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Research Report

Model Simulations for Trade Policy Analysis: the impact of potential trade agreements on Austria

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Model Simulations for Trade Policy Analysis: the impact of potential trade agreements on Austria

Joseph Francois, Olga Pindyuk

Abstract

In this paper, we examine possible medium-term changes in EU trade policy, including the negotiation and implementation of Free Trade Agreements (FTAs) with regional entities like ASEAN and the NAFTA countries. We also examine the possible conclusion of the Doha Round of multilateral trade negotiations. Such changes in policy at the regional and global level imply changes in trade policy and industrial structure that affect Austria as part of the network of European industry. To accomplish this, we work with a computable general equilibrium model (CGE) of the Austrian economy and its major global trading partners. This model is benchmarked to 2020 macroeconomic projections. The modeling scenarios are based on a mix of tariff reductions for goods and non-tariff barriers (NTB) reductions for services. The services liberalization scenario is based on protection with an "actionability" assumption. The results include estimated changes in GDP, welfare, as well as in the value added contained in Austrian exports. The focus on value added provides important insight to the overall impact on the Austrian economy. In all policy cases examined, the striking message is the importance of high technology services (ICT and other business services) to the total growth in Austrian exports, on a value added basis. This reflects both the high value added content of trade in this sector, and the apparent comparative advantage of Austria in this sector in the 2020 baseline.

Keywords: trade agreements, ASEAN, NAFTA, Doha Round, Austria, CGE

JEL-codes: F15, F17, C68

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**Model Simulations for Trade Policy Analysis:
the impact of potential trade agreements on Austria**

J. Francois, O. Pindyuk



FIW – Research Centre International Economics

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Vienna, December 2010

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Executive Summary

Recent studies for the European Commission have examined the impact of regional and multilateral agreements on the European Community as a whole. This study examines possible medium-term changes in EU trade policy on Austria, including the negotiation and implementation of Free Trade Agreements (FTAs) with regional entities like ASEAN and the NAFTA countries. It also examines the possible conclusion of the Doha Round of multi-lateral trade negotiations. Such changes in policy at the regional and global level imply changes in trade policy and industrial structure that affect Austria as part of the network of European industry.

The motivation for pursuing an agreement with the ASEAN countries is their collective importance for the EU as trading partners, when viewed as a combined trading block. Collectively, the ASEAN countries represent roughly 6 percent of extra-EU Austrian trade. This is more than Japan and Korea combined, and roughly at par with trade with China. Services dominate Austrian exports to ASEAN. This contrasts sharply with the general pattern of Austrian exports, where manufacturing dominates. This point is seen even more clearly when we examine trade on a value added basis. On this basis, services account for over 60 percent of the value added contained in Austrian exports to ASEAN.

The potential benefits of an EU-US agreement are substantial. The North American economies, collectively, account for 25% of Austrian extra-EU exports, and over 20% of imports. However, in contrast to ASEAN, this trade is concentrated in manufactured goods rather than in services. This means that barriers to trade in goods are relatively much more important in a trans-Atlantic context than they are in the ASEAN context, where services are the dominant linkage between exports and Austrian value added.

Possible trade agreements under the Doha Round of WTO negotiations, and on a regional basis with NAFTA and ASEAN countries, are examined with a computer-based model of world production and trade. This model is benchmarked to 2020 macroeconomic projections. From this model, the highest GDP growth and welfare increase for Austria are estimated under the Trans-Atlantic scenario – 0.25% and EUR 874 million respectively. Liberalization of trade under the ASEAN scenario yields the lowest increase in GDP – less than 0.1%. Imports increase roughly in line with exports in all the scenarios. The Doha scenario yields gains similar, but slightly less than under a NAFTA agreement (0.24% of GDP).

The study also presents estimated changes in the value added contained in Austrian exports under all three liberalization scenarios. Under all scenarios, the value added content of expanded exports is between 45% and 65% of the gross value of expanded exports. This reflects the role of complex production chains, and the difference between gross exports (which include imported intermediate goods) and the domestic value added contained in those exports. For example, with the ASEAN experiment, where export growth in

services is the primary contributor to total export growth (reflecting the export composition discussed in Section 3), 65% of gross export growth is in value added, while under the Doha case, the value added accounts only for 45% of gross export growth. The NAFTA case is in the middle, with value added contained in new exports equal to 55% of gross new export values. There is also a strong difference in the importance of different sectors to total value added growth. For example, though import protection in motor vehicles is relatively low in North America, the motor vehicle sector is actually quite important when look at the impact of a North American FTA on Austrian value added contained in exports. In all cases, one striking message from the simulations is the importance of high technology services (ICT and other business services) to the total growth in Austrian exports, on a value added basis. This reflects both the high value added content of trade in this sector, and the apparent comparative advantage of Austria in this sector in the 2020 baseline.

CHAPTER 1: INTRODUCTION

Austrian trade policy is bound tightly to European policy on several levels. An obvious linkage is the core institutional mechanisms that establish trade policy at the level of the European Union. These translate directly into the rules that govern Austria's trade with its major partners, both in Europe but also outside the scope of the European Economic Area. A second set of linkages involves the tight connections at industry level between Austrian firms and those in other EU Member States, especially firms in Germany, Italy, and the new Members. Cross border linkages at industry level mean that the trade-related performance of the Austrian economy hinges on what happens at the European level. This also means industrial policy and the evolution of industrial structure in other Member States impacts directly on Austria.

In this paper, we examine possible medium-term changes in EU trade policy, including the negotiation and implementation of Free Trade Agreements (FTAs) with regional entities like ASEAN and the NAFTA countries. We also examine the possible conclusion of the Doha Round of multilateral trade negotiations. Such changes in policy at the regional and global level imply changes in trade policy and industrial structure that affect Austria as part of the network of European industry. Recent studies for the European Commission have examined the impact of regional and multilateral agreements on the European Community as a whole. This includes the Francois, Norberg, and Thelle (2007) study of and EEU-Korea FTA, the Francois et al (2009) study of a EU-ASEAN FTA, and the wiiw (2009) study of the likely impact of the NAMA (non-agricultural market access) elements of the Doha Round for European industry. However, studies of this type have focused on policy analysis at the level of the European Community as a whole, with much less focus on the impact on individual Members like Austria.

CHAPTER 2: OVERVIEW OF THE MAJOR EU REGIONAL TRADE INITIATIVES AND DOHA ROUND

In this chapter we describe recent EU regional trade initiatives with respect to North America and South East Asia, as well as the basic features of the Doha Round of WTO negotiations.

a. EU-East Asia Trade Agreement

The five countries (Indonesia, Malaysia, Philippines, Singapore and Thailand) established the Association of Southeast Asian Nations (ASEAN) on 8 August 1967. Today, ASEAN encompasses 10 South East Asian countries with the addition of Brunei Darussalam (1984), Vietnam (1995), Laos (1997), Burma/Myanmar (1997) and Cambodia (1999). The ASEAN countries comprise around 0.6 billion people and collectively generate a GDP of about 1.5 billion USD. In 2009, EU-ASEAN trade represented almost 1% of total world trade, ASEAN being the EU's 5th largest trading partner¹. The EU main exports to ASEAN are business services (27% of total exports in 2007) and other services (16%). In manufacturing exports, the major export categories are electrical machinery and other manufacturing; the main imports from ASEAN to the EU are business services, other services, as well as textiles and clothing.

