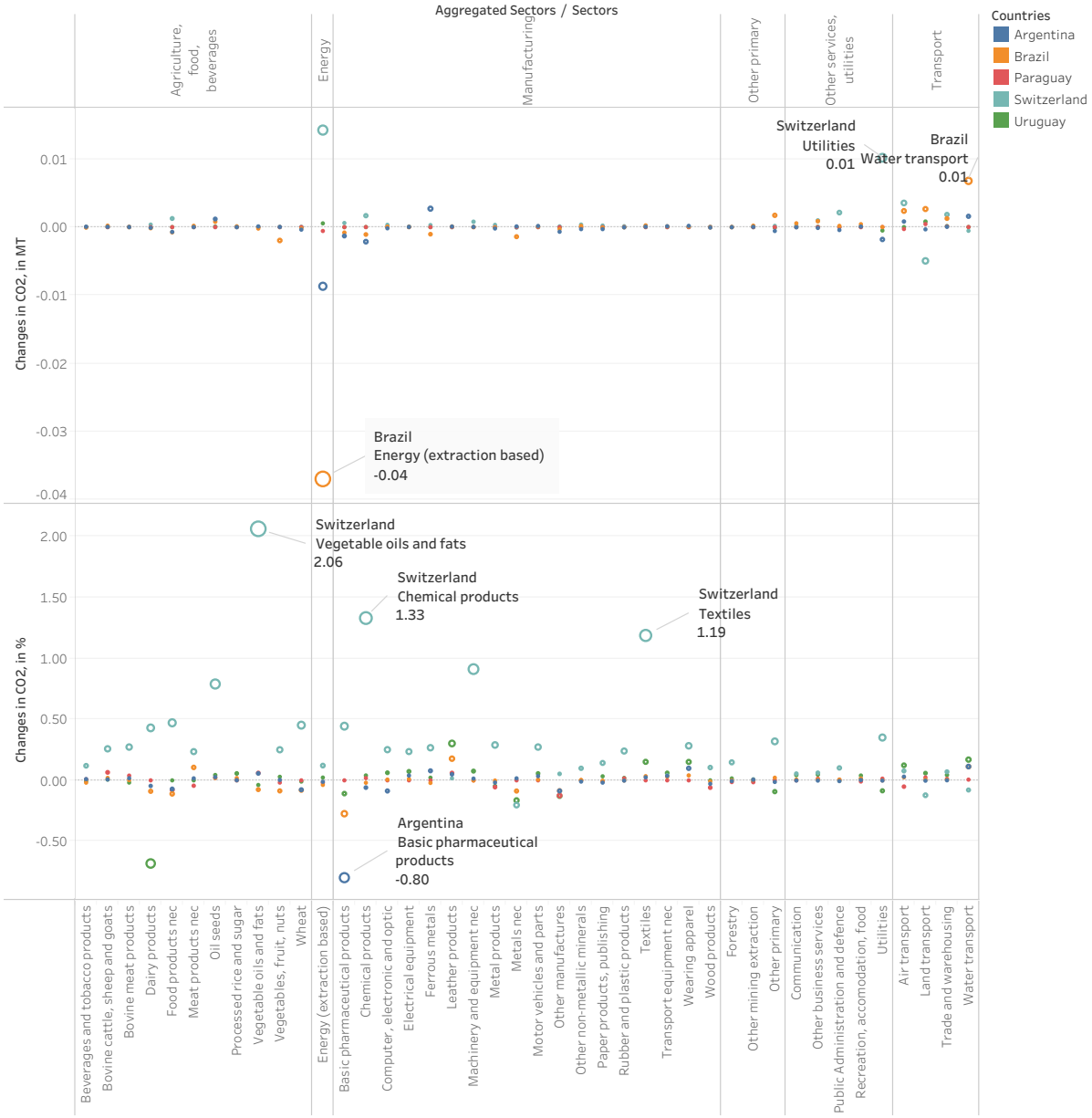
In order to better understand which sectors are behind the aggregate changes presented above, Figure 15 to Figure 18 provide further detail on the sectoral contribution to each greenhouse emission based on the given sector's activity. While most changes are minor or zero, a few sectors clearly drive the results presented in Table 8. In particular, regarding $CO_2$ emissions, Brazil's energy sector is estimated to have a lower emission by 0.04 MT $CO_2$-eq (as this sector shrinks somewhat due to other sectors in Brazil expanding). Although, when looking at estimated

[39] See underlying data in Table 24 in Annex II.

changes in percentages, the biggest decrease is estimated to take place in Argentina's pharmaceutical products, with a 0.8% decrease. There is an estimated increase in Switzerland's energy and utility sector of 0.01 MT, and Brazil's water transport of 0.01 MT. When considering percentage changes, it is the vegetable oils and chemical products sectors that stand out, although both represent a very small change in terms of million tons.

Both in $CH_4$ and $N_2O$ emissions, the most important contributing sector is Brazil's bovine cattle, sheep and goat sector, with a 0.07 MT $CO_2$-eq increase in $CH_4$, and a 0.03 MT $CO_2$-eq increase in $N_2O$. Both are due to a small increase in exports of these sectors leading to increased activity in these sectors. Looking at percentage changes, a few Swiss sectors stand out. However, all are sectors with very low initial $CO_2$ emissions, resulting in insignificant changes when measured in MT. Finally, there is no significant change in fluorinated gases emissions.

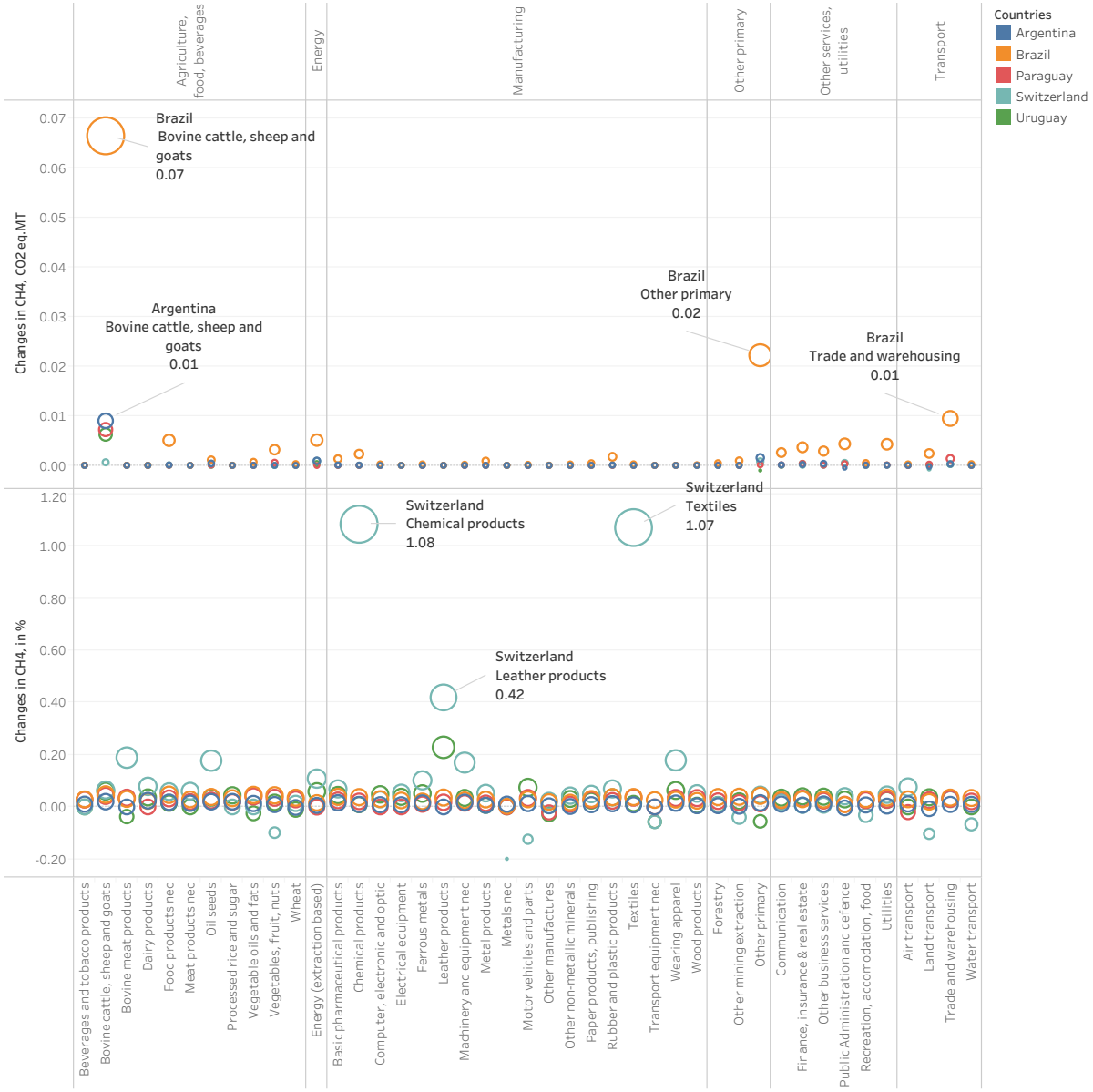
*Figure 15 Sectoral changes in $CO_2$ emissions by activity*[40]




Source: Own calculations using GTAP. CO2 is measured based on the output from the activity taking place in the given sector.

[40] See underlying data in Table 22 and Table 24 in Annex II.

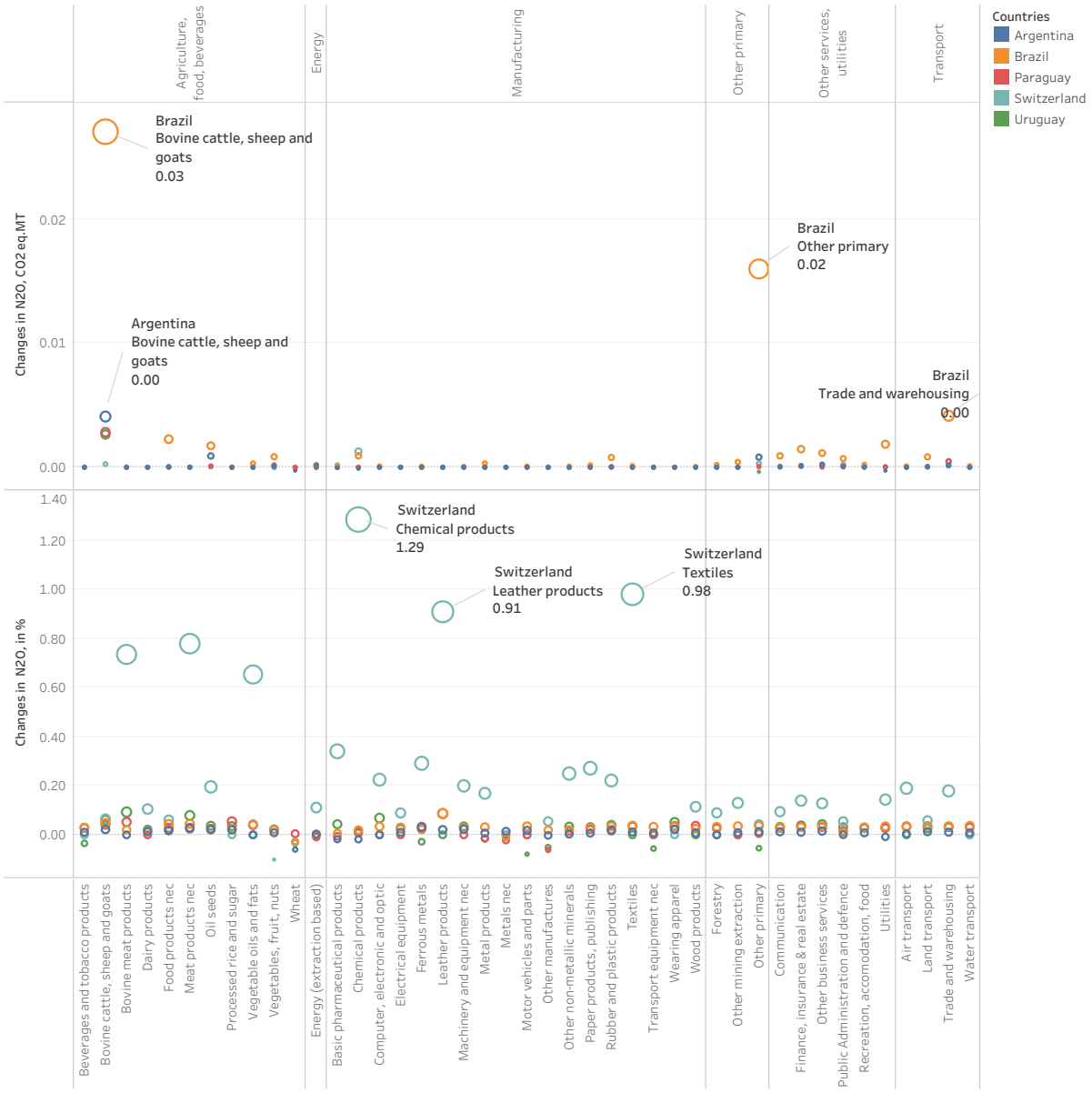
*Figure 16 Sectoral changes in $CH_4$ emissions by activity, (in MT $CO_2$-eq)*[41]




Sum of CH4activity and sum of CH4activity% for each Sectors broken down by Aggregated Sectors. Colour shows details about Countries. For pane Sum of CH4activity: Size shows sum of CH4activity. For pane Sum of CH4activity%: Size shows sum of CH4activity%. The view is filtered on Countries and Aggregated Sectors. The Countries filter has multiple members selected. The Aggregated Sectors filter excludes Final consumption (Govt, Households).

[41] See underlying data in Table 25, Table 27, and Table 28 in Annex II.

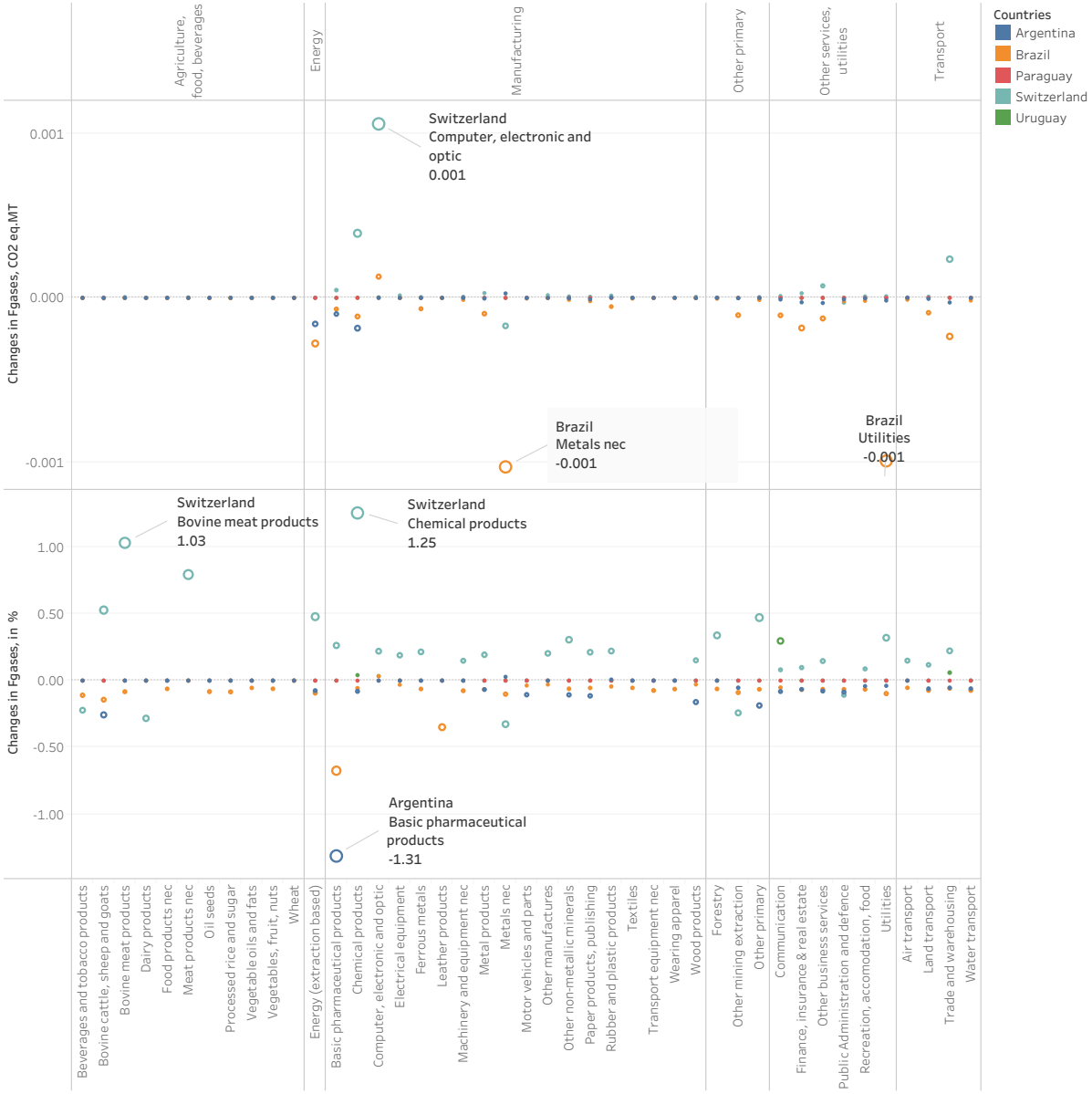
*Figure 17 Sectoral changes in $N_20$ emissions by activity, (in MT $CO_2$-eq)*[42]




Sum of N2Obyactivity and sum of N2Obyactivity% for each Sectors broken down by Aggregated Sectors. Colour shows details about Countries. For pane Sum of N2Obyactivity: Size shows sum of N2Obyactivity. For pane Sum of N2Obyactivity%: Size shows sum of N2Obyactivity%. The view is filtered on Countries and Aggregated Sectors. The Countries filter has multiple members selected. The Aggregated Sectors filter excludes Final consumption (Govt, Households).

[42] See underlying data in Table 29 Table 30 in the Annex II.

*Figure 18 Sectoral changes in fluorinated gases emissions by activity, (in MT $CO_2$-eq)*[43]




Sum of Fgasesactivity and sum of Fgasesactivity% for each Sectors broken down by Aggregated Sectors. Colour shows details about Countries. For pane Sum of Fgasesactivity: Size shows sum of FgasesactivityAbsoluteValue. For pane Sum of Fgasesactivity%: Size shows sum of Fgases%absolutevalue. The view is filtered on Countries and Aggregated Sectors. The Countries filter has multiple members selected. The Aggregated Sectors filter excludes Final consumption (Govt, Households).

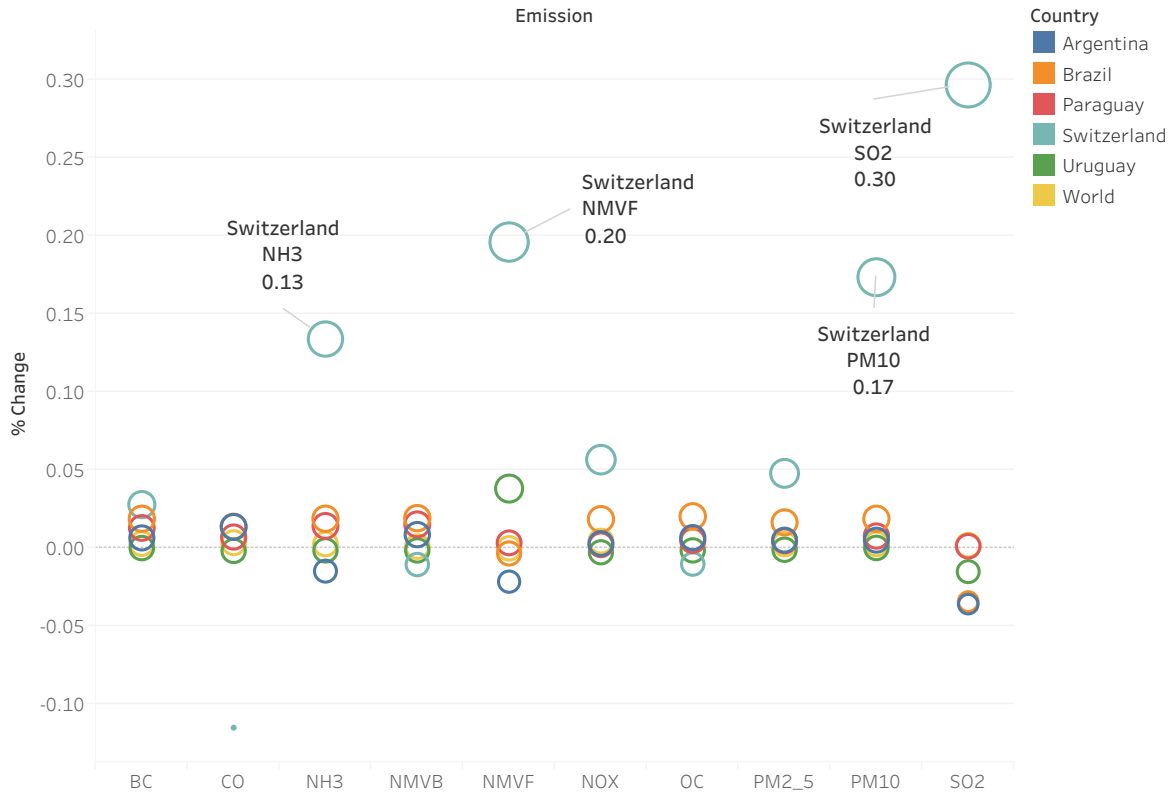
### *4.2.2.2 Air pollution and air quality*

Our estimates indicate that air pollution will not change significantly in the MERCOSUR countries as shown in Figure 19, while for other countries the changes are estimated to be negligible. Percentage changes in our air pollution indicators for Switzerland are between 0.1% and 0.3%, with $NH_3$ (ammonia) increasing by 0.13%, NMVF (Non-methane volatile organic compounds (long cycle carbon) by 0.2%, $SO_2$ by 0.3%, and $PM_{10}$ by 0.17%. These changes are driven by the small estimated increase in overall Swiss manufacturing activities, as discussed in Section 4.2.1. For

[43] See underlying data in Table 31 and Table 33 in Annex II.

the world as a whole, and for the rest of the world, the changes are negligible for air pollutants (consistently ±0.0%).

*Figure 19 Change in other air pollution (in %)*[44]




Source: Own calculations using GTAP.

