Economic modelling of EU free trade agreements: Reflections by a partial bystander

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September 2017

Abstract:

This paper discusses various aspects of economic modelling of EU free trade agreements (FTAs). It starts with a brief description of the basic features of Computable General Equilibrium (CGE) models and their gradual adaptation to modern trade theory. The paper then discusses the underlying workhorse data and points to a few critical areas which are in need of further efforts to increase the quality of model based simulations. It also describes on-going efforts and past projects that the Commission has undertaken to improve the tools available to modellers. Some necessary practical modelling choices are then discussed in terms of their impact on the modelling results followed by some thoughts on how the results of relatively complex technical undertakings such as CGE modelling exercises could be presented to a broad audience.

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1. Introduction

The EU's trade and investment policy – or the common commercial policy – is an exclusive power of the EU, which is carried out by the European Commission (the Commission). It relates to trade in goods as well as to trade in services and to areas such as foreign direct investment (FDI), trade related aspects of intellectual property rights, public procurement and technical barriers to trade, etc. The EU's trade and investment policy is often carried out through negotiations, which are conducted by the Commission on behalf of all EU countries.

The basic motivation for opening up to trade is that it leads to increased specialisation and improved resource allocation, allowing firms to exploit economies of scale and to lower production costs. At the same time the increased presence of foreign competitors puts a downward pressure on prices and offers greater product variety for consumers. In addition, over time, trade openness allows ideas and technologies to spread and spurs innovation and productivity growth.

All these reinforcing channels amount to profound changes to how an economy works. However the many inter-linkages at play and lack of data make these effects difficult to quantify. That is perhaps one of the reasons for why trade policy may be one of the most thoroughly analysed areas of activities of the Commission. For example, in the case of EU free trade agreements (FTAs), the impact is in fact analysed before, during as well as after the negotiation process.

A Commission Impact assessment (IA) is needed before major trade negotiations can begin and for all other significant trade policy proposals. It assesses if e.g. an FTA is justified and how the FTA should be designed to achieve desired policy objectives. The IA follows an integrated approach that assesses the environmental, social and economic impacts of a range of policy options and prepares evidence for the College of Commissioners of the advantages and disadvantages so as enabling them to take a decision.

A trade sustainability impact assessment (SIA) is carried out during negotiations to help the Commission as a negotiator to shape the negotiating process in a direction coherent with overall EU policy. It is made up of (i) an analysis of the potential economic,[1] environmental and social impacts that the trade agreement might have, both in the EU and in the partner countries; and (ii) a transparent and wide consultation process.

The economic assessment of the negotiated outcome (EANO) focus on the economic value of trade barrier reductions following the final, precise outcome of the negotiations and are thus carried out after their conclusion. The analysis follows the actual text of the agreement, including the tariff dismantling schedules, which makes it possible also to assess the reduction in non-tariff measures (NTMs) in the form of trade cost reduction of separate provisions of the agreement.[2]

Finally, ex-post evaluations are used to assess the extent to which EU action is achieving the set policy objectives and how performance can be improved in the future. The aim is to provide a reliable and objective assessment of how efficient and effective an initiative has been a number of years after implementation. Civil society organisations participate in the

[1] The general rule is that the economic analyses in SIAs should build on the economic analyses in the previous IAs.

[2] The notation NTM is deliberately used here since not all NTMs are non-tariff barriers (NTBs).

monitoring of trade agreements that have been concluded between the EU and partner countries and provide input specifically on social and environmental issues.

Most studies the Commission undertakes to assess the economic impact of FTAs are carried out using computable general equilibrium (CGE) models, which are state of the art tools for overall assessments of trade agreements at region, country and broad sector level. These models are computer-based simulations which calculate the future state of the global economy (including any country or region specifically analysed) as a consequence of a specified set of (trade) policy changes.

For example, assume that policymakers decide to raise import barriers on steel to relieve the competition pressure on the domestic industry. A CGE model would then also show how detrimental protecting this one sector from competition would be to downstream industries that use steel as inputs (due to higher steel prices). Furthermore, the inter-linkages in the CGE model would also pick up the impact on upstream industries. Less steel will be used overall in the economy and, hence, there will be less use made of business services like logistics. CGE models are therefore important for evaluating economy-wide effects of specific policy decisions.

Over the past decades(s) CGE models have undergone changes to keep up with the economic theory on which they are grounded. Still, more work is needed to refine models to account for theoretical advances, but also to improve access to data, not least on NTMs, and to carry out simulations at a finer level of aggregation. Simulation results are further sensitive to parameterization and modellers' approach/choice to solve the model at hand. Finally, presentation of the simulation results in terms of aggregation of the results and the fact that not all outputs of the simulations can possibly be reported also matters for outsiders' perception.

The purpose of this paper is to look into these issues in somewhat more detail and thus to shed some light on some of the quite complicated issues the Commission is faced with carrying out studies on the impact of FTAs. It is by no means an attempt to be comprehensive and to deal with all issues that may be in need of attention. It is rather a presentation of food for thought from a semi-technical bureaucrat's point of view, dealing with the most common questions and issues raised by high-level policymakers and the general public with an interest in trade, including explicit free trade critics. Finally, the paper should facilitate a deeper understanding of some of the complexities underpinning the results of the economic analyses of (EU) FTAs that are carried out.

The paper is organised as follows: Section 2 briefly touches upon how recent theoretical advances in trade theory are reflected in CGE modelling. Section 3 looks into the data available to simulate the impact of FTAs, with a particular focus on NTMs in goods and services. Section 4 presents Commission efforts to alleviate some of the data and modelling constraints, while Section 5 discusses some practical modelling choices needed to be made to produce as accurate results of the simulations as possible. Section 6 looks into how modelling results are presented in the age of anti-trade sentiments and reviews some options to make them easier to understand for the general public. Section 7 concludes.

2. CGE models: basic setting, adaptation to modern trade theory and common criticism[3]

CGE models have been the workhorse type of models for assessing the economy-wide impact of trade liberalisation for more than three decades.[4] The main advantage of CGE models is that they analyse the effects of trade policy taking into account the main links between the domestic and international production of goods and services. They also include consumption and investment decisions of firms across sectors as well as of consumers and the government and account for the fact that different sectors compete for capital, labour and land.

Output comes in the form of results on a wide range of indicators such as: (i) GDP or welfare (equivalent variation); (ii) Impact by sector in terms of exports, imports, production and value added reflecting inter-sectoral input-output links including sourcing of inputs (goods and services) from abroad; (iii) Impact on factors of production (land, capital and labour of various skill categories) in terms of e.g. wages and (iv) CO2 emissions, land use, etc.

This type of models help answer 'what if…' questions by simulating the price, income and substitution effects of different policy changes and comparing them to a so called baseline (i.e., what would happen without a policy change). The baseline is key since it is the counterfactual against which the economic outcome of the initiative is assessed. Hence, the models allow economists to simulate how all sectors and actors adjust to the changes to costs, prices and/or incentives that a trade policy change would cause. This allows for an assessment of all the direct and indirect effects of changes to trade policy.

2.1. Basic setting

On the production side, trade liberalisation leads to efficiency gains from reallocation and substitution of factors of production across sectors as a response to changes in factor returns. Both labour and capital can respond to changes in factor returns (if you allow them to) so that, for example, the supply of labour would increase when wages go up. Such effects would add to the gains from reallocating production factors only, but are rarely modelled as there is no clear theoretical basis for modelling labour market reactions to trade policy changes, see Section 5.1.1.

On the demand side, often, a Cobb-Douglas type utility function fix expenditure shares across private consumption, government consumption and savings while maximising total per capita utility. Following a trade policy shock, changes in consumption are re-allocated between sectors and regions analysed.

