MAIN ASPECTS OF THE CGE MODEL

The EU and US are deeply inter-linked economies, both with each other and with the rest of the world. Against this set up, any change in policies affecting Transatlantic trade can have far-reaching effects not only across the two economies but also elsewhere. For example, a fall in bilateral trade costs via a tariff cut, or a reduction of non-tariff barriers, in a certain sector can make production more competitive and available at lower prices by exposing producers to greater competition while offering them the possibility to serve larger markets. This lower priced production can then benefit consumers or be used as cheaper inputs of downstream industries, at home or abroad.

Thus, lower trade barriers would also improve competitiveness of downstream sectors, which may themselves be also undergoing the impact of a cut in their own level of trade protection. As a result, in each economy the most productive sectors/firms will expand using the production factors (labour and capital) that the least productive sectors/firms will shed. These effects will not be exhausted in the EU and US, as these economic changes as well as the increase in overall economic efficiency (and GDP) across the Transatlantic economy will have an impact on the other economies with whom they trade. The largest trading partners for the EU and US will *a priori* be the most impacted.

These links between sectors and countries and the future economic response to changes in trade policy can best be captured in a so-called 'Computable General Equilibrium' (CGE) model. These CGE models help answering "what-if" questions by simulating the impact of trade policy changes on prices, incomes and substitution effects across products and sectors in equilibrium on markets under different assumptions. The results of these trade policy scenarios are compared with a "baseline", i.e. the future state of the world economy in the absence of such trade policy changes. The effect of the policy change can then be quantified as the difference between the two. The following sections provide additional technical insight of the main features of the model that was used in this analysis of the potential economic effect of a FTA between the EU and the US.

1. The components of the model

The CGE model employed is based on a robust analytical work, described in detail in Francois, van Meijl, and van Tongeren (2005). The most important aspects of the model can be summarised as follows:

- it covers global world trade and production in a dynamic manner allowing for results to be projected into the future
- it allows for scale economies and imperfect competition
- it includes intermediate linkages between sectors
- it allows for trade to impact on capital stocks through investment effects

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

licenses. Part of the income is distributed as subsidy payments to some sectors, primarily in agriculture.

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

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

Manufacturing sectors are modelled as involving imperfect or monopolistic competition. Monopolistic competition involves scale economies that are internal to each firm, depending on its own production level. An important property of the monopolistic competition model is that increased specialisation at intermediate stages of production yields returns due to specialisation, where the sector as a whole becomes more productive the broader the range of specialised inputs. These gains spill over through two-way trade in specialised intermediate goods. With these ‘spillovers’, trade liberalisation can lead to global scale effects related to specialisation. Similar gains follow from consumer good specialisation.

While the model covers changes in gross trade flows, it does not model changes in net international capital flows. Rather the capital market closure involves fixed net capital inflows and outflows. This precludes the model from giving any indications of changes in international investment flows. This is an important limitation of these type of models and in practice it means that from this point of view the macroeconomic results underestimate the potential economic gains as for example the impact on foreign direct investment (which is crucial, notably in the services sectors) will not be captured.

2. Other features summarized

The inclusion of scale economies and imperfect competition implies agglomeration effects like those emphasized in the recent economic literature. Potential provisions in areas of competition and regulatory policy are not explicitly taken into account. Regulatory policy is implicitly dealt with in the choice of the different degrees of NTM reduction in the different scenarios. To the extent that anticompetitive practices are private practices which are subject to regulation, these are as well indirectly implicated in the choice of NTM reduction levels. This can be understood to make our approach conservative; if we were to factor in competition provisions (beyond the degree implicated by the current choice of NTM reduction levels), the gains would likely be higher. It is also worth noticing that the estimation of the impact of NTMs on trade costs originates from a business survey which focused on many competition aspects. These were later incorporated in econometric models that estimated the NTM ad valorem equivalents used in the CGE model and that allowed the estimation of the effects of NTM reduction.

We focused on the model's long-run results. Long-run effects include those of the short-run as well as further effects such as those resulting from capital accumulation. Thus the results of the long-run, dynamic scenarios involve a mix of induced investment, and also productivity effects flowing from the interaction between investment and variety/specialization gains. As a rule of thumb, the long run can be taken to represent the steady state some 8 to 10 years after the FTA has been in place.