### 4.2.2.3 *Environmental risks*

#### 4.2.2.3.1 Deforestation risks

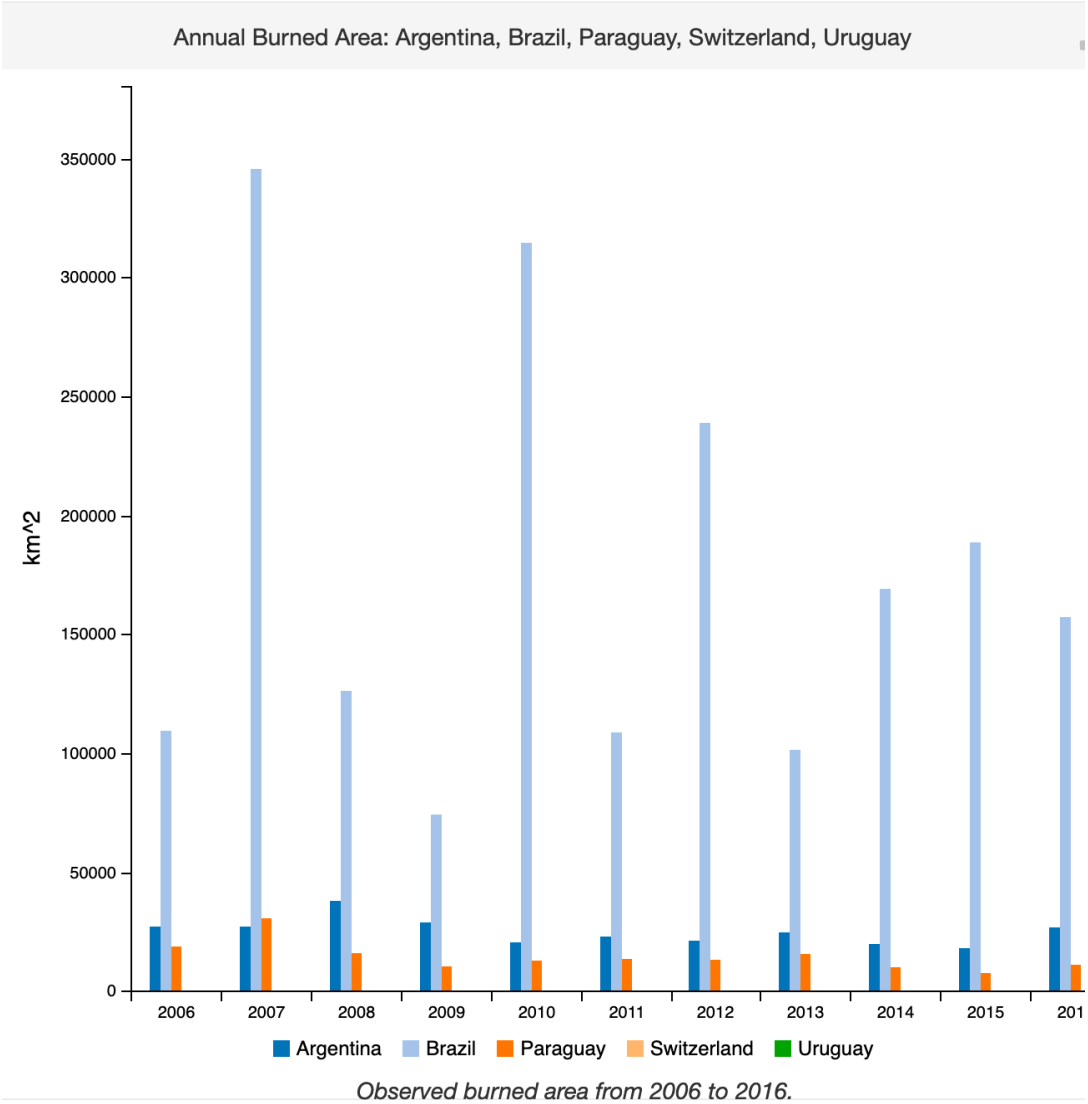
A major environmental issue identified in previous SIAs for some of the MERCOSUR countries is deforestation (LSE Consulting, 2019). This issue also came to the forefront of discussions, with some of the European signatory countries expressing serious concerns. For example, the Austrian parliament's EU subcommittee voted in mid-September to reject the draft free trade agreement, thus obliging their government to veto the pact at EU level. The risk of deforestation has been highlighted by recent events, as significant forest fires in Brazil took place. Deforestation also becomes a source of atmospheric trace gases and aerosols, and increases atmospheric $CO_2$.

Figure 20 shows the size of the yearly burned area in $km^2$ from 2006 to 2016 for each MERCOSUR country and Switzerland. While in Uruguay and in Switzerland there was no observed burned area over the period, there was a continuous observed burning in all other countries. The most pronounced area burned was in Brazil, which is also the country with the greatest land area.

[44] See underlying data in Table 24 in Annex II.

Figure 21 shows the scale of deforestation together with the increase in the share of land used for agricultural activities for each MERCOSUR country and Switzerland over the last decade. While in Uruguay and in Switzerland the share of forests in total land area increased over time, there was a continuous decrease in forests in all other countries. The most important reduction in the share of forests took place in Paraguay, where while the share of forests was 46.5% in 2005, it shrank to 37.7%, which is almost a 20% decrease in forest area over the period. While Brazil has still by far the highest share of forests in total land, the trend over the last decade is also a clear continuous reduction in this share.

*Figure 20 Annual Burned Area*




Source: http://www.globalfiredata.org.[45]

[45] Note, this is the most recent data available at the time of writing.

*Figure 21 Share of forests and agricultural land in total land area*


Source: World Development Indicators, World Bank

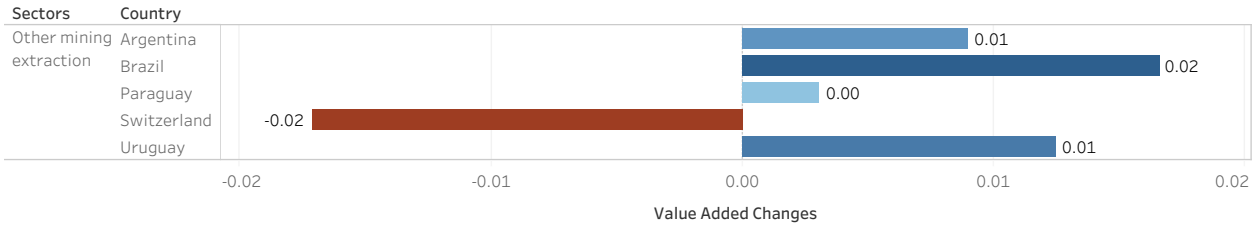
### *4.2.2.4 Deforestation risks linked to mining*

Negative environmental impacts from mining range from heavy metal pollution to deforestation. For example, weak environmental management and enforcement in the mining sector has led to harmful by-products, waste, and difficult mine closures in Argentina (World Bank, 2016). There are various factor which might increase environmental damage linked to mining in Argentina, one being the increased pressure for lithium mining, of which Argentina has relatively high reserves. In Brazil's Amazon, mining (including gold mining) is a driving factor behind deforestation in the region. Sonter *et al.* (2017) find that mining significantly increased forest loss in the region, resulting in about 11,670 km$^2$ of deforestation between 2005 and 2015. This amounts to about 9% of all Amazon forest loss during the period. Additionally, gold mining poses clear risks for mercury pollution in the Amazon basin (Adler Miserendino *et al*., 2017).

We can expect that if we do have changes in mining activities under the EMFTA, these will have a negative impact on a range of environmental outcomes, including land use and protection of forests, water pollution, soil fertility and contamination, toxic chemicals, and mineral and other natural resources. However, the market access terms of the EMFTA actually lead directly to only very small changes in mining activities since most mining products were already exempted from

tariffs before the agreement. The occurring changes are driven more by general equilibrium effects (i.e. due to other sectors contracting slightly). Figure 22 depicts the estimated changes in the intensity of mining activities. In all MERCOSUR countries, mining activities are estimated to increase, albeit to a very minor extent, with the biggest increase estimated to take place in Brazil amounting to a 0.02% increase. Hence the consequent negative environmental impact linked to changes in mining activities due to the trade agreement are expected to be very limited, though still negative. Additionally, the detailed figures above showing each sector's contribution to GHGs showed no discernible change driven by the mining sector. While there are risks, they do not appear to manifest in this case.

*Figure 22 Estimated changes in mining activities (in %)*[46]




Source: Own calculations using GTAP.

#### 4.2.2.4.1 Land use risks due to agriculture sector and deforestation

According to the 2009 Trade Sustainability Impact Assessment (SIA) of the Association Agreement under negotiation between the European Community and MERCOSUR (Kirkpatrick and George, 2009), there was an expected increase in agricultural production. According to the report, this increase in production would increase demand for resources, most importantly land and water, but also potentially increasing deforestation, contributing to deterioration in biodiversity and climate change.

Our results indicate a minor change in agricultural activity due to the trade agreement with the EMFTA. Figure 23 shows the estimated percentage change in the agricultural sector's value added. In all countries these changes remain below 0.1%. In Argentina, Brazil, and Paraguay, the expansion of agricultural activities is estimated to correspond to a less than a 0.05% change. The most pronounced change is estimated take place in Uruguay, with an estimated 0.05% increase in bovine cattle, sheep and goats (driven by non-bovine cattle).

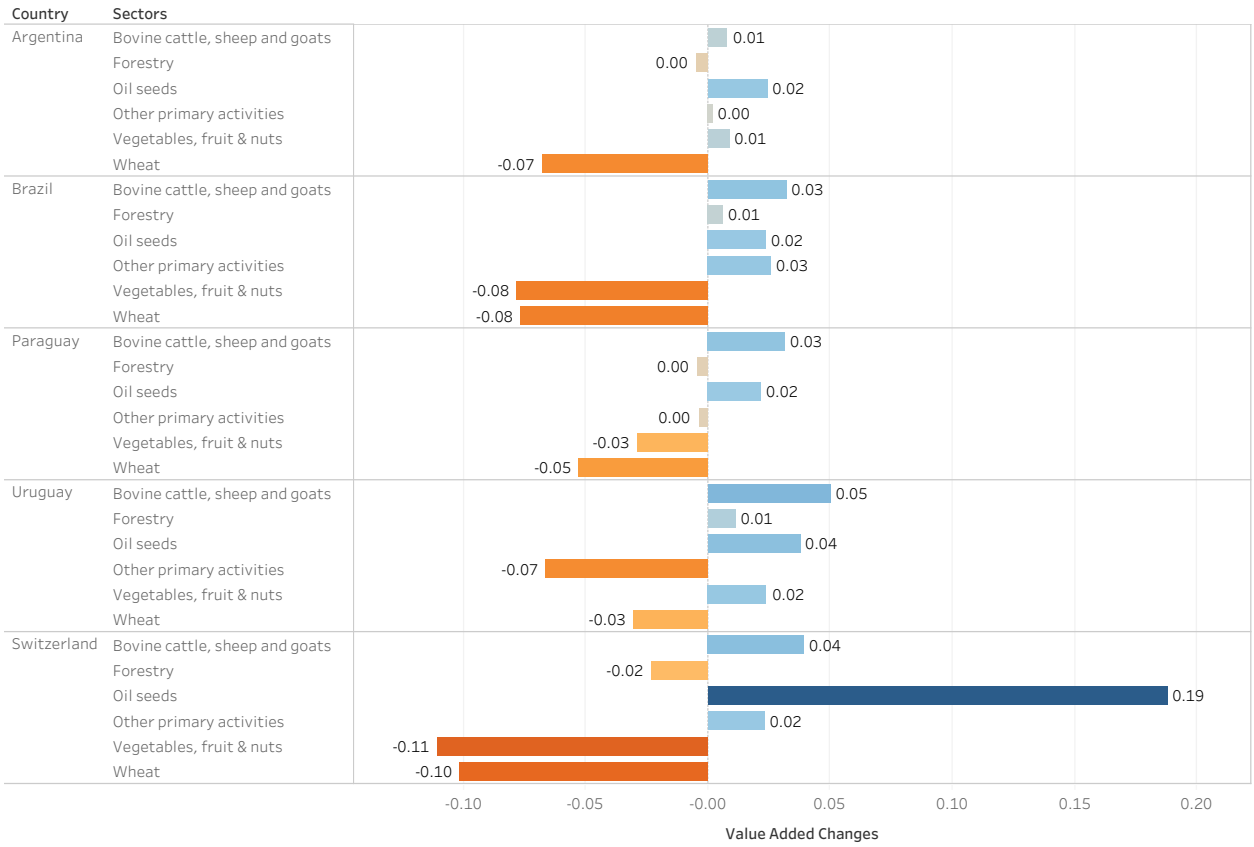
The expected changes in agricultural activities are somewhat higher in Switzerland, but nevertheless still small, with all changes below 0.2%. In Switzerland estimated increase would take place in oil seeds (0.19%), and cattle (0.04%), while vegetables, fruit and nuts, and wheat would shrink by about 0.1%.

An increased demand for agricultural land, which would potentially have a negative impact on the environment, would be also seen from the market signal of increased land prices. There is an

[46] See underlying data in Table 35 in the Annex II.

estimated increase in land prices in all MERCOSUR countries. This is mainly driven by the previously presented increase in some of the agricultural activities which underpin the increased demand for land. Nevertheless, the estimated changes are all below or around 0.1% (and so at most minor). The greatest estimated increase is in Brazil's land prices (0.1%), indicating an increased demand for land, potentially resulting in increased incentives for further deforestation. Furthermore, land prices for Switzerland are also estimated to see a (minor) increase of 0.07%.

*Figure 23 Estimated change in value added in agricultural sectors, in %*[47]




Source: Own calculations using GTAP.

It is important to note that most of the historically large increases in land demand for commodity crops in MERCOSUR have indeed been generated by increased international trade, in particular from China. For example, soybean exports from Brazil to China expanded almost 17 times in the last 15 years.[48] Moreover, if the EU-MERCOSUR FTA does increase trade in agricultural goods (mainly of meats), then this can be expected to substantially expand land use demand, and hence, deforestation risks in the MERCOSUR countries. However, as explained above, the EMFTA creates very limited incentives for expansion in agricultural and food trade between Switzerland and MERCOSUR, and this explains why the consequent deforestation risks are muted. This also contrasts sharply with possible impacts from the EU-MERCOSUR agreement. The key difference

[47] See underlying data in Table 35 in the Annex II.

[48] Using UN COMTRADE data, from US$2 billion in 2000 to US$35 billion in 2014 (Zalles *et al.,* 2019).

is the importance of largely unchanged import quotas for agricultural products in the case of the EMFTA.

When we use an alternative specification of our core economic model, wherein supply of agricultural land is allowed to expand as a result of a larger demand for land as a production factor for agricultural and food activities, we find again minor changes in agricultural land use (see Table 10). This provides an estimate of potential (upper bound) risk for repurposing forests for agricultural purposes. We find that land use increases by 0.02% for MERCOSUR as a whole. This result is driven mainly by increases in Argentina and Brazil. Assuming that all the new agricultural land is taken through deforestation, instead of repurposing existing land, this implies potential deforestation effects of the EMFTA of around 901 square kilometres (km2) until the agreement has been fully implemented, when the full economic impacts should be in effect. This implies a yearly deforestation rate of 43 km2, which represents 0.1% of the current yearly deforestation of more than 40,000 km2.

*Table 10*
MERCOSUR: Estimated upper bound land use changes and comparison to current deforestation

| | Agricultural land area in 2017, $km^2$ | Estimated % change in land use from CGE model, percent | Potential deforestation until 2040, $km^2$ | Potential deforestation yearly average 2020-40, $km^2$ | Deforestation yearly average 1990-2015, $km^2$ | Share of potential against current deforestation |
|---|---|---|---|---|---|---|
| Argentina | 1,487,000 | 0.02 | 297 | 14 | 4,801 | 0.30% |
| Brazil | 2,835,460 | 0.02 | 567 | 27 | 33,229 | 0.08% |
| Paraguay | 218,850 | 0.01 | 22 | 1 | 3,646 | 0.03% |
| Uruguay | 144,496 | 0.01 | 14 | 1 | -655 | -- |
| MERCOSUR | 4,685,806 | 0.02 | 901 | 43 | 41,022 | 0.10% 1/ |

Sources: Own estimations using GTAP-10 database, with additional data from the World Development Indicators, UNSD Environmental Indicators and Tabeau et al. (2017).
1/ See text with reference to Zalles (2019). Historically, around 20% of agricultural land expansion involves deforestation, so the 0.10% potential would imply 0.02% if realized at the historical rate of land repurposing versus expansion.

This estimate of potential deforestation should be viewed in the context of historical land use patterns. The deforestation rates in Brazil decreased sharply between 2009 and 2014, with a low of 5000 $km^2$ in 2014. Nevertheless, deforestation rates have started increasing again in the last years, with an average deforestation for 2015-2018 of almost 7000 $km^2$ (Butler, 2019). However, these more recent deforestation rates still remain well below the rates observed at the beginning of the 2000s, which consistently surpassed 20000 $km^2$. Therefore, if we use a yearly deforestation rate of 7000 $km^2$ in Brazil (instead of the long term average of more than 30000 $km^2$) the share of the potential deforestation associated with the implementation of the EMFTA will represent around 0.25% (instead of 0.08%) of current yearly deforestation rates.

Tabeau *et al.* (2017) find that statistical and economic data show that land use intensity is much more significant than the expansion of agricultural land. However, Argentina and Brazil have

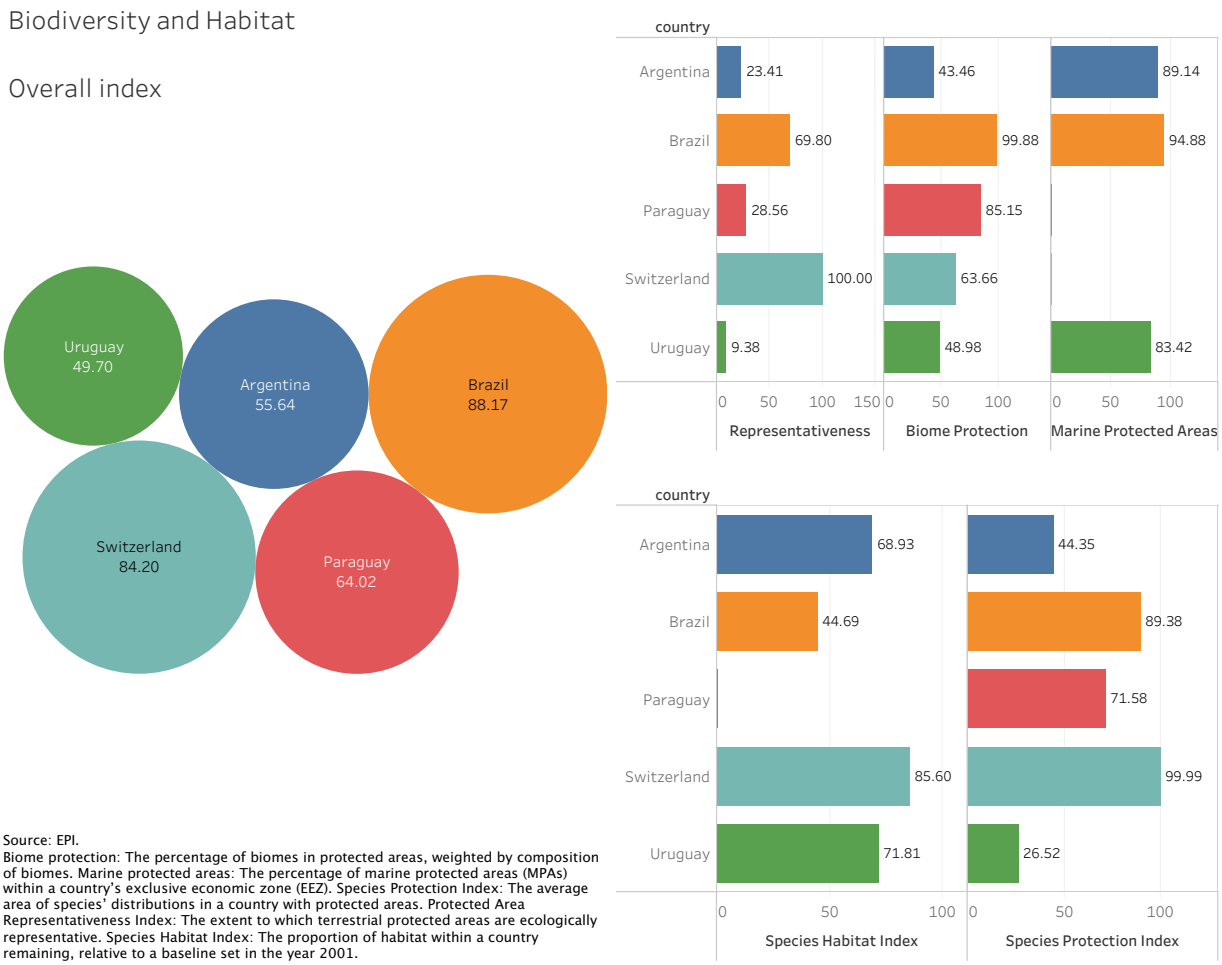
experienced large increases in land expansion due to a surge of international demand for commodity crops (i.e. soya, sugarcane, corn). Zalles *et al.* (2019) find that even though land used for commodity crops almost doubled in Brazil between 2000 and 2014, 80% of this increase was achieved through the repurposing of pastures and the intensification of land use (considering a pasture transition period of 3 years or less). Thus, if we use these results from Zalles *et al.* (2019) that 20% of increased agricultural production is achieved through deforestation (and the remaining 80% through land repurposing), then the share of the potential deforestation associated with the EMFTA drops well below 0.1% of current yearly deforestation rates, and closer to 0.02%.

Finally, when we use a larger land use elasticity of 0.5 (instead of the weighted average for MERCOSUR of 0.319) we find results with similar magnitudes. Land use in MERCOSUR increases to 0.024% (instead of increasing by 0.020%), which translates into a yearly deforestation rate that represents 0.13% (instead of 0.10%) of current rates. However, if we assume again that 20% of this land use expansion is achieved through deforestation, then the expected deforestation from the EMFTA will also drop well below 0.1% of current yearly deforestation rates. While deforestation is decidedly relevant, the magnitudes identified here are quite small relative to the overall problem. Again, this is because of the role played by agricultural quotas in the EMFTA, combined with the relative size of the economies involved. On the other hand, one can expect that the EU-MERCOSUR agreement could have larger effects.