Some models incorporate imperfect competition for some sectors, introducing price mark-ups that represent monopolistic profits in equilibrium. These price mark-ups are reduced by intensified competition under trade liberalization, generating additional welfare gains. Some recent models incorporate heterogeneous firms features, which generate productivity gains from reallocation of market shares to more productive firms under trade liberalization, see Section 2.2.

[3] Parts of this section draw heavily on Hertel (2013).

[4] See Dixon (2006) for an overview of the evolution of the use of CGE models in modelling trade policy in addition to the literature cited in Hertel (2013).

Trade is modelled based on the assumption of imperfect substitutability of products depending on their origin (the Armington assumption) with the elasticity of substitution (EoS) between domestic and imported goods taking on different values compared to the EoS between imported goods. The values of the Armington elasticities matter greatly since CGE models react the following way to a simple unilateral trade liberalisation scenario: lower import tariffs lead to more imports but also to higher exports which are needed to sustain a fixed trade balance.

For exports to increase prices have to fall (which they do via a real depreciation); this in turn raises costs of imports to restore the trade balance. However, depending on the value of the elasticities, the process may lead to relatively large and negative terms-of-trade effects which tend to outweigh the allocative efficiency gains from tariff reduction, especially in a low tariff world. One way of alleviating this problem would be to increase the values of the elasticities since it would increase the size of the allocative efficiency gains. It would also reduce the magnitude of the price drop needed to maintain trade in balance. At the same time, higher elasticities result in larger production and employment adjustments and may lead to a disproportionate specialisation.

2.2. Adaptation to modern trade theory

Newer trade theory provides avenues for additional gains from trade liberalisation which would help to counter the Armington based negative terms-of-trade effects (see Section 2.1.) Krugman (1980) introduced gains from trade liberalisation in the form of scale economies and a greater number of varieties through an increase in imports. Melitz (2003) introduced the notion of heterogeneous firms in trade with the implication that exposure to trade will lead to that the more productive firms export, the least productive firms exit and that some less productive firms (continue to) produce only for the domestic market (thereby raising overall average productivity levels).

Attempts have been made to introduce Melitz type of structures in CGE models. Based on Melitz (2003), Balistreri and Rutherford (2013) do so and find significant productivity and variety effects. Similarly, Zhai (2008) implements a simplified version of the Melitz model in a CGE framework and finds that the welfare gains from 50% tariff cuts worldwide roughly doubles compared to the regular Armington setting, albeit with significant differences between the countries analysed. Dixon et al (2016) derive Armington, Krugman and Melitz type of models from a more general case and reproduce Melitz type of results. However, they do not find higher welfare effects in this specification compared to the Armington model. Dixon et al (2016) further point to the importance of having empirically sound elasticities for meaningful model based policy analysis.[5]

One set of CGE models, especially useful for ex-post assessments of FTAs, can be fed with trade elasticities and trade costs reductions which have been econometrically estimated on the same data that is used in the baseline for the simulation exercise.[6] General equilibrium-consistent estimates of the impact of the FTA are then obtained by undoing the FTA in a subsequent CGE simulation through inversing (i) the duty reductions according to the agreement and (ii) the lowering of other trade costs as implied by the preceding econometric

[5] For this analysis, the authors calibrated the relevant CGE parameters to get trade responses consistent with econometric evidence on the sensitivity of imports to price changes.

[6] See Costinot and Rodríguez-Clare (2014) for an overview of tests of this approach.

exercise. Hence, the current status quo is compared with a counterfactual situation in which the FTA does not exist. One of the main advantages of this approach is that no direct measures of observed reductions in NTMs are needed (c.f. Section 5.2.1). It can also be used for ex-ante studies under the assumption that estimated elasticities and trade costs reductions continue to hold also in the future.

2.3. Common criticism of CGE models and CGE modelling results

Much of the criticism of GCE models implies that they may be exaggerating the welfare gains from trade liberalisation, but some arguments have been put forward suggesting that these may in fact be underestimated. Two arguments along this line carry particular importance. First, the CGE models that are used in trade liberalisation simulations do not account for increased productivity effects associated with greater incentives to innovate from enhanced competitive pressure.

Second, the impact of liberalisation on foreign investment (increasingly an important component of modern trade agreements) is in most models unaccounted for. This is an important drawback as FDI is a significant part of modern economic integration and the presence of FDI is proven to be in itself a catalyst for knowledge and technology advancements in recipient countries, which eventually lead to productivity gains, see Section 4.4 for Commission efforts to alleviate this constraint.

Thirdly, CGE models do not capture the impact of reduced uncertainty FTAs bring about. For example, a country's applied tariffs are in many cases (depending on the partner) lower than its bound tariffs. Removing this 'water in the tariffs' has positive impacts in terms of removing uncertainty, but since applied tariffs are not cut, models do not account for this. The same holds for the services area for which, in most cases, FTAs bind currently applied levels of protection rather than generating real market access.

In addition, CGE models have been criticised for simplifying reality and for omitting important issues.[7] For example, when trade costs are reduced the mechanics of the model ensure that the output of the more competitive sectors of an economy is expected to increase (relative to the baseline) while the opposite holds true for the less competitive sectors. For this to happen labour has to move from contracting to expanding sectors, where wages increase. This process is assumed to be relatively friction free. This assumption may be appropriate within sectors but it is less so between sectors. Moreover the fiscal implications that this adjustment entails in the presence of labour market frictions (re-training, temporary wage replacement payments, etc.) are not accounted for in the macroeconomic welfare analysis.

Another type of criticism often made of CGE models concerns how the macroeconomic impact of trade policy changes depends on the extent to which demand and supply react to prices changes. Greater responses lead to stronger substitution effects between imports and domestic products and to enhanced welfare gains. The trade elasticities could usefully be updated; see Section 3.5 for more details on this issue.

Finally as in all trade models, in cases where initial levels of trade are low, liberalisation will not bring about any meaningful gains. This could e.g. be the case if trade barriers are prohibitive. This "small shares" or in its extreme form "stuck on zero trade" problem may

[7] At the same time, CGE models are criticized for being "black-box" type of models without providing clarity and transparency on their inner workings.

make trade models inappropriate especially for some developing countries and least developed countries which may have its bulk of trade concentrated in a few sectors only with a limited number of trading partners. It can also be important when analysing the impact of trade policy initiatives on innovation-driven economies. Hummels and Klenow (2005) find that as countries expand trade, the extensive margin accounts for around 60 percent of the increase in exports of larger economies. This increase does not affect the terms of trade, but is not captured by CGE models which do not feature any extensive margin.[8, 9]

3. Overview of data issues and sources

3.1. Default model data

Data for CGE models are usually drawn from the Global Trade Analysis Project (GTAP) database. The GTAP database is a global database characterizing economic linkages between sectors, countries and regions, combining detailed bilateral trade, transport and protection data as well as data on energy, emissions and power technologies. It is built on the most reliable international data sources (including Eurostat data for EU countries) and undergoes constant scrutiny by the different stakeholders and users such as the Commission, the World Bank, OECD, IMF, WTO, United Nations, FAO, etc.

The underlying input-output tables are heterogeneous in sources, base years, and sector details, thus for achieving consistency, substantial efforts are made to make the disparate sources comparable. The objective of the GTAP database is to facilitate the operation of economic simulation models ensuring users a consistent set of economic facts, not to provide a repository of IO tables. The latest release of the GTAP database represents 140 countries/regions and 57 (goods and services) sectors and features three base years. With its wide country and sector coverage, the GTAP database, which is fully documented, is the only global database available for this type of analyses which can guarantee long-term continuity and regular updates.[10]

At the same time the GTAP database also suffers from some weaknesses. For example, the sector classification itself (42 GTAP goods sectors compared about 5000 products at the 6-digit level of the Harmonised System) to sets limits to what can be achieved in terms of precision of the results. In addition, in light of the rapid development of the services industry, the current services sector classification may not only seem relatively aggregated but perhaps also somewhat outdated. In addition, relying on base data for a single year can be problematic for certain agricultural- and commodity sectors for which prices tend strongly fluctuate. Furthermore, once simulation results are analysed at sector level it has happened more than once that the Commission has detected errors in an underlying tariff for a specific product which makes up the lion's share of trade in a GTAP sector and thus significantly influence the sectoral results.