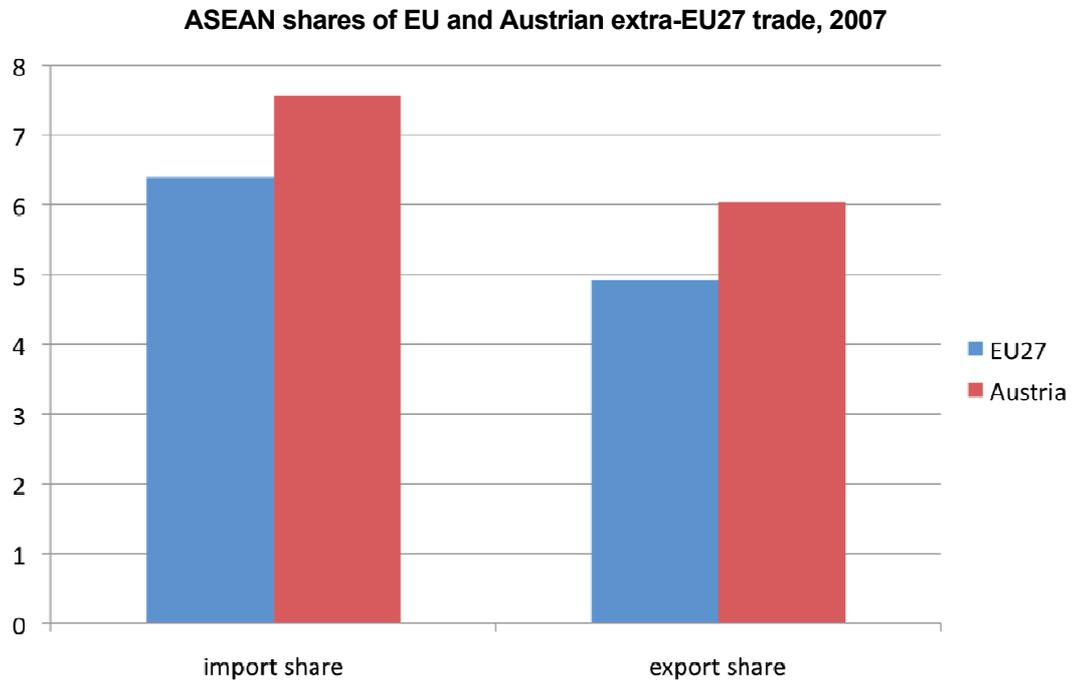
ASEAN countries have been moving to greater economic integration since the 1990s. The ASEAN Free Trade Area (AFTA) concerns local manufacturing in all ASEAN countries. The AFTA agreement was signed on 28 January 1992 in Singapore. Countries which joined ASEAN later have not fully met the AFTA's obligations, but they are officially considered part of the AFTA as they were required to sign the agreement upon entry into ASEAN. They were given longer time frames in which to meet AFTA's tariff reduction obligations. Recently, ASEAN has concluded free trade agreements with China, Korea, Japan, Australia, New Zealand, and India.

Currently, ASEAN is negotiating a free trade agreement with the EU. The negotiations process started in 2007. However, progress in these negotiations was slow and both sides agreed in March 2009 to call a pause to negotiations. Recently, the negotiations were restarted as EU Member States asked the Commission to pursue negotiations with those individual ASEAN countries that show interest in negotiating comprehensive FTAs bilaterally. The final shape of an EU agreement or set of agreements, with the countries that make up ASEAN remains to be established.

¹ See <http://ec.europa.eu/trade/creating-opportunities/bilateral-relations/regions/asean/>.

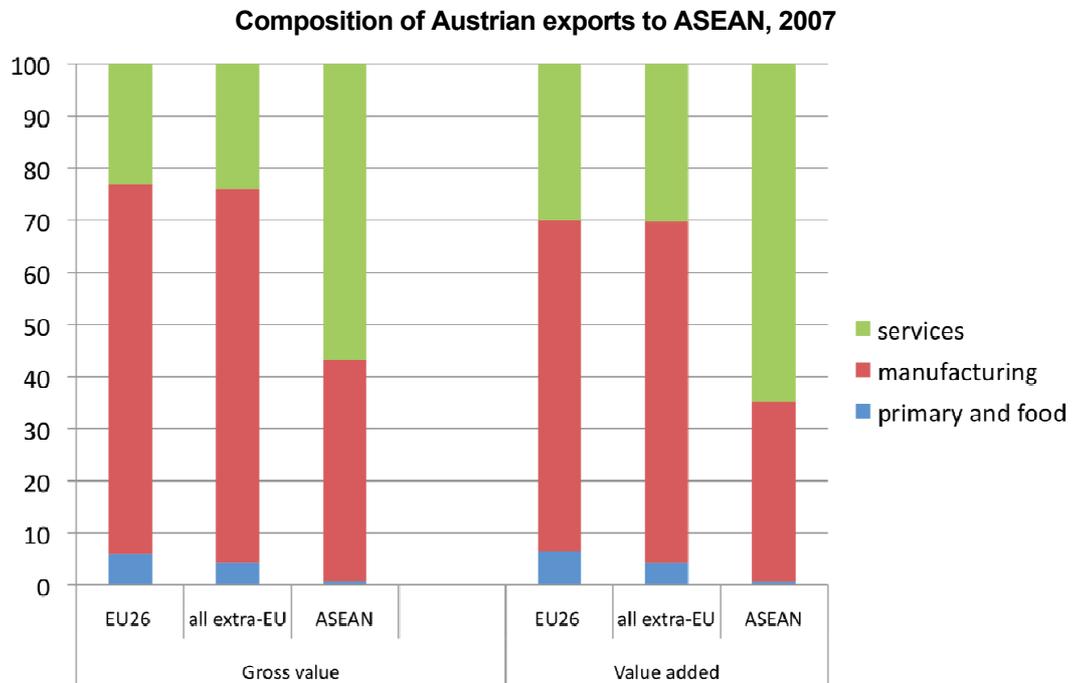
The motivation for pursuing an agreement with the ASEAN countries is their collective importance for the EU as trading partners, when viewed as a combined trading block.

Figure 2.1



Note: includes services trade. Source: COMTRADE and GTAP8.

Figure 2.2



Source: own calculations based on GTAP8.

Figure 2.1 above highlights the importance of the ASEAN block as a destination of Austrian exports, and as a source of imports. Collectively, the ASEAN countries represent roughly 6 percent of Austrian extra-EU trade as a combined trading block. This is more than Japan and Korea combined, and roughly at par with trade with China.