#### 4.2.2.4.2 Biodiversity risks due to agriculture and forest activities

MERCOSUR countries are quite different in their current situation regarding biodiversity and habitat. Based on the 2018 EPI indexes, Brazil is the best performer in terms of overall performance with the EPI index in biodiversity and habitat being 88. The sub-indexes provide more insights into the underlying factors both in biome protection, which is the percentage of biomes in protected areas, weighted by national composition of biome, and in marine protected areas, which is the percentage of marine protected areas within a country's exclusive economic zone. Brazil outperforms all other countries (including Switzerland). However, in species habitat, which is the proportion of habitat within a country remaining, relative to a baseline set in the year 2001, it has the lowest performance. On the other hand, Uruguay has the lowest overall score with 49.7, followed by Argentina with 55.6, and Paraguay with 64.2.

*Figure 24 Biodiversity and Habitat, 2018, EPI*



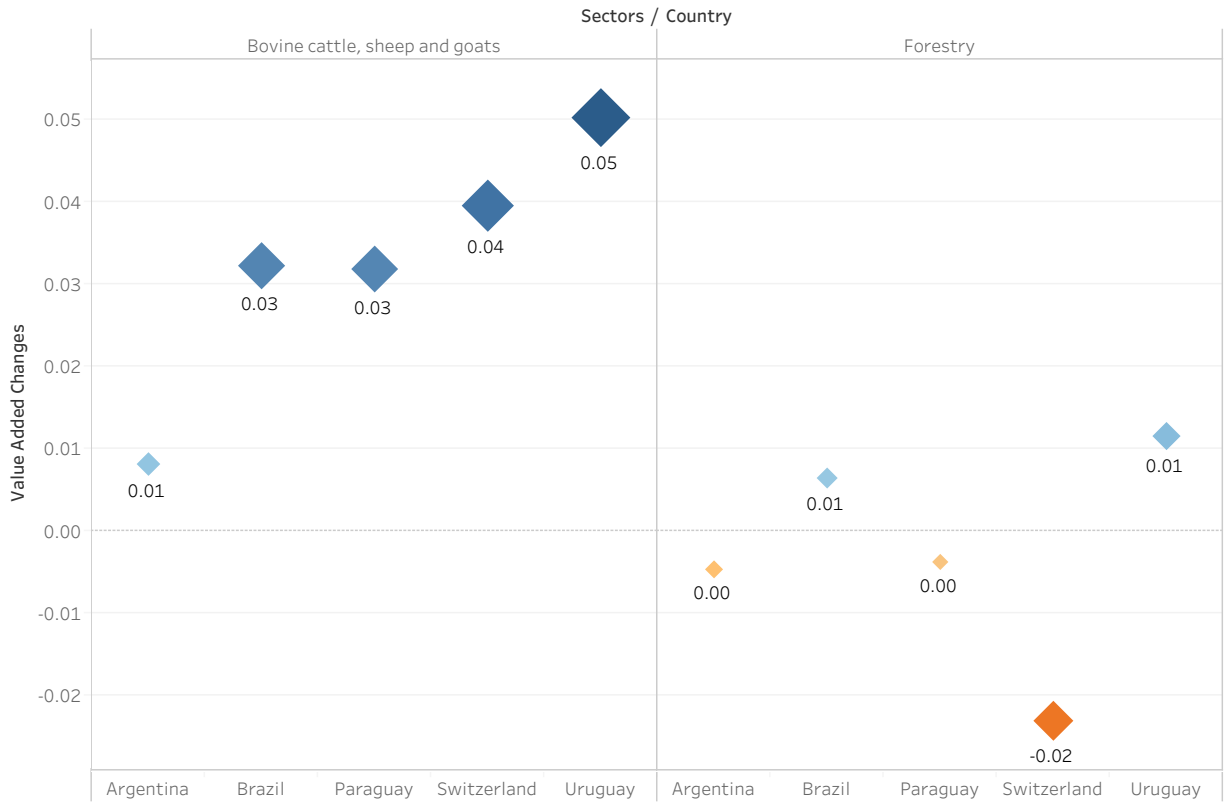

Source: EPI.
Biome protection: The percentage of biomes in protected areas, weighted by composition of biomes. Marine protected areas: The percentage of marine protected areas (MPAs) within a country's exclusive economic zone (EEZ). Species Protection Index: The average area of species' distributions in a country with protected areas. Protected Area Representativeness Index: The extent to which terrestrial protected areas are ecologically representative. Species Habitat Index: The proportion of habitat within a country remaining, relative to a baseline set in the year 2001.

The 2019 EU-MERCOSUR interim SIA report highlights biodiversity as an area of concern to be covered in the final SIA report, but apart from limited discussion on FAO findings related to fisheries, and noting that EU agreements typically include provisions for sharing information on biodiversity and habitat to fisheries, as well as commitments not to degrade protections in the area, little analysis is actually provided. (This is pending with the final EC report.) However, the earlier 2007 final SIA report on an EU-MERCOSUR agreement (the current EU SIA is not the first such impact assessment) does go further, highlighting the potentially unfavourable impact of an EU-MERCOSUR agreement on biodiversity, intensified by increased demand in Europe for biofuels, particularly from Brazil. That report highlighted potential threats to biodiversity, most importantly linked to timber logging, conversion of land to soya been production, agricultural production (most importantly cattle ranching and sugarcane production). According to the report, the most sensitive areas are the Amazon region due to potential further deforestation, the Brazilian Cerrado which is the most biologically rich savannah (here the main risk is increased monoculture crop production), extensive areas of wetland at the Deltas of the Orinoco, Parana and Tigre rivers (where the risk to biodiversity stems from plantation forestry), the Pampas of Argentina, Uruguay and southern Brazil, and the Brazilian sertão (where the main risk is being

cattle ranching, soya and cereal production). The older EU report also highlights the importance of strict measures of public control to avoid potentially significant adverse impacts.

Figure 25 looks at two main activities highlighted by previous SIAs as potential risks. While the estimated changes in forestry activities are judged to be minor, there is an expected increase in bovine cattle, sheep, and goat production, with the highest increase is estimated to take place in Uruguay, equivalent to a 0.05% increase in overall production. This is driven by an increase in non-bovine cattle supporting the estimated increase in exports in these products (see Table 4 and Table 5). Keeping in mind the relative magnitudes involved, this change may result in a negative impact on biodiversity in the long run, most importantly in Uruguay.

*Figure 25 Change in cattle, sheep, goats and forestry activity (% change in value added)*[49]




Source: Own calculations using GTAP.

#### 4.2.2.4.3 Further Water Risks

Another environmental risk relates to water quality, which intersects with concerns about the general health of ecosystems (biodiversity). An important market access concession in the EMFTA is the elimination of Swiss textile tariffs. As discussed above, this leads to an increase of MERCOSUR exports of 0.64 percent, though with little discernible change in output levels. Textile production is associated with high volume water usage, as well as toxic metals pollution (Cardoso

[49] See underlying data in Table 35 in the Annex II.

de Oliveira Neto *et al*., 2019; Sandin *et al*., 2018). While there is an increase in MERCOSUR textile exports, there is basically no corresponding increase in output, meaning increased trade under the EMFTA involves diversion of trade from other destinations. As such, in this case we do not identify dangers to water quality from expanded textile production. Additionally, the risk to water quality linked to land use and mining, as discussed above, is limited.

## 4.3 Trade in Environmental Goods

An important subset of all goods shipped from Switzerland to MERCOSUR are classifiable as environmental goods (EGs). Improved market access in these goods may carry positive implications for pollution control, alternative energy use, and reduction in water and raw materials waste. The definition of environmental goods and their categories are taken from APEC and EU lists in the recent EG negotiations:[50]

(i) Air pollution control (APC) products, used to remove polluted particles from the air, emitted at industrial sites. Brazil is listed as one of the countries with higher applied tariffs in this sector in products like marine scrubbers, slurry pumps and vacuum pumps (the latter together with Argentina);

(ii) Cleaner and renewable energy (CRE) products, required for the generation of electricity by methods that are environmentally preferable to conventional alternatives. Brazil is listed as one of the countries with higher applied tariffs in this sector in clutches, shaft couplings and biomass boilers;

(iii) Energy efficiency (EE) products, to manage and restrain the growth in energy consumption. Brazil is listed as one of the countries with higher applied tariffs in this sector in products like fuel cells and IE4 motors (the latter together with Argentina);

(iv) Environmental monitoring, analysis and assessment (EMAA) products used to measure air quality, water quality, heavy metal contamination in soil, hydrocarbon pollution, and biological pollution. Brazil is listed as one of the countries with higher applied tariffs in this sector in products like thermometers, barometers, multimeters and gas meters (the latter together with Argentina);

(v) Environmentally preferable products (EPP) that cause significantly less 'environmental harm' at some stage of their life cycle than alternative products that serve the same purpose. Brazil is listed as one of the countries with higher applied tariffs in this sector in bamboo;

(vi) Environmental remediation and clean-up (ERC) products, designed to counteract environmental degradation, including anthropogenic disasters. Both Argentina and Brazil are listed as countries with higher applied tariffs in this sector in products like absorbers, oil skimmers and soil-heating apparatus;

[50] See for example European Commission (2016a).

(vii) Noise and vibration abatement (NVA) products, to control noise pollution and reduce engine noise. Both Argentina and Brazil are listed as countries with higher applied tariffs in this sector in products like rail absorbers, mufflers and exhaust pipes. Brazil is also listed in cork for insulation;

(viii) Resource efficiency (RE) products, like solar or thermal stoves and sealing devices. Brazil is listed as one of the countries with higher applied tariffs in the latter product;

(ix) Solid and hazardous waste management (SHWM) products. Brazil is listed as one of the countries with higher applied tariffs in the machines used for mixing, kneading, crushing, grinding, screening, sifting, homogenizing, emulsifying or stirring; and

(x) Wastewater management and water treatment (WMWT) products. Brazil is listed as one of the countries with higher applied tariffs in this sector in products like sludge dewatering centrifuges, slurry pumps and Woven pile fabrics and chenille fabrics (the latter together with Argentina).

In Table 11 we present a list of the top 15 environmental goods that Switzerland is currently exporting to MERCOSUR at an HS6 level. Under the EMFTA, these goods will see tariff decreases from an average of 12.20 initial MFN weighted tariff to an average of 0.34 preferential weighted tariff. These are mainly machines, instruments and other appliances that are used for water treatment, solar panel installations, and for environmental quality control and monitoring. With few exceptions, MERCOSUR countries have no general standards or specific production and consumption requirements (e.g. certification and labelling) for the environmental goods described above. For example, all MERCOSUR countries have adopted regulations on energy efficiency, establishing mandatory energy labelling for home appliances, gas appliances and buildings, in the case of Uruguay[51] and Brazil,[52] or for specific products in the case of Argentina,[53] like refrigerators, freezers, air conditioners, electric washing machines, and incandescent and fluorescent lamps (the latter also for Paraguay).[54]

[51] Uruguay, Ministerio de Industria, Energía y Minería, http://www.eficienciaenergetica.gub.uy/normas-y-especificaciones-tecnicas

[52] Brazil, Law 10.295 of 17 October 2001, Energy Efficiency Law.

[53] Argentina, Secretaría de Energía, http://www.energia.gob.ar/contenidos/verpagina.php?idpagina=3445

[54] Paraguay, Ministerio de Industria y Comercio, Decree N° 7103 27 April 2017, http://www.snin.gov.py/reglamentos/Decreto%20N%C2%BA%207103_17%20_Registro%20Imp.%20L%C3%A1mparas%20y%20LPI.pdf

*Table 11 Top 15 environmental goods (EG) exports from Switzerland to MERCOSUR (by HS-6 product line), based on EGA classifications*

| | HS-6 code | EG Category | Current tariffs (%) | EMFTA tariffs (%) | Import value ('000 US$) | Product description |
|---|---|---|---|---|---|---|
| 1 | 8486.10 | 2. CRE | 14.00 | 0.00 | 9,394.5 | Machines and apparatus for the manufacture of boules or wafers |
| 2 | 8414.90 | 10. WMWT | 14.00 | 0.00 | 7,744.5 | Pumps and compressors; parts, of air or vacuum pumps, air or other gas compressors and fans |
| 3 | 8479.89 | 9. SHWM | 12.00 | 0.00 | 6,357.5 | Machines and mechanical appliances; n.e.s. in item no. 8479.8, having individual functions |
| 4 | 9031.80 | 5. EMAA | 10.67 | 0.00 | 6,008.1 | Instruments, appliances and machines; for measuring or checking |
| 5 | 9027.80 | 5. EMAA | 8.75 | 0.00 | 5,919.7 | Instruments and apparatus; for physical or chemical analysis, for measuring or checking |
| 6 | 9027.90 | 5. EMAA | 3.50 | 0.00 | 5,527.4 | Microtomes and parts and accessories thereof |
| 7 | 3926.90 | 10. WMWT | 12.22 | 0.00 | 4,545.5 | Plastics; other articles n.e.s. in chapter 39 (for use in medicine, laboratories and pharmaceuticals) |
| 8 | 8504.40 | 3. EE | 16.22 | 2.00 | 3,855.7 | Electrical static converters |
| 9 | 8481.80 | 10. WMWT | 15.14 | 0.00 | 3,295.2 | Taps, cocks, valves and similar appliances; for pipes, boiler shells, tanks, vats |
| 10 | 8479.90 | 9. SHWM | 15.00 | 0.00 | 3,285.4 | Machines and mechanical appliances; parts, of those having individual functions |
| 11 | 9032.89 | 5. EMAA | 15.20 | 0.00 | 3,204.4 | Regulating or controlling instruments and apparatus; automatic, other than hydraulic or pneumatic |
| 12 | 8411.99 | 2. CRE | 0.00 | 0.00 | 3,182.2 | Turbines; parts of gas turbines (excluding turbo-jets and turbo-propellers) |
| 13 | 9027.50 | 5. EMAA | 11.67 | 0.00 | 3,138.4 | Instruments and apparatus; using optical radiations (UV, visible, IR) |
| 14 | 8419.89 | 1. APC | 12.00 | 2.00 | 2,952.1 | Machinery, plant and laboratory equipment; for treating materials by change of temperature |
| 15 | 9026.90 | 5. EMAA | 16.00 | 0.00 | 2,815.2 | Instruments and apparatus; parts and accessories for those measuring or checking t liquids or gases |

Notes: The environmental goods (EG) definitions are based on the combined APEC and EU HS6 lists of goods. Categories are also based on the EG agreement (EGA) negotations for goods.
EG Categories :1 Air pollution control (APC). 2 Cleaner and renewable energy (CRE). 3 Energy efficiency (EE). 4 Environmentally preferable products (EPP).
5 Environmental monitoring, analysis and assessment (EMAA). 6 Environmental remediation and clean-up (ERC). 7 Noise and vibration abatement (NVA). 8 Resource efficiency (RE).
9 Solid and hazardous waste management (SHWM). 10 Wastewater management and water treatment (WMWT).

Table 12 reports more broadly the changes in MERCOSUR tariffs for this category of goods under the EMFTA (Swiss tariffs are essentially zero percent for these products already). The average tariff applied to EGA goods – which include pollution control devices, machinery used in clean energy production, and pollution monitoring devices, among others – is 12.1 percent and affects 5.1 percent of Swiss exports to MERCOSUR. With EMFTA these tariffs will fall from a 12.1 to a 0.34 percent tax on Swiss exports of EGA goods to MERCOSUR. While we flag these reductions in taxes in the report, we have not attempted to explicitly quantify any potential impact of reduced costs for environmental goods on environmental degradation in the MERCOSUR countries.

Based on Swiss export data, Brazil is the main market for environmental goods in MERCOSUR. The main product areas are equipment and instrumentation associated with pollution control and clean-up.[55] Some European companies in this sector are already present in the Brazilian market, like Camfil (Sweden)[56] and Ahlstrom-Munksjö (Finland).[57] For the use of these products it is important to note that Brazil has recently issued a regulation to improve its air quality standards, based on the air quality guide values recommended by the World Health Organization (WHO) in 2005.[58]

In Argentina, wind projects have proliferated between the late 20th century and early 21st century, mainly in the South of the Province of Buenos Aires (SUBA, by its Spanish acronym).

[55] University of Manchester, Trade Sustainability Impact Assessment (SIA) of the Association Agreement under Negotiation between the European Community and MERCOSUR, November 2008, https://trade.ec.europa.eu/doclib/docs/2008/november/tradoc_141394.pdf, p. 47 and 61.

[56] https://www.camfil.com/pt-br

[57] https://www.ahlstrom-munksjo.com/pt-br/produtos/meio-filtrante/filtragem-de-ar-para-industria/controle-de-poluicao-do-ar/

[58] Brazilian National Environmental Council (CONAMA), Resolution No. 491 of 19 November 2018. However, in June 2019, the Attorney General's Office (PGR) filed with the Federal Supreme Court a Direct Action of Unconstitutionality (ADI 6148) against this Resolution, for alleged unconstitutionality due to insufficient protection of the rights to information, health and the ecologically balanced environment.

Today, the competitiveness of the wind sector due to cost reductions, fast technological development and the need of international wind companies to expand their markets into new regions, opens new trade opportunities in Argentina.[59]

Although the increasing trade of these products may have negative environmental impacts, it is also important to note that environmental impacts may also be positive if environmental goods are adopted for use in domestic productive activities. Environment gains could be obtained through access to air quality protection, noise abatement, and remediation services for contaminated land and water.

Table 12 MERCOSUR tariffs against Swiss environmental goods exports

| | Initial (MFN) tariff, % | EMFTA tariff, % | share in Swiss exports to Mercosur, % | share in total Swiss trade, % |
|---|---|---|---|---|
| 1 Air pollution control (APC) | 12.70 | 0.59 | 0.59 | 0.20 |
| 2 Cleaner and renewable energy (CRE) | 11.39 | 0.00 | 0.85 | 1.00 |
| 3 Energy efficiency (EE) | 14.47 | 0.63 | 0.49 | 0.62 |
| 4 Environmentally preferable products (EPP) | 11.62 | 1.93 | 0.14 | 0.03 |
| 5 Environmental monitoring, analysis and assessment (EMAA) | 9.91 | 0.12 | 1.60 | 1.13 |
| 6 Environmental remediation and clean-up (ERC) | 20.00 | 0.00 | 0.00 | 0.00 |
| 7 Noise and vibration abatement (NVA) | 14.87 | 0.00 | 0.07 | 0.02 |
| 8 Resource efficiency (RE) | 14.14 | 2.05 | 0.02 | 0.06 |
| 9 Solid and hazardous waste management (SHWM) | 13.29 | 0.90 | 0.48 | 0.71 |
| 10 Wastewater management and water treatment (WMWT) | 14.25 | 0.19 | 0.84 | 1.22 |
| **All environmental goods** | 12.09 | 0.34 | 5.08 | 4.99 |

Notes: The environmental goods (EG) definitions are based on the combined APEC and EU HS6 lists of goods.
Categories are also based on the EG agreement (EGA) negotations for goods.

[59] Luciana Vanesa Clementi, 'Energía Eólica y Territorios en Argentina.' (Universidad Nacional del Sur 2017) <http://repositoriodigital.uns.edu.ar/bitstream/123456789/4197/1/TESIS%20DOCTORAL.Clementi%20Luciana%20%202017.pdf>.

# 5 Concluding discussion: Lesson learned and possibilities for follow up analysis

In this report, we have examined the possible environmental effects of the EMFTA. The exercise has involved a model-based assessment of the economic impact, alongside a mapping of economic outcomes into environmental outcomes. The follow-up analysis is both quantitative and qualitative.

The terms of reference for this study called for a top down assessment of the EMFTA. In particular, a CGE model has been used to estimate the macroeconomic and sector level economic effects. These in turn have been used to estimate changes in model-based environmental indicators. The analysis also takes advantage of what is called multi-region input output (MRIO) analysis of the benchmark database, as well as the counterfactual database (meaning the post-EMFTA database). MRIO analysis makes possible the tracing of resource and embodied emission flows across global value chains.

To our knowledge, this is one of the first studies formally conducted for the Swiss government on the environmental effects of a Swiss trade agreement across all industries.[60] The combination of CGE modelling and complementary MRIO-based value chain analysis provides a top-down assessment of the impact of the EMFTA. However, it does not in itself identify flanking measures that might be taken, nor does it provide a more micro or detailed (bottom-up) picture for specific products. In the present context, we believe that such an analysis is sufficient. This is because in most sectors the EMFTA involves commitment to maintain existing preferences, including agri-food quotas. The consequent trade and output effects are therefore quite limited and this translates into very limited potential environmental impact.

As with any modelling exercise, there are uncertainties associated with the CGE model outputs. We consider that the main inputs to estimate the economic impact of the EMFTA (tariff, non-tariff, and quota change) have been thoroughly and appropriately included, since we used the actual product-level changes negotiated. This represents a strength of our analysis, as explained above. Therefore, as long as the final (signed) agreement does not deviate substantially from the negotiated agreement, the estimated economic impacts in this study should hold. In particular, if the final quotas and tariffs related to agricultural and food products remain in line with the negotiated ones, the main environmental impacts in our study should also hold. On the other hand, computational general equilibrium models are large and complex systems with several key parameters (e.g. trade elasticities, production and consumption parameters), and macroeconomic assumptions (i.e. closures) among others. In the context of the EMFTA analysis, where there is limited trade liberalisation and hence relatively small trade and economic effects, the need to test the sensitivity of our results to these parameters is less relevant. In principle, the expected variations in the economic results should be relatively small, and since the estimated impacts are already relatively small, then no significant changes are expected from such a sensitivity analysis. Nevertheless, one area where our main CGE model could provide divergent results under different assumptions is the estimation on the land use impacts. To deal with this

[60] Environmental effects of liberalisation of the agricultural sector has been done in 2019: Umweltauswirkungen einer Marktöffnung im Landwirtschaftsbereich – Analyse drei theoretischer Handelsszenarien, Studie im Auftrag des BAFU

uncertainty, we have also used (and reported on) an alternative model specification where land use is modelled differently (see Section 3.4). Using this alternative model specification, however, does not alter our main results, and the impacts on land use (and its associated impact on deforestation) remain negligible.