[8] In a recent econometric ex-post analysis of the EU-Korea FTA, Lakatos and Nilsson (2017) find positive impact of the agreement on exports at the extensive margin of both the EU and Korea.

[9] Attempts to incorporate the extensive margin (in terms of new entry of firms) into CGE models have been faced with problems related to model instability due to the standard CES cost function, see Hertel et al (2013).

[10] The Commission usually takes the existing data as given, but has on certain occasions had to introduce corrections.

3.2. Baseline

The impact of a trade policy shock cannot be evaluated without a baseline i.e. the counterfactual situation in which the economy would have been should there have been no trade policy change. Creating a realistic baseline is as difficult as it is important. The Commission usually relies upon predictions about the future by others, such as short term projections on GDP growth from the IMF and longer term projections on e.g. population from the UN, but also on energy consumption, labour participation rates, etc.[11]

Recent developments in trade policy that are not yet reflected in the GTAP database have to be taken into account in the baseline. For example, the EU has concluded an FTA with Colombia and Peru (which Ecuador recently has joined), something which may influence the model simulated outcome of an EU FTA with the Mercosur. Some FTAs are clearly more relevant to put in the baseline than others. For example, the conclusion of the EU's FTA with Vietnam is likely to be less important when studying the impact of the EU-Canada FTA (CETA) compared to EU FTAs with other countries in the South-East region. For practical and pragmatic reasons, the Commission has therefore introduced a rule of thumb saying that only FTAs accounting for more than 1% of EU or its partner's trade (in goods and services) should be included in the baseline.

3.3. Main sources of NTMs in goods

When it comes to trade policy analysis, data on NTMs are particularly worth mentioning. As tariffs have come down worldwide NTMs are fast becoming the main friction to trade. The trade costs imposed by NTMs are therefore increasingly important to address from a policy standpoint. However, one should recall that not all NTMs are trade restricting and that some measures may lead to increased certainty, trust and thus more trade. In addition, an often forgotten aspect of NTMs is that lower regulatory barriers between partner countries may improve market access also for third countries. For example, if an agreement is reached on mutual acceptance of e.g. standards between two trading partners, a third country exporter would then only need to comply with one set of standards for when exporting to both markets instead of complying with two sets of standards as before the FTA entered into force.

Trade policy makers need estimates of NTMs in goods and services in general but quantifying their ad-valorem equivalents (AVEs) is challenging. To arrive at estimates of trade costs of NTMs, researchers have adopted different techniques, such as surveys, econometrics, and/or expert opinions; see Annex for an overview and coverage of the most comprehensive sources.

Kee et al (2009) provide multilateral AVEs of NTMs of 93 countries at the 6-digit level of the Harmonised System (HS).[12, 13] The authors find that the NTMs on average add more than 85% to the restrictiveness imposed by tariffs and that for close to half of the countries in the (original) sample NTMs are more restrictive than tariffs. From an EU perspective, one drawback is that the NTM estimates of the EU countries are based on intra-EU imports as well as extra-EU imports and are thus biased downwards since they include effects of lower barriers to trade in the internal market.

[11] GTAP lists a number of sources for baseline data at: https://www.gtap.agecon.purdue.edu/models/dynamic/baseline/default.asp.

[12] Hence, it does not provide for estimates of bilateral NTMs in trade between country pairs.

[13] The original dataset contained 78 countries but has been updated.

Cadot and Gourdon (2015) have calculated AVEs of technical barriers to trade (TBTs) and sanitary and phytosanitary (SPS) measures for sections of the HS based on data for 65 countries. For half of the products they analyse at the HS6-level, they find that TBT NTMs raise trade unit values with on average 5% and SPS raise the unit values by on average 3%. Deep integration clauses in FTAs (especially conformity assessment provisions) seem to lower these price increases with about a quarter. The estimates are not country specific.

Beghin et al (2015) allow for market imperfections and trade-facilitating effects of NTMs on the Kee et al (2009) dataset to derive AVEs for technical regulations. They find that about 5% of the tariff lines in the sample exhibit NTMs with negative AVEs, i.e. the NTMs are trade enhancing. Taking this into account reduces the trade restrictive level of NTMs obtained by Kee et al (2009), who imposed the condition that all NTMs reduce trade.

In a Commission sponsored project, Ecorys (2009) carried out a survey and got 5500 responses among US and EU firms across 23 goods and services sectors. Econometrics were then used to generate trade cost estimate at the sectoral level reflecting exporting firms' perceived difficulties in terms of market access.[14]

Box 1: Example from the Ecorys (2009) questionnaire

> Consider exporting to the US (EU), keeping in mind your domestic market. If 0 represents a completely 'free trade' environment, and 100 represents an entirely closed market due to NTMs, what value between 0 – 100 would you use to describe the overall level of restrictiveness of the US (EU) market to your export product (service) in this sector?

Importantly, Ecorys (2009) argued that it is not realistic to assume that all NTMs can be reduced; some are the results of geography, language or simply preferences. Ecorys (2009) therefore introduced the concept of 'actionability', i.e. the degree to which an NTM can realistically be reduced (in e.g. an FTA). With variations by sector, they found that overall about 50 percent of all NTMs are actionable. The estimates are based on expert opinions and cross-checks with regulators, legislators and businesses and supported by the survey. The estimated levels of 'actionability' would benefit from validation through additional work and sector specific analyses.

For some ex-ante studies carried out by the Commission, the extent to which NTMs may be reduced through FTA negotiations has been assessed by Commission sector experts.

3.4. Main sources of NTMs in services

Jafari and Tarr (2014) make use of a World Bank database[15] on barriers faced by foreign suppliers of services in 103 countries over 11 sectors to produce AVEs of the barriers for all these sectors and countries. However, their methodology assumes that the average of the price or cost impact, as estimated by a number of Australian authors[16] on data from the mid-1990s, applies across all the countries and sectors in their sample and their analysis thus only sheds light on the inter-sector and inter-country variation rather than on the overall *level* trade restrictiveness of NTMs in services.

[14] See Ecorys (2009), Box 3.2 for an overview of the steps taken to arrive at these estimates.

[15] http://data.worldbank.org/data-catalog/services-trade-restrictions. See Borchert et al (2014) for a guide to the database.

[16] The authors are mentioned in Jafari and Tarr (2014), Section 2.4.

Fontagné et al (2016) provide AVEs of restrictions on services trade in nine sectors for 117 countries in 2011. They used a reduced form of gravity type approach on GTAP services trade data without relying on either OECD or World Bank services trade restriction indices. The authors note that their estimates are approximations and are likely to include a range of costs beyond policy. However, they are not measuring the cost of regulations but their impact on trade.

The World Banks' Services Trade Restrictions Database (STRD) contains information (but no AVEs) on policies that affect international trade in services for 103 countries in five major services sectors[17] by Mode 1, 3 and 4. The indices take on values between zero (open without restrictions) and 100 (completely closed). Focus is on MFN measures that discriminate against foreign services and foreign services providers; preferential policies are generally not covered.[18] Information for OECD countries has been gathered from open sources, while information from non-OECD countries was collected through a questionnaire. Policy information has been reviewed by government officials. The database was last updated on 1 April 2011.[19]

The OECD's Services Trade Restrictiveness Indices (STRIs) cover 42 OECD and non-OECD countries and 22 services sectors in Modes 1, 3 and 4. They are composite indices taking values between zero (representing an open market) and one (a market completely closed to foreign services providers).[20] The online STRI regulatory database displays the detailed information that built the index, along with sources and comments.[21]

The OECD's policy simulator allows users to obtain an overview of the indices and the key measures driving the index of a selected country in a specific sector and how the indices would changes should policies change as a result of e.g. an FTA. Like in case of the World Bank STRD, the OECD's STRIs are measures of MFN restrictions and do not take into account preferential concessions as granted in some FTAs. The database is updated annually.