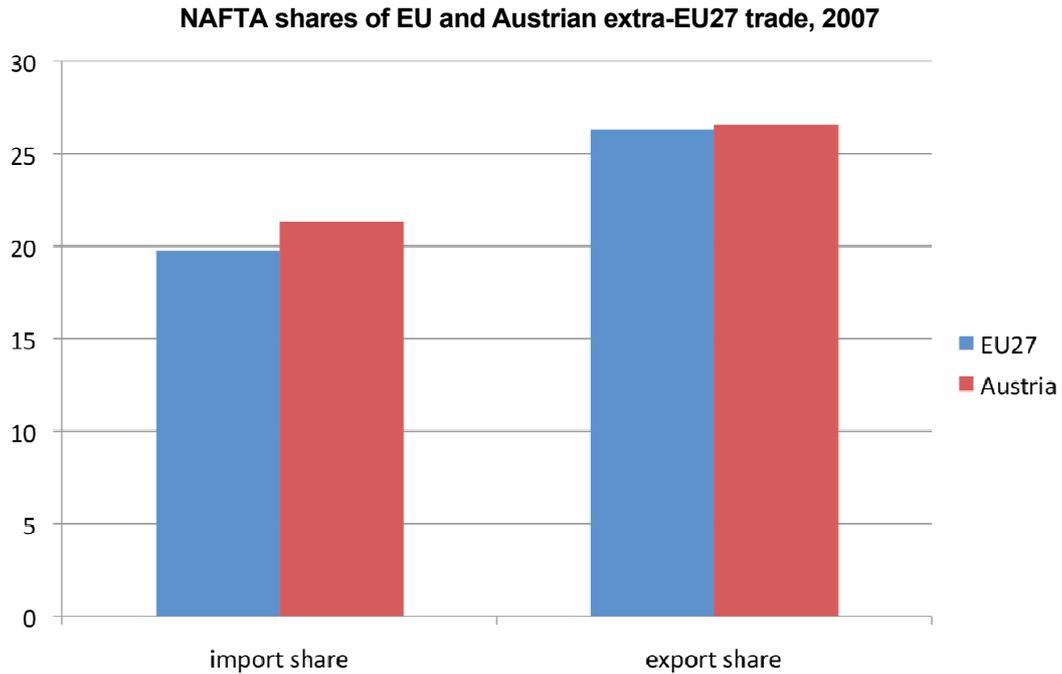
Figure 2.2 highlights the actual composition of trade with ASEAN. The first set of columns presents the composition of Austrian exports to ASEAN on a gross value basis. Here, we can already see that services dominate Austrian exports to ASEAN. This contrasts sharply with the general pattern of Austrian exports, where manufacturing dominates. This point is seen even more clearly when we examine trade on a value added basis. The second set of columns in Figure 2.2 present Austrian exports on a value added basis (reflecting estimated direct sector value added, as well as Austrian value added linked to demand for intermediates). On this basis, services account for over 60 percent of the value added contained in Austrian exports to ASEAN. Again, this contrasts sharply with the general pattern of Austrian exports, where manufacturing dominates the export profile.

b. Transatlantic Free Trade Agreement

The EU recently entered free trade area negotiations with Canada. This is in the context of an existing agreement with Mexico on goods, and the ongoing transatlantic regulatory cooperation (TRC) process, which deals with diverging regulations that constitute non-tariff measures (NTMs) to trade and investment. On a regular basis, the EU and US, its major trading partner, meet to discuss the transatlantic relation at different levels. Every year, a high level EU-US Summit takes place to address economic cooperation and market integration, to prevent disruptive and costly disputes and stimulate trade and investment flows by reducing both at-the-border and behind-the-border costs.

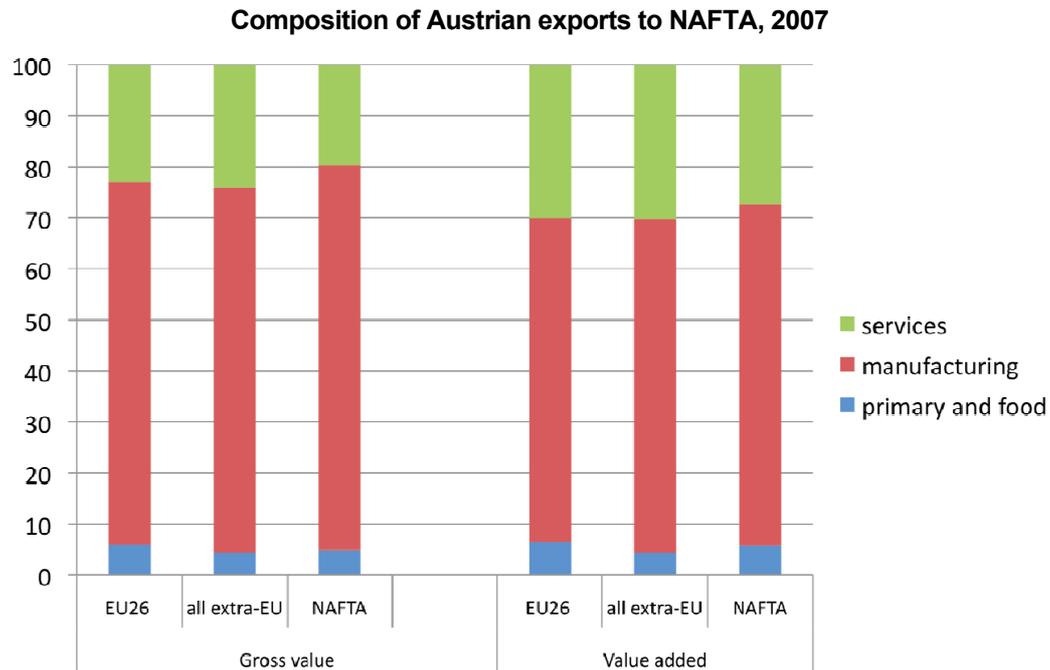
In 2002, in Washington, agreements were reached on Guidelines for Regulatory Cooperation and Transparency to encourage EU and US agencies to consult with each other on a voluntary basis. Following this, a Roadmap for EU-US regulatory Cooperation and Transparency was developed in 2004. In its May 2005 communication, "A Stronger EU-US Partnership and a More Open Market for the 21st Century", the EC identified regulatory cooperation as a prime objective of transatlantic co-operation. This was followed in 2005 by the High-Level Regulatory Cooperation Forum, which was set up to develop a joint regulatory work plan and the political leaders agreed to move forward in the fields of investment, public procurement, services and improvements in mutual recognition of professional qualifications. The 2007 EU-US Summit launched the Transatlantic Economic Framework and the Transatlantic Economic Council (TEC) to help further strengthen EU-US economic integration.

Figure 2.3



Note: includes services trade. Source: COMTRADE and GTAP8.

Figure 2.4



Source: own calculations based on GTAP8.

The potential benefits of an EU-US agreement are substantial, as illustrated by a recent EC report on transatlantic NTBs. (Berden, Francois, Tamminen, Thelle, and Wymenga, 2009). However, despite ongoing dialogue and initiatives, high expectations linked to previous initiatives have not been met with respect to the United States. Hence, while the EU

and Canadian governments are now in explicit dialogue linked to an eventual FTA, the process with the US is nascent. Indeed, like ASEAN, the shape of EU agreements with the NAFTA economies may ultimately involve bilateral agreements rather than an EU-NAFTA treaty.