In the model, sectors are linked through intermediate input coefficients (based on national social accounts data) as well as competition in primary factor markets. The model includes imperfect competition, short-run and long-run macroeconomic closure options, as well as the standard static, perfect competition, Armington-type of model as a subset. For this study, the model assumes a fixed labour supply and the hypothesis that labour markets clear in the long-run (i..e there is no long-term unemployment). This also means that factors can eventually be fully reallocated across sectors in response to the change in trade policy.

On the policy side, it offers the option to implement tariff reductions, export tax and subsidy reduction, trade quota expansion, input subsidies, output subsidies, and reductions in trade costs. International trade costs include shipping and logistic services (the source of fob-cif margins) but can also be modelled as Samuelson-type deadweight costs. This can be used to capture higher costs when producing for export markets, due to regulatory barriers or NTBs that do not generate rents (or where the rents are dissipated through rent-seeking).

3. Data used for the baseline

The model runs on the GTAP database, version 8. It provides the data for the empirical implementation of the model. The database is the most up-to-date source of internally consistent data on production, consumption and international trade by country and sector. While the GTAP database is itself benchmarked for 2007, it has been projected to 2027 here, and the 2027 benchmark serves as baseline against all experiments.

The GTAP data on protection incorporate the Macmaps data set, which includes a set of ad valorem equivalents (AVEs) of border protection across the world. The source information concerns various instruments, such as specific tariffs, mixed tariffs and quotas, which cannot be directly compared or summed. In order to be of use in a CGE model, these were converted into an AVE per sector, per country and per trading partner. The source of data use for the trade costs associated with NTMs is the Ecorys (2009) study.

4. Sector aggregation

For the purpose of this study, the GTAP database is aggregated into 20 sectors, as shown in Table 1.

Table 1: Sectors in the model

	Sectors	Market structure
1	Agriculture, forestry, fisheries	Armington
2	Other primary sectors	Armington
3	Processed foods	Monop Comp
4	Chemicals	Monop Comp

5	Electrical machinery	Monop Comp
6	Motor vehicles	Armington
7	Other transport equipment	Armington
8	Other machinery	Monop Comp
9	Metals and metal products	Armington
10	Wood and paper products	Armington
11	Other manufactures	Monop Comp
12	Water transport	Armington
13	Air transport	Armington
14	Finance	Armington
15	Insurance	Armington
16	Business services	Armington
17	Communications	Armington
18	Construction	Armington
19	Personal services	Armington
20	Other services	Armington

5. Market structure

From the sectors listed in Table 1, industrial sectors and most service sectors (except public services, utilities, and transport) are specified with monopolistic competition while all other sectors have perfect competition. Econometrically-based substitution elasticities for goods originate from Ecorys (2009) while elasticities for the services sectors were obtained from Dee (2010).

6. Country aggregation

The country aggregation used for the model is presented in Table 2.

Table 2: List of regions in the model

Region name	Description
European Union	27 Member States
United States	United States
Other OECD	Canada, Mexico, Switzerland, Turkey, Norway, Iceland, Japan, Korea, Australia, New Zealand, and Taiwan, and Hong Kong
Easter Europe	Albania, Belarus, Moldova, Ukraine, Bosnia-Herzogovina, other Balkans
Mediterranean	Egypt, Morocco, Tunisia, rest of North Africa
China	China
India	India
ASEAN	Cambodia, Indonesia, Lao, Malaysia, Philippines, Singapore, Thailand, Vietnam, Myanmar, Brunei
MECOSUR	Argentina, Brazil, Paraguay, Uruguay, Venezuela
Low income	Ethiopia, Madagascar, Malawi, Mozambique,

	Tanzania, Uganda, Other low income Africa, Bangladesh, Other low income Asia (other low income are from GTAP regions xse, xsa, xwf, xec)
Rest of World	Rest of the World

NTM estimates

Non-Tariff Measures are defined as 'all non-price and non-quantity restrictions on trade in goods, services and investment, at federal and state level'. This measure thus includes border measures (customs procedures, etc.) as well as behind-the border measures flowing from domestic laws, regulations and practices.

While trade policy makers have made significant progress in lowering barriers to international trade linked to tariffs, the policy relevance of non-tariff measures (NTMs) has increased. The reason for the greater attention to NTMs is three-fold. First, as the level of tariffs has decreased, the relative importance of NTMs has increased. In addition, during this time, significant progress has been made in terms of quantifying the effects of NTMs, leading to a better understanding of the costs these barriers impose on the cost of doing business. And finally, there is some evidence of NTMs being used as substitution for the tariffs that have been reduced. Thus in this study, we include the modelling of lowering NTMs in addition to the lowering of tariffs. In this subsection we describe the process of obtaining the estimated NTMs employed in the analysis.

