TRADE Chief Economist Note

REFLECTIONS ON THE ECONOMIC MODELLING OF FREE TRADE AGREEMENTS

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Abstract

This paper discusses various aspects of economic modelling of free trade agreements (FTAs) raised directly or indirectly by high-level policymakers and the general public with an interest in trade, including explicit free trade critics. It starts with a brief description of the basic features of computable general equilibrium (CGE) models, their gradual adaptation to modern trade theory and some of the criticism they have been subject to. 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 have been 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 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 scarcity 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 European Commission (the Commission), which is negotiating the European Union's (EU's) trade and investment policy on behalf of all EU countries.[2] For example, in the case of EU free trade agreements (FTAs), the impact is in fact analysed before, during as well as twice 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.[3] 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 of the proposal 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.[4] It is made up of (i) an analysis of the potential economic,[5] 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

[2] See Nilsson (2018) for more details on the objectives and scope of EU trade and investment policy as well as the decision making process, including conclusion and ratification of EU FTAs.

[3] See https://ec.europa.eu/info/law/law-making-process/planning-and-proposing-law/impact-assessments_en for additional information, including links to an overview of Impact assessment reports.

[4] For an overview of on-going and completed SIAs, see http://ec.europa.eu/trade/policy/policy-making/analysis/policy-evaluation/sustainability-impact-assessments/index_en.htm.

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

carried out *after their conclusion*.[6] The analysis follows the actual text of the agreement, including the tariff dismantling schedules, which makes it possible also to assess the reduction of non-tariff measures (NTMs) in the form of trade cost reduction of separate provisions of the agreement.[7]

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.[8] 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 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 undertaken 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 choice of closure. Finally, how the simulation results are presented matters for policy makers' and the general public's perception.

The purpose of this paper is to look into these issues in detail and thus to shed light on some of the quite complicated issues economists are faced with carrying out studies on the impact

[6] See http://ec.europa.eu/trade/policy/policy-making/analysis/#_bilateral-regional for such analyses carried out over the past years.

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

[8] For an overview of on-going and completed ex-post evaluations, see http://ec.europa.eu/trade/policy/policy-making/analysis/policy-evaluation/ex-post-evaluations/.

of FTAs in a political environment. It is by no means comprehensive. 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 the foundations of CGE models, how recent theoretical advances in trade theory are reflected in CGE modelling and some of the criticism that CGE models have been subject to. 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 efforts to alleviate some of the data and modelling constraints, while Section 5 discusses some practical modelling choices to be made to produce as accurate results of the simulations as possible. Section 6 looks into which modelling results to present and how to make them easier to understand for laymen. Section 7 concludes.

2. CGE models: basic setting, adaptation to modern trade theory and common criticism[9]

CGE models have been the workhorse for assessing the economy-wide impact of trade liberalisation for more than three decades.[10] 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.

[9] Some parts of this section draw heavily on Hertel (2013).

[10] 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).

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 could add to the gains from reallocating production factors only, but are rarely modelled as there is no definitive 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 a price mark-up, which is determined by the elasticity of substitution between different varieties of products, representing monopolistic profits which are exhausted under a competitive equilibrium. In a model with variable mark-ups, price mark-ups are reduced by intensified competition under trade liberalization and generate additional welfare gains together with an increase in the number of varieties of products consumed. 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.

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.[11] The values of the Armington elasticities matter greatly since lower import tariffs lead to more imports but also to higher exports which are needed to restore the external balance. The volume and prices changes required to do so hinge critically on these trade elasticities.

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.

In light of the fact that current elasticities are based on only a handful of countries, none of which is European, and are outdated (see Section 3.5), using alternative estimates based on sectoral expertise (since no other comprehensive set of elasticities exist) should remain an option to the modeller and could be one way of dealing with this issue. Increasing the size of

[11] See Armington (1969).

the trade elasticities, would increase the size of the allocative efficiency gains and reduce the magnitude of the price drop needed to maintain trade in balance. At the same time, higher elasticities result in larger trade, production and employment adjustments and may lead to a disproportionate specialisation. Another way could be to adjust assumptions regarding the economy's supply side response to allow for an increase in labour, capital and/or productivity, see Section 5.1.1.