Figures 2.3 and 2.4 highlight the importance of the NAFTA market for Austria. The North American economies, collectively, account for 25% of Austrian extra-EU exports, and over 20% of imports. However, in contrast to ASEAN, this trade is concentrated in manufactured goods rather than in services. This means that barriers to trade in goods are relatively much more important in a trans-Atlantic context than they are in the ASEAN context, where services are the dominant linkage between exports and Austrian value added.

c. Doha Development Round

The Doha round of WTO negotiations, which was launched back in November 2001, aims at opening agricultural and manufacturing markets, as well as decreasing barriers to trade in services and expanding intellectual property regulation. The intent of the round, according to its proponents, was to make trade rules fairer for developing countries, however finding consensus among negotiating parties has turned out to be rather difficult. The negotiations collapsed on 29 July 2008 over issues of agricultural trade between the United States, India, and China. In particular, there was insoluble disagreement between India and the United States over the special safeguard mechanism (SSM), a measure designed to protect poor farmers by allowing countries to impose a special tariff on certain agricultural goods in the event of an import surge or price fall. After that the negotiations have remained in impasse.

Recently, several countries have called for negotiations to start again. The declaration at the end of the G20 summit of world leaders in London in 2009 included a pledge to complete the Doha round. Brazil and Pascal Lamy have led the process of resuscitating the Doha Round, focusing on the role of the United States in overcoming the deadlock. Even allowing for likely exceptions for sensitive and special products, concluding the Doha Round of trade negotiations would bring significant reduction in barriers to trade in manufactures and agricultural products. While there is great potential for liberalization in services as well, at this stage there is little evidence that current offers in services would provide liberalization, though there would be improved security linked to market access.

CHAPTER 3: MODELING METHODOLOGY

In this chapter we describe our approach to modelling trade liberalization. We start with the model overview, and then proceed with description of the data and scenarios we use to model trade liberalization initiatives.

a. Model description

We assess impact of the major trade liberalization initiatives on Austria using a computable general equilibrium model (CGE) of the Austrian economy and its major global trading partners.

The General Equilibrium Model²

The CGE model employed is based on an extended version of the Francois, van Meijl, and van Tongeren (2005) model. This model has been extended to focus on the Austrian economy, and has also been updated with more recent production and trade data. The most important aspects of the model can be summarised as follows:

- It covers global world trade and production
- 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
- It allows for short-run and long-run adjustment in labour markets

Key features of the model

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.

² For more technical description of the model see Appendix A.

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. Constant returns to scale are assumed in primary and service sectors, while several manufacturing sectors (processed foods, chemicals, industrial machinery) are modelled as subject to increasing returns under monopolistic competition. In all sectors, products from different regions are assumed to be imperfect substitutes, linked to a mix of geographic and firm-based aspects of supply. This is discussed more in the annex.

Data used for modelling

The model runs on the GTAP database, version 8. The database is the best and most up-to-date source of internally consistent data on production, consumption and international trade by country and sector.³ Our trade and production data are all valued in 2007 Euros. Trade data are based on UNCTAD COMTRADE data as reported (in the case of the EC) by Eurostat and as integrated into the GTAP database. 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 have been converted into an AVE per sector, per country and per trading partner.⁴

Based on the most recent macroeconomic projections from the IMF, as reported in its October 2010 World Economic Outlook, we extend our data to 2020 (similarly to Christie et al. (2009a)). The core of the baseline projections is the real GDP growth rates summarized in Table 3.1. (Note that for 2016-2020 we use IMF projected growth rates for 2014-2015, which are close to two-year moving average growth rates over the 2000-2015 IMF baselines). Macroeconomic projection involves imposing the baseline trends on the CGE model, linking investment to underlying income and savings rates, and then using the model to estimate the underlying TFP growth rates, at the national level, consistent with the IMF-based growth projections. We also impose medium-term real price trends for energy, based on IEA projections. Because the model also includes employment, production, and consumption at the national level by industry, as well as bilateral trade flows, we are then able to also estimate changes in the underlying structure of the global economy as well. The estimated changes in global production, employment, and trade are consistent with baseline 2007 economic structures (input-output shares). The results of this projection serve as a starting point for modelling of our trade policy scenarios.

³ For more information, please refer to Dimaran and McDougall (2006).

⁴ The MacMaps database is the result of a joint effort by the International Trade Center (governed by UNCTAD and WTO) and Cepii.

Table 3.1

IMF macro data

GDP in billions of current US\$

		nominal GDP 2004	nominal GDP 2005	nominal GDP 2006	nominal GDP 2007	nominal GDP 2008	nominal GDP 2009	IMF projecte d annual growth rate 2008- 2015	IMF projecte d annual growth rate 2014- 2015	actual annual growth rate 2006- 2007
AUT	Austria	289.4	303.4	322.6	372.8	416.6	382.1	1.07	1.83	3.66
EUN	European Union 26	13,495	14,389	16,663	18,004	15,998	15,725	0.98	2.17	1.96
USA	USA	12,264	12,638	12,976	13,229	13,229	12,881	1.68	2.67	2.31
CAN	Canada	992	1,134	1,279	1,424	1,499	1,336	1.62	2.09	2.51
MEX	Mexico	760	849	953	1,026	1,090	875	2.63	4.07	4.13
JPN	Japan	4,606	4,552	4,363	4,378	4,887	5,069	0.63	1.72	2.20
KOR	Korea	722	845	952	1,049	931	833	3.64	3.97	5.14
OCD	Other advanced 1/	2,331	2,640	3,350	3,731	2,920	4,973	2.82	3.66	3.30
CHN	China	1,932	2,257	2,713	3,494	4,520	4,985	9.59	9.46	13.44
ASN	ASEAN	813	979	1,165	1,360	1,372	1,638	5.45	6.10	5.68
BRA	Brazil	666	890	1,093	1,366	1,636	1,574	4.12	4.14	5.02
IND	India	690	810	908	1,152	1,261	1,237	7.81	8.14	9.77
RUS	Russia	591	764	990	1,300	1,667	1,232	2.72	4.07	8.34
ROW	ROW	5,364	6,246	7,889	9,302	6,417	9,226	6.13	6.66	7.36

Denmark, Finland, France, Germany, Greece, Hong Kong SAR, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan Province of China, United Kingdom, and United States. The total here excludes those reported separately.

Sector and regional aggregation

For the purpose of this study, we aggregate the GTAP database into 20 sectors. The sector structure is shown in Table 3.2. The GTAP agricultural and food processing sectors are classified according to the Central Product Classification (CPC). The other GTAP sectors are defined by reference to the International Standard Industry Classification (ISIC rev.3 as defined by United Nations Statistic Division). Services and utility classifications predate the GATS and are based on IMF balance of payments statistics (BOP) and UN definitions.

Our regional aggregation involves 14 regions, as detailed below in Table 3.3.