This study has benefited from a very detailed analysis of the actual tariff, non-tariff and quota changes associated with the negotiated EMFTA. This level of detail allows our CGE model to provide relatively realistic estimates of the economic activity changes associated with the negotiated agreement. Given that the level of the Mercosur countries' market access to Switzerland is being maintained (but not substantially increased) under the EMFTA, we estimate negligible changes in trade and production levels in Mercosur, which in turn imply muted environmental impacts. The limited economic effects we estimate from EMFTA are the main difference with other studies. Alig *et al.* (2019), for instance, worked with a much more ambitious trade liberalisation scenario (up to 50% reductions in tariffs). We have benefitted from hindsight. We have been able to work with the actual negotiated market access commitments. The earlier studies did not have this information to the same extent and detail. The actual negotiated agreement turns out to include far less changes in market access conditions than had been assumed in earlier studies, which accordingly means less economic impact so also less environmental impact than what was estimated in those earlier studies. Similarly, the EU-Mercosur agreement is expected to provide greater relative changes in market access for the Mercosur countries (since the previous GSP conditions have been already revoked), and consequently, the EU-Mercosur agreement can be expected to generate much larger economic activity changes in Mercosur. Hence, the two agreements should be viewed as being quite different. This difference is reinforced by the larger economic mass of the EU with respect to the EFTA countries.

Had the EMFTA led to more substantial changes vis-à-vis current market access conditions, with associated expectations for more substantial changes to trade and production patterns, it would have made sense to follow this CGE based (relatively macroeconomic) environmental impact and risk assessment with a more detailed product-specific analysis. This also holds for similar exercises of future agreements. In particular, while the CGE-MRIO assessment provides an important part of the environmental impact picture, there are also well-established follow-up methods that can build on the resulting CGE-MRIO estimates of trade and production changes to provide richer estimates over the full life-cycle of products (aka life cycle analysis or LCA), as the Federal Office for the Environment has done with the agricultural sector. The CGE-MRIO approach is "comprehensive," in that it is built on a full system of resource flows from extraction through production and finally to consumption. However, while supply chain and LCA analysis of detailed products is not, by definition, comprehensive in the same way, it does offer the potential for valuable analysis at a more detailed level once the broader effects are identified and quantified, as has been done here. In particular, the first-stage CGE model-based top-down estimates of the FTA impacts could be complemented by a second stage bottom-up life-cycle analysis for the most relevant products and sectors affected. Such second stage analysis, in our view, could take the form of hybrid LCA, merging the CGE and MRIO estimates with LCA assessments.[61]

[61] See for example Thomassen *et al*. (2009), Suh (2004), Palma-Rojas *et al*. (2017), and Munasinghe *et al*. (2019).

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# 7 Annex I.: Overview on technical aspects of the modelling of the FTA between EFTA States and MERCOSUR

## 7.1 Overview of the economic modelling

Our quantitative strategy to estimate the economic effects of the FTA involves the use of a computable general equilibrium (CGE). This model, in turn, is calibrated using the GTAP database,[62] and an integrated assessment that builds on an econometric estimation of trade elasticities that determine the trade volume effects of the trade cost reductions in FTAs. In particular, we measure three different types of trade costs: tariff-rate quotas (TRQs), preferential tariffs and non-tariff measures (NTMs). The resulting structurally estimated general equilibrium model (SEGE model) ensures consistency between the empirically-based estimates of the effects of trade agreements, and the subsequent modelling of those agreements.

## 7.2 The CGE model of global production and trade

We employ a computable general equilibrium (CGE) model with multiple countries, multiple sectors, intermediate linkages and multiple factors of production, as developed in Bekkers and Francois (2018) and Bekkers *et al.* (2018). Trade is modelled as in Eaton and Kortum (2002) with the remaining structure of the model largely following the standard GTAP model (Corong *et al.* 2017). The main difference from GTAP is the incorporation of the Eaton and Kortum demand structure, where we derive the gravity equation for our structural estimation of the trade elasticities and changes in trade costs, as discussed above, from this same model. The model set-up and calibration combine features of the older computable general equilibrium (CGE) models (cf. Dixon and Jorgenson, 2013), with the micro-foundations of the more recent quantitative trade models (see Costinot and Rodríguez-Clare, 2014, for an overview). This means that analytically we model trade linkages with the improved micro-founded Eaton and Kortum (2002) structure, while at the same time we have structurally estimated the trade parameters and relevant trade cost changes employing a gravity model derived from the same structural general equilibrium model. Thus, we employ a state-of-the-art CGE model that deals with recent academic criticism of standard CGE models –i.e. that models should be micro-founded based on recent trade theory and the main parameters of the model should be structurally estimated using the same underlying data (cf. Costinot and Rodríguez-Clare, 2014; Bekkers, Francois, and Rojas-Romagosa 2018).

Model simulations are based on a multi-region, multi-sector model of the world economy. Sectors are linked through intermediate input coefficients (based on national input-output and social accounting data) as well as competition in primary factor markets. On the policy side, it offers the option to implement tariff reductions, export tax and subsidy reduction, trade quota expansion, input subsidies, output subsidies, and reductions in NTM related trade costs. International trade costs include shipping and logistic services (the source of FOB-CIF margins) but can also be modelled as Samuelson-type deadweight (iceberg) trade costs. These deadweight

[62] Version 10 with base year 2014. See Aguiar *et al.* (2019).

costs can be used to capture higher costs when producing for export markets due to regulatory barriers or NTBs that raise costs.

In the model, there is a single representative composite household in each region, with expenditures allocated over personal consumption and savings. The composite household owns endowments of the factors of production and receives income by selling these factors to firms. It also receives income from tariff revenue and rents accruing from import/export quota licenses. Part of the income is distributed as subsidy payments to some sectors, primarily in agriculture.

The initial condition of any CGE model is that supply and demand are in balance at some equilibrium set of prices and quantities where workers are satisfied with their wages and employment, consumers are satisfied with their basket of goods, producers are satisfied with their input and output quantities and savings are fully expended on investments. Adjustment to a new equilibrium, governed by behavioural equations and parameters in the model, are largely driven by price equations that link all economic activity in the market. For any perturbation to the initial equilibrium, all endogenous variables (i.e. prices and quantities) adjust simultaneously until the economy reaches a new equilibrium. Constraints on the adjustment to a new equilibrium include a suit of accounting relationships that dictate that in aggregate, the supply of goods equals the demand for goods, total exports equal total imports, all (available) workers and capital stock is employed, and global savings equals global investment. Economic behaviour drives the adjustment of quantities and prices given that consumers maximise utility given the price of goods and consumers' budget constraints, and producers minimise costs, given input prices, the level of output and production technology.

In the structural general equilibrium model, the "whole" economy for the relevant aggregation of economic agents is specified as a set of simultaneous equations. This means that the entire economy is classified into production and consumption sectors. These sectors are then modelled collectively. Production sectors are explicitly linked together in value-added chains from primary goods, through higher stages of processing, to the final assembly of consumption goods for households and governments. These links span borders as well as industries. The link between sectors is both direct, such as the input of steel into the production of transport equipment, and also indirect, as with the link between chemicals and agriculture through the production of fertilizers and pesticides. Sectors are also linked through their competition for resources in primary factor markets (capital, labour, and land). The general conceptual structure of a regional economy in our structural general equilibrium model is detailed in Figure 26 and Figure 27.

*Figure 26 Production Structure in the CGE model*

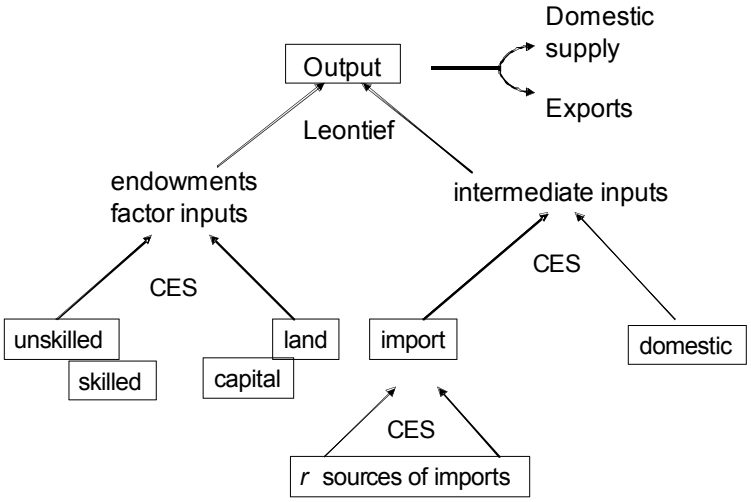
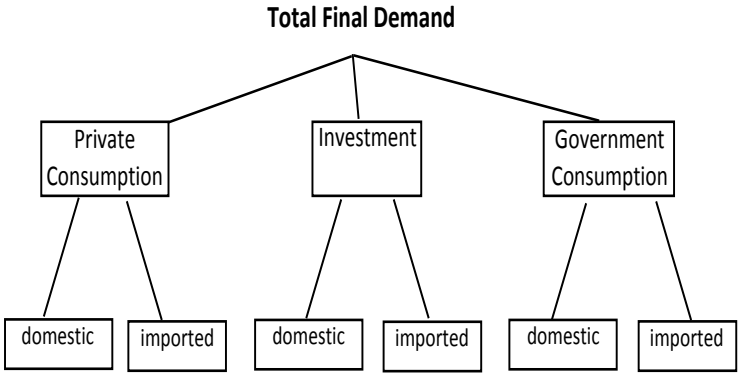



*Figure 27 Consumption Structure in the CGE model*




On the production side, firms produce output, employing land, labour, capital, and natural resources and combine these with intermediate inputs, within each region/country. In technical terms, we model a combination of value added and intermediate inputs, where intermediates (both imported and domestic) are combined in fixed proportions along with value added (known as a Leontief function). Value added itself (e.g. labour and capital) involves what is known as a CES functional form. Firm output is then purchased by consumers, government, the investment sector, and by other firms, and detailed in Figure 27. Firm output can be and is also sold for export. In the model, arable land is only employed in the agricultural sectors, while capital and labour (both skilled and unskilled) are mobile between all production sectors. While capital is assumed to be fully mobile within regions, land, labour and natural resources are not.

In the experiments themselves, we follow the literature and employ recursive dynamics to link changes in investment expenditure to changes in capital stocks. This involves a fixed savings rate, with changes in savings following from changes in income levels. This change is then transmitted into investment and hence into changes in capital stocks (see Francois, McDonald, and Nordstrom, 1996; as well as Bekkers, *et al.,* 2018; for technical discussions). In reporting, we focus

on the reference year of 2040, where we incorporate dynamic effects linking savings, investment, and capital stocks.

For the purpose of defining the scenarios, trading costs are modelled as in ECORYS (2009), CEPR (2012), and Egger, *et al.* (2015), meaning iceberg trade cost reductions. In the case of goods, benchmark values for trade cost reductions are based on gravity-based estimates of the trade cost from ECORYS (2009), except where estimates are unavailable. Where unavailable from the ECORYS/CEPR studies, we use estimates from Egger *et al.* (2015), where services estimates are initially taken from Jafari and Tarr (2015). To fit our global data to the theoretical model, following Egger and Nigai (2015) and Bekkers and Francois (2018), total trade costs and technology parameters are fit from actual import shares (calibration), imposing an exact fit. Changes in trade costs (the structural general equilibrium experiments themselves) are based on assumed 50% and 20% reductions in actionable trade costs, as discussed in the main text.

Taxes are included at several levels in the modelling. Production taxes are placed on intermediate or primary inputs, or on output. Tariffs are levied at the border. Additional internal taxes are placed on domestic or imported intermediate inputs, and may be applied at differential rates that discriminate against imports. Where relevant, taxes are also placed on exports, and on primary factor income. Finally, where relevant (as indicated by social accounting data) taxes are placed on final consumption, and can be applied differentially to consumption of domestic and imported goods.

On the production side, in all sectors, firms employ domestic production factors (capital, labour and land) and intermediate inputs from domestic and foreign sources to produce outputs in the most cost-efficient way that technology allow. Perfect competition is assumed in all sectors, but products from different regions are assumed to be imperfect substitutes.

In the standard GTAP model, tariffs and tariff revenues are explicit in the GTAP database, and therefore in the core model. However, NTMs affecting goods and services trade, as well as cost savings linked to trade facilitation, are not explicit in the database and hence a technical coefficient must be introduced to capture these effects. For this, we instead model NTMs as a mix of dead weight or iceberg costs, and rents generated by these NTMs. In formal terms, dead-weights costs capture the impact of non-tariff measures on the price of imports from a particular exporter due to destination-specific changes in costs for production and delivery.

## 7.3 Underlying data and projections to 2040

The model employs version 10 of the GTAP database, which is benchmarked to the year 2014 (Aguiar *et al.* 2019). The GTAP database is a global multi-regional input-output (GMRIO) database that has extensive and comprehensive economic data for 141 countries/regions and 67 production sectors. This database provides disaggregated data for sectoral production, consumption, taxes and subsidies, trade, government finances, labour variables for different skill levels, and data on other production factors. This database is then projected to the year 2040, using real GDP projections[63] from the OECD, working age population projections from the UN,

[63] .GDP baseline projections are based on the SSP2 scenario developed by the OECD. See Dellink *et al.* (2017).

while domestic and international capital is endogenously determined by the model based on expected rates of return within and between different regions

Tariffs reflect the most recent applied rates, as incorporated in the GTAP database, as of 2014. We update this information by assume that currently agreed FTAs are implemented. This include the Comprehensive Economic and Trade Agreement (CETA) between the EU and Canada, the EU-Japan Economic Partnership Agreement, and the EU-South Korea FTA. In addition, we assume that by 2040, the EU will also have signed an EU-MERCOSUR FTA and that there is FTA between the EU-27 and the United Kingdom (i.e. a soft-Brexit scenario). Note that although some assumptions regarding these potential agreements might impact the "baseline" projections, they will have very limited effects on our "scenario" analysis. In other words, we aim to create a baseline economy in 2040 that reflects as much as possible current and projected economic events, but these assumptions will not be the main determinants of the estimated effects on the EFTA-MERCOSUR agreement.

Since FTA usually create structural effects in the economies involved, CGE analyses are usually medium to long-term economic assessments. In this regard, we employ the most recent GTAP database (version 10 with base year 2014) as our main data source, and project this database to 2040 using OECD and UN macroeconomic and population projections, respectively. These projections to 2040 constitute our "baseline" scenario, which is a business-as-usual scenario without trade policy effects. We then define the FTA scenario (see the following section) and simulate the trade policy changes expected from the agreement. Then, the economic effects of the FTA are the quantified differences between the "baseline" equilibrium (before the policy change) and the "scenario" equilibrium after the policy change.

## 7.4 Sectoral and regional aggregation

While the GTAP database has 67 sectors and 141 different regions are available, for the purpose of this study we have aggregated sectors to allow us to concentrate on the key results.

As explained in Section 3.4in the man report, the sector aggregation is based on a pre-analysis where we identify the products and sectors that can potentially benefit from the EFTA-MERCOSUR FTA. In addition, we also separate sectors where environmental issues might be important – based on particular environmental concerns, as well as current GHG emissions. To this end we use the negotiated preferential tariffs and TRQs from the agreement.[64] Based on this product-line information and using trade data from the Swiss Federal Customs Administration (FCA) and from COMTRADE, we aggregate the product-level data (HS-8) to the 65 sectors in the GTAP-10 database. This yields trade-weighted current (MFN or GSP) tariffs and the trade-weighted negotiated preferential tariffs. These aggregated data allow us to analyse which sectors are currently the most important regarding current trade flows and which ones are mostly affected by the new expected tariffs and TRQs from the agreement.

The resulting sectoral aggregation used in the CGE model are presented in Table 13. The regional aggregation isolates Switzerland, the four MERCOSUR countries (Argentina, Brazil, Paraguay and Uruguay). The remaining regions are chosen as to separate other important trade partners for

[64] The product-line information at the HS-8 level was provided by SECO based on the negotiated agreement.

which trade diversion effects might be interesting to capture separately (see Table 14). Note that although we have 20 country/regions in the CGE model, it remains a global trade model, since all 141 regions in the GTAP database are included in the analysis, although many of them are aggregated into regions (e.g. Rest of Latin America, Middle East and North Africa, and Rest of the World).

*Table 13 Sectoral aggregation used in the CGE model*

| | Code | Sector Names | Aggregated GTAP codes |
|---|---|---|---|
| | | **Primary sectors** | |
| 1 | wht | Wheat | wht |
| 2 | v_f | Vegetables, fruit, nuts | v_f |
| 3 | osd | Oil seeds | osd |
| 4 | ctl | Bovine cattle, sheep and goats | ctl |
| 5 | frs | Forestry | frs |
| 6 | PRY | Other primary | pdr, gro, c_b, pfb, ocr,oap, rmk, wol, fsh |
| 7 | oxt | Other mining extraction | oxt |
| 8 | ENY | Energy (extraction based) | coa, oil, gas, p_c |
| | | **Manufacturing sectors** | |
| 9 | cmt | Bovine meat products | cmt |
| 10 | omt | Meat products nec | omt |
| 11 | mil | Dairy products | mil |
| 12 | vol | Vegetable oils and fats | vol |
| 13 | PRS | Processed rice and sugar | pcr, sgr |
| 14 | ofd | Food products nec | ofd |
| 15 | b_t | Beverages and tobacco products | b_t |
| 16 | tex | Textiles | tex |
| 17 | wap | Wearing apparel | wap |
| 18 | lea | Leather products | lea |
| 19 | lum | Wood products | lum |
| 20 | ppp | Paper products, publishing | ppp |
| 21 | chm | Chemical products | chm |
| 22 | bph | Basic pharmaceutical products | bph |
| 23 | rpp | Rubber and plastic products | rpp |
| 24 | nmm | Other non-metallic minerals | nmm |
| 25 | i_s | Ferrous metals | i_s |
| 26 | nfm | Metals nec | nfm |
| 27 | fmp | Metal products | fmp |
| 28 | ele | Computer, electronic and optic | ele |
| 29 | eeq | Electrical equipment | eeq |
| 30 | ome | Machinery and equipment nec | ome |
| 31 | mvh | Motor vehicles and parts | mvh |
| 32 | otn | Transport equipment nec | otn |
| 33 | omf | Other manufactures | omf |
| | | **Service sectors** | |
| 34 | UTY | Utilities | ely, gdt, wtr |
| 35 | TRW | Trade and warehousing | trd, whs |
| 36 | otp | Land transport | otp |
| 37 | wtp | Water transport | wtp |
| 38 | atp | Air transport | atp |
| 39 | cmn | Communication | cmn |
| 40 | FIR | Finance, insurance & real estate | ofi, ins, rsa |
| 41 | obs | Other business services | obs |
| 42 | RAF | Recreation, accomodation, food | afs, ros |
| 43 | OSV | Public Administration and defence | cns, osg, edu, hht, dwe |

*Table 14 Regional aggregation used in the CGE model*

| | code | Country / region name |
|---|---|---|
| 1 | CHE | Switzerland |
| 2 | ARG | Argentina |
| 3 | BRA | Brazil |
| 4 | PRY | Paraguay |
| 5 | URY | Uruguay |
| 6 | EFT | Rest of EFTA |
| 7 | E27 | European Union 27 |
| 8 | GBR | United Kingdom |
| 9 | RUS | Russian Federation |
| 10 | CHK | China and Hong Kong |
| 11 | JPN | Japan |
| 12 | KOR | Korea |
| 13 | SEA | Southeast Asia |
| 14 | IND | India |
| 15 | USA | USA |
| 16 | CAN | Canada |
| 17 | MEX | Mexico |
| 18 | LAM | Rest of Latin America |
| 19 | MNA | Middle East and North Africa |
| 20 | ROW | Rest of the World |

## 7.5 Calculation of the trade cost changes associated with the FTA between EFTA States and MERCOSUR

In this section we explain how we obtain the changes in three broad categories of trade policies: tariffs, tariff-rate quotas (TRQs) and non-tariff measures (NTMs).

### 7.5.1 Estimating the changes in tariffs implicit in the negotiated FTA

As main input for the new tariff structure we use the HS-8 tariff-line information provided by SECO based on the negotiated FTA. This datafile provides the preferential ad-valorem equivalent (AVE) tariffs that are expected to be in place in 2040 if the PTA is implemented (i.e. the "realistic FTA scenario"). These tariffs are given for the consolidated MERCOSUR region (i.e. not separated by country).

The datafile includes the currently applied MFN AVE tariffs for Swiss exports into MERCOSUR (by each member and consolidated). There are around 10 thousand product-lines with tariff data. It also provides information on Swiss tariffs for imports from MERCOSUR. There is information on MFN bound and applied tariffs, for around nine thousand product-lines. However, in this case the tariffs are given in Swiss francs (CHF) and not in AVE terms. The preferential tariffs are also

given in CHF and there is also information on the negotiated tariff-rate quotas (TRQ). Since MERCOSUR countries currently benefit from GSP-tariffs, we then update the applied MFN tariff to reflect those tariff lines for which there is a lower GSP tariff. The GSP rates were also provided by SECO, and for around six thousand product-lines we use the GSP rate instead of the applied MFN rate.

To map the HS-8 product-line information into the 65 sectors in the GTAP-10 database, we estimated trade-weighted sectoral tariffs using HS-8 trade data.

The HS-8 trade data were taken from the Swiss Federal Customs Administration (FCA) using the Swiss-Impex database.[65] We took the 2018 Swiss exports and imports to/from each MERCOSUR member (i.e. Argentina, Brazil, Paraguay and Uruguay), and then consolidated them into a MERCOSUR total. In the case of Swiss imports from MERCOSUR, we also took information regarding the quantities imported, which was usually provided in kilograms, but we also downloaded supplementary quantity measures (e.g. units, litres, square meters). Using these quantity data, we estimated unit-price values, which were then used to estimate AVE tariffs, using the formula:

$$\mathrm{T}_{ave} = \frac{T_V}{P} * 100$$

where $\mathrm{T}_{ave}$ is the tariff in AVE terms, $\mathrm{T}_V$is the tariff value in CHF and $P$ is the estimated CHF import unit-prices (excluding tariff charges). For MERCOSUR imports from Switzerland we employ the UN COMTRADE HS-6 trade data by each individual MERCOSUR country and add it up to a MERCOSUR total.

### 7.5.2 Estimating the tariff margins for Swiss imports from MERCOSUR

To analyse the potential changes in tariff structure that can be result from the implementation of the EFTA-MERCOSUR FTA, we calculate the tariff margin – i.e. the difference between the currently applied MFN (or GSP) tariff and the preferential tariff from the FTA.

We first calculate the trade-weighted tariffs by matching the FCA trade data with the SECO tariff data. Then we estimate the trade-weighted MFN and preferential tariffs at the HS-6 level and then aggregate these to the 65 sectors in the GTAP-10 database. We also estimate simple-mean tariffs at the HS-8 level and aggregate them to the 65 sectors. However, since we need the trade data on Swiss imports and quantities to estimate the unit prices and AVE tariffs, we cannot calculate the simple-mean tariffs for products and sectors without FCA trade data.