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 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. 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 once the modeller controls for the same trade volume effects from the different model specifications, but their work points to the importance of having empirically sound elasticities for meaningful model based policy analysis.[12] Akgul et al (2016) present for the first time a GTAP modelling framework taking firm heterogeneity into account and shows its importance for decomposing welfare changes, see Section 5.3.1.

The question about whether and how to include imperfect competition, scale economies and firm heterogeneity in CGE models used for trade policy analysis remain a topic of debate in academic circles. In so far as the outcome in terms of gains from trade significantly varies depending on the inclusion of these features, the reply to his question is essential. To this end, Akgul (2017) surveys the theoretical literature and recent advances in CGE implementation of this set of issues.[13]

[12] 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.

[13] This discussion is also relevant for section 5.3.1 which discusses how to implement productivity gains from trade.

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.[14] 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 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.

Bekkers and Rojas-Ramagosa (2017) compare different methodological approaches to predicting the welfare effects of the Transatlantic Trade and Investment Partnership (TTIP). They conclude that the two main approaches (CGE models and structural gravity models) both have merit and note a certain degree of convergence in the literature in the sense that CGE models increasingly use structural estimations as inputs, while structural gravity models have become more complex over time, thereby bringing to bear some of the key features of CGE models.

2.3. Common criticisms and drawbacks of CGE models and CGE modelling results

CGE models have been subject to general critique, but also in the way they sometimes are employed which critics claim exaggerates welfare gains from trade liberalisation.[15] For example, when trade costs are reduced the mechanics of the model ensure that the output of the more competitive sectors of an economy increases (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 friction free.[16] This assumption may be appropriate within sectors but it is less so between sectors.[17] 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.

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

[15] The critique applies to the use of CGE models in general and not specifically to the way the models are used by the European Commission.

[16] See Boeters and Savard (2013).

[17] However, one should note that e.g. a welder in one industry more easily could be a welder in another industry compared to having to change occupations. Problems related to inter-industry mobility could also be related to inter-regional mobility should other industries be located elsewhere.

Raza et al (2014) criticizes the fact that much of the estimated welfare gains in several TTIP studies, e.g. CEPR (2013), depends upon reductions of NTMs. The authors argue that the subsequent social costs can be substantial while the macroeconomic adjustment costs in CGE models are assumed to negligible in terms of cost of unemployment due job displacement and losses in duty revenues. They further criticize CGE models more broadly taking the point of departure in the move from microeconomic general equilibrium theory to a situation in which macroeconomic constraints matter but where the underlying assumptions remain microeconomic in nature.[18]

Ackerman and Gallagher (2008) also critically assess the use of CGE models to project the effects of trade policy changes. Using estimates of the potential gains from the Doha Round as an example, they point to that the Doha Round would bring close to no gains to poor people in developing countries and further argue that trade liberalisation has not helped alleviating people from poverty to the extent claimed. They also critically review the modelling of poverty reduction, services, productivity effects and employment effects, etc. Ackerman and Gallagher (2008) call for the development of more realistic models that account for employment- and adjustment effects of trade agreements.

On the other hand, some arguments have been put forward suggesting that the impact of trade liberalisation as assessed using CGE models may be underestimated. Several arguments along this line carry importance. Firstly, 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.[19]

Secondly, the impact of liberalisation on foreign investment (an increasingly important component of modern trade agreements) is unaccounted for in most models. This is an important drawback as foreign direct investment (FDI) is a significant part of modern economic integration and the presence of FDI has been shown to be in itself a catalyst for knowledge and technology advancements in recipient countries, which eventually lead to productivity gains,[20] see Section 4.5 for 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, since applied tariffs rather than bound tariffs are cut in the simulations, models do

[18] The critique is extensive and only a snapshot of some of the main issues touched upon is presented here.

[19] For example, Hall (2011) finds substantial positive impacts of product innovation on revenue productivity, while the impact of process innovation is more ambiguous.