Table 3.2

Model sectoring scheme

Acronym used	Sector	Share in Austrian exports in 2007, %
AFF	Agriculture, forestry, fisheries	0.7
OPS	Other primary sectors	0.2
PRF	Processed foods	4.6
CHM	Chemicals	10.1
ELM	Electrical machinery	3.4
MVH	Motor vehicles	12.6
OTN	Other transport equipment	1.8
OMC	Other machinery	18
MTL	Metals and metal products	11.1
WPP	Wood and paper products	7.5
OMG	Other manufactures	6.6
WTP	Water transport	0.6
ATP	Air transport	2.1
FIN	Finance	0.5
INS	Insurance	1.4
BUS	Business services	9.5
CMN	Communications	0.5
CNS	Construction	0.6
ROS	Personal services	0.9
OSV	Other services	7.2

Table 3.3

Regional Aggregation Scheme

	Acronym used	Share in Austrian exports in 2007, %
Austria	AUT	
European Union	EUN	69.5
United States	USA	7.2
Canada	CAN	0.6
Mexico	MEX	0.3
Japan	JPN	1.1
Korea	KOR	0.5
Other Advanced Economies	OCD	5.7
China	CHN	1.8
ASEAN	ASN	1.8
Brazil	BRA	0.5
India	IND	0.6
Russia	RUS	1.9
Rest of World	ROW	8.5

b. Value added structure of trade in the baseline

In our experiments, we will focus, in part, on the value added content of trade and the impact of our trade liberalization scenarios on this pattern of exports, adjusted for the value added content of exports. To provide context for this discussion, in Table 3.5 below, we present an overview of our estimated exports structure for Austria in the 2020 baseline in terms of value added. This reflects an estimate of direct value added per euro of exports, combined with indirect value added. The latter accounts for intermediate linkages between sectors. According to these calculations, sectors with the highest value added are business services, personal services, insurance and primary sectors. It is these sectors, where, according to our projections, Austria also has the highest growth in 2007-2020. With the exception of business services, sectors with the biggest shares in exports, on the contrary, have relatively low value added. For example, motor vehicles, the second biggest exports sector, are characterized by the lowest value added in the economy. This reflects the deep cross-border integration of the sector, where gross value relies on complex value chains and cross-border as well as domestic value added activities.

Table 3.5

Ranking of Austrian industries by value added per euro of exports

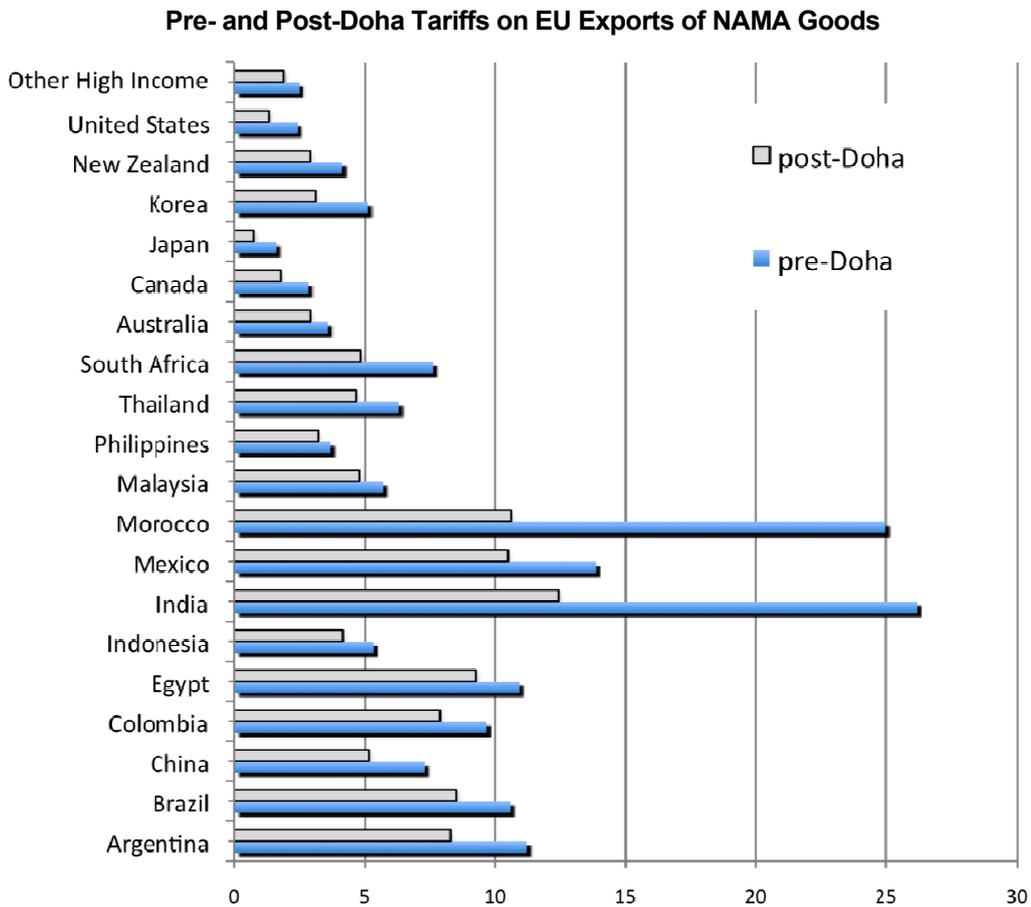
Sector	Share in exports in 2020, %	Total value added per euro of exports in 2020	Rank of industries total value added per euro of exports in 2020
Agriculture, forestry fisheries	1.6	0.73	5
Other primary sectors	0.7	0.79	2
Processed foods	5.6	0.60	9
Chemicals	8.7	0.55	12
Electrical machinery	1.7	0.52	16
Motor vehicles	13.0	0.34	20
Other transport equipment	1.9	0.46	18
Other machinery	15.5	0.55	14
Metals and metal products	10.1	0.55	13
Wood and paper products	7.5	0.58	11
Other manufactures	8.0	0.52	15
Water transport	0.7	0.45	19
Air transport	2.1	0.50	17
Finance	0.5	0.59	10
Insurance	1.5	0.74	4
Business services	10.3	0.80	1
Communications	0.5	0.66	8
Construction	0.8	0.69	7
Personal services	1.0	0.77	3
Other services	8.3	0.73	6

Source: Projected GTAP by authors, with authors' calculations

c. Simulations scenarios

The modelling scenarios are based on a mix of tariff reductions for goods and NTB (trade cost) reductions for services. Following Gootiiz and Mattoo’s assessment of services schedules of commitments under Doha Round negotiations, we focus on tariff reductions for the Doha scenario. For regional agreements, we also include a reduction in barriers to trade in services. The services liberalization scenario is based on protection as reported by Francois, Hoekman, and Woerz (2007), with an “actionability” assumption (meaning that roughly half of existing estimated services barriers can actually be reduced through negotiations) based on the recent ECORYS study of NTBs for the European Commission (Berden et al 2007). A detailed discussion of tariff rates and likely reductions in these rates under Doha for industrial goods is provided in wiiw (2009). For agricultural goods, a summary is provided by Brockmeier and Pelikan (2009). Figure 2.1 summarizes Doha tariff reductions.