As in the case of NTMs in goods (Section 3.2), Ecorys (2009) also provides estimates of NTMs in some services sectors.

Finally it is more challenging to econometrically estimate AVEs for services than for goods. For goods, variation in tariffs over time allows estimating elasticities of substitution and import demand. For services, where no such observable variation exists, estimation of such parameters is less straight forward. These parameters are, however, in turn needed for the estimation of AVEs.

[17] The five services sectors are further broken down to include 19 subsectors in total.

[18] For 20 EU countries, the database also includes a description of preferential policies.

[19] When checked in mid-February 2017.

[20] Geloso Grosso et al (2014), describe the scoring and weighting system resulting in the indices.

[21] http://qdd.oecd.org/subject.aspx?Subject=063bee63-475f-427c-8b50-c19bffa7392d.

3.5. Elasticities

Elasticities (of substitution perhaps in particular) are central to the results of CGE modelling.[22] A high EoS generates relatively large trade impacts for a given size of a tariff shock. The GTAP sectors reflect relatively large aggregates of individual products; accordingly, substitution elasticities are lower than they would be for product categories that are defined more narrowly and, thus, are more substitutable for each other.

Traditionally, CGE modellers have made use of elasticities which have been based on econometric time series estimations of price variations between domestic goods and imports. Hertel et al (2004) identify problems related to this approach (e.g. insufficient observed variation in relative prices) which they address to produce a new set of EoSs between imported goods.

This new set of EoSs is currently incorporated into the most recent version of the GTAP database (v.9).[23] However, the elasticities obtained by Hertel et al (2004) are based on a dataset used by Hummels (1999), who in turn used data from 1992 on the USA, New Zealand, Argentina, Brazil, Chile, and Paraguay. That is, the Armington elasticities used for the lion's share of CGE analyses using GTAP data date back to the early 1990s and are based on empirical work on only six countries out of which none is European. Furthermore, the EoSs for a given sector are the same across all regions, which is another weakness.

Further, the EoSs between imported commodities follows the "rule of two", i.e., it equals the EoSs between domestic and imported goods multiplied by two.[24] This approach which was first proposed by Jomini et al (1991) has been retained in the GTAP database, but does not seem to have a particularly strong or recent empirical foundation.

4. Commission efforts to improve modelling framework and data

Over the past years, the Commission has undertaken as series of projects aiming to primarily improve the underlying data used to assess the impact of EU FTAs, but efforts have also been directed towards the modelling tools themselves. The sub-sections below describe the main thrust of some of these efforts, but additional work is needed in other areas as well.

4.1. Public Procurement

The last couple of years, the Commission has been active in trying to improve data and modelling techniques in the area of public procurement. It is an economically important area as public procurement accounts for close to 20% of GDP in the EU (including utilities) and reach similar levels in other developed countries. Moreover, the relative importance of public procurement in a trade policy perspective has increased over time as tariffs have come down and commitments in the field are limited at both bilateral and multilateral level. In addition,

[22] In addition to Armington elasticities there is a number of other elasticities of substitution, such as between labour, land and capital, that also are important for modelling outcomes as well as regular price elasticities of demand and export supply elasticities.

[23] Hertel and van der Mensbrugghe (2016).

[24] Ibid.

following the financial crisis protectionism increased as many countries have promoted procurement of domestically produced goods and services.[25]

In order to facilitate the modelling of public procurement in a CGE framework, DG Trade commissioned a project carried out by the GTAP centre to build a multiregional input-output (MRIO) table which explicitly accounts for (i) sourcing of imports by agent and product, (ii) splitting data on total investment into private investment and public investment and (iii) incorporate a modelling modification to accommodate the changes in the database and to allow the modelling of removal of 'buy domestic' or 'home bias' policies, see the end of Section 5.2.1.[26]

In another strand of work on public procurement, the Commission has launched an initiative under its Service for Foreign Policy Instruments (FPI). The project's main objective is to improve the availability, coverage and quality of data on public procurement markets in an international context. In a first step, an appropriate methodology for government procurement data collection and for assessing the contestability of public procurement markets in third countries will be developed. The methodology will cover all modalities of delivery of international procurement, be globally applicable and result in a harmonized and coherent database.

Hence, the first project is more related to changes in the GTAP modelling framework to allow for modelling of public procurement commitments in a CGE context, while the second project is more preoccupied with the data side; data which inter alia could be used as input for future CGE simulations.

At a second stage, the methodology will be applied in the following trading partners: Australia, Brazil, China, India, Indonesia, Thailand and New Zealand. Local experts will collect and encode barriers by, inter alia, making use of the decently developed OECD taxonomy of public procurement barriers. The project deliverables will cover detailed public procurement data (including cross-border data) and an economic assessment of the impact of policy instruments and practices that may discriminate or restrain market access in third countries' public procurement markets.

4.2. Trade in Services by Sector and Mode of Supply

The General Agreement on Trade in Services (GATS) defines trade in services as the supply of a service through any of four modes of supply.[27] For example, does trade between two countries in legal services takes place through cross-border supply (Mode 1)? Or does it take place by commercial presence (Mode 3)? Since the commitments under the GATS are specified according to the four modes of supply – and services are negotiated bilaterally and multilaterally according to the modes of supply – services trade statistics should ideally also be available by mode of supply. To this end, the Commission supports WTO efforts to improve the GTAP database in the services domain, with a view to simulate the impact of services liberalisation e.g. in an FTA context more precisely and accurately.

[25] See the Global Trade Alert database (www.globaltradealert.org).

[26] As a by-product of this project the GTAP-MRIO database which will soon be publicly available.

[27] Mode 1 – cross-border supply: from the territory of one country into the territory of another country; Mode 2 – consumption abroad: in the territory of one country to the service consumer of other country; Mode 3 – commercial presence: by a service supplier of one country, through commercial presence in the territory of other country and Mode – 4 presence of natural persons: by a service supplier of one country, through presence of natural persons of a country in the territory of any other country.

WTO together with the OECD has developed a data set on bilateral trade in services by partner which covers total services and sectors for the years 1995 to 2012. This approach will serve as model for developing the data set on trade in services by mode of supply based on the latest Balance of Payments methodology (BPM6), covering data as of 2005 to the latest year available.

4.3. Splitting GTAP sectors

The sectoral aggregation of the GTAP database was decided upon long ago and does not fully reflect the evolution of trade that has taken place of the past decades. While the HS goods nomenclature contains about 5000 products at the 6-digit level, the number of GTAP goods sectors counts some 40 sectors, out of which, in terms of trade value disproportionally many are in agriculture.

However, agricultural sectors are often sensitive in FTA negotiations. The Commission has therefore together with its Joint Research Centre (JRC) decided to work to split the existing GTAP sector 19 – Cattle Meat[28] into two new sectors "Bovine meat" and "Other ruminant meat" for all countries in the GTAP database, but with a particular focus on the EU and trade partners for whom the refinement of the data is highly relevant. In a second effort, fishery products will be split from GTAP sector 25 – Other Food.[29] The aim is to present the split of the two sectors in the form of a database together with all relevant methodological information related to its construction so as to be in better position should future splits of sectors be deemed necessary.

As services trade continues to increase in importance, splitting certain services sectors such as sector 54 – Other Business Services, in which real estate services are lumped together with e.g. ICT services and other professional services, should perhaps be considered.

4.4. Foreign Direct Investment

Despite advances in the literature on trade and FDI and the latter's importance for a country's economic performance, economists still face difficulties as far as assessing the impact of investment agreements or investment related trade effects in a CGE framework. One of the main underlying reasons is the lack of harmonised data on FDI stocks and flows.