[20] For example, Smarzynska Javorcik (2004) finds positive productivity spill-overs from FDI taking place through contacts between foreign affiliates and their local suppliers in upstream sectors in Lithuania. Similarly, Haskel et al (2007) estimate a positive impact on a UK plant's total factor productivity and the share of a foreign affiliate in the industry of that plant.

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.

Lakatos and Nilsson (2017) argue that the increase in predictability of the Korean trade policy regime played an important role in explaining the increase in EU exports to Korea following the conclusion of the EU Korea FTA. Moreover, Handley (2014) shows that binding trade policy commitments also at the level of the WTO make a difference even if applied tariff levels do not change. Similarly, in the services area, Lamprecht and Miroudot (2018) show that binding currently applied levels of protection tend to have a positive impact on exports even if no actual liberalisation takes place.

Fourthly, Kehoe et al (2017) review how CGE models are used to perform trade policy analysis and highlight some shortcomings these models should address if they are to continue to be used to evaluate the impact of trade reforms. One main such shortcoming (as in all trade models) relates to the need to deal with cases where initial levels of trade are low. This could e.g. be the case if trade barriers are prohibitive. This problem may 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. In these cases, CGE models underestimate the impact of trade liberalisation.[21]

The "small shares" issue 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 those CGE models which do not feature an extensive margin.[22, 23]

Bouët et al (2008) propose to remedy this problem by using imports from a reference group of similar countries, which has been defined based on the countries' per capita income and openness to trade.

[21] The importance of less traded products also emerges in Forizs and Nilsson (2017) who, in a significantly simpler exercise targeting policymakers, compare the ex-ante economic assessment the EU–Korea FTA with observed data. Their results point to sound projections against observed data at the aggregate level and in the largest sectors, such as machinery, as opposed to trade in less important sectors.

[22] 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.

[23] 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).

3. Overview of data issues and sources

3.1. Default model data

Data for global CGE models are usually drawn from the Global Trade Analysis Project (GTAP) database.[24] 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 (GTAP 9) 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.[25]

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) sets limits to what can be achieved in terms of precision of the results, not least since trade negotiations of sensitive products are carried out at tariff line level.

As a result, partial equilibrium (PE) models may sometimes be preferred to CGE models for trade policy analyses at a fine level of product aggregation, even though PE models lack linkages between sectors, countries and regions and thus cannot provide an assessment of the economy-wide impact of trade policy changes. To bridge the gap between PE and CGE modelling, Narayanan et al (2010) developed a PE model nested within the standard GTAP model to facilitate such analyses. Their framework allows users to assess the impact of trade liberalisation at detailed product level and obtain regular CGE based results at GTAP sector level, while remaining within the same analytical structure.

[24] See Aguiar et al (2016a) for an overview of the GTAP 9 database.

[25] Another set of IO tables that is frequently used for analytical purposes is the World Input-Output Database (WIOD) which provides data for 43 "major" countries in the world (including the 28 EU Member States) and 56 sectors for the period 2000-2014, thus making it less suitable for trade policy analysis where the direct or indirect impact on developing countries and/or least developed countries is of importance. In addition, it does not include bilateral tariff data.

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.[26] 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 modellers have 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.

Hence, sometimes users have to change the data in the GTAP database because more recent data is available or the data does not accurately reflect reality. This is not straightforward. If the production value of a certain sector in a certain country is deemed to be different from what is in the GTAP database, it is not enough only to adjust the size of the sector; you also need to alter many other entries in the database to make sure that accounting identities hold.

For adjusting tariff rates in the GTAP database, Malcolm (1998) suggests using a set of procedures (ALTERTAX) that minimize the impact on the value flows in the database through altering parameters and closures. Similarly, Horridge (2011) has developed a program (GtapAdjust) which, after the modeller has converted the GTAP data into a more manageable format, should be used to alter flows in the database, e.g. in the case of a trade ban, before the database in converted back to the original GTAP format again.

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.[27]

The GTAP database reflects the chosen base year. The base year in turn may be affected by one-time off events in specific sectors/countries which may distort the outcome of the simulations. For example, should exports of particular (food) products be prohibited because of outbreak of disease during a specific period of time, the base year may reflect zero exports and thus zero weight of tariffs if those products dominate the sector. In a dynamic simulation, this issue becomes problematic since the forward simulations assume previous year's trade

[26] The GTAP Center has proposed to introduce additional services sectors in version 10 of the GTAP database, see GTAP (2017a).