Figure 3.1



Source: wiiw (2009)

Table 3.6 below presents an overview of tariffs faced by Austrian exports in the North American and ASEAN markets. From the table, tariff protection in motor vehicles is very

high in Asian markets, though relatively low in North America. (This is also a sector where EU protection is relatively high, averaging 7.5 percent). Processed foods is also a highly sensitive sector for the EU, Canada, and ASEAN, though less so for the US.

Table 3.6

Tariffs on Austrian Exports and EU tariffs

	United States	Canada	ASEAN	European Union
Agriculture, forestry, fisheries	2.1	0.4	2.8	10.5
Other primary sectors	0.0	0.1	0.9	0.1
Processed foods	2.6	11.7	13.2	16.1
Chemicals	0.9	2.0	4.5	1.8
Electrical machinery	1.1	0.4	0.4	0.3
Motor vehicles	2.2	3.1	17.0	7.5
Other transport equipment	0.5	0.3	2.0	1.1
Other machinery	1.3	1.9	3.3	1.4
Metals and metal products	1.8	2.1	8.5	1.9
Wood and paper products	0.2	0.8	7.0	0.3
Other manufactures	4.1	4.8	9.3	2.6

In terms of services, Francois, Hoekman and Woerz (2007) reported estimated barriers to services that average 7.6 percent for ASEAN, 10.3 percent in North America, and 7.5 percent in the EU. These barriers are reduced by 50% under the FTA scenarios, in addition to full elimination of bilateral tariff barriers for manufacturing and food products.

CHAPTER 4: MODELING RESULTS

In this chapter we present the results of our simulations. Table 4.1 compares outcomes of three scenarios for the Austrian economy. Exports growth is positive under all three scenarios; the highest exports growth is achieved in the Trans-Atlantic scenario (0.8%). All the three liberalization options have positive impact on the economy in terms of both GDP and welfare change. GDP changes are proportional to exports ones. The highest GDP growth and welfare increase are achieved under the Trans-Atlantic scenario – 0.25% and EUR 874 million respectively. Liberalization of trade under the ASEAN scenario yields the lowest increase in GDP – less than 0.1%. Imports increase roughly in line with exports in all the scenarios, while net exports see a slight decrease (by EUR 27 – 137 mln).

Table 4.1

Modeling results

Scenarios	ASEAN	Trans-Atlantic	Doha
Austrian exports growth, %	0.3	0.8	0.68
Austrian imports growth, %	0.3	0.79	0.69
NX change, EUR mln	-31.2	-26.9	-136.8
GDP growth, %	0.08	0.25	0.24
Welfare change, EURO mln	262	874	763

Source: GTAP, authors' calculations. Welfare gains are annual.

Inspection of Table 4.2 reveals that three scenarios cause quite different changes to the sectoral structure of exports. In the ASEAN scenario, exports of processed food, electrical and other machinery decline, while the biggest exports increase occurs in business and personal services. In the Trans-Atlantic scenario, sectors, which would lose in the increased external competition, are chemicals, electrical machinery, other transport equipment and agricultural produce; sectors, which would benefit the most in terms of exports growth, are motor vehicles, water transport, finance, insurance, business and other services. Under Doha scenario, exports decrease is expected in exports of primary sectors, chemicals, and other manufactures; the biggest increase of exports will occur in processed food, agricultural produce, water transport, other transport equipment, wood, and motor vehicles.

It is noteworthy, that services exports grow the fastest relative to other sectors in the regional trade liberalization scenarios, while multilateral liberalization under the Doha scenario is expected to stimulate relatively more exports of manufacturing products and agricultural produce.

Table 4.2

Changes in Austrian exports by sectors, %

Sector	Share in exports in 2020, %	Rank of industries by direct and indirect value added per euro of exports in 2020*	ASEAN	Trans-Atlantic	Doha
Agriculture, forestry, fisheries	1.6	2	0.42	-0.17	3.59
Other primary sectors	0.7	4	0.09	0.03	-2.29
Processed foods	5.6	1	-0.30	0.90	6.69
Chemicals	8.7	12	0.12	-1.76	-3.39
Electrical machinery	1.7	15	-0.16	-0.61	0.99
Motor vehicles	13.0	20	0.10	2.14	1.74
Other transport equipment	1.9	17	-0.02	-0.38	2.47
Other machinery	15.5	14	-0.17	0.26	1.25
Metals and metal products	10.1	13	0.35	0.15	0.27
Wood and paper products	7.5	8	0.41	0.24	1.81
Other manufactures	8.0	11	0.44	1.70	-4.87
Water transport	0.7	18	0.50	0.96	2.80
Air transport	2.1	19	0.36	2.07	0.55
Finance	0.5	16	0.48	1.45	0.68
Insurance	1.5	7	0.38	1.88	1.07
Business services	10.3	3	1.10	1.72	1.22
Communications	0.5	10	0.52	1.36	0.88
Construction	0.8	9	0.85	0.89	0.57
Personal services	1.0	5	1.10	1.31	1.20
Other services	8.3	6	0.70	1.70	1.25
Total	100		0.30	0.80	0.68

* Rank 1 corresponds to the highest value added per euro of exports

Source: GTAP, authors' calculations

As Table 4.3 shows, under all three scenarios exports to Korea and ASEAN grow, while exports to the EU, Mexico and Russia fall. Two scenarios of regional trade liberalization result in decrease of exports to China, obviously indicating trade diversion effects. As it could be expected, in the ASEAN scenario Austrian exports to ASEAN members increases the most (25%), while in the Trans-Atlantic scenario it is Canada and United States, Austrian exports to which grow the fastest (16% and 12% respectively).

Under the Doha scenario exports to China surge by 14.5%, exports to Korea, Japan and ASEAN also experience fast growth. In contrast to the regional trade liberalization scenarios, where exports decline for many partners, in the Doha scenario there is decline in exports only to Mexico, Russia, and EU.

Table 4.3

Changes in Austrian exports by partners, %

Partner	Share in 2020, %	ASEAN	Trans-Atlantic	Doha
European Union	65.4	-0.1	-0.2	-0.6
United States	7.1	-0.5	12.1	1.3
Canada	0.6	-0.6	15.9	1.4
Mexico	0.3	-0.6	-1.3	-4.4
Japan	0.9	-0.6	-0.8	10.2
Korea	0.5	3.0	2.8	10.2
Other Advanced Economies	5.7	-0.4	-0.7	5.7
China	2.0	-2.2	-1.4	14.5
ASEAN	2.0	25.1	6.2	6.7
Brazil	0.8	-0.5	-0.8	5.2
India	0.9	-0.3	-0.4	5.2
Russia	2.4	-0.5	-0.5	-0.7
Rest of World	11.3	-0.4	-0.6	0.1
Total	100.0	0.3	0.8	0.7