It is important to remark that a large share of total Swiss imports from MERCOSUR (around 75% in 2018) are from one single product: gold used for non-monetary purposes (i.e. the product-line 7108.1200). Switzerland refines around 70% of the unrefined gold mined in the world, but due to re-exports from third-countries, it is not clear if the gold imports from MERCOSUR are actually produced in MERCOSUR. Therefore, in this initial tariff-line analysis we do not consider these gold imports – which are included in the GTAP NFM (non-ferrous metals) sector. But we will take this

[65] https://www.gate.ezv.admin.ch/swissimpex/index.xhtm

sector separately in our CGE analysis. For instance, according to the GFMS Gold Survey, Brazil and Argentina are part of the World's largest 15 gold producers (83 and 57 tonnes per year, respectively).[66]

Table 15 shows the results of our product-line tariff calculations, when excluding the NFM sector. We observe that the largest trade-weighted tariff margins are in the dairy sector (MIL) with a 30-percentage point (pp) margin, followed by processed meats (CMT and OMT) and wearing apparel (WAP) with around 8pp. The remaining manufacturing sectors have tariff margins usually below 5pp, while agricultural and extraction sector have tariff margins of zero, with some exceptions, but never above 2pp.

In Table 15 we also present the trade-weighted applied MFN and preferential tariffs. We observe that for all non-food manufacturing sectors, preferential tariffs are set to zero, while most agricultural tariffs remain unchanged and food tariffs are substantially reduced. Note however, that in this initial tariff-line analysis we did not consider the effect of the new tariff-rate quotas (TRQs) expected from the FTA. When we refine our analysis to include the negotiated TRQs for agricultural and food products, we find that these quotas effectively constrain (or neutralise) any potential trade increases that could have been achieved through the reduction in tariffs (see below).

[66] As part of the implementation in 2014 of the version 6 of the IMF's Balance of Payments and International Investment Position Manual (BPM6), gold used for non-monetary purposes was included in the current account and not any more in the financial account.

*Table 15* Swiss sectoral imports from MERCOSUR: PTA tariff margins and trade shares

| | | | trade-weighted | | | simple-mean | non-services | non-services | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **GTAP sector name** | **GTAP code** | **Tariff margin** | **Applied GSP tariff (AVE)** | **Preferential tariff (AVE)** | **Tariff margin** | **trade share FCA** | **trade share GTAP-10** | **trade share GTAP-10** | **TRQ** |
| 1 | Paddy rice | PDR | – | – | – | – | 0.0% | 0.0% | 0.0% | – |
| 2 | Wheat | WHT | 0.00 | 14.62 | 14.62 | 0.00 | 0.5% | 0.0% | 0.0% | 1 |
| 3 | Other cereal grains | GRO | 0.69 | 58.53 | 57.85 | 1.88 | 0.0% | 0.1% | 0.1% | 1 |
| 4 | Vegetables, fruit, nuts | V_F | 0.38 | 0.39 | 0.01 | 0.90 | 4.2% | 0.8% | 0.4% | 1 |
| 5 | Oil seeds | OSD | 0.00 | 0.00 | 0.00 | 0.00 | 0.1% | 0.2% | 0.1% | 0 |
| 6 | Sugar cane, sugar beet | C_B | – | – | – | – | 0.0% | 0.0% | 0.0% | 0 |
| 7 | Plant-based fibers | PFB | 0.00 | 0.00 | 0.00 | 0.00 | 0.0% | 0.1% | 0.1% | 0 |
| 8 | Other crops | OCR | 0.00 | 0.00 | 0.00 | 0.00 | 21.2% | 1.9% | 0.9% | 0 |
| 9 | Bovine cattle, sheep & goats | CTL | 0.00 | 0.00 | 0.00 | 0.00 | 0.0% | 0.0% | 0.0% | 0 |
| 10 | Other animal products | OAP | 0.00 | 4.55 | 4.55 | 0.00 | 0.7% | 0.9% | 0.4% | 1 |
| 11 | Raw milk | RMK | – | – | – | – | – | – | – | – |
| 12 | Wool, silk-worm cocoons | WOL | 0.04 | 0.04 | 0.00 | 1.95 | 0.1% | 0.1% | 0.0% | 0 |
| 13 | Forestry | FRS | 0.00 | 0.00 | 0.00 | 0.00 | 0.0% | 0.0% | 0.0% | 0 |
| 14 | Fishing | FSH | 0.00 | 0.00 | 0.00 | 0.00 | 0.0% | 0.0% | 0.0% | 0 |
| 15 | Coal | COA | – | – | – | – | 0.0% | 0.0% | 0.0% | – |
| 16 | Oil | OIL | – | – | – | – | 0.0% | 0.0% | 0.0% | – |
| 17 | Gas | GAS | – | – | – | – | 0.0% | 0.0% | 0.0% | – |
| 18 | Other Mining Extraction | OXT | 0.00 | 0.00 | 0.00 | 0.00 | 0.0% | 0.2% | 0.1% | 0 |
| 19 | Cattle meat products | CMT | 8.00 | 23.38 | 15.38 | 3.30 | 7.9% | 9.9% | 4.9% | 0 |
| 20 | Other meat product | OMT | 4.06 | 32.88 | 28.81 | 2.64 | 8.1% | 13.2% | 6.5% | 1 |
| 21 | Vegetable oils & fats | VOL | 0.00 | 0.00 | 0.00 | 0.11 | 8.7% | 0.8% | 0.4% | 1 |
| 22 | Milk & dairy products | MIL | 29.76 | 38.36 | 8.61 | 19.60 | 0.0% | 0.1% | 0.0% | 1 |
| 23 | Processed rice | PCR | 0.00 | 0.00 | 0.00 | 0.00 | 2.4% | 3.9% | 1.9% | 0 |
| 24 | Processed sugar | SGR | 0.01 | 0.10 | 0.10 | 0.01 | 1.0% | 0.8% | 0.4% | 0 |
| 25 | Other processed foods | OFD | 0.18 | 0.61 | 0.43 | 1.97 | 7.7% | 9.6% | 4.7% | 1 |
| 26 | Beverages & tobacco prods | B_T | 0.03 | 2.71 | 2.68 | 5.68 | 5.7% | 10.4% | 5.1% | 1 |
| 27 | Textiles | TEX | 2.07 | 2.07 | 0.00 | 3.15 | 0.1% | 2.5% | 1.2% | 0 |
| 28 | Wearing apparel | WAP | 4.02 | 4.02 | 0.00 | 6.36 | 0.1% | 0.9% | 0.4% | 0 |
| 29 | Leather products | LEA | 0.00 | 0.00 | 0.00 | 0.01 | 1.3% | 1.3% | 0.6% | 0 |
| 30 | Wood products | LUM | 0.00 | 0.00 | 0.00 | 0.00 | 0.5% | 1.1% | 0.5% | 0 |
| 31 | Paper products, publishing | PPP | 0.23 | 0.23 | 0.00 | 0.01 | 2.0% | 0.2% | 0.1% | 0 |
| 32 | Petroleum, coal products | P_C | 0.00 | 0.00 | 0.00 | 0.00 | 0.0% | 2.7% | 1.3% | 0 |
| 33 | Chemicals & chemical prods | CHM | 0.05 | 0.05 | 0.00 | 0.23 | 5.9% | 9.7% | 4.8% | 0 |
| 34 | Pharmac. & medicinal prods | BPH | 0.00 | 0.00 | 0.00 | 0.00 | 2.9% | 5.1% | 2.5% | 0 |
| 35 | Rubber & plastics prods | RPP | 0.04 | 0.04 | 0.00 | 0.00 | 0.5% | 1.9% | 0.9% | 0 |
| 36 | Other non-metallic minerals | NMM | 0.00 | 0.00 | 0.00 | 0.00 | 0.3% | 0.4% | 0.2% | 0 |
| 37 | Ferrous metals | I_S | 0.00 | 0.00 | 0.00 | 0.00 | 0.6% | 0.4% | 0.2% | 0 |
| 38 | Non-ferrous metals | NFM | 1/ | 1/ | 1/ | 1/ | 1/ | 1/ | 1/ | 1/ |
| 39 | Metal products | FMP | 0.00 | 0.00 | 0.00 | 0.00 | 0.3% | 0.9% | 0.5% | 0 |
| 40 | Computer & electronic prods | ELE | 0.00 | 0.00 | 0.00 | 0.00 | 1.7% | 3.1% | 1.5% | 0 |
| 41 | Electrical equipment | EEQ | 0.00 | 0.00 | 0.00 | 0.00 | 0.7% | 1.4% | 0.7% | 0 |
| 42 | Other machinery & equipment | OME | 0.00 | 0.00 | 0.00 | 0.00 | 1.6% | 3.8% | 1.9% | 0 |
| 43 | Motor vehicles & parts | MVH | 0.00 | 0.00 | 0.00 | 0.00 | 0.6% | 0.9% | 0.4% | 0 |
| 44 | Other transport equipment | OTN | 0.00 | 0.00 | 0.00 | 0.00 | 4.2% | 5.3% | 2.6% | 0 |
| 45 | Other manufactures | OMF | 0.00 | 0.00 | 0.00 | 0.00 | 8.3% | 5.2% | 2.6% | 0 |
| 46 | Electricity | ELY | – | – | – | – | – | – | 2.8% | – |
| 47 | Gas manufacture, distribution | GDT | – | – | – | – | – | – | 0.3% | – |
| 48 | Water | WTR | – | – | – | – | – | – | 0.1% | – |
| 49 | Construction | CNS | – | – | – | – | – | – | 0.0% | – |
| 50 | Wholesale & retail trade | TRD | – | – | – | – | – | – | 1.6% | – |
| 51 | Accommodation & food | AFS | – | – | – | – | – | – | 1.1% | – |
| 52 | Land transport | OTP | – | – | – | – | – | – | 5.4% | – |
| 53 | Water transport | WTP | – | – | – | – | – | – | 0.2% | – |
| 54 | Air transport | ATP | – | – | – | – | – | – | 2.2% | – |
| 55 | Warehousing activities | WHS | – | – | – | – | – | – | 0.1% | – |
| 56 | Communication | CMN | – | – | – | – | – | – | 1.6% | – |
| 57 | Other financial intermediation | OFI | – | – | – | – | – | – | 1.7% | – |
| 58 | Insurance | INS | – | – | – | – | – | – | 0.9% | – |
| 59 | Real estate activities | RSA | – | – | – | – | – | – | 2.2% | – |
| 60 | Other business services | OBS | – | – | – | – | – | – | 24.1% | – |
| 61 | Recreational services | ROS | – | – | – | – | – | – | 3.2% | – |
| 62 | Other government services | OSG | – | – | – | – | – | – | 0.5% | – |
| 63 | Education | EDU | – | – | – | – | – | – | 1.9% | – |
| 64 | Heatth | HHT | – | – | – | – | – | – | 0.9% | – |
| 65 | Dwellings | DWE | – | – | – | – | – | – | 0.0% | – |

Notes: The tariff margin is the difference between the applied MFN tariff and the preferential FTA tariff. "–" sectors with no trade data. Applied GSP when applicable, otherwise we employ the applied MFN tariff. 1/ NFM sector excluded due to large share of gold imports. The TRQ column refers to sectors where changes in the tariff-rate quotas could change trade volumes.
Source: GTAP-10 database, SECO and FCA.

In Table 15 we also present the trade shares (sectoral Swiss imports from MERCOSUR with respect to total Swiss imports from MERCOSUR) with the 2018 FCA data, which does not include services trade. As a comparison, we also include the trade shares from the GTAP database for 2014 (its latest available year), for both the non-services and the total trade. We find that the non-services trade shares from FCA and GTAP have a correlation of 0.8, part of the differences could be explained by the use of different years. However, there is a very large difference in the

OCR (other crops) sector. In the FCA data this represents coffee imports (tariff-line 0901.1100), which seem to be related to a different trade accounting methodology (using product ownership, instead of product origin).

Finally, the last column of the table identifies the sectors – aggregated also from the negotiated TRQs – for which the changes in the current quotas associated with the PTA could positively affect current trade volumes.

### 7.5.3 Estimating the tariff margins for MERCOSUR imports from Switzerland

In the case of Swiss exports, we employ the HS-6 level trade data from UN-COMTRADE. This provides the data on imports from Switzerland reported by individual MERCOSUR countries. Equivalently as in the case of Swiss imports, we then estimate the trade-weighted tariffs at the HS-6 level and aggregate to the 65 sectors in GTAP. Table 16 shows the trade-weighted MFN, preferential tariffs and the resulting tariff margins, as well as the single-mean tariff margin and the trade share data from COMTRADE and GTAP. In this case the COMTRADE and GTAP trade data have a high correlation of 0.96.

For MERCOSUR, the tariff margins are above 10 percentage points in several manufacturing sectors with modest trade values (e.g. MVH, OMF, PPP, TEX, WAP) and around 5pp for the most important Swiss exporting sectors (CHM ad BPH), which account for more than 60% of total exports. The preferential tariffs are set to zero in all agricultural sectors, although there are negligible Swiss exports in these sectors. The manufacturing sectors do obtain substantial reductions in tariffs, in particular textiles and apparel (TEX and WAP), paper and metal products, among others. On the other hand, the dairy sector (MIL) has no tariff changes but it does benefit from an increase in quotas (see the TRQ section below).

*Table 16 Swiss sectoral exports to MERCOSUR: PTA tariff margins and trade shares*

| | | | trade-weighted | | | simple-mean | non-services | non-services | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | **GTAP sector name** | **GTAP code** | **Tariff margin** | **Applied MFN tariff (AVE)** | **Preferential tariff (AVE)** | **Tariff margin** | **trade share COMTRADE** | **trade share GTAP-10** | **trade share GTAP-10** |
| 1 | Paddy rice | PDR | – | – | – | 6.67 | 0.0% | 0.0% | 0.0% |
| 2 | Wheat | WHT | – | – | – | 5.00 | 0.0% | 0.0% | 0.0% |
| 3 | Other cereal grains | GRO | 0.00 | 0.00 | 0.00 | 4.11 | 0.0% | 0.0% | 0.0% |
| 4 | Vegetables, fruit, nuts | V_F | – | – | – | 8.69 | 0.0% | 0.0% | 0.0% |
| 5 | Oil seeds | OSD | – | – | – | 4.50 | 0.0% | 0.0% | 0.0% |
| 6 | Sugar cane, sugar beet | C_B | – | – | – | 5.33 | 0.0% | 0.0% | 0.0% |
| 7 | Plant-based fibers | PFB | – | – | – | 11.18 | 0.0% | 0.0% | 0.0% |
| 8 | Other crops | OCR | 8.00 | 8.00 | 0.00 | 7.03 | 0.0% | 0.0% | 0.0% |
| 9 | Bovine cattle, sheep & goats | CTL | 0.00 | 0.00 | 0.00 | 1.31 | 0.0% | 0.0% | 0.0% |
| 10 | Other animal products | OAP | 3.23 | 3.23 | 0.00 | 4.93 | 0.0% | 0.0% | 0.0% |
| 11 | Raw milk | RMK | – | – | – | – | – | 0.0% | 0.0% |
| 12 | Wool, silk-worm cocoons | WOL | – | – | – | 12.61 | 0.0% | 0.0% | 0.0% |
| 13 | Forestry | FRS | 6.00 | 6.00 | 0.00 | 1.85 | 0.0% | 0.0% | 0.0% |
| 14 | Fishing | FSH | – | – | – | 6.58 | 0.0% | 0.0% | 0.0% |
| 15 | Coal | COA | – | – | – | 0.00 | 0.0% | 0.0% | 0.0% |
| 16 | Oil | OIL | – | – | – | 0.00 | 0.0% | 0.0% | 0.0% |
| 17 | Gas | GAS | – | – | – | 0.00 | 0.0% | 0.0% | 0.0% |
| 18 | Other Mining Extraction | OXT | 4.00 | 4.00 | 0.00 | 3.48 | 0.1% | 0.1% | 0.0% |
| 19 | Cattle meat products | CMT | – | – | – | 10.05 | 0.0% | 0.0% | 0.0% |
| 20 | Other meat product | OMT | – | – | – | 11.14 | 0.0% | 0.0% | 0.0% |
| 21 | Vegetable oils & fats | VOL | 9.99 | 10.01 | 0.02 | 8.94 | 0.1% | 0.1% | 0.1% |
| 22 | Milk & dairy products | MIL | 0.00 | 22.16 | 22.16 | 18.20 | 0.0% | 0.0% | 0.0% |
| 23 | Processed rice | PCR | – | – | – | 10.33 | 0.0% | 0.0% | 0.0% |
| 24 | Processed sugar | SGR | 14.99 | 16.00 | 1.01 | 15.38 | 0.0% | 0.0% | 0.0% |
| 25 | Other processed foods | OFD | 10.32 | 12.05 | 1.73 | 11.22 | 3.1% | 2.0% | 1.5% |
| 26 | Beverages & tobacco prods | B_T | 12.39 | 20.00 | 7.61 | 16.59 | 0.2% | 0.4% | 0.3% |
| 27 | Textiles | TEX | 17.43 | 18.34 | 0.91 | 23.32 | 0.2% | 0.2% | 0.2% |
| 28 | Wearing apparel | WAP | 11.25 | 34.23 | 22.98 | 33.94 | 0.0% | 0.1% | 0.0% |
| 29 | Leather products | LEA | 5.06 | 22.10 | 17.05 | 20.09 | 0.0% | 0.1% | 0.0% |
| 30 | Wood products | LUM | 7.57 | 11.14 | 3.57 | 6.71 | 0.1% | 0.1% | 0.1% |
| 31 | Paper products, publishing | PPP | 13.81 | 14.21 | 0.41 | 11.06 | 0.4% | 0.6% | 0.4% |
| 32 | Petroleum, coal products | P_C | 0.73 | 0.73 | 0.00 | 0.71 | 7.3% | 0.0% | 0.0% |
| 33 | Chemicals & chemical prods | CHM | 5.94 | 6.45 | 0.52 | 7.17 | 33.4% | 26.5% | 20.0% |
| 34 | Pharmac. & medicinal prods | BPH | 5.52 | 5.59 | 0.07 | 4.00 | 31.1% | 35.6% | 26.8% |
| 35 | Rubber & plastics prods | RPP | 9.81 | 12.57 | 2.75 | 13.81 | 1.1% | 1.2% | 0.9% |
| 36 | Other non-metallic minerals | NMM | 9.41 | 10.55 | 1.15 | 10.26 | 0.3% | 0.5% | 0.4% |
| 37 | Ferrous metals | I_S | 12.13 | 13.06 | 0.92 | 11.08 | 0.3% | 0.4% | 0.3% |
| 38 | Non-ferrous metals 1/ | NFM | 5.28 | 10.41 | 5.13 | 8.05 | 0.3% | 1.1% | 0.8% |
| 39 | Metal products | FMP | 14.24 | 15.64 | 1.40 | 15.90 | 1.2% | 1.4% | 1.0% |
| 40 | Computer & electronic prods | ELE | 9.29 | 10.55 | 1.26 | 13.35 | 6.9% | 8.9% | 6.7% |
| 41 | Electrical equipment | EEQ | 10.74 | 13.33 | 2.59 | 15.33 | 2.3% | 2.8% | 2.1% |
| 42 | Other machinery & equipment | OME | 11.90 | 12.16 | 0.27 | 12.10 | 6.9% | 11.0% | 8.3% |
| 43 | Motor vehicles & parts | MVH | 12.60 | 12.77 | 0.17 | 13.97 | 0.4% | 1.0% | 0.8% |
| 44 | Other transport equipment | OTN | 1.03 | 1.06 | 0.02 | 10.82 | 0.6% | 2.4% | 1.8% |
| 45 | Other manufactures | OMF | 9.92 | 11.33 | 1.41 | 16.19 | 3.7% | 3.7% | 2.8% |
| 46 | Electricity | ELY | – | – | – | – | – | – | 1.4% |
| 47 | Gas manufacture, distribution | GDT | – | – | – | – | – | – | 0.0% |
| 48 | Water | WTR | – | – | – | – | – | – | 0.1% |
| 49 | Construction | CNS | – | – | – | – | – | – | 0.0% |
| 50 | Wholesale & retail trade | TRD | – | – | – | – | – | – | 1.5% |
| 51 | Accommodation & food | AFS | – | – | – | – | – | – | 0.9% |
| 52 | Land transport | OTP | – | – | – | – | – | – | 1.3% |
| 53 | Water transport | WTP | – | – | – | – | – | – | 0.2% |
| 54 | Air transport | ATP | – | – | – | – | – | – | 1.7% |
| 55 | Warehousing activities | WHS | – | – | – | – | – | – | 0.0% |
| 56 | Communication | CMN | – | – | – | – | – | – | 0.6% |
| 57 | Other financial intermediation | OFI | – | – | – | – | – | – | 3.0% |
| 58 | Insurance | INS | – | – | – | – | – | – | 2.6% |
| 59 | Real estate activities | RSA | – | – | – | – | – | – | 0.1% |
| 60 | Other business services | OBS | – | – | – | – | – | – | 7.2% |
| 61 | Recreational services | ROS | – | – | – | – | – | – | 1.4% |
| 62 | Other government services | OSG | – | – | – | – | – | – | 0.5% |
| 63 | Education | EDU | – | – | – | – | – | – | 1.6% |
| 64 | Heatth | HHT | – | – | – | – | – | – | 0.6% |
| 65 | Dwellings | DWE | – | – | – | – | – | – | 0.0% |

Notes: The tariff margin is the difference between the applied MFN tariff and the preferential FTA tariff. "–" sectors with no trade data.

Source: GTAP-10 database, SECO and UN COMTRADE.

### 7.5.4 Estimation of the TRQ impacts on trade volumes

As explained before, the changes in TRQs are a very important component of the FTA. Therefore, we separately identify and analyse the product-lines for which the new TQR could potentially affect current trade volumes. To this effect we employed the within-quota and out-of-quota trade data from FCA, as well as more detailed information on the negotiated TRQs provided by SECO.

In total, there are 72 product-lines with TRQ information, which can be grouped into 25 broad product categories. Most of these TRQs correspond to Swiss imports from MERCOSUR. For each product category we take the current within- and out-of-quota trade, the newly negotiated quotas and based on this information, we perform a case-by-case analysis on if/how the new TRQs can affect current trade volumes.