About a decade ago, the Commission sponsored an attempt to overcome a part of this hurdle by asking the Centre d'Études Prospectives et d'Informations Internationales (CEPII) to construct a FDI database suitable for trade and investment related policy assessment fitting the GTAP framework.[30] They used existing FDI data from various sources, which were not suitable for CGE modelling since the data was not balanced, many values were missing or did not correspond to mirror values. To tackle these issues, CEPII developed a methodology that

[28] "Cattle Meat: fresh or chilled meat and edible offal of cattle, sheep, goats, horses, asses, mules, and hinnies. raw fats or grease from any animal or bird."

[29] "Other Food: prepared and preserved fish or vegetables, fruit juices and vegetable juices, prepared and preserved fruit and nuts, all cereal flours, groats, meal and pellets of wheat, cereal groats, meal and pellets n.e.c., other cereal grain products (including corn flakes), other vegetable flours and meals, mixes and doughs for the preparation of bakers' wares, starches and starch products; sugars and sugar syrups n.e.c., preparations used in animal feeding, bakery products, cocoa, chocolate and sugar confectionery, macaroni, noodles, couscous and similar farinaceous products, food products n.e.c."

[30] Boumellassa, et al (2007).

estimated the missing values with econometrics and balanced the database with entropy-based method. Despite CEPII fully documenting the method used and proposing a solution allowing for the integration of new information, the database has not been updated and is not used.

This is unfortunate since one could expect FDI to play an important complementary role to trade liberalisation. Nevertheless, attempts to model FDI, with different underlying motives and logic have been undertaken, but seemingly without tapping into real data, see e.g. Ciuriak and Xiao (2014), Lai and Zhu (2006), Lejour et al (2008) and the literature cited therein and Tarr (2013).

4.5. The EU28 GTAP Input-Output Tables

The European Court of Auditors evaluated whether the Commission has appropriately assessed the economic effects of its preferential trade agreements[31] and recommended that the Commission updates the underlying supply and use tables for EU28 used as input for the economic analysis to reflect the most accurate technical coefficients and structures of commodities for final and intermediate uses.

As a result, the Commissions Directorate-General for Trade (DG Trade) funded the project "Improving the European Input-Output Database for Global Trade Analysis (EU-GTAP)", which was carried out by DG JRC. The main objective of the project was to submit a set of Input-Output Tables for the 28 Member States for the latest available year (i.e.: 2010) under the new European System of Accounts (ESA10) methodology and in compliance with GTAP submission requirements. The project was finalised in January 2017 and the GTAP version 9.2 already incorporates the most recent IO tables for the EU countries.

4.6. Disaggregating the GTAP database for Africa

Some ten years ago, the Commission co-sponsored a project carried out by the GTAP centre to disaggregate the number of African countries in the GTAP database from 15 regions to 31 regions. The undertaking involved producing the database itself with the proposed disaggregation, reviewing the international data sources, collecting/estimating additional data and adjusting the data base in response to established priorities and incorporating the final I-O tables and creating a final data base to be distributed to the general public

5. Practical modelling choices

5.1. Closure rules

CGE models contain more variables than equations; hence some variables have to be determined exogenously (outside the model). The choice of variables which are to be exogenous is called the model closure. Alternative closures may significantly influence the results of CGE simulations and the way in which to sensibly interpret them. The most common closure rules relate to the labour and capital markets, the current account and the government balance. Variables defining technology, consumer taste and government instruments such as tax rates are usually exogenous.

[31] European Court of Auditors (2014), Are preferential trade arrangements appropriately managed?, Special report.

5.1.1. Labour and capital closure

The default closure in the GTAP model fixes the capital and labour supply and requires the model to restore equilibrium by adjusting the rate of return to capital and the wage rate. This is sometimes described as reflecting a short- or medium-term time horizon in which labour supply is relatively "sticky". Under an alternative closure rule, the return to capital and/or wages can be fixed. The supply of capital and/or labour then adjusts to restore equilibrium. This is sometimes described as reflecting longer-run "steady-state" growth conditions. Each of these closure rules are extreme; capital and labour supply is neither perfectly elastic nor perfectly inelastic. The reality is likely to be somewhere in between (but dependent on the projection horizon).

The 'fixed employment closure' is commonly used for analyses of (EU) FTAs since there is no established theoretical framework linking the functioning of labour markets to CGE models/trade policy changes.[32] In addition, in an EU context it would be highly complex to model the reaction of 28 labour markets to a trade shock, when the reservation wage differs across EU Member States and the incentives for people already in employment to change jobs are different across sectors and countries as well. The 'fixed employment closure' provides information on shifts between sectors thus indicating in which sectors employment is likely to increase and decrease as a result of the new agreement.

Notwithstanding, the specific closure adopted should be suited to the circumstances of the economies affected by the model. For example, the 'fixed wage closure', as opposed to the 'fixed employment closure', could be used to model trade impacts on developing countries that have a large reserve pool of labour in subsistence rural agriculture and for which a perfectly elastic supply of unskilled labour would be an appropriate assumption. In other words, an analysis of a policy implemented in a period of high capacity utilization should adopt a different closure than an analysis of a policy implemented in a period, or a semi-permanent situation, of high excess capacity.

5.1.2. Current account closure

The current account closure relates to whether or not the current account balance should be fixed. A fixed current account implies that when a trade policy shock results in unbalanced changes in imports and exports, the original trade balance is restored by (implicit) exchange rate adjustments. Alternatively, the current account can be allowed to adjust to the trade shock. The change in the current account then must be offset by equivalent changes in capital flows. In reality, unbalanced trade impacts are likely to have both effects: inducing subsequent exchange rate adjustments and also offsetting capital flows.

5.1.3. Government balance closure

The government balance closure describes whether the difference between government revenues and spending is endogenous or exogenous. If government spending is fixed, the government balance changes as revenues are impacted by losses in duties paid as trade is liberalised and through subsequent changes in consumption patterns. This could potentially be

[32] Boeters and Savard (2013) notes that a theoretically founded, structural model of involuntary unemployment, which contains enough free parameters to be calibrated to empirical wage curve elasticity parameters is not easily available. But some trade models do allow for changes in employment, see e.g. Felbermayr and Prat (2013).

an appropriate choice if a country has poverty alleviating measures in place through a certain level of government consumption or subsidy programmes that need to remain unchanged.

The alternative is to fix the government balance and let government spending vary with revenue. For example, the EU's Stability and Growth Pact requires Member States' annual budget deficits not to exceed 3 per cent of GDP. Should other countries have similar rules in place while concluding FTAs with large partners this closure may be suitable.

In simulations of the impact of EU Economic Partnership Agreements (EPAs) with the African Caribbean and Pacific countries, determining the impact on government revenues is a core issue, why the closure which fixes expenditures and allows the government balance to change was chosen.

5.2. NTM reductions

There is certain leeway for modellers to implement trade policy changes one way or the other and there is no strict guidance on what is right or wrong. This section briefly touches upon the difficulties to assess the magnitude of NTM reductions ex-ante and ex-post and how to implement them, implications of the choice of labour closure sectors and specificities relating to the Single Market.

5.2.1. FTA achievements in practice

In ex-ante analyses of FTAs it is difficult to judge the extent to which NTMs will be reduced (if at all) and how much such reduction will affect trading costs. For example, if a trading partner has a restriction in place on imports of eggs in the form of additional sanitary controls, if it is assumed that the negotiations will conclude that there will be a mutual recognition of each other's controls, how much in percentage terms will the price of EU eggs in the foreign market go down? The same issue arises in ex-post analyses as well, albeit one knows what has happened in terms of NTM reductions. However, the difficulty remains to estimate the value of some form of an agreement on NTM reductions in terms of lower trade costs remain.