Source: GTAP, authors' calculations

Table 4.4

Changes in Austrian exports,

Value added basis, million euros at 2007 prices

	ASEAN	Trans-Atlantic	Doha
Agriculture, forestry, fisheries	8.0	-3.2	67.8
Other primary sectors	0.8	0.3	-20.7
Processed foods	-15.8	48.2	357.8
Chemicals	9.4	-135.4	-260.6
Electrical machinery	-2.2	-8.4	13.6
Motor vehicles	7.4	151.5	122.7
Other transport equipment	-0.4	-5.3	34.4
Other machinery	-23.3	34.6	168.7
Metals and metal products	30.5	13.2	23.7
Wood and paper products	28.3	16.8	125.2
Other manufactures	29.0	113.4	-324.6
Transport	9.7	28.0	70.9
Finance and insurance	9.0	40.5	22.3
Business and ICT	148.7	236.4	167.7
Construction	7.4	7.8	5.0
Other services	92.0	152.0	213.1
total exports, value added basis	338.7	690.3	787.2
total gross exports	516.9	1,227.6	1,719.7

Source: model estimates by authors

Finally, Table 4.4 presents a different view of exports. In Table 4.4 we return to the concept of exports on a value added basis. From the benchmark 2020 data, we have estimated the value added share of gross Austrian exports by sector (see Table 3.5). From this starting point, in Table 4.4 we present changes in the value added contained in Austrian exports, by sector. Again this is reported for all three scenarios. Under all scenarios, the value added content of expanded exports is between 45% and 65% of the gross value. This also varies widely by scenario. For example, with the ASEAN experiment, where export growth in services is the primary contributor to total export growth (reflecting the export composition discussed in Section 3), 65% of gross export growth is value added, while under the Doha case, the value added in addition exports is only 45% of gross export growth. The NAFTA case is in the middle, with value added contained in new exports equal to 55% of gross new export values. There is also a strong difference in the importance of different sectors to total value added growth. For example, though import protection in motor vehicles is relatively low in North America (see Table 3.6), the sector is actually quite important when we look at the impact of a North American FTA on Austrian value added contained in exports. In all cases though, the striking message is the importance of high technology services (ICT and other business services) to the total growth in Austrian exports, on a value added basis. This reflects both the high value added content of trade in this sector, and the apparent comparative advantage of Austria in this sector in the 2020 baseline.

ANNEXES

ANNEX A – Technical overview of the CGE Model

B.1. Introduction

The core CGE model is based on the assumption of optimizing behaviour on the part of consumers, producers, and government. Consumers maximize utility subject to a budget constraint, and producers maximize profits by combining intermediate inputs and primary factors at least possible cost, for a given technology. The model employed here is based on Francois, van Meijl, and van Tongeren (2005) model (the FMT model). The FMT model is a standard, multi-region computable general equilibrium (CGE) model, with important features related to the structure of competition (as described by Francois and Roland-Holst 1997). Imperfect competition features are described in detail in Francois (1998). Social accounting data are based on the most recent Version 7.1 of the GTAP dataset (www.gtap.org). It includes 16 regions and 32 sectors. The full computer code for the FMT model can be downloaded from this link:

<http://www.i4ide.org/people/~francois/data/DohaModel.zip>

The model is implemented in GEMPACK, a software package designed for solving large applied general equilibrium models⁵. The model is solved as an explicit non-linear system of equations, through techniques described by Harrison and Pearson (1994). More information can be obtained <http://www.monash.edu.au/policy/gempack.htm>. For a detailed discussion of the basic algebraic model structure represented by the GEMPACK code, refer to Hertel (1996). This appendix provides a broad overview of the model and detailed discussion of mathematical structure is limited to added features, while the standard GTAP structure is covered in Hertel (1996).

B.2. General structure

The general conceptual structure of a regional economy in the model is as follows: firms produce output, employing land, labour, capital, and natural resources and combine these with intermediate inputs, within each region/country. Firm output is purchased by consumers, government, the investment sector, and by other firms. Firm output can also be sold for export. Land is only employed in the agricultural sectors, while capital and labour (both skilled and unskilled) are mobile between all production sectors. While capital is assumed to be fully mobile within regions, land, labour and natural resources are not.

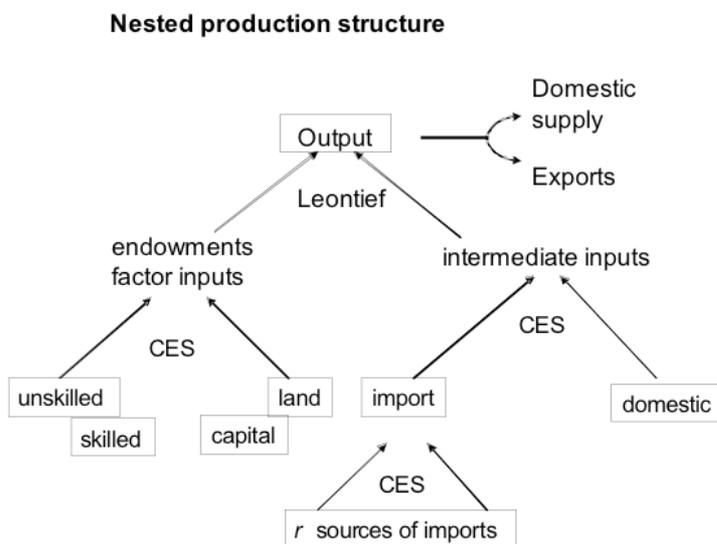
All demand sources combine imports with domestic goods to produce a composite good. In constant returns sectors, these are Armington composites. In increasing returns sectors, these are composites of firm-differentiated goods. Relevant substitution and trade elastic-

⁵ The result of our analysis can be downloaded and replicated our results, but the user will need access to GEMPACK, in order to make modifications to the code or data.

ities are available in Table B.1. The production and consumption structure of the CGE model can be best understood by using a technology tree as shown in Figure B.1.

Figure B.1

The Basic Production Flows in the Model



B.3 Taxes and policy variables

Taxes are included in the theory of the model at several levels. Production taxes are either placed on intermediate or primary inputs, or on output. Some trade taxes are modelled at the border. There are also additional internal taxes that can be 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 indicated by social accounting data as being relevant, taxes are placed on final consumption, and can be applied differentially to consumption of domestic and imported goods.

Trade policy instruments are represented as import or export taxes/subsidies. This includes applied most-favoured nation (MFN) tariffs, antidumping duties, countervailing duties, price undertakings, export quotas, and other trade restrictions. The major exception is service-sector trading costs, which are discussed in the next section. The full set of tariff vectors are based on WTO tariff schedules, combined with possible Doha and regional initiatives as specified by the Commission during this project, augmented with data on trade preferences. The set up of services trade barrier estimates is described below.

B.4. Trade and transportation costs

International trade is modelled as a process that explicitly involves trading costs, which include both trade and transportation services. These trading costs reflect the transaction costs involved in international trade, as well as the costs of the physical activity of transportation itself. Those trading costs related to international movement of goods and related logistic services are met by composite services purchased from a global trade services sector, where the composite "international trade services" activity is produced as a Cobb-Douglas composite of regional exports of trade and transport service exports. Trade-cost margins are based on reconciled f.o.b. and c.i.f. trade data, as reported in version 7 of the GTAP dataset.