In some cases, most notably for bovine meats, the FTA is consolidating (i.e. guaranteeing) current access to the Swiss market obtained under the GSP. Hence, no trade effects are expected. In other cases, it is expected that the new quotas will actually increase trade volumes and we estimate the percentage increase of trade for that product and then estimate what that percentage increase represents for the aggregated sector in our CGE model. The volume changes are then translated into value changes using the current average import prices from MERCOSUR or for all regions when MERCOSUR is not currently exporting those particular products to Switzerland. Finally, some of the quota increases come at the expense of reducing imports from other (non-MERCOSUR) countries, so that total Swiss imports in those products are constant. In these cases, besides estimating the trade change for MERCOSUR countries at the aggregate sector level, we also estimate how much trade from other (non-EU and non-EFTA) regions will have to decrease to keep overall Swiss imports unchanged.

A summary of the TRQ analysis is presented in Table 17. In the upper part or the table, we analyse the Swiss imports from MERCOSUR. Here we find that the products with the largest expected increases in trade values are olive oil, wine and honey. The table also shows that the quota increases in the FTA only yield very limited changes in the trade value in meat products. The lower part of the table shows the TRQs for MERCOSUR imports from Switzerland. There a fewer products here and we find that only cheese products will have a substantial trade increase.

### 7.5.5 Structural gravity estimates of NTMs and trade elasticities

For the purpose of defining scenarios, trading costs associated with NTMs are modelled by extension of the gravity modelling in ECORYS (2009), CEPR (2012), and Egger *et al.* (2015), meaning iceberg trade cost reductions. In the case of both goods and services, benchmark values for trade costs and for cost reductions are based on gravity-based estimates of the trade cost reductions realized under different types of PTAs, as classified by level of ambition. For this

*Table 17 TRQ analysis for broad product categories*

| Sector name | Sector code | Product category | Bilateral quota | Unit | Estimated trade effect | Reduces non-Mercosur trade |
|---|---|---|---|---|---|---|
| **Swiss Imports from Mercosur** | | | | | | |
| Wheat | wht | Wheat for human consumption | 1,500 | Tons | 0 No effect | |
| | | Wheat for animal feeding | 1,000 | Tons | 0.435 million US$ | |
| Vegetables, fruits & nuts | v_f | Apples | 150 | Tons | 0 No effect | |
| | | Pears | 150 | Tons | 0 No effect | |
| | | Cherries (fresh May to August) | 150 | Tons | 0 No effect | |
| | | Fresh grapes for pressing | 1,500 | Tons | 2.621 million US$ | |
| | | Onions | 500 | Tons | 0.335 million US$ | yes |
| Cattle | ctl | Live horses, not for slaughter | 100 | Horses | 0 No effect | |
| Other primary activities | pry | Maize for animal feeding | 7,000 | Tons | 1.666 million US$ | |
| | | Honey | 2,000 | Tons | 5.843 million US$ | |
| Cattle meat products | cmt | Bovine meat | 3,000 | Tons | 0 No effect | |
| | | Sheep and lamb meat | 200 | Tons | 1.927 million US$ | yes |
| Other meat products | omt | Swine | 200 | Tons | 2.913 million US$ | |
| | | Poultry | 1,000 | Tons | 3.318 million US$ | |
| Milk & dairy products | mil | Butter | 100 | Tons | 1.455 million US$ | |
| | | Milk | 300 | Tons | 1.173 million US$ | |
| Vegetable oils & fats | vol | Groundnut (and soybean) oil | 2,000 | Tons | 3.293 million US$ | |
| | | Olive oil | 1,000 | Tons | 6.664 million US$ | yes |
| Processed rice and sugar | prs | Rice for animal feeding | 1,000 | Tons | 0 No effect | |
| | | Maize meals for human consumption | 500 | Tons | 0.321 million US$ | |
| Other processed food | ofd | Potatoes | 600 | Tons | 4.559 million US$ | yes |
| | | Apple juice | 30 | Tons | 0.056 million US$ | yes |
| | | Fruit juices | 150 | Tons | 0.253 million US$ | yes |
| Beverage & tobacco products | b_t | Wine | 3,500 | Tons | 6.230 million US$ | |
| **Mercosur imports from Switzerland** | | | | | | |
| Milk & dairy products | mil | Cheese | 960.96 | Tons | 11.284 million US$ | |
| Other processed food | ofd | Chocolate | | | 0 No effect | |
| | | Baby food | 50 | Tons | 0.3967 million US$ | |
| Beverage & tobacco products | b_t | Wine | 100,000 | Liters | 0 No effect | |

purpose, our gravity model data includes a version of the DESTA database indicators of PTA depth (Dür *et al.* 2014). Algebraically, our estimator is a two-stage Poisson, where the first stage is used to control for endogeneity of PTAs, as developed in Egger *et al*. (2015). Actual trade elasticity estimates are based on the data used in our computable model (the most recent are GTAP10, benchmarked to 2014), at the full level of sector aggregation for tradable sectors (56 sectors), and for all regions. We use tariff data to estimate trade price elasticities for goods, and World Bank STRI-based data for services to obtain price elasticities for services (where we also work, in some specifications, with trade cost estimates from Jafari and Tarr , 2015). We should stress that in general, we find that existing PTAs with services components offer minimal effective market access concessions in services (apart from the EU itself). This is consistent with the general "sense of the literature" in this regard.

Technically, the gravity model of trade can be generalized for a broad class of trade models as follows (see Head and Mayer, 2015):

$$(1) \qquad v_{k,i,j} = A_{l,i} B_{k,i,j} C_{k,j} D_{k,j}$$

where $v_{k,i,j}$ is the value of trade in sector *k* originating in source country *i* and sold to destination country $j$. The terms $A_{k,i}$, $B_{k,i,j}$, $C_{k,j}$ and $D_{k,j}$ are source country, pairwise, and destination country determinants of trade flows. Frequently, the source and destination county effects are controlled for with importer and exporter fixed effects, with emphasis then placed on the pairwise role of factors like distance, tariffs, and trade agreements. We distinguish between terms $C_{k,j}$ and $D_{k,j}$ because it is sometimes useful to separate destination demand effects from other destination related variables. The table below maps the general equation (1) to specific standard empirical trade models.

Pairwise gravity specifications in standard empirical models

| | $B_{ij}$ |
|---|---|
| Armington | services $(\tau_{ij}S_{ij})^{1-\sigma}$ goods $(T_{m,ij}T_{x,ij}\tau_{ij}S_{ij})^{1-\sigma}$ |
| Krugman-Ethier | services $(\tau_{ij}S_{ij})^{1-\sigma}$ goods $(T_{m,ij}T_{x,ij}\tau_{ij}S_{ij})^{1-\sigma}$ |
| Melitz | services $(\tau_{ij}S_{ij})^{-\theta} f_{ij}^{1-\frac{\theta}{(\sigma-1)}}$ goods $(\tau_{ij}T_{x,ij}S_{ij})^{-\theta} f_{ij}^{1-\frac{\theta}{(\sigma-1)}} T_{m,ij}^{1-\sigma\frac{\theta}{(\sigma-1)}}$ |
| Eaton-Kortum | services $(\tau_{ij}S_{ij})^{1-\sigma}$ goods $(T_{m,ij}T_{x,ij}\tau_{ij}S_{ij})^{1-\sigma}$ |
| $T_{m,ij}$ | bilateral import tariff multiplier $T_{m,ij} = (1 + t_{m,ij})$ where $t_{m,ij}$ is the import tax rate |
| $T_{x,ij}$ | bilateral export tax multiplier $T_{x,ij} = (1 + t_{x,ij})$ where $t_{x,ij}$ is the export tax rate |
| $S_{ij}$ | bilateral distance cost multiplier $S_{ij} = (1 + s_{ij})$ where $s_{ij}$ is the shipping rate |
| $\sigma$ | elasticity of substitution in demand |
| $f_{ij}$ | firm fixed cost parameter entering $j$ from $i$ in Melitz model |
| $\tau_{ij}$ | actual iceberg costs between $i$ and $j$ |
| $\theta$ | Pareto shape parameter in Melitz model |

Note that with an assumption of granularity, meaning $\theta = (\sigma - 1)$, the tariff elasticity and iceberg (NTM) elasticities in Melitz collapse to the otherwise common parameterization of the Armington, Krugman-Ethier, and Eaton-Kortum

In computable models such as the GTAP model and recent structural gravity models, a version of equation (1) is explicitly incorporated in log or proportional change form:

$$\widehat{v_{\iota,s,d}} = \widehat{A_\iota} + \widehat{B_{\iota J}} + \widehat{C_J} \quad (2)$$

where $\hat{y} = \frac{dy}{y} = d \ln y$. In estimating trade elasticities and the role of NTBs, we expand the term $B_{ij}$ as follows:

$$B_{k,ij} = \sum_z \beta_{k,z} x_{k,i,j} \quad (3)$$

where the terms $\beta_k$ are coefficients to be estimated, and $x_{ij}$ are pairwise explanatory variables.

In formal terms, we follow Santos Silva and Teneyro (2006), and Egger *et al.* (2011, 2015) in employing a generalized-linear exponential-family model for estimating gravity models. One merit of such models is that, unlike ordinary least squares on the log-transformed model, they obtain consistent parameters in the presence of heteroskedasticity even if it is unknown whether the disturbance term is log-additive or level-additive. Furthermore, in line with Terza (1998, 2009), Greene (2002, 2012), Terza *et al.* (2008), and Egger *et al.* (2011, 2015) we apply a control-function approach, which is capable of absorbing the endogeneity problem and obtaining consistent parameter estimates, including the partial treatment effects of interest.

Formally, in estimating equation (1) we represent $v_{k,i,j}$ as the dependent variable and specify it as an exponential function of a linear index of the form:

(4) $v_{k,ij} = \exp\left(\sum_z \beta_{k,z} x_{z,k,i,j} + a_{k,i} + c_{k,j} + c(z_{k,ij})\right) u_{k,ij}$

where $x_{k,z,ij}$ is a vector of observable (log) pairwise trade-cost measures *z* (such as log distance, tariffs, and others) at industry level, $\beta_k$ is a conformable parameter vector, $\{a_{k,i}, c_{k,j}\}$ catch-all measures of exporter- and importer-specific factors (estimated as parameters on *i*-specific and *j*-specific binary indicator variables, respectively). Moreover,

(5) $c(z_{k,ij}) = h_{k,ij} a_h = (h_{1,k,ij}, \dots, h_{Dk,,ij}) a_h,$

is a control function used to control for endogeneity if trade agreement depth, which is derived from the assumption of multivariate normality of the disturbances between the processes of selecting into depth and the stochastic term about $v_{k,i,j}$.

Critically, we also include trade with self (domestic shipments) in our regressions. This allows us to identify home market effects (including various interactions with home trade). Because we work with our structural model data (the GTAP database) we have values for trade with self at the same level of aggregation as trade with other countries. A similar approach is also followed in recent applications based on the WIOD database. Note that because we control for destination and pairwise effects in our regression analysis, the exporter fixed effect terms provide, on the basis of trading partner demand, an estimate of the reduced form supply factors determining demand for products indexed *i,k*. For services, we combine STRI data from the World Bank and Francois *et al.* (2015a), alongside trade cost estimates from Jafari and Tarr (2015) in lieu of tariff data to estimate price elasticities for services (see Egger *et al.,* 2019).

We use the estimated trade equations to predict home market demand in the absence of pairwise trade costs (tariffs) and controlling for other pairwise differences $\beta_k x_{ij}$, but without the home trade effect. The result is a predicted value for home trade $\widetilde{v_{k,JJ}}$ which can be compared to the actual value of home trade $v_{idd}$ to obtain an estimate of MFN-based trade costs (those not controlled for with pairwise variables) in our regressions based on estimated home bias. Taking the estimated price elasticity from out tariff coefficient, $\beta_{k,T}$, the MFN level trade cost $\gamma_{k,j}$ is:

(6) $\gamma_{k,j} = \left( e^{\left( \frac{\widetilde{v_{k,JJ}}}{v_{k,jj}} \beta_{k,T}{}^{-1} \right)} - 1 \right) \times 100.$

Similarly, comparison of predicted pairwise MFN trade and actual trade from the stage two estimation of equation (4) provides a basis for mapping pairwise trade cost reductions at sector and country level to depth of existing PTAs.

The result of this exercise is a database of MFN-level trade costs, reductions in these costs on a pairwise basis mapped to PTA depth, and a consistent set of trade price elasticities (those used to convert PTA related trade volume effects into trade cost reduction estimates). For the current study, and based on the legal analyses of how the EFTA-MERCOSUR agreement compares with other agreements signed by both parties (see Section 2 in main report), we take the agreement to be a "deep" agreement (with a DESTA index of six). With this information we can then obtain the country-sector specific NTM-associated AVE trade cost reductions. In other words, the econometric analysis isolates the trade effects associated with comparable agreements regarding the trade effects for each sector and in each country in the agreement. These

estimations are then used to assess the expected sector-country-specific trade changes from the EMFTA.

Importantly, the trade elasticities, which are one of the most important parameters in the model, are estimated econometrically from the same underlying trade data used in the model. In addition, other parameters (e.g. share terms) are also fitted from the actual model data, and some elasticities (specifically substitution in value added) taken for the literature. Following Egger and Nigai (2015) and Bekkers *et al.* (2018), total trade costs and technology parameters are calibrated using actual import shares, imposing an exact fit. Changes in trade costs (the structural general equilibrium experiments themselves) follow from our gravity-based estimates of trade costs as discussed above.

To sum up, the above econometric gravity estimations provide both the trade elasticities –which are a key behavioural component of the CGE model – as well as the country-sector specific AVE reductions in trade costs associated with the NTMs for the EMFTA. In other words, based on our evaluation that this particular agreement classifies as a "deep" agreement (based on the DESTA depth index), we then estimate the trade cost reductions associated with the implicit NTMs in the agreement for each Swiss and MERCOSUR sector. The particular AVE NTM reductions are presented in the summary table with all trade cost reductions in the following section.

### 7.5.6 Summary of the trade costs changes implicit in the FTA

In Table 18 we summarise the trade costs estimated in the previous three sections for tariffs, TRQs and NTMs. We observe that for Swiss imports from MERCOSUR, the highest tariffs are for textiles and wearing apparel. TRQs are the driving policy shocks for the agricultural and food sectors. NTM reductions are expected to have moderate effects for some primary and manufacturing sectors, while they are the only policy shock regarding trade in services.

On the other hand, MERCOSUR imports from Switzerland will be mainly affected by the tariff changes, in particular for manufacturing sectors. Moreover, NTM reductions are also expected to have a positive impact on Swiss exports for a broad set of sectors.

*Table 18 Summary of the trade cost reductions implicit in the FTA*

| | | | Mercosur exports to Switzerland | | | Swiss exports to Mercosur | | |
|---|---|---|---|---|---|---|---|---|
| | | | Tariffs a/ % power change | TRQs b/ bilateral export quantity %ch | NTM c/ AVE reduction estimates | Tariffs a/ % power change | TRQs b/ bilateral export quantity %ch | NTM c/ AVE reduction estimates |
| | | **Primary sectors** | | | | | | |
| 1 | wht | Wheat | - | 272.57 | 10.71 f/ | - | - | 8.06 |
| 2 | v_f | Vegetables, fruit & nuts | d/ | 70.54 | 29.68 f/ | - | - | 23.47 |
| 3 | osd | Oil seeds | - | - | 2.56 | - | - | 2.98 |
| 4 | ctl | Cattle | - | - | 15.73 | - | - | 11.51 |
| 5 | frs | Forestry | - | - | - | -5.66 | - | - |
| 6 | PRY | Other primary activities | d/ | 47.15 | 4.82 f/ | -1.35 | - | 3.53 |
| 7 | oxt | Other mining extraction | - | - | 4.12 | -3.85 | - | 2.51 |
| 8 | ENY | Energy | - | - | 2.21 | - | - | 1.17 |
| | | **Manufacturing sectors** | | | | | | |
| 9 | cmt | Cattle meat products | d/ | 3.87 | 0.76 f/ | -0.72 | - | 0.70 |
| 10 | omt | Other meat product | d/ | 9.38 | 18.28 f/ | - | - | 12.23 |
| 11 | mil | Milk & dairy products | d/ | 519.14 | 7.56 f/ | - | 628.21 | 5.16 |
| 12 | vol | Vegetable oils & fats | - | 252.47 | 17.58 f/ | -9.08 | - | 11.73 |
| 13 | PRS | Processed rice and sugar | - | - | 14.51 | -12.90 | - | 7.65 |
| 14 | ofd | Other processed food | d/ | 10.68 | 9.59 f/ | -9.85 | e/ | 6.45 |
| 15 | b_t | Beverages & tobacco products | d/ | 11.89 | 11.29 f/ | -16.66 | - | 6.59 |
| 16 | tex | Textiles | -2.02 | - | 3.94 | -14.73 | - | 2.64 |
| 17 | wap | Wearing apparel | -3.87 | - | 20.58 | -8.38 | - | 14.43 |
| 18 | lea | Leather products | - | - | 11.49 | -6.05 | - | 8.82 |
| 19 | lum | Wood products | - | - | 1.94 | -6.81 | - | 1.48 |
| 20 | ppp | Paper & Paper Products | -0.23 | - | - | -12.09 | - | - |
| 21 | chm | Chemicals & chemical prods | -0.05 | - | 0.06 | -5.67 | - | 0.44 |
| 22 | bph | Pharmac. & medicinal prods | - | - | 0.06 | -5.23 | - | 0.44 |
| 23 | rpp | Rubber & plastics prods | -0.04 | - | 0.06 | -9.16 | - | 0.44 |
| 24 | nmm | Other non-metallic minerals | - | - | - | -8.51 | - | - |
| 25 | i_s | Ferrous metals | - | - | 4.80 | -10.73 | - | 3.41 |
| 26 | nfm | Non-ferrous metals | - | - | - | -5.68 | - | 13.93 |
| 27 | fmp | Metal products | - | - | 1.67 | -12.31 | - | 1.25 |
| 28 | ele | Computer & electronic prods | - | - | - | -9.49 | - | - |
| 29 | eeq | Electrical equipment | - | - | - | -10.20 | - | - |
| 30 | ome | Other machinery & equipment | - | - | 2.36 | -10.61 | - | 1.79 |
| 31 | mvh | Motor vehicles & parts | - | - | 17.76 | -11.17 | - | 14.54 |
| 32 | otn | Other transport equipment | - | - | - | -1.02 | - | - |
| 33 | omf | Other manufactures | - | - | 2.70 | -8.91 | - | 2.04 |
| | | **Service sectors** | | | | | | |
| 34 | UTY | Utilities | - | - | 0.44 | - | - | 0.79 |
| 35 | TRW | Trade and warehousing | - | - | - | - | - | - |
| 36 | otp | Land transport | - | - | 0.11 | - | - | 0.42 |
| 37 | wtp | Water transport | - | - | 1.96 | - | - | 3.23 |
| 38 | atp | Air transport | - | - | 4.19 | - | - | 4.43 |
| 39 | cmn | Communication | - | - | 1.15 | - | - | 2.30 |
| 40 | FIR | Finance, insurance & real estate | - | - | 5.01 | - | - | 4.38 |
| 41 | obs | Other business services | - | - | - | - | - | - |
| 42 | RAF | Recreation, accommodation & f | - | - | 0.18 | - | - | 0.94 |
| 43 | OSV | Government and other services | - | - | 0.01 | - | - | 0.07 |

Notes:

a/ Tariffs are given in percentage changes to the power of the tariff using trade-weighted changes in the tariff reduction from the FTA.

b/ TRQs were estimated using the HS8 TRQ information to estimate the percentage increase in trade due t the new quota.

c/ NTMs were estimated using a gravity model that identifies NTM ad-valorem equivalents using the depth of PTA (from the DESTA database) and the NTM estimated value are country of destination and sector specific.

d/ In these cases there is a decrease in the tariff margins, but the increase in the TRQs is the binding element.

e/ In these cases there is an increase in the TRQs but the reduction in the tariff margin is the binding element

f/ In the case where TRQs are binding, the NTMs do not have any effect on export quantities. The values showed are just indicative of potentialtrade costs reductions.