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

structure.[28] Similarly, substantial variations in the composition of trade from one year to the next may also have a significant impact on the trade weighted tariff.

Movements in real exchange rates affect the relative size of the economies. For example, an appreciation of the US dollar vs. the Euro will make the US economy larger relative to the EU economy. Real exchange rate appreciation may further be an issue in fast growing developing countries, something which obviously is difficult to speculate about in a baseline stretching a decade or two into the future. But unless this and issues such as growth assumptions and changes in trade composition are carefully examined in the baseline, analyses of the impact of FTAs with an implementation period of some 15 years will thus contain non-trivial uncertainties as a result of projections of the underlying GTAP database based on real variables.

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.

[28] The procedure proposed by Horridge (2011) and described above could be used to alleviate such issues.

Kee et al (2009) provide multilateral AVEs of NTMs of 93 countries at the 6-digit level of the Harmonised System (HS).[29, 30] 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.

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.[31]

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

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

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

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

estimated levels of 'actionability' would benefit from validation through additional work and sector specific analyses.

Even if it is possible for the analyst to find AVEs of NTMs relating to trade in specific sectors between two countries, the difficulty remains to assess what the agreement will or has achieved, see Section 5.2.1 for further discussion.

3.4. Main sources of NTMs in services

Jafari and Tarr (2014) make use of a World Bank database[32] 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[33] 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.

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.[34]

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[35] 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.[36] 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.[37]

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

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

[34] It is noteworthy that there is only weak correlation between the Jafari and Tarr (2014) and the Fontagné et al (2016) AVEs for e.g. insurance and transport sectors.

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

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

[37] When checked in mid-February 2017.

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).[38] The online STRI regulatory database displays the detailed information that built the index, along with sources and comments.[39]

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.

3.5. Elasticities

Hillberry and Hummels (2013) note that "trade elasticities are of particular interest because they significantly impact upon the modelled effects of policy experiments on trade patterns, welfare and factor returns, among other important phenomena". They review the literature estimating trade elasticities focussing on central aspects such as underlying assumptions to estimating methods, with a view to guide practitioners into using the best elasticity estimates. They argue in favour of modellers using econometrically estimated elasticities that use identifying assumptions in the underlying data and exploit shocks that are similar to the policy experiment for which it will be used.

Elasticities (of substitution perhaps in particular) are central to the results of CGE modelling.[40] 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.

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

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

[40] 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.

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).[41] 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 and they are also the same across all services sectors, which are additional weaknesses.

Moreover, the EoSs between imported commodities follows the "rule of two", i.e., it equals the EoSs between domestic and imported goods multiplied by two.[42] 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. Recent analyses looking into this issue provide mixed evidence in support of the "rule of two".[43] In addition, the EoSs are the same for all services sectors in the GTAP database.

A vast and growing empirical literature in this area suggests that due to inter alia aggregation bias, sectoral elasticities tend to be higher than elasticities at aggregate level published in the 1980s and 1990s.[44]

4. Efforts to improve the GTAP modelling framework and data

Over the past years, a series of projects aiming to improve the underlying GTAP data in general, including data used to assess the impact of FTAs, have been undertaken. Examples highlighted in recent GTAP Board meetings point to concentration of work to collaborate with contributors to the I-O tables to identify on where the largest adjustments occur, integrate energy subsidies and develop the substitution elasticities data base.[45] Other current GTAP Board priorities include improving the services trade data, the agricultural production data and

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

[42] Ibid.

[43] See e.g. Feenstra et al (2017).

[44] See e.g. Imbs and Mejean (2015), Imbs and Mejean (2017), Ossa (2015), Simonovska and Waugh (2014) and Broda and Weinstein (2006). See also Arkolakis et al (2012).

[45] GTAP (2017b).

commodity and factor taxes, updating export subsidies and implement further sector disaggregation.