B.5. The composite household and final demand structure

Final demand is determined by an upper-tier Cobb-Douglas preference function, which allocates income in fixed shares to current consumption, investment, and government services. This yields a fixed savings rate. Government services are produced by a Leontief technology, with household/government transfers being endogenous. The lower-tier nest for current consumption is specified as a Constant-difference elasticity (CDE) functional form, as parameterized in the core GTAP database. This allows for shifts in demand shares linked to non-homothetic consumer preferences. The regional capital markets adjust so that changes in savings match changes in regional investment expenditures⁶.

B.6. Demand for Imports

The basic structure of demand is based on CES (Armington) preferences. While the model also includes features linked to firm level product differentiation, for the purpose of long-run macroeconomic projections with endogenous TFP and capital accumulation, we follow a relatively standard approach and implement national product differentiation. Goods are differentiated by country of origin, and the similarity of goods from different regions is measured by the elasticity of substitution. Formally, within a particular region, we assume that demand for goods from different regions is aggregated into a composite import according to the following CES function, where α is a CES preference weight:

$$(1) \quad q_{j,r}^M = \left[\sum_{i=1}^R \alpha_{j,i,r} M_{j,i,r}^{\rho_j} \right]^{1/\rho_j}$$

⁶ Note that the Cobb-Douglas demand function is a special case of the CDE demand function employed in the standard GTAP model code. It is implemented through GEMPACK parameter files.

In equation (1), $M_{j,i,r}$ is the quantity of imports in sector j from region i consumed in region r . The elasticity of substitution between varieties from different regions is then equal to σ_j^M , where $\sigma_j^M = 1/(1-\rho_j)$. Composite imports are combined with the domestic good q^D in a second CES nest, yielding the Armington composite q .

$$(2) \quad q_{j,r} = \left[\Omega_{j,M,r} (q_{j,r}^M)^{\beta_j} + \Omega_{j,D,r} (q_{j,r}^D)^{\beta_j} \right]^{1/\beta_j}$$

The elasticity of substitution between the domestic good and composite imports is then equal to σ_j^D , where $\sigma_j^D = 1/(1-\beta_j)$. At the same time, from the first order conditions, the demand for import $M_{j,i,r}$ can then be shown to equal

$$(3) \quad \begin{aligned} M_{j,i,r} &= \left[\frac{\alpha_{j,i,r}}{P_{j,i,r}} \right]^{\sigma_j^M} \left[\sum_{i=1}^R \alpha_{j,i,r}^{\sigma_j^M} P_{j,i,r}^{1-\sigma_j^M} \right]^{-1} E_{j,r}^M \\ &= \left[\frac{\alpha_{j,i,r}}{P_{j,i,r}} \right]^{\sigma_j^M} (P_{j,r}^M)^{\sigma_j^M - 1} E_{j,r}^M \end{aligned}$$

where $E_{j,r}^M$ represents expenditures on imports in region r on the sector j Armington composite, and $P_{j,r}$ denotes aggregate prices levels within an import country, while $P_{j,i,r}$ denotes a bilateral import price. In practice, the two nests can be collapsed, so that imports compete directly with each other and with the corresponding domestic product. This implies that the substitution elasticities in equations (2) and (3) are equal.

ANNEX B – Mapping of Model Sectors to NACE and GTAP Sectors

Table B.1

Mapping of Model Sectors to NACE and GTAP Sectors

CGE Model Sectors	NACE sectors	GTAP sectors
1 Agriculture, forestry, fish	<p>11 Growing of crops; market gardening; horticulture</p> <p>12 Farming of animals</p> <p>20 Forestry, logging and related services activities</p> <p>50 Fishing, operation of fish hatcheries and fish farms</p>	<p>1 PDR - Paddy rice</p> <p>2 WHT - Wheat</p> <p>3 GRO - Cereal grains n.e.c.</p> <p>4 V_F - Vegetables, fruit, nuts</p> <p>5 OSD - Oil seeds</p> <p>6 C_B - Sugar cane, sugar beet</p> <p>7 PFB - Plant-based fibers</p> <p>8 OCR - Crops n.e.c.</p> <p>9 CTL - Bovine cattle, sheep and goats, horses</p> <p>10 OAP - Animal products n.e.c.</p> <p>11 MLK - Raw milk</p> <p>12 WOL - Wool, silk-worm cocoons</p> <p>13 FRS - Forestry</p> <p>14 FSH - Fishing</p>
2 Other primary sectors	<p>101 Anthracite,not agglomrtd</p> <p>101 Bitum.coal not agglomrtd</p> <p>101 Oth coal,not agglomerat.</p> <p>101 Briquettes etc (coal)</p> <p>102 Lignite,not agglomerated</p> <p>102 Lignite,agglomerated</p> <p>103 Peat</p> <p>111 Extraction of crude petroleum and natural gas</p> <p>120 Mining of uranium and thorium ores</p> <p>131 Mining of iron metals</p> <p>132 Mining of non-ferrous metal ores, except uranium and thorium ores</p> <p>141 Quarrying of stone</p> <p>142 Quarrying of sand and clay</p> <p>143 Mining of chemical and fertilizer minerals</p> <p>144 Production of salt</p> <p>145 Other mining and quarrying n.e.c.</p>	<p>15 COA - Coal</p> <p>16 OIL - Oil</p> <p>17 GAS - Gas</p> <p>18 part OMN - Minerals n.e.c.</p>
3 Processed Foods	<p>151 Meat products</p> <p>152 Fish and fish products</p> <p>153 Fruits and vegetables</p> <p>154 Vegetable and animal oils and fats</p> <p>155 Dairy products; ice cream</p> <p>156 Grain mill products and starches</p> <p>157 Prepared animal feeds</p> <p>158 Other food products</p> <p>160 Tobacco products</p>	<p>19 CMT - Bovine meat prods</p> <p>20 OMT - Meat products n.e.c.</p> <p>21 VOL - Vegetable oils and fats</p> <p>22 MIL - Dairy products</p> <p>23 PCR - Processed rice</p> <p>24 SGR - Sugar</p> <p>25 OFD - Food products n.e.c.</p> <p>26 part B_T - Beverages and tobacco products</p> <p>26 part B_T - Beverages and tobacco products</p>
4 Chemicals and plastics	<p>241 Basic chemicals</p>	<p>33 part CRP - Chemical, rubber, plastic products</p>

CGE Model Sectors	NACE sectors	GTAP sectors
	242 Pesticides, other agro-chemical products 243 Paints, coatings, printing ink 244 Pharmaceuticals 245 Detergents, cleaning and polishing, perfumes 246 Other chemical products 251 Rubber products 252 Plastic products	
5 Electrical machinery	321 Electronic valves and tubes, other electronic comp.	40 ELE - Electronic equipment
6 Motor vehicles	341 Motor vehicles 342 Bodies for motor vehicles, trailers 343 Parts and accessories for motor vehicles	38 MVH - Motor vehicles and parts
7 Other transport equipment	351 Ships and boats 352 Railway locomotives and rolling stock 353 Aircraft and spacecraft 354 