# 8 Annex II: Tables with underlying data for figures presented in the report

*Table 19 Provisions present in different EFTA agreements*

| | PTA: | date_signature | year_signature | date_entry_into_force | year_entry_into_force | tariff_cuts | customs_union | goods_nt | goods_mfn | ser_general | ser_specific | ser_gatsref | ser_mfn | ser_nt | ser_movement | inv_chapter | ecommerce_chapter | ipr_trips_1994 | ipr_scope_substantial | comp_chap | regulation_transparency_chapter | NTI_corruption_chapter | NTI_labour_chapter | NTI_env_chapter | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | EFTA Finland | 27/03/1961 | 1961 | 26/06/1961 | 1961 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** |
| 2 | EFTA Spain | 26/06/1979 | 1979 | 01/05/1980 | 1980 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **3** |
| 3 | EFTA Turkey | 10/12/1991 | 1991 | 01/04/1992 | 1992 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | **5** |
| 4 | EFTA Israel | 17/09/1992 | 1992 | 01/01/1993 | 1993 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | **4** |
| 5 | EFTA Poland | 10/12/1992 | 1992 | 15/11/1993 | 1993 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **4** |
| 6 | EFTA Romania | 10/12/1992 | 1992 | 01/05/1993 | 1993 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **4** |
| 7 | Bulgaria EFTA | NA | 1993 | 01/07/1993 | 1993 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | **3** |
| 8 | EFTA Hungary | 29/03/1993 | 1993 | 01/10/1993 | 1993 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2** |
| 9 | EFTA Estonia | 07/12/1995 | 1995 | 01/06/1996 | 1996 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | **5** |
| 10 | EFTA Latvia | 07/12/1995 | 1995 | 01/06/1996 | 1996 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | **4** |
| 11 | EFTA Lithuania | 07/12/1995 | 1995 | 01/08/1996 | 1996 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | **4** |
| 12 | EFTA Slovenia | 13/12/1995 | 1995 | 01/07/1995 | 1995 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | **5** |
| 13 | EFTA Morocco | 19/06/1997 | 1997 | 01/12/1999 | 1999 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | **4** |
| 14 | EFTA Macedonia | 19/06/2000 | 2000 | 01/05/2002 | 2002 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | **5** |
| 15 | EFTA Mexico | 27/11/2000 | 2000 | 01/07/2001 | 2001 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | **11** |
| 16 | Croatia EFTA | 21/06/2001 | 2001 | 01/01/2002 | 2002 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | **6** |
| 17 | EFTA Jordan | 21/06/2001 | 2001 | 01/01/2002 | 2002 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | **5** |
| 18 | EFTA Singapore | 24/06/2002 | 2002 | 01/01/2003 | 2003 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | **13** |
| 19 | Chile EFTA | 26/05/2003 | 2003 | 01/12/2004 | 2004 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | **13** |
| 20 | EFTA Lebanon | 24/06/2004 | 2004 | 01/01/2007 | 2007 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | **5** |
| 21 | EFTA Tunisia | 17/12/2004 | 2004 | 01/06/2005 | 2005 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | **7** |
| 22 | EFTA Korea | 15/12/2005 | 2005 | 01/09/2006 | 2006 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | **11** |
| 23 | EFTA Southern African Customs Union (SACU) | 01/07/2006 | 2006 | 01/05/2008 | 2008 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | **6** |
| 24 | EFTA Egypt | 27/01/2007 | 2007 | 01/08/2007 | 2007 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | **8** |
| 25 | Canada EFTA | 26/01/2008 | 2008 | 01/07/2009 | 2009 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | **6** |
| 26 | Colombia EFTA | 25/11/2008 | 2008 | 01/09/2014 | 2014 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | **13** |
| 27 | Albania EFTA | 17/12/2009 | 2009 | 01/11/2010 | 2010 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | **6** |
| 28 | EFTA GCC | 22/06/2009 | 2009 | 01/07/2014 | 2014 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | **10** |
| 29 | EFTA Serbia | 17/12/2009 | 2009 | 01/10/2010 | 2010 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | **6** |
| 30 | EFTA Peru | 14/07/2010 | 2010 | 01/07/2011 | 2011 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | **11** |
| 31 | EFTA Ukraine | 24/06/2010 | 2010 | 01/06/2012 | 2012 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | **12** |
| 32 | EFTA Hong Kong | NA | 2011 | NA | 2012 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | **12** |
| 33 | EFTA Montenegro | NA | 2011 | NA | 2012 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | **7** |
| 34 | Bosnia and Herzegovina EFTA | 24/06/2013 | 2013 | NA | NA | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | **8** |
| 35 | Central America EFTA | 24/06/2013 | 2013 | NA | NA | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | **14** |
| 36 | EFTA Philippines | 28/04/2016 | 2016 | NA | NA | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | **13** |
| 37 | EFTA Georgia | 27/06/2016 | 2016 | 01/09/2017 | 2017 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | **13** |
| 38 | EFTA Ecuador | 25/06/2018 | 2018 | NA | NA | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | **13** |
| 39 | EFTA Indonesia | 16/12/2018 | 2018 | NA | NA | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | **12** |
| 40 | EFTA MERCOSUR | NA | NA | NA | NA | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | **15** |

## *Table 20 Provisions present in different MERCOSUR agreements*

| | PTA: | date_signature | year_signature | date_entry_into_force | year_entry_into_force | tariff_cuts | custom_union | goods_nt | goods_mfn | ser_general | ser_specific | ser_mfn | ser_nt | ser_gatsref | ser_movement | inv_chapter | ecommerce_chapter | ipr_trips_1994 | ipr_scope_substantial | comp_chap | regulation_transparency_chapter | NTI_corruption_chapter | NTI_labour_chapter | NTI_env_chapter | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Bolivia MERCOSUR | 17/12/1996 | 1996 | 28/02/1997 | 1997 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | **6** |
| 2 | Chile MERCOSUR | 25/06/1996 | 1996 | 01/10/1996 | 1996 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | **7** |
| 3 | MERCOSUR Mexico | 05/07/2002 | 2002 | 05/01/2006 | 2006 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** |
| 4 | Andean Countries MERCOSUR | 18/10/2004 | 2004 | 05/01/2005 | 2005 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | **7** |
| 5 | India MERCOSUR | 25/01/2004 | 2004 | 01/06/2009 | 2009 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| 6 | MERCOSUR Peru | 30/11/2005 | 2005 | 06/02/2006 | 2006 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | **7** |
| 7 | Cuba MERCOSUR | 21/07/2006 | 2006 | 02/07/2007 | 2007 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2** |
| 8 | Israel MERCOSUR | 18/12/2007 | 2007 | 23/12/2009 | 2009 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **5** |
| 9 | MERCOSUR Southern African Customs Union (SACU) | 15/12/2008 | 2008 | 01/04/2016 | 2016 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **3** |
| 10 | Chile MERCOSUR Protocol on Services | 26/05/2009 | 2009 | 19/06/2011 | 2011 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **5** |
| 11 | Egypt MERCOSUR | NA | 2010 | NA | NA | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **5** |
| 12 | European Union MERCOSUR | NA | NA | NA | NA | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | **15** |

## *Table 21 Macroeconomic results using the CGE Eaton-Kortum model*

| | EFTA - Mercosur PTA | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | CHE | MER | **Other EFTA** | | ARG | BRA | PRY | URY |
| **% changes with respect to baseline in 2040** | **Switzerland** | **Mercosur** | **countries** | | **Argentina** | **Brazil** | **Paraguay** | **Uruguay** |
| | | | | | | | | |
| Real GDP (volume) | 0.06 | 0.01 | 0.03 | | 0.00 | 0.01 | 0.01 | 0.03 |
| Real national income | 0.09 | 0.00 | 0.04 | | 0.00 | 0.00 | 0.00 | 0.01 |
| Exports (value) | 0.31 | 0.13 | 0.24 | | 0.10 | 0.15 | 0.05 | 0.12 |
| Imports (value) | 0.33 | 0.12 | 0.29 | | 0.10 | 0.13 | 0.03 | 0.09 |
| | | | | | | | | |
| Consumer prices | 0.09 | -0.06 | 0.05 | | -0.05 | -0.06 | -0.04 | -0.05 |
| Terms of trade | 0.09 | -0.03 | 0.04 | | -0.03 | -0.03 | -0.01 | -0.04 |
| | | | | | | | | |
| Real wages by occupation | | | | | | | | |
| Officials, managers and professionals | 0.07 | 0.00 | 0.07 | | 0.00 | 0.01 | 0.00 | 0.02 |
| Technicians and associated professions | 0.08 | 0.01 | 0.07 | | 0.00 | 0.01 | 0.01 | 0.03 |
| Clerks | 0.07 | 0.00 | 0.08 | | 0.00 | 0.01 | 0.01 | 0.02 |
| Service and shop workers | 0.08 | 0.01 | 0.08 | | 0.00 | 0.01 | 0.01 | 0.03 |
| Agricultural and unskilled workers | 0.17 | 0.01 | 0.14 | | 0.00 | 0.01 | 0.01 | 0.02 |
| | | | | | | | | |
| Real factor prices | | | | | | | | |
| Land | 0.07 | 0.09 | 0.03 | | 0.08 | 0.10 | 0.03 | 0.03 |
| Natural Resources | -0.16 | 0.13 | -0.10 | | 0.08 | 0.16 | -0.02 | 0.00 |
| Capital | -0.01 | -0.01 | 0.02 | | 0.00 | -0.01 | 0.00 | 0.00 |
| | | | | | | | | |
| CO2 emissions (percentage change) | 0.11 | 0.00 | 0.04 | | -0.01 | 0.00 | 0.00 | 0.02 |
| Global CO2 emissions (percentage change) | 0.0002 | | | | | | | |
| | | | | | | | | |
| | **Mercosur** | | | | **Argentina** | **Brazil** | **Paraguay** | **Uruguay** |
| Swiss exports to: | 55.25 | | | | 45.39 | 58.86 | 64.49 | 37.98 |
| Swiss imports from: | 4.99 | | | | 4.58 | 5.28 | 6.90 | 4.24 |

*Table 22 $CO_2$ emissions changes, MT $CO_2$, by activity*

| | change pre- to post-experiment | | | | | | |
|---|---|---|---|---|---|---|---|
| | MER | ARG | BRA | PRY | URY | CHE | WORLD |
| Wheat | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetables, fruit, nuts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Oil seeds | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bovine cattle, sheep and goats | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Forestry | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other primary | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Minerals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Energy (extraction based) | -0.05 | -0.01 | -0.04 | 0.00 | 0.00 | 0.01 | -0.12 |
| Bovine meat products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Meat products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dairy products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetable oils and fats | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Processed rice and sugar | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Beverages and tobacco products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Textiles | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wearing apparel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Leather products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wood products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Paper products, publishing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.03 |
| Basic pharmaceutical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rubber and plastic products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mineral products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Ferrous metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |
| Metals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Metal products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Computer, electronic and optic | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electrical equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery and equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Motor vehicles and parts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Manufactures nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Utilities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.11 |
| Trade and warehousing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Transport nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.01 |
| Water transport | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | -0.01 |
| Air transport | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.01 |
| Communication | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FIRE services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Business services nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Recreation, accomodation, food | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Public Administration and defe | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 |

*Table 23 $CO_2$ emissions changes, MT $CO_2$, by use*

| | change pre- to post-experiment | | | | | | |
|---|---|---|---|---|---|---|---|
| | MER | ARG | BRA | PRY | URY | CHE | WORLD |
| Wheat | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetables, fruit, nuts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Oil seeds | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bovine cattle, sheep and goats | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Forestry | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other primary | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Minerals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Energy (extraction based) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.02 |
| Bovine meat products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Meat products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dairy products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetable oils and fats | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Processed rice and sugar | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Beverages and tobacco products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Textiles | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wearing apparel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Leather products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wood products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Paper products, publishing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical products | -0.01 | -0.01 | 0.00 | 0.00 | 0.00 | 0.00 | -0.07 |
| Basic pharmaceutical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Rubber and plastic products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mineral products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.01 |
| Ferrous metals | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 |
| Metals nec | 0.00 | 0.00 | -0.01 | 0.00 | 0.00 | 0.00 | 0.03 |
| Metal products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Computer, electronic and optic | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electrical equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery and equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Motor vehicles and parts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Manufactures nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Utilities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 |
| Trade and warehousing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport nec | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | -0.01 | -0.01 |
| Water transport | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | -0.02 |
| Air transport | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | -0.01 |
| Communication | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FIRE services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Business services nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Recreation, accomodation, food | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Public Administration and defe | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 |
| Final consumption (Govt, Househ | -0.05 | -0.01 | -0.04 | 0.00 | 0.00 | 0.02 | -0.03 |

*Table 24 $CO_2$ emission changes, in %, by activity*

| | change pre- to post-experiment | | | | | | |
|---|---|---|---|---|---|---|---|
| | MER | ARG | BRA | PRY | URY | CHE | WORLD |
| Wheat | -0.07 | -0.08 | -0.08 | 0.00 | -0.01 | 0.45 | 0.00 |
| Vegetables, fruit, nuts | -0.06 | 0.00 | -0.09 | -0.02 | 0.03 | 0.25 | 0.00 |
| Oil seeds | 0.02 | 0.03 | 0.02 | 0.02 | 0.04 | 0.79 | 0.00 |
| Bovine cattle, sheep and goats | 0.01 | 0.01 | 0.02 | 0.07 | 0.01 | 0.26 | 0.00 |
| Forestry | 0.00 | -0.01 | 0.00 | -0.01 | 0.02 | 0.15 | 0.00 |
| Other primary | 0.01 | -0.01 | 0.02 | 0.00 | -0.09 | 0.32 | 0.00 |
| Minerals nec | 0.00 | 0.01 | 0.00 | -0.02 | -0.01 | 0.01 | 0.00 |
| Energy (extraction based) | -0.03 | -0.01 | -0.04 | -0.02 | 0.02 | 0.12 | 0.00 |
| Bovine meat products | 0.01 | 0.02 | 0.00 | 0.04 | -0.02 | 0.27 | 0.00 |
| Meat products nec | 0.08 | 0.02 | 0.11 | -0.04 | 0.00 | 0.24 | 0.00 |
| Dairy products | -0.08 | -0.05 | -0.09 | 0.00 | -0.68 | 0.43 | 0.00 |
| Vegetable oils and fats | -0.02 | 0.06 | -0.08 | 0.06 | -0.04 | 2.06 | -0.01 |
| Processed rice and sugar | 0.01 | 0.00 | 0.02 | 0.00 | 0.06 | 0.00 | 0.00 |
| Food products nec | -0.09 | -0.07 | -0.11 | -0.08 | 0.00 | 0.47 | 0.00 |
| Beverages and tobacco products | 0.00 | 0.01 | -0.02 | 0.01 | -0.01 | 0.12 | 0.00 |
| Textiles | 0.03 | 0.02 | 0.03 | 0.00 | 0.15 | 1.19 | 0.00 |
| Wearing apparel | 0.07 | 0.10 | 0.04 | 0.00 | 0.15 | 0.28 | 0.00 |
| Leather products | 0.08 | 0.05 | 0.18 | 0.06 | 0.30 | 0.02 | 0.00 |
| Wood products | -0.02 | -0.03 | -0.01 | -0.06 | 0.00 | 0.11 | 0.00 |
| Paper products, publishing | -0.01 | -0.02 | 0.00 | -0.01 | 0.03 | 0.14 | 0.00 |
| Chemical products | -0.04 | -0.06 | -0.02 | 0.02 | 0.04 | 1.33 | -0.01 |
| Basic pharmaceutical products | -0.46 | -0.80 | -0.27 | 0.00 | -0.11 | 0.44 | 0.01 |
| Rubber and plastic products | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.24 | 0.00 |
| Mineral products nec | 0.00 | -0.01 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 |
| Ferrous metals | 0.02 | 0.08 | -0.02 | 0.00 | 0.02 | 0.27 | 0.00 |
| Metals nec | -0.06 | 0.02 | -0.09 | 0.00 | -0.16 | -0.20 | 0.01 |
| Metal products | -0.01 | -0.02 | 0.00 | -0.06 | -0.05 | 0.29 | 0.00 |
| Computer, electronic and optic | -0.01 | -0.09 | 0.01 | 0.00 | 0.06 | 0.25 | 0.00 |
| Electrical equipment | 0.02 | 0.04 | 0.01 | 0.00 | 0.07 | 0.24 | 0.00 |
| Machinery and equipment nec | 0.00 | 0.01 | 0.00 | 0.00 | 0.08 | 0.91 | 0.00 |
| Motor vehicles and parts | 0.01 | 0.03 | 0.01 | 0.00 | 0.06 | 0.27 | 0.00 |
| Transport equipment nec | 0.03 | 0.04 | 0.03 | 0.00 | 0.06 | 0.04 | 0.00 |
| Manufactures nec | -0.09 | -0.09 | -0.09 | -0.12 | -0.13 | 0.05 | 0.00 |
| Utilities | 0.00 | 0.00 | 0.00 | 0.01 | -0.09 | 0.35 | 0.00 |
| Trade and warehousing | 0.00 | 0.00 | 0.01 | 0.01 | 0.04 | 0.07 | 0.00 |
| Transport nec | 0.01 | 0.00 | 0.01 | 0.02 | 0.06 | -0.12 | 0.00 |
| Water transport | 0.11 | 0.11 | 0.11 | 0.01 | 0.17 | -0.08 | 0.00 |
| Air transport | 0.02 | 0.03 | 0.03 | -0.05 | 0.12 | 0.08 | 0.00 |
| Communication | 0.00 | 0.00 | 0.01 | 0.00 | 0.04 | 0.06 | 0.00 |
| FIRE services | 0.01 | 0.00 | 0.01 | 0.01 | 0.06 | 0.05 | 0.00 |
| Business services nec | 0.00 | 0.00 | 0.01 | 0.01 | 0.05 | 0.06 | 0.00 |
| Recreation, accomodation, food | 0.01 | 0.00 | 0.02 | -0.01 | 0.04 | 0.01 | 0.00 |
| Public Administration and defe | 0.00 | -0.01 | 0.01 | 0.00 | 0.00 | 0.10 | 0.00 |

*Table 25 CH4 emission changes, MT $CO_2$-eq, by activity*

| | change pre- to post-experiment | | | | | | |
|---|---|---|---|---|---|---|---|
| | MER | ARG | BRA | PRY | URY | CHE | WORLD |
| Wheat | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetables, fruit, nuts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Oil seeds | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bovine cattle, sheep and goats | 0.09 | 0.01 | 0.07 | 0.01 | 0.01 | 0.00 | 0.06 |
| Forestry | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other primary | 0.02 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.02 |
| Minerals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Energy (extraction based) | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.02 |
| Bovine meat products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Meat products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dairy products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetable oils and fats | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Processed rice and sugar | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food products nec | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| Beverages and tobacco products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Textiles | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wearing apparel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Leather products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wood products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Paper products, publishing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Basic pharmaceutical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rubber and plastic products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mineral products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Ferrous metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Metals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Metal products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Computer, electronic and optic | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electrical equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery and equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Motor vehicles and parts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Manufactures nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Utilities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Trade and warehousing | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 |
| Transport nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Water transport | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Air transport | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Communication | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FIRE services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Business services nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Recreation, accomodation, food | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Public Administration and defe | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Table 26 $CH_4$ emission changes, MT $CO_2$-eq, by use*

| | change pre- to post-experiment | | | | | | |
|---|---|---|---|---|---|---|---|
| | MER | ARG | BRA | PRY | URY | CHE | WORLD |
| Wheat | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetables, fruit, nuts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Oil seeds | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bovine cattle, sheep and goats | 0.14 | 0.01 | 0.11 | 0.01 | 0.01 | 0.00 | 0.09 |
| Forestry | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other primary | 0.02 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.02 |
| Minerals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Energy (extraction based) | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.02 |
| Bovine meat products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Meat products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dairy products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetable oils and fats | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Processed rice and sugar | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Beverages and tobacco products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Textiles | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wearing apparel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Leather products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wood products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Paper products, publishing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Basic pharmaceutical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rubber and plastic products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mineral products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Ferrous metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Metals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Metal products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Computer, electronic and optic | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electrical equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery and equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Motor vehicles and parts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Manufactures nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Utilities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Trade and warehousing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Water transport | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Air transport | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Communication | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FIRE services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Business services nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Recreation, accomodation, food | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Public Administration and defe | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| Final consumption (Govt, Househ | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Table 27 $CH_4$ emission changes, MT $CO_2$-eq, in %, by activity*

| | change pre- to post-experiment | | | | | | |
|---|---|---|---|---|---|---|---|
| | MER | ARG | BRA | PRY | URY | CHE | WORLD |
| Wheat | 0.03 | 0.00 | 0.04 | 0.03 | -0.01 | 0.01 | 0.00 |
| Vegetables, fruit, nuts | 0.04 | 0.01 | 0.04 | 0.04 | 0.02 | -0.10 | 0.00 |
| Oil seeds | 0.03 | 0.02 | 0.04 | 0.02 | 0.04 | 0.18 | 0.00 |
| Bovine cattle, sheep and goats | 0.04 | 0.02 | 0.05 | 0.04 | 0.06 | 0.07 | 0.00 |
| Forestry | 0.03 | 0.00 | 0.04 | 0.02 | 0.01 | 0.01 | 0.00 |
| Other primary | 0.04 | 0.02 | 0.04 | 0.01 | -0.06 | 0.05 | 0.00 |
| Minerals nec | 0.04 | 0.00 | 0.04 | 0.02 | 0.02 | -0.04 | 0.00 |
| Energy (extraction based) | 0.01 | 0.01 | 0.02 | 0.00 | 0.06 | 0.11 | 0.00 |
| Bovine meat products | 0.03 | 0.00 | 0.03 | 0.04 | -0.04 | 0.19 | 0.00 |
| Meat products nec | 0.02 | 0.01 | 0.03 | 0.02 | 0.00 | 0.06 | 0.00 |
| Dairy products | 0.03 | 0.02 | 0.02 | 0.00 | 0.04 | 0.08 | 0.00 |
| Vegetable oils and fats | 0.05 | 0.01 | 0.05 | 0.04 | -0.02 | 0.00 | 0.01 |
| Processed rice and sugar | 0.03 | 0.02 | 0.03 | 0.02 | 0.04 | 0.00 | 0.00 |
| Food products nec | 0.05 | 0.02 | 0.05 | 0.03 | 0.01 | 0.06 | 0.00 |
| Beverages and tobacco products | 0.03 | 0.01 | 0.03 | 0.03 | 0.00 | 0.00 | 0.00 |
| Textiles | 0.04 | 0.01 | 0.04 | 0.04 | 0.01 | 1.07 | 0.00 |
| Wearing apparel | 0.03 | 0.01 | 0.03 | 0.03 | 0.06 | 0.18 | 0.00 |
| Leather products | 0.02 | 0.00 | 0.04 | 0.02 | 0.23 | 0.42 | 0.00 |
| Wood products | 0.02 | 0.00 | 0.02 | 0.03 | 0.01 | 0.05 | 0.00 |
| Paper products, publishing | 0.03 | 0.01 | 0.03 | 0.03 | 0.02 | 0.05 | 0.00 |
| Chemical products | 0.04 | 0.01 | 0.04 | 0.02 | 0.01 | 1.08 | 0.00 |
| Basic pharmaceutical products | 0.04 | 0.02 | 0.04 | 0.03 | 0.05 | 0.07 | 0.00 |
| Rubber and plastic products | 0.03 | 0.01 | 0.04 | 0.02 | 0.04 | 0.07 | 0.00 |
| Mineral products nec | 0.02 | 0.00 | 0.02 | 0.01 | 0.03 | 0.04 | 0.00 |
| Ferrous metals | 0.02 | 0.02 | 0.02 | 0.01 | 0.05 | 0.10 | 0.00 |
| Metals nec | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | -0.20 | 0.00 |
| Metal products | 0.03 | 0.01 | 0.03 | 0.01 | 0.01 | 0.05 | 0.00 |
| Computer, electronic and optic | 0.03 | 0.01 | 0.03 | 0.00 | 0.05 | 0.03 | 0.00 |
| Electrical equipment | 0.02 | 0.01 | 0.02 | 0.00 | 0.04 | 0.05 | 0.00 |
| Machinery and equipment nec | 0.02 | 0.02 | 0.03 | 0.02 | 0.03 | 0.17 | 0.00 |
| Motor vehicles and parts | 0.03 | 0.01 | 0.03 | 0.03 | 0.07 | -0.12 | 0.00 |
| Transport equipment nec | 0.01 | 0.00 | 0.03 | 0.00 | -0.06 | -0.06 | 0.00 |
| Manufactures nec | 0.01 | 0.00 | 0.02 | -0.02 | -0.03 | 0.02 | 0.00 |
| Utilities | 0.03 | 0.00 | 0.04 | 0.03 | 0.03 | 0.05 | 0.00 |
| Trade and warehousing | 0.03 | 0.01 | 0.04 | 0.03 | 0.03 | 0.03 | 0.00 |
| Transport nec | 0.01 | -0.01 | 0.02 | 0.03 | 0.04 | -0.10 | 0.00 |
| Water transport | 0.03 | 0.01 | 0.03 | 0.02 | 0.00 | -0.07 | 0.00 |
| Air transport | 0.02 | 0.01 | 0.03 | -0.02 | 0.00 | 0.08 | 0.00 |
| Communication | 0.03 | 0.01 | 0.03 | 0.03 | 0.04 | 0.02 | 0.00 |
| FIRE services | 0.03 | 0.01 | 0.03 | 0.03 | 0.04 | 0.01 | 0.00 |
| Business services nec | 0.02 | 0.01 | 0.03 | 0.02 | 0.04 | 0.01 | 0.00 |
| Recreation, accomodation, food | 0.03 | 0.01 | 0.03 | 0.03 | 0.03 | -0.03 | 0.00 |
| Public Administration and defence | 0.01 | 0.00 | 0.01 | 0.01 | 0.03 | 0.04 | 0.00 |