While the GTAP centre undertakes many of key improvements to the GTAP database, many others collaborate and contribute to improve the GTAP database. Efforts have also been directed towards the modelling tools themselves, e.g. the work by Akgul et al (2016) on firm heterogeneity already mentioned in Section 2.2. The sub-sections below describe the main thrust of some additional previous and on-going efforts.

4.1. Trade in value added

So called global value chains, which denotes location of different stages of production in different countries, account for an increasing share of international trade. This means that unfinished goods cross borders several times before being finalised with the result that gross trade flows from traditional trade statistics no longer provide an adequate measure for understanding domestic value added and national income.

Walmsley and Minor (2016) modify the standard GTAP model to account for this type of supply chains by tracking imports and tariffs by commodity, agent, source and destination. Hence, it is possible to disentangle the impact of an increase in imports of intermediates as opposed to an increase in imports for final consumption. In a similar vein, the objective of the project "Value added development in the GTAP framework" is to decompose the gross GTAP trade data into valued added trade data, by integrating extra information directly in the GTAP model code, see Fusacchia and Salvatici (2018).

4.2. Public Procurement

Public procurement is an economically important area. For example, it 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, following the financial crisis protectionism increased as many countries have promoted procurement of domestically produced goods and services.[46]

In order to facilitate the modelling of public procurement in a CGE framework, the Commission has sponsored 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

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

and to allow the modelling of removal of 'buy domestic' or 'home bias' policies, see Section 5.2.2.[47]

4.3. 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.[48] 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.

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.[49] 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.[50]

4.4. Splitting GTAP sectors

The sectoral aggregation of the GTAP database was decided upon long ago. The number of sectors should be seen against the fact that full IOs are required to capture the input-output relations. This in turn limits the number of sectors available especially in a multi-country and multi-region context. As a result, 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 food and agriculture.

Analysts and policy makers alike are always looking for as detailed results as possible. The approach suggested by Narayanan et al (2010) ensures that liberalisation of products at a detailed level is correctly reflected also at GTAP sector level, see Section 3.1. Horridge (2005) presents a different solution through the program SPLITCOM, which splits or disaggregates any GTAP sector into two or more new sectors. The program preserves GTAP

[47] Carrico (2017) discusses in detail the development of the GTAP MRIO and reviews other approaches to MRIO development as well as issues of feasibility and limitations.

[48] 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.

[49] See http://www.oecd.org/sdd/its/balanced-trade-in-services.htm.

[50] See Cernat et al (2018).

accounting identities and allows the user to aggregate the new database with more sectors back to the initial one with fewer sectors. It is designed to allow the user to supply the necessary data to carry out the split, but if such data is not available the program will provide it based on neutral assumptions.

Over the long run, one could expect to see further disaggregation of sectors in GTAP. However, this requires work on data for all the 140 countries/regions in the database. The forthcoming GTAP 10 database reflects such a step and foresees eight more sectors. While the number of food and agricultural sectors remains the same, there will be three more manufacturing sectors and five more services sectors. For example, Sector 54 – Other Business Services will see Real estate activities split from ICT services and other professional services. Still, much of the knowledge-based economy is not represented in GTAP. Activities of Google, Amazon, eBay, Alibaba etc. are largely, if not completely, missing, which means that potential impact of liberalisation of e-commerce or of policy measures relating to data flows cannot be assessed.

4.5. 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.[51] 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 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, with varying degrees of linkages to 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).

Fukui and Lakatos (2012) have added to the work in this area through an analysis of foreign affiliate statistics and the creation of such a database. This database then fed into subsequent work they did on analysing the economic impact of removing barriers to FDI in India by

[51] Boumellassa, et al (2007).

developing and extending the GTAP model to account for this data as well as the FDI stocks data, see Lakatos and Fukui (2014).

4.6. Efforts to improve the underlying representation of national economies

The European Court of Auditors evaluated whether the Commission has appropriately assessed the economic effects of its preferential trade agreements[52] 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.

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.[53] 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.

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

[53] For example, Laborde Debucquet and Fousseini (2017) demonstrate that solutions to the standard International Food Policy Research Institute (IFPRI) model is sensitive to the choice of closure rule as is the distribution of impact between agents; where some agents may win or lose depending on the choice of model closure.