Amongst the literature on NTMs are a number of OECD studies, i.e. OECD (2000) on technical standards and conformity, OECD (2001) on sanitary, phytosanitary and technical barriers to trade, OECD (2005) on Customs fees and charges on imports, OECD (2006) on the review of different methods for assessing NTMs and the OECD (2009) on assessments in agro-food trade. More recently, literature aimed more directly at providing estimates of the impact of barriers includes the EU sponsored ECORYS (2009) study on NTMs on EU-US Trade and Investment, the joint EU-Government of Canada (2010) study, and the EC sponsored Copenhagen Economics (2009) study on EU-Japan trade. The EU-US and EU-Japan studies both make use of a recent business survey originating in the Ecorys study. The Copenhagen Economics led study supplemented these with direct questions on cost impacts, similar to some of the OECD studies on cost impacts of regulatory differences.

The EC NTM project led by ECORYS (2009) had the stated goal of trying to "shed light on the existence of nontariff measures (NTMs) and regulatory divergence at the sector level of EU-US trade." Estimating the trade costs of NTMs is a difficult exercise. The basis for such estimation in the ECORYS (2009) study comes from an extensive business survey incorporating firms originating in the EU, US and third countries, operating in the EU and/or US. (The survey is further described below). That large scale survey on both sides of the Atlantic was conducted in order to assess which NTMs companies perceive to have the most deleterious impact on their business. The results from the survey were then incorporated in a set of econometric models to estimate current levels of NTBs impacting US-EU trade. The use of a gravity model allowed for calculation of ad valorem equivalents of NTBs.

The business survey was based on the following question: "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 you report product (service) in this sector?" Based on the results of this survey the study presented a list of NTMs in 23 different sectors.

The finished product of the business survey generated bilateral NTM index numbers (between 0 and 100) based on the answers from 5,500 companies, which then were cross-checked against other indicators. These index numbers were then transformed into" levels of trade restrictions" which in turn were used as inputs to gravity regressions.

The gravity analysis was used to calculate how much trade and investment costs can be reduced for each sector when NTMs are aligned and regulatory convergence is achieved. A priori one can expect NTMs to have a negative effect, because the higher the regulatory divergence (i.e. the higher the NTM) the more trade and investments are inhibited. However, we also know empirically that countries trade and invest more with countries that are larger (i.e. with higher levels of GDP) and trade and invest less with countries that are further away. Gravity analysis corrects for size of GDP and distance and is therefore well-suited for analysing the effects on NTMs on trade and investment flows. The coefficients emerging from the gravity equation estimates were then used to infer trade cost equivalents resulting from current levels of NTMs using methodology presented in Anderson, Bergstrand, Eggers and Francois (2009), which were incorporated into the studies as basis for liberalizing trade.

The Table below summarizes the estimates of potential trade cost that could be lowered with the elimination of regulatory barriers and/ or regulatory convergence. These are can be found in ECORYS (2009) and served as the basis for the experiments in this report.

Total trade cost estimates from NTM reduction, ECORYS (2009)				
		A	B	E
NTM project sector no		Total trade barriers: EU barriers agains US exports	Total trade barriers: US barriers against EU exports	trade price elasticities
1	Food and beverages	56.8	73.3	2.46
10,11,12	Chemicals	13.6	19.1	5.09
15,16	Electrical machinery	12.8	14.7	9.65
18	Motor vehicles	25.5	26.8	10
19	Other transport equipment	18.8	19.1	7.14
21	Metals and metal products	11.9	17.0	13.91
23	Wood and paper products	11.3	7.7	7.99
14,22	Other manufactures	N/A	N/A	6.56
	average goods	*21.5*	*25.4*	*8.0*
2	Transport			
	air	2.0	2.0	3.8
	water	8.0	8.0	3.8
3	Finance	11.3	31.7	2.04
5	Insurance	10.8	19.1	3.18
4,8	Business and ICT	14.9	3.9	3.18
6	Communcations	11.7	1.7	3.18
7	Construction	4.6	2.5	4.21
9	Personal, cultural, other services	4.4	2.5	8.71
	average services	*8.5*	*8.9*	*4.0*
source: ECORYS(2009), Annex Table III.1				