Instead of NTMs pertaining to specific goods as above, trade facilitation can be considered an area in which NTMs can be reduced horizontally across the board for goods trade. The OECD trade facilitation indicators (TFIs) cover all border procedures for more than 160 countries across income levels, geographical regions and development stages.[33] For example, if an FTA is deemed to improve the border regime of a partner country to a certain extent or in specific areas, the partner's existing TFIs can be compared to "best practice" as the OECD labels it, to the average of the partner's income groups or geographical group. The change (e.g. the percentage change) in the partner's overall TFI can then be modelled as a reduction in trade costs.

The assessment of likely NTM reduction is usually more difficult for services than for goods. This is mainly due to the nature of trade liberalisation of services, which usually takes place through binding, i.e. a commitment by the negotiating partner not to raise the levels of existing barriers, thus removing uncertainty in terms of risks for economic operators. This impact is difficult to estimate since it is not a traditional cut in trade barriers. At the same time, it is acknowledged that removing uncertainty through binding has a value. How should

[33] https://www.oecd.org/trade/facilitation/indicators.htm#About-TFI

then the removal of this uncertainty be quantified in terms of reduced trade costs for this particular type of services trade?

The impact of real services liberalisation is also problematic. If restrictions are found in the form of a cap on the number of foreign engineers allowed to deliver a service, not only are the benefits of removing these restrictions *per se* difficult to assess; they may also easily spill into goods trade (if for example foreign engineering services are needed to install imported technically advanced goods such as solar panels or wind turbines). Similarly, in the CETA agreement, how much is it worth to the EU that Canada has removed the commercial presence requirements for the supply of engineering services in Manitoba?

Finally, some NTM reductions achieved in bilateral FTAs are multilateral in nature; e.g. the adoption of UNECE standards benefits all operators exporting to the country adopting these standards. Hence, in such cases NTM reductions achieved in FTAs would also have to be applied to third countries to be modelled properly.

5.2.2. Implementing NTM reductions

Even if one manages to quantify the value of a certain NTM reduction in AVE terms, the implementation of the NTM reduction is not straightforward. One can imagine modelling NTM reductions as a change in duty on imports. This approach leads the modeller to having to deal with issues related to losses in duty revenues (which do not exist since there are no duties paid on NTMs). On the other hand, removal or reductions of NTMs can also be modelled as efficiency gains in the sense that the importer receives more of the good for the same price. But it is not evident that trade liberalisation through mutual recognition or harmonisation of technical regulations is best modelled as an increase in efficiency.

Recently, Kutlina-Dimitrova (2016) used a 'phantom tax' approach to assess the removal of 'home-biased' government procurement policies, which was modelled by a subsidy accruing to domestic producers and a tax levied on imports. The approach provides for an exact match in terms of revenue flows to ensure that there are no tax revenues gains/losses from a change in the 'home bias'. This makes it interesting for modelling changes in NTMs, though the approach is as of yet untested using dynamic CGE models.

Walmsley and Minor (2016) use another approach which they call the 'willingness to pay method' and apply it to an estimation of WTO's Trade Facilitation Agreement. They then contrast their results with the outcome of a simulation of the same scenario using efficiency gains instead and find smaller GDP impact but higher welfare effects.

5.3. Other implementation issues

5.3.1. Productivity gains

Productivity gains in perfect competition models come from inter-sectoral reallocation of production factors as opposed to price mark-ups in imperfect competition models. However, following Melitz (2003), it is known that there are also intra-sectoral productivity gains through the reallocation of production from lower- to higher-productivity firms within sectors, since only the more productive firms engage in exports. One would thus expect trade liberalisation to lead to larger market shares for more the productive exporting firms and more production in higher productivity sectors.

This in turn implies higher average wages in the economy since exporting firms tend to pay higher wages. Hence, there should be a positive correlation between changes in productivity and wages, something which would be consistent with the observed long-run relationship across countries and over time between wages and productivity. The literature further suggests that the elasticity of labour supply to wages is positive on both the intensive (already employed) and extensive margin (newcomer to the labour market).[34] One question facing modellers is whether such productivity gains should be modelled. If yes, how should they be implemented?

Ciuriak and Xiao (2016) suggest that since wages tend to rise with increases in productivity, this could provide the basis for an empirically based calibration of a heterogeneous-firms based productivity gain by allowing the quantity of labour to increase in proportion to the wage rate.

5.3.2. The Single Market and export diversion

Assessing the impact of EU FTAs on the EU requires special attention since the EU as a whole is usually not treated as a single economy by the CGE models even if it is aggregated into one region. This means that French imports of a particular good from Spain is treated the same way as French imports of the same good from Morocco (from an elasticity point of view).

This can be explained by the fact that the workhorse GTAP modelling framework is based on the hypothesis that goods are differentiated by origin and are imperfect substitutes. As discussed in Section 3.5, there is one elasticity of substitution between domestic and imported goods and services and one another elasticity of substitution between third country goods and services. The value of the latter is double the value of the former in the GTAP database.

As a result, consumers are half as willing to substitute consumption away from domestically produced goods to imported goods compared to switching between imported goods. At the same time, despite the Single Market, there is no French preference for EU products over third country products, something which tends to exaggerate the extent of trade diversion in the modelling results for the EU.

The Mirage model developed by CEPII allows for an intermediate nest of two quality categories, which can be specified by the user regarding the products to which it applies and the grouping of countries into the (two) quality categories. Substitutability within quality categories is higher than between them. This would allow addressing the above described problem, albeit through the back door.

In addition, in the latest version of the GTAP model (v. 7), the top-level Armington elasticity is allowed to be region-specific as well as commodity-specific, which in principle opens up for the possibility to differentiate, but it remains unclear what the basis for such differentiation would be in practice.[35]

[34] See Ciuriak and Xiao (2016) and the literature cited therein.

[35]

6. Presentation and interpretation of results

Results of CGE simulations may sometimes seem counterintuitive. To correctly interpret them, one needs to pay attention to several factors. For example, all simulation results have to be seen against the baseline. It may thus be important to pay attention to the construction of the baseline. That is, what assumptions have been made for the development of the economies examined in absence of the trade policy change simulated? Are other FTAs under negotiation taken into account? Do e.g. projections for the production value of certain sectors decades into the future seem to make sense?

If a sector turns out to be negatively affected with lower production and exports as a result of a policy change, one has to keep in mind that the outcome should be compared to a situation without the policy change. Consequently, if the results are presented ten years after the policy change the sector in question may very well have increased both production and exports compared to the initial time period, but with production and export values that are lower than what they would have been in absence of the change in policy.