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 medium-term time horizon in which factor accumulation does not play a large role. 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. In the case of an externally fixed rate of return on capital, this is sometimes described as reflecting longer-run "steady-state" growth conditions. In the case of sticky wages, this is often chosen to reflect a situation in which there is an excess supply of labour and employment levels are demand-driven. 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.[54] 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 (as opposed to skilled 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. Similarly, one could imagine to model sticky wages in the short-run and flexible wages in the long-run.

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

[54] 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).

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 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. The closure which fixes expenditures and allows the government balance to change may therefore be 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. Disdier et al (2016) make a distinction between the different types of impact different (agricultural) NTMs may have. They note that in the literature a distinction has been made between direct increases in costs (as above) to export to the partner country market resulting from the need to comply with certain requirements, e.g. in terms of obtaining necessary certifications. In addition, NTMs may give rise to supply-shifting effects if an NTM would introduce a prohibition of imports of certain products (e.g. hormone-fed beef), or a demand-shifting effect if NTMs affect consumer preferences, which is a possibility if they would require information in terms of origin, production, or other types of labels. Potentially, the latter two NTM effects could affect the elasticity of substitution between products but since data on such changes is missing this potential impact cannot be modelled.

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.[55] 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.[56] The change (e.g. the percentage change) in the partner's overall TFI can then be modelled as a reduction in trade costs, without the need to have access to estimates of the actual levels of NTMs.

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 (potentially up to the level committed in GATS),[57] thus removing uncertainty in terms of risks for economic operators and providing an insurance effect to services exporters. 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, c.f. Section 2.3.

How should then the removal of this uncertainty be quantified in terms of reduced trade costs for this particular type of services trade? Ciuriak et al (2016) argue that existing measures of services AVEs already reflect both actual restrictions and the difference between bound commitments and applied practice, the so-called 'water'. While stating that the interaction between water and a country's general regulatory risk is an open research issue, they note that the AVEs can be adjusted to give different weight to the 'water' depending on its magnitude and the country's regulatory policy risk profile.

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?

Assessing the impact of services liberalisation may also take the form of a version of the "small shares" problem, since, unlike the case for goods, there are no protection levels readily

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

[56] Moïsé and Sorescu (2013) extend the OECD's database on trade facilitation indicators to 170 countries and assess the trade cost reduction potential of improvement in trade facilitation to about 15%. The availability of information, the simplification and harmonization of documents, the streamlining of procedures and the use of automated processes appear to be the most important policy areas.

[57] General Agreement on Trade in Services.

available in the GTAP database for services. This implies that if e.g. the EU has a bilateral deficit in services trade with a specific partner, the CGE model will interpret this as if the EU has a comparative disadvantage in services trade with this partner. If the EU then sees significant gains in goods sectors due to tariff and NTM reductions, resources will flow to these sectors away from services sectors (since resources are fixed) aggravating the problem.[58]

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.

CEPR (2013) makes the distinction between direct spill-overs and indirect spill-over effects and models such spill-overs in the context of the TTIP. Direct spill-overs former refers to streamlining of regulations and standards in between the EU and the US and benefits third countries exporting to the EU and the US since third country exporters now find it easier to meet the regulatory requirements. Indirect spill-overs arise third countries adopt some of the streamlining of regulations the EU and the US have agreed upon, which, given the economic weight of the EU and the US in world trade, is a real possibility. This in turn means that, in this case, the EU and the US would gain improved market access in third countries from lower levels of NTBs; something that also holds for third countries' trade between themselves.

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. The removal or reductions of NTMs can 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.

However, one can also imagine NTMs that are not neutral and provide rents to either the importer or the exporter. For example, the allocation of quotas or licenses may benefit either importers or exporters depending on how the system for their allocation is set up. Hence, a reduction of a neutral NTM is associated with an efficiency gain, the reduction of rents going to the importer is comparable to an import tax reduction and the reduction of rents destined for the exporter can be modelled as a cut in an export tax. If information on the nature of NTMs is available, such distinction can be made, see Disdier et al (2016) for an example.