*Table 28 $N_2O$ emission changes, MT $CO_2$-eq, by activity*

| | change pre- to post-experiment | | | | | | |
|---|---|---|---|---|---|---|---|
| | MER | ARG | BRA | PRY | URY | CHE | WORLD |
| Wheat | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetables, fruit, nuts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Oil seeds | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.01 |
| Bovine cattle, sheep and goats | 0.04 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.02 |
| Forestry | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other primary | 0.02 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| Minerals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Energy (extraction based) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bovine meat products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Meat products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dairy products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetable oils and fats | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Processed rice and sugar | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Beverages and tobacco products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Textiles | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wearing apparel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Leather products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wood products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Paper products, publishing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Basic pharmaceutical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rubber and plastic products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mineral products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Ferrous metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Metals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Metal products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Computer, electronic and optic | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electrical equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery and equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Motor vehicles and parts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Manufactures nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Utilities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Trade and warehousing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Water transport | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Air transport | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Communication | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FIRE services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Business services nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Recreation, accomodation, food | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Public Administration and defence | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Table 29 $N_2O$ emission changes, MT $CO_2$-eq, by use*

| | change pre- to post-experiment | | | | | | |
|---|---|---|---|---|---|---|---|
| | MER | ARG | BRA | PRY | URY | CHE | WORLD |
| Wheat | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetables, fruit, nuts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Oil seeds | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.01 |
| Bovine cattle, sheep and goats | 0.06 | 0.01 | 0.04 | 0.00 | 0.00 | 0.00 | 0.03 |
| Forestry | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other primary | 0.02 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| Minerals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Energy (extraction based) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bovine meat products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Meat products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dairy products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetable oils and fats | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Processed rice and sugar | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Beverages and tobacco products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Textiles | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wearing apparel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Leather products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wood products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Paper products, publishing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.01 |
| Basic pharmaceutical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rubber and plastic products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mineral products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Ferrous metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Metals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Metal products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Computer, electronic and optic | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electrical equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery and equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Motor vehicles and parts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Manufactures nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Utilities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Trade and warehousing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Water transport | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Air transport | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Communication | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FIRE services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Business services nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Recreation, accomodation, food | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Public Administration and defence | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Final consumption (Govt, Households) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total | 0.08 | 0.01 | 0.06 | 0.00 | 0.00 | 0.00 | 0.02 |

*Table 30 $N_2O$ emission changes, MT CO2-eq, in %, by activity*

| | change pre- to post-experiment | | | | | | |
|---|---|---|---|---|---|---|---|
| | MER | ARG | BRA | PRY | URY | CHE | WORLD |
| Wheat | -0.03 | -0.06 | -0.03 | 0.00 | -0.03 | -0.03 | 0.00 |
| Vegetables, fruit, nuts | 0.02 | 0.01 | 0.02 | 0.02 | 0.02 | -0.10 | 0.00 |
| Oil seeds | 0.02 | 0.02 | 0.03 | 0.02 | 0.04 | 0.20 | -0.01 |
| Bovine cattle, sheep and goats | 0.04 | 0.02 | 0.05 | 0.04 | 0.06 | 0.07 | 0.00 |
| Forestry | 0.03 | 0.00 | 0.03 | 0.03 | 0.00 | 0.09 | 0.00 |
| Other primary | 0.03 | 0.01 | 0.04 | 0.01 | -0.05 | 0.04 | 0.00 |
| Minerals nec | 0.03 | 0.01 | 0.04 | 0.00 | 0.00 | 0.13 | 0.00 |
| Energy (extraction based) | 0.00 | 0.00 | 0.00 | -0.01 | 0.00 | 0.11 | 0.00 |
| Bovine meat products | 0.02 | 0.00 | 0.02 | 0.05 | 0.09 | 0.74 | 0.00 |
| Meat products nec | 0.04 | 0.03 | 0.04 | 0.02 | 0.08 | 0.78 | 0.00 |
| Dairy products | 0.02 | 0.01 | 0.01 | 0.00 | 0.02 | 0.11 | 0.00 |
| Vegetable oils and fats | 0.04 | 0.00 | 0.04 | 0.04 | 0.00 | 0.65 | 0.01 |
| Processed rice and sugar | 0.03 | 0.02 | 0.02 | 0.05 | 0.04 | 0.00 | 0.00 |
| Food products nec | 0.04 | 0.02 | 0.04 | 0.03 | 0.02 | 0.06 | 0.00 |
| Beverages and tobacco products | 0.03 | 0.01 | 0.03 | 0.03 | -0.03 | 0.00 | 0.00 |
| Textiles | 0.04 | 0.01 | 0.04 | 0.03 | 0.00 | 0.98 | 0.00 |
| Wearing apparel | 0.03 | 0.02 | 0.03 | 0.04 | 0.05 | 0.00 | 0.00 |
| Leather products | 0.06 | 0.02 | 0.09 | 0.09 | 0.00 | 0.91 | 0.00 |
| Wood products | 0.02 | 0.01 | 0.02 | 0.04 | 0.00 | 0.11 | 0.00 |
| Paper products, publishing | 0.02 | 0.01 | 0.03 | 0.02 | 0.03 | 0.27 | 0.00 |
| Chemical products | 0.02 | -0.02 | 0.02 | 0.01 | 0.01 | 1.29 | 0.00 |
| Basic pharmaceutical products | 0.00 | -0.02 | 0.01 | -0.01 | 0.04 | 0.34 | 0.01 |
| Rubber and plastic products | 0.03 | 0.02 | 0.03 | 0.02 | 0.04 | 0.22 | 0.00 |
| Mineral products nec | 0.02 | 0.00 | 0.02 | 0.01 | 0.03 | 0.25 | 0.00 |
| Ferrous metals | 0.02 | 0.03 | 0.02 | 0.03 | -0.03 | 0.29 | 0.00 |
| Metals nec | -0.01 | 0.01 | -0.01 | -0.02 | 0.00 | 0.00 | 0.00 |
| Metal products | 0.03 | 0.01 | 0.03 | -0.01 | -0.01 | 0.17 | 0.00 |
| Computer, electronic and optic | 0.03 | 0.00 | 0.03 | 0.00 | 0.07 | 0.22 | 0.00 |
| Electrical equipment | 0.03 | 0.01 | 0.03 | 0.00 | 0.02 | 0.09 | 0.00 |
| Machinery and equipment nec | 0.03 | 0.02 | 0.03 | 0.00 | 0.03 | 0.20 | 0.00 |
| Motor vehicles and parts | 0.03 | 0.02 | 0.03 | 0.00 | -0.08 | 0.00 | 0.00 |
| Transport equipment nec | 0.02 | 0.01 | 0.03 | 0.00 | -0.06 | 0.00 | 0.00 |
| Manufactures nec | 0.00 | 0.00 | 0.02 | -0.06 | -0.05 | 0.05 | 0.00 |
| Utilities | 0.02 | -0.01 | 0.03 | 0.03 | 0.03 | 0.14 | 0.00 |
| Trade and warehousing | 0.03 | 0.01 | 0.04 | 0.03 | 0.03 | 0.18 | 0.00 |
| Transport nec | 0.03 | 0.01 | 0.03 | 0.04 | 0.03 | 0.06 | 0.00 |
| Water transport | 0.03 | 0.01 | 0.04 | 0.03 | 0.00 | 0.00 | 0.00 |
| Air transport | 0.03 | 0.00 | 0.03 | 0.03 | 0.00 | 0.19 | 0.00 |
| Communication | 0.03 | 0.01 | 0.03 | 0.03 | 0.03 | 0.09 | 0.00 |
| FIRE services | 0.03 | 0.01 | 0.03 | 0.03 | 0.04 | 0.14 | 0.00 |
| Business services nec | 0.03 | 0.02 | 0.03 | 0.03 | 0.04 | 0.13 | 0.00 |
| Recreation, accomodation, food | 0.03 | 0.01 | 0.03 | 0.03 | 0.03 | 0.03 | 0.00 |
| Public Administration and defence | 0.01 | 0.00 | 0.01 | 0.02 | 0.03 | 0.05 | 0.00 |

*Table 31 Fluorinated gases emission changes, MT $CO_2$-eq, by activity*

| | change pre- to post-experiment | | | | | | |
|---|---|---|---|---|---|---|---|
| | MER | ARG | BRA | PRY | URY | CHE | WORLD |
| Wheat | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetables, fruit, nuts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Oil seeds | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bovine cattle, sheep and goats | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Forestry | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other primary | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Minerals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Energy (extraction based) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bovine meat products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Meat products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dairy products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetable oils and fats | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Processed rice and sugar | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Beverages and tobacco products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Textiles | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wearing apparel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Leather products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wood products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Paper products, publishing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Basic pharmaceutical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rubber and plastic products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mineral products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Ferrous metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Metals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Metal products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Computer, electronic and optic | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electrical equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery and equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Motor vehicles and parts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Manufactures nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Utilities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Trade and warehousing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Water transport | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Air transport | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Communication | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FIRE services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Business services nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Recreation, accomodation, food | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Public Administration and defence | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Table 32 Fluorinated gases emission changes, MT $CO_2$-eq, by use*

| | change pre- to post-experiment | | | | | | |
|---|---|---|---|---|---|---|---|
| | MER | ARG | BRA | PRY | URY | CHE | WORLD |
| Wheat | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetables, fruit, nuts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Oil seeds | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bovine cattle, sheep and goats | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Forestry | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other primary | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Minerals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Energy (extraction based) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bovine meat products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Meat products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dairy products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetable oils and fats | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Processed rice and sugar | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Beverages and tobacco products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Textiles | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wearing apparel | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Leather products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wood products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Paper products, publishing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.01 |
| Basic pharmaceutical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Rubber and plastic products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Mineral products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Ferrous metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Metals nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| Metal products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Computer, electronic and optic | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electrical equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery and equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Motor vehicles and parts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport equipment nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Manufactures nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Utilities | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Trade and warehousing | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Water transport | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Air transport | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Communication | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FIRE services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Business services nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Recreation, accomodation, food | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Public Administration and defence | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Final consumption (Govt, Households) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Total | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

*Table 33 Fluorinated gases emission changes, in % changes, by activity*

| | change pre- to post-experiment | | | | | | |
|---|---|---|---|---|---|---|---|
| | MER | ARG | BRA | PRY | URY | CHE | WORLD |
| Wheat | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetables, fruit, nuts | -0.06 | 0.00 | -0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| Oil seeds | -0.07 | 0.00 | -0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bovine cattle, sheep and goats | -0.16 | -0.26 | -0.14 | 0.00 | 0.00 | 0.53 | 0.00 |
| Forestry | -0.06 | 0.00 | -0.06 | 0.00 | 0.00 | 0.34 | 0.00 |
| Other primary | -0.07 | -0.19 | -0.07 | 0.00 | 0.00 | 0.47 | 0.00 |
| Minerals nec | -0.09 | -0.05 | -0.09 | 0.00 | 0.00 | -0.24 | 0.00 |
| Energy (extraction based) | -0.09 | -0.08 | -0.09 | 0.00 | 0.00 | 0.48 | 0.00 |
| Bovine meat products | -0.08 | 0.00 | -0.08 | 0.00 | 0.00 | 1.03 | 0.00 |
| Meat products nec | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.79 | 0.00 |
| Dairy products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.28 | 0.00 |
| Vegetable oils and fats | -0.05 | 0.00 | -0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| Processed rice and sugar | -0.07 | 0.00 | -0.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| Food products nec | -0.05 | 0.00 | -0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| Beverages and tobacco products | -0.10 | 0.00 | -0.11 | 0.00 | 0.00 | -0.22 | 0.00 |
| Textiles | -0.05 | 0.00 | -0.05 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wearing apparel | -0.05 | 0.00 | -0.06 | 0.00 | 0.00 | 0.00 | 0.00 |
| Leather products | -0.20 | 0.00 | -0.35 | 0.00 | 0.00 | 0.00 | 0.00 |
| Wood products | -0.04 | -0.16 | -0.03 | 0.00 | 0.00 | 0.15 | 0.00 |
| Paper products, publishing | -0.07 | -0.11 | -0.05 | 0.00 | 0.00 | 0.21 | 0.00 |
| Chemical products | -0.07 | -0.08 | -0.06 | 0.00 | 0.04 | 1.25 | 0.00 |
| Basic pharmaceutical products | -0.94 | -1.31 | -0.67 | 0.00 | 0.00 | 0.26 | 0.01 |
| Rubber and plastic products | -0.03 | 0.01 | -0.04 | 0.00 | 0.00 | 0.22 | 0.00 |
| Mineral products nec | -0.06 | -0.11 | -0.06 | 0.00 | 0.00 | 0.31 | 0.00 |
| Ferrous metals | -0.06 | 0.00 | -0.06 | 0.00 | 0.00 | 0.21 | 0.00 |
| Metals nec | -0.09 | 0.03 | -0.10 | 0.00 | 0.00 | -0.33 | 0.01 |
| Metal products | -0.07 | -0.07 | -0.07 | 0.00 | 0.00 | 0.19 | 0.00 |
| Computer, electronic and optic | 0.03 | 0.00 | 0.03 | 0.00 | 0.03 | 0.22 | 0.00 |
| Electrical equipment | -0.03 | 0.00 | -0.03 | 0.00 | 0.00 | 0.19 | 0.00 |
| Machinery and equipment nec | -0.07 | 0.00 | -0.08 | 0.00 | 0.00 | 0.15 | 0.00 |
| Motor vehicles and parts | -0.04 | -0.11 | -0.04 | 0.00 | 0.00 | 0.00 | 0.00 |
| Transport equipment nec | -0.06 | 0.00 | -0.07 | 0.00 | 0.00 | 0.00 | 0.00 |
| Manufactures nec | -0.03 | 0.00 | -0.03 | 0.00 | 0.00 | 0.20 | 0.00 |
| Utilities | -0.09 | -0.04 | -0.10 | 0.00 | 0.00 | 0.32 | 0.00 |
| Trade and warehousing | -0.06 | -0.05 | -0.06 | 0.00 | 0.06 | 0.22 | 0.00 |
| Transport nec | -0.07 | -0.06 | -0.07 | 0.00 | 0.00 | 0.12 | 0.00 |
| Water transport | -0.07 | -0.06 | -0.07 | 0.00 | 0.00 | 0.00 | 0.00 |
| Air transport | -0.05 | 0.00 | -0.05 | 0.00 | 0.00 | 0.15 | 0.00 |
| Communication | -0.05 | -0.08 | -0.05 | 0.00 | 0.30 | 0.08 | 0.00 |
| FIRE services | -0.07 | -0.07 | -0.07 | 0.00 | 0.00 | 0.10 | 0.00 |
| Business services nec | -0.07 | -0.08 | -0.06 | 0.00 | 0.00 | 0.15 | 0.00 |
| Recreation, accomodation, food | -0.06 | -0.04 | -0.07 | 0.00 | 0.00 | 0.09 | 0.00 |
| Public Administration and defence | -0.07 | -0.09 | -0.06 | 0.00 | 0.00 | -0.11 | 0.00 |

*Table 34 Estimated change in other air pollution (in %)*

| Pollution type | Switzerland | Argentina | Brazil | Paraguay | Uruguay | World |
|---|---|---|---|---|---|---|
| **BC** | 0.03 | 0.01 | 0.02 | 0.01 | 0.00 | 0.00 |
| **CO** | -0.11 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 |
| **$NH_3$** | 0.13 | -0.01 | 0.02 | 0.01 | 0.00 | 0.00 |
| **NMVB** | -0.01 | 0.01 | 0.02 | 0.02 | 0.00 | 0.00 |
| **NMVF** | 0.20 | -0.02 | 0.00 | 0.00 | 0.04 | 0.00 |
| **NOX** | 0.06 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 |
| **OC** | -0.01 | 0.01 | 0.02 | 0.01 | 0.00 | 0.00 |
| **$PM_{10}$** | 0.17 | 0.01 | 0.02 | 0.01 | 0.00 | 0.00 |
| **$PM_{2\_5}$** | 0.05 | 0.01 | 0.02 | 0.00 | 0.00 | 0.00 |
| **$SO_2$** | 0.30 | -0.04 | -0.03 | 0.00 | -0.01 | 0.00 |
| **$N_2O$** | 0.56 | -0.03 | -0.02 | 0.01 | 0.02 | 0.00 |
| **$CH_4$** | -0.04 | 0.00 | 0.01 | 0.01 | 0.04 | 0.00 |
| **FGAS** | 0.20 | -0.07 | -0.07 | 0.00 | 0.02 | 0.00 |
| **$CO_2$_energy** | -0.07 | 0.01 | 0.00 | 0.01 | 0.06 | 0.00 |
| **$CO_2$_utility** | 0.20 | 0.01 | 0.01 | 0.02 | -0.98 | 0.00 |
| **$CO_2$_total** | -0.07 | 0.01 | 0.00 | 0.01 | 0.06 | 0.00 |

*Table 35 Changes in sectoral value added (in %)*

| | CHE | | ARG | BRA | PRY | URY |
|---|---|---|---|---|---|---|
| | **Switzerland** | **MERCOSUR** | **Argentina** | **Brazil** | **Paraguay** | **Uruguay** |
| **Primary sectors** | | | | | | |
| Wheat | -0.10 | -0.07 | -0.07 | -0.08 | -0.05 | -0.03 |
| Vegetables, fruit & nuts | -0.11 | -0.06 | 0.01 | -0.08 | -0.03 | 0.02 |
| Oil seeds | 0.19 | 0.02 | 0.02 | 0.02 | 0.02 | 0.04 |
| Cattle | 0.04 | 0.03 | 0.01 | 0.03 | 0.03 | 0.05 |
| Forestry | -0.02 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 |
| Other primary activities | 0.02 | 0.02 | 0.00 | 0.03 | 0.00 | -0.07 |
| Other mining extraction | -0.02 | 0.02 | 0.01 | 0.02 | 0.00 | 0.01 |
| Energy | -0.03 | 0.02 | 0.01 | 0.02 | 0.02 | 0.09 |
| **Manufacturing sectors** | | | | | | |
| Cattle meat products | 0.09 | 0.03 | 0.01 | 0.04 | 0.05 | 0.08 |
| Other meat product | -0.02 | 0.11 | 0.03 | 0.15 | 0.00 | 0.02 |
| Milk & dairy products | 0.41 | -0.09 | -0.06 | -0.08 | 0.00 | -0.75 |
| Vegetable oils & fats | 2.29 | 0.00 | 0.06 | -0.06 | 0.07 | 0.01 |
| Processed rice and sugar | -0.72 | 0.04 | 0.01 | 0.05 | 0.03 | 0.09 |
| Other processed food | 0.49 | -0.19 | -0.07 | -0.24 | -0.31 | 0.01 |
| Beverages & tobacco products | 0.04 | 0.01 | 0.01 | 0.00 | 0.00 | 0.08 |
| Textiles | 1.21 | 0.06 | 0.02 | 0.07 | -0.10 | 0.84 |
| Wearing apparel | 0.16 | 0.11 | 0.15 | 0.09 | -0.04 | 0.38 |
| Leather products | -0.13 | 0.20 | 0.13 | 0.24 | 0.09 | 0.49 |
| Wood products | -0.08 | 0.02 | -0.01 | 0.03 | 0.01 | 0.02 |
| Paper & Paper Products | 0.06 | 0.00 | -0.04 | 0.01 | -0.02 | 0.00 |
| Chemicals & chemical prods | 1.31 | -0.05 | -0.08 | -0.04 | 0.02 | 0.02 |
| Pharmac. & medicinal prods | 0.28 | -0.90 | -1.34 | -0.80 | -0.46 | -0.60 |
| Rubber & plastics prods | 0.21 | 0.01 | 0.02 | 0.01 | -0.01 | -0.04 |
| Other non-metallic minerals | 0.05 | 0.01 | -0.02 | 0.02 | 0.01 | 0.02 |
| Ferrous metals | 0.22 | -0.01 | 0.08 | -0.03 | 0.04 | -0.01 |
| Non-ferrous metals | -0.34 | -0.06 | 0.02 | -0.11 | 0.00 | -0.28 |
| Metal products | 0.34 | -0.04 | -0.02 | -0.04 | -0.15 | -0.33 |
| Computer & electronic prods | 0.22 | 0.04 | -0.10 | 0.05 | 0.11 | 0.03 |
| Electrical equipment | 0.25 | 0.14 | 0.05 | 0.16 | -0.10 | 0.11 |
| Other machinery & equipment | 0.97 | -0.22 | 0.01 | -0.25 | -0.05 | -0.03 |
| Motor vehicles & parts | 1.58 | 0.06 | 0.07 | 0.06 | 0.07 | 0.06 |
| Other transport equipment | -0.52 | 0.20 | 0.20 | 0.20 | 0.19 | 0.14 |
| Other manufactures | 0.14 | -0.18 | -0.10 | -0.20 | -0.12 | -0.35 |
| **Service sectors** | | | | | | |
| Utilities | 0.01 | 0.00 | -0.01 | 0.00 | 0.07 | 0.02 |
| Trade and warehousing | 0.04 | 0.01 | 0.00 | 0.01 | 0.01 | 0.02 |
| Land transport | -0.14 | 0.01 | 0.00 | 0.01 | 0.01 | 0.05 |
| Water transport | -0.09 | 0.13 | 0.15 | 0.13 | 0.02 | 0.13 |
| Air transport | 0.07 | 0.02 | 0.01 | 0.02 | -0.04 | 0.12 |
| Communication | 0.00 | 0.01 | 0.01 | 0.02 | 0.00 | 0.03 |
| Finance, insurance & real estate | -0.09 | 0.00 | -0.01 | 0.00 | -0.02 | 0.01 |
| Other business services | -0.08 | 0.06 | 0.03 | 0.08 | 0.06 | 0.09 |
| Recreation, accommodation & food | -0.04 | 0.01 | 0.01 | 0.01 | 0.00 | 0.03 |
| Government and other services | 0.05 | 0.01 | 0.00 | 0.01 | 0.00 | 0.02 |