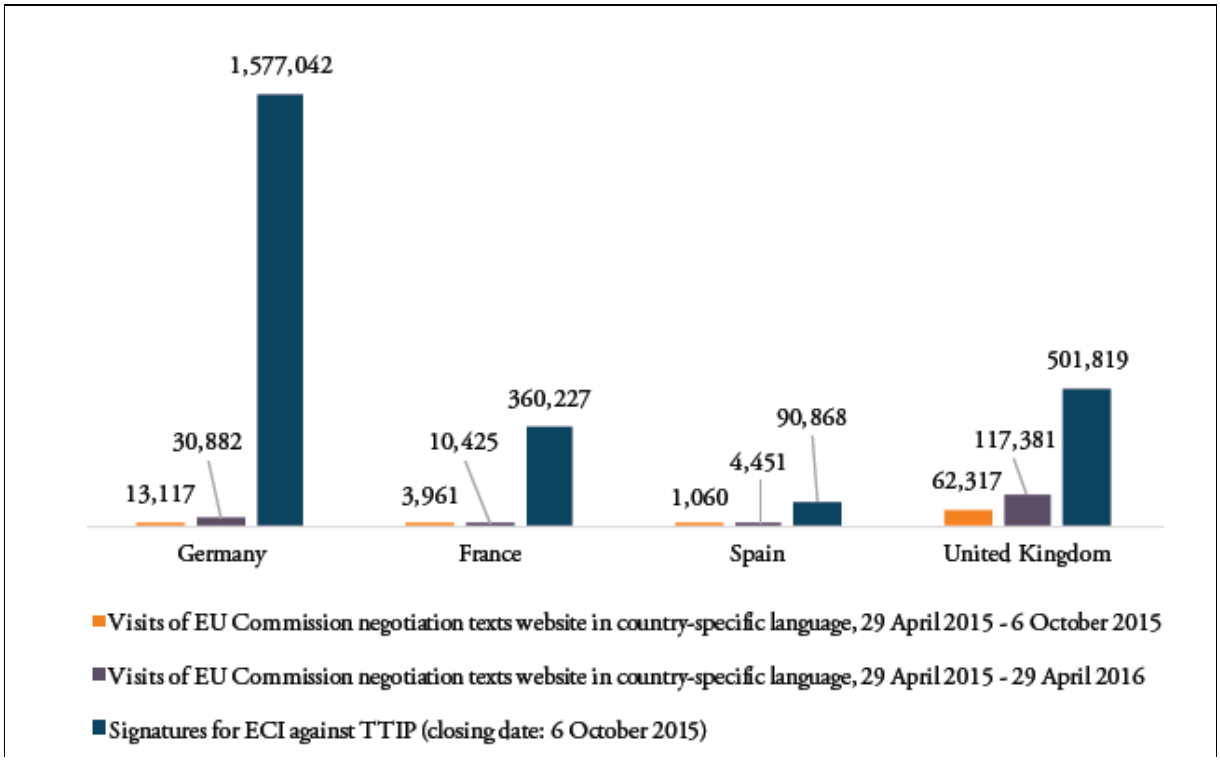
With the most commonly used closure for the labour market in which labour is fixed and wages vary, it is necessary to consider that the model cannot expand the factors of production (as might be the case in real life), but instead pulls them across to the most efficient sector. This may partially explain a decline in output in some sectors when production increases in other sectors, something which has to be borne in mind.

6.1. Trade policy in the age of anti-globalism

Decision makers, non-governmental organisations (NGOs) and general observers alike have increasingly started to scrutinise EU trade policy and the outcome of trade policy modelling simulations,[36] which have become subject to fierce criticism in some cases. For example, the Transatlantic Trade and Investment Partnership (TTIP) with the US has been subject to criticism and to negative campaigning in several EU Member States, but perhaps particularly in Germany. Anti-TTIP groups managed to collect more than 1.5 million signatures of Germans against TTIP, while the Commission's German language website on TTIP received less than 15.000 visits, see Figure 1 below.

[36] For example, the Commission's Civil Society Dialogue (CSD), which involves regular, structured meetings to discuss a wide range of topical issues that are shaping public opinion, has seen about 200 civil society organisations representing more some 350 participants taking part in 18 CSD meetings in 2016, see http://trade.ec.europa.eu/civilsoc/statistics.cfm.

Figure 1: Number of visits to EU Commission's official TTIP negotiation texts' website versus number of signatures collected by "Stop TTIP" campaign organisations



Source: Bauer (2016)

Similarly, investment protection agreements, which have existed for decades and count to thousands, have become target for significant debate and criticism. As many as 97% of the replies to a Commission public consultation on investor state dispute settlement (ISDS) were submitted by a small number of campaign groups whose responses often were identical or similar to one another.[37]

The widespread negative perception of TTIP as successfully brought forward by a number of NGOs (see Bauer 2016 for an analysis of the German and Austrian perspective) has also spilled over to the Comprehensive Economic Trade Agreement (CETA) with Canada, which was subject to little or no attention when it was started back in 2009. Other EU FTAs recently concluded or in the making seem to be of less interest (Japan, Vietnam, Ecuador, etc.).

Against this background, one can ask oneself whether it matters if an FTA will bring significant economic gains to a country or to specific sectors of a country. However, with an obligation to present to potential economic impact ex-ante and a commitment to do so ex-post, the Commission has to meet its requirements while trying to complement simulation results with additional information about trade and trade policy, see Section 6.3.

[37] Bauer (2016).

6.2. Which results should be presented?

6.2.1. Macroeconomic variables of interest

DG Trade has traditionally presents its study results based on simulations using CGE models in terms of main macroeconomic impacts. That is, what is the likely impact on GDP, exports and imports (total as well as bilateral), production and wages (for skilled and unskilled workers)? One should note that these only make out a handful of potential results that actually could be presented. One question that arises is whether a fraction of percent change in GDP is meaningful to anyone who is not into modelling of trade agreements (and can provide a qualitative judgement of the number). Would it then be better to present the results in terms of an absolute increase in GDP of €X billion?[38]

Furthermore, the statement of a certain annual GDP change by a certain year somewhere about a decade after envisaged entry into force causes significant confusion with laymen as to whether this is a cumulative gain as of this point in time, a cumulative gain up to this point in time (correct answer) or a permanent shift in the level of GDP as of this point in time.

6.2.2. Static vs. dynamic simulations

CGE results coming out of so called static models (no time dimension) measure the impact of an FTA as if it would be fully implemented at present. Reallocation of factors, in particular capital which in the real world occurs over a cycle of investment and depreciation (and possibly divestment) has to be approximated for an assumed time horizon.

Dynamic CGE models on the other hand, which have become the standard tool used by DG Trade, allow for a phasing of the impact of the FTA over time and for an explicit treatment of factor allocation decisions and assess the impact once it has been fully implemented. Some of the latter type of models only provide for results in the end-year of implementation, while others provide for year-by-year changes until and including the end-year.[39] Dynamic models can be run in static setting so as to provide two sets of results comparing the two approaches.

6.2.3. Sensitivity analyses

Introducing a number of sensitivity analyses to the simulations might be useful. This could lead to a presentation of the results in ranges, which would avoid having the results cited at the second decimal (with the underlying belief that the figures reflect the true effect) and instead provide an indication of the magnitude and direction of the estimated impact. For example, one could easily imagining carrying out sensitivity analyses using different closures, see Section 5.1., or using different parameter values.

[38] Alternatively to GDP the impact on economic welfare could be presented (and it sometimes is). However, this concept, which is based on so called "equivalent variation", i.e., the lump sum payment at pre-shock prices that would have to be made to households to leave them as well off as in the post-shock economy is subject to the same drawbacks as GDP. In addition, it may be more difficult for policy makers and the general public to comprehend.

[39] Some contractors the Commission has used have not been in the position to provide figures on annual changes in GDP.

6.2.4. Less is more?

In ex-ante analyses, more than one scenario is often simulated since one does not know beforehand what the negotiations will result in. This is not the case for analyses carried out once the negotiations have been concluded since the negotiating texts then are available. Nevertheless, should one present static- as well as dynamic simulation results and a minimum of one sensitivity analysis for both the short-run and the long-run (or after certain number of years), one ends up with eight outcomes per variable, something which is too comprehensive to be practical from a communication point of view. If it is an ex-ante analysis, and more than one scenario is run, the number of outcomes double again. The same holds if more than one baseline is considered.

Table 1 illustrates what the results would look like for one country (and one scenario) only. Clearly, the number of results to consider quickly becomes overwhelmingly large. It may therefore be appropriate to define a main scenario under e.g. a dynamic simulation with a preferred closure rule and time span to limit the comments that otherwise would have to be made to all the results. Additional results, if so desired, could be presented in Annex.

Table 1: Example of main results of a CGE simulation of a trade agreement for one country

	Scenario 1							
	Baseline 1							
	Static				Dynamic			
	Closure 1		Closure 2		Closure 1		Closure 2	
	Short-run	Long-run	Short-run	Long-run	Short-run	Long-run	Short-run	Long-run
GDP								
Total exports								
Bilateral exports								
Total imports								
Bilateral imports								
Wages (skilled)								
Wages (unskilled)								

Source: Own illustration.