Aguiar et al (2016b) 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

[58] See e.g. the case of EU services trade with Turkey in BKP (2016).

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 (2015) 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 imperfect competition models which add markup changes to inter-sectoral allocations. However, following Melitz (2003), it is known that there are similar 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).[59] One question facing modellers is whether such productivity gains should be modelled. If yes, how should they be implemented?

Ciuriak and Xiao (2016) suggest using a unitary elasticity of labour supply to the wage rate which should be interpreted as modelling an increase in labour productivity which rises in proportion to the increase in the wages rate.

Akgul et al (2016), on the other hand, implements Melitz's firm heterogeneity theory in the GTAP model and use it to run a stylised tariff removal simulation which eliminates manufacturing tariffs on trade between the US and Japan and compare the results across different model specifications. They find that variety, scale, productivity and fixed cost effects are significant sources of welfare change.

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

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. BKP (2016) notes that in a single market like the US, a New York consumer does not treat a California produce (much) differently from a local New York produce, but would be less prepared to switch to a Mexican product of tariff on the latter was reduced. At the same time, despite the Single Market, there is no French preference for EU products over third country products and a German consumer would treat an Austrian product on the same footing as one from Morocco or South Africa. This 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.[60] 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.

6. Presentation and interpretation of results

Results of CGE simulations may sometimes seem counterintuitive, especially to policy makers and the general public who may not be familiar with the logic through which the results should be seen. 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

[60] See Decreux and Valin (2007).

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. The same is often seen in terms of reduced exports to third countries when a country gains access to a partner country market.

6.1. Which results should be presented to the general public?

6.1.1. Macroeconomic variables of interest

The Commission 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 the volume of GDP of $X billion in constant prices (the variable QGDP in GTAP) which upfront should be easier to grasp?[61]

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 or a permanent shift in the level of GDP as of this point in time.

6.1.2. 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

[61] 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.

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 many government agencies, 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.[62] Dynamic models can be run in static setting so as to provide two sets of results comparing the two approaches.

6.1.3. Sensitivity analyses

Introducing a number of sensitivity analyses to the simulations might be useful, not least for the modeller and the drafter of the report that the results feed into. 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.

In ex-ante studies, as opposed to ex-post studies, the magnitude of reductions in trade barriers under the FTA analysed is unknown.[63] As a result, ex-ante, it is common to simulate the potential impact of an FTA under e.g. a less ambitious and a more ambitious scenario. Furthermore, one could easily imagining carrying out sensitivity analyses also using different closures, see Section 5.1., or using different parameter values.

6.1.4. 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.[64]

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

[63] In the case of ex-post analyses, the problem of how to convert the achieved NTM reductions according to the text of the agreement into reductions of AVEs remains.

[64] However, different baselines have different prices levels so caution is required when comparing difference scenarios against different baselines.

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.

6.2. Complementing with other types of information

In attempts to make trade policy more 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 Canada. On the map of Europe that is displayed on the dedicated website for this purpose,[65] one can click on any EU Member State to get a further breakdown of where firms are regionally located in the country and infographics and factsheets on the same website provide information on the type of products they export and the number of jobs in the country supported by the country's exports to Canada. While the data does not display what the potential impact of the trade agreement with Canada 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.

7. Summary and conclusions

This paper reviews some of the main features and drawbacks 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 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.

[65] See http://ec.europa.eu/trade/policy/in-focus/ceta/ceta-in-your-town/ for the Canada example.

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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

AVE of NTMs		GOODS	SERVICES		Grand Total
Code	Country	Kee et al (2009)	Jafari and Tarr (2014)	Fontagné et al (2016)	
EGY	Egypt	x	x	x	3
SLV	El Salvador	x			1
EST	Estonia	x		x	2
ETH	Ethiopia	x	x		2
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

AVE of NTMs		GOODS	SERVICES		Grand Total
Code	Country	Kee et al (2009)	Jafari and Tarr (2014)	Fontagné et al (2016)	
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
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

AVE of NTMs		GOODS	SERVICES		Grand Total
Code	Country	Kee et al (2009)	Jafari and Tarr (2014)	Fontagné et al (2016)	
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
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.**