6.3. Complementing with other types of information

In attempts to make trade policy more transparent and interesting for the general public, the Commission has undertaken efforts to communicate on the number of firms which trade with some of our trading partners, and where they are located. For example, such data has been set up for EU exports to the US and to Canada. On the map of Europe that is displayed on the dedicated website for this purpose,[40] one can click on any EU Member State to get a further breakdown of where firms are regionally located in the country, the type of products they export and the share of jobs the region accounts for in terms of the total number of jobs in the country supported by the country's exports to the US. While the data does not display what the potential impact of a trade agreement with the US in this case might be, it illustrates the extent of linkages to trade at local level and the dependency on exports that firms around the corner where we live are subject to.

[40] See http://ec.europa.eu/trade/policy/countries-and-regions/countries/united-states/trade-in-your-town/ for the US example.

In similar, efforts, the Commission (Rueda-Cantuche and Sousa, 2016), has shown that EU exports foster more and better job opportunities for European citizens. From 1995 to 2011 the number of jobs in the EU that were supported by exports of goods and services to the rest of the world increased by 67% to reach around 31 million. These represented 1 in 7 jobs across the EU Member States (up from 1 in 11 jobs in 1995). They tended to be high-skilled and were on average better paid. Rueda-Cantuche and Sousa (2016) further show that about 19 million jobs outside the EU depended on EU exports in 2011 as a result of EU exporters increasingly relying on foreign inputs.

7. Summary and conclusions

This paper reviews some of the main features of CGE models and the data that is employed to assess the impact of (EU) FTAs. It highlights main data sources, associated shortcomings and efforts undertaken by the Commission to remedy some of the key concerns primarily as far as data is concerned. The paper further examines some technical challenges and practical modelling choices which trade policy modellers have to deal with and the implications of the former for the simulation results. Finally, it discusses which key results that should be presented in order to keep FTA report reading digestible for trade policy makers and trade policy interested audiences and if additional information regarding the importance and impact of trade should be included in such reports.

In light of the above, important as discussions on the merits of modelling tools may be, one should also remember that the output of any model will never be of higher quality than the data put into it. This being said, despite criticisms of both data and analytical framework, the few alternatives to CGE models that have been proposed have not yet proven to be sufficiently reliable for ex-ante analyses of economy-wide effects of trade policy changes.

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ANNEX

Main sources of AVEs of NTMs in goods and services – an overview of country coverage

AVE of NTMs		GOODS	SERVICES		Grand Total
Code	Country	Kee et al (2009)	Jafari and Tarr (2014)	Fontagné et al (2016)	
ALB	Albania	x	x	x	3
DZA	Algeria	x	x		2
ARG	Argentina	x	x	x	3
ARM	Armenia		x		1
AUS	Australia	x	x	x	3
AUT	Austria	x	x	x	3
BHR	Bahrain		x		1
BGD	Bangladesh	x	x	x	3
BLR	Belarus	x	x		2
BEL	Belgium		x	x	2
BLX	Belgium-Luxembourg	x			1
BOL	Bolivia	x	x		2
BWA	Botswana		x		1
BRA	Brazil	x	x	x	3
BRN	Brunei	x			1
BGR	Bulgaria		x	x	2
BFA	Burkina Faso	x			1
BDI	Burundi		x		1
KHM	Cambodia		x		1
CMR	Cameroon	x	x		2
CAN	Canada	x	x	x	3
CHL	Chile	x	x	x	3
CHN	China	x	x	x	3
COL	Colombia	x	x	x	3
COG	Congo, the Democratic of		x		1
CRI	Costa Rica	x	x		2
CIV	Cote d'Ivoire	x	x		2
HRV	Croatia			x	1
CYP	Cyprus			x	1
CZE	Czech Republic	x	x	x	3
DNK	Denmark	x	x	x	3
DOM	Dominican Republic		x		1
ECU	Ecuador		x	x	2
EGY	Egypt	x	x	x	3
SLV	El Salvador	x			1
EST	Estonia	x		x	2
ETH	Ethiopia	x	x		2

AVE of NTMs		GOODS	SERVICES		Grand Total
Code	Country	Kee et al (2009)	Jafari and Tarr (2014)	Fontagné et al (2016)	
FIN	Finland	x	x	x	3
FRA	France	x	x	x	3
GAB	Gabon	x			1
GEO	Georgia		x		1
DEU	Germany	x	x	x	3
GHA	Ghana	x	x		2
GRC	Greece	x	x	x	3
GTM	Guatemala	x	x		2
HND	Honduras	x	x		2
HKG	Hong Kong	x		x	2
HUN	Hungary	x	x	x	3
ISL	Iceland	x			1
IND	India	x	x	x	3
IDN	Indonesia	x	x	x	3
IRN	Iran		x	x	2
IRL	Ireland	x	x	x	3
ITA	Italy	x	x	x	3
JPN	Japan	x	x	x	3
JOR	Jordan	x	x		2
KAZ	Kazakhstan	x	x	x	3
KEN	Kenya	x	x		2
KOR	Korea, Republic of	x	x	x	3
KWT	Kuwait		x		1
KGZ	Kyrgyzstan		x	x	2
LVA	Latvia	x		x	2
LBN	Lebanon	x	x		2
LSO	Lesotho		x		1
LTU	Lithuania	x	x	x	3
LUX	Luxembourg			x	1
MDG	Madagascar	x	x		2
MWI	Malawi	x	x		2
MYS	Malaysia	x	x	x	3
MLI	Mali	x	x		2
MUS	Mauritius	x	x	x	3
MEX	Mexico	x	x	x	3
MDA	Moldova	x			1
MNG	Mongolia		x		1
MAR	Morocco	x	x		2
MOZ	Mozambique		x		1
NAM	Namibia		x		1
NPL	Nepal		x		1

AVE of NTMs		GOODS	SERVICES		Grand Total
Code	Country	Kee et al (2009)	Jafari and Tarr (2014)	Fontagné et al (2016)	
NLD	Netherlands	x	x	x	3
NZL	New Zealand	x	x	x	3
NIC	Nicaragua	x	x		2
NGA	Nigeria	x	x		2
NOR	Norway	x			1
OMN	Oman	x	x		2
PAK	Pakistan		x	x	2
PAN	Panama		x		1
PNG	Papua New Guinea	x			1
PRY	Paraguay	x	x	x	3
PER	Peru	x	x	x	3
PHL	Philippines	x	x	x	3
POL	Poland	x	x	x	3
PRT	Portugal	x	x	x	3
QAT	Qatar		x		1
ROM	Romania	x	x	x	3
RUS	Russian Federation	x	x	x	3
RWA	Rwanda	x	x		2
SAU	Saudi Arabia	x	x		2
SEN	Senegal	x	x		2
SGP	Singapore	x		x	2
SVK	Slovakia			x	1
SVN	Slovenia	x		x	2
ZAF	South Africa	x	x	x	3
ESP	Spain	x	x	x	3
LKA	Sri Lanka	x	x	x	3
SDN	Sudan	x			1
SWE	Sweden	x	x	x	3
CHE	Switzerland	x		x	2
TZA	Tanzania	x	x		2
THA	Thailand	x	x	x	3
TTO	Trinidad and Tobago	x	x		2
TUN	Tunisia	x	x	x	3
TUR	Turkey	x	x	x	3
UGA	Uganda	x	x		2
UKR	Ukraine	x	x		2
GBR	United Kingdom	x	x	x	3
USA	United States of America	x	x	x	3
URY	Uruguay	x	x	x	3
UZB	Uzbekistan		x		1
VEN	Venezuela	x	x	x	3

AVE of NTMs		GOODS	SERVICES		Grand Total
Code	Country	Kee et al (2009)	Jafari and Tarr (2014)	Fontagné et al (2016)	
VNM	Viet Nam		x		1
YEM	Yemen		x		1
ZMB	Zambia	x	x		2
ZWE	Zimbabwe		x		1
Grand total		**93**	**103**	**65**	**n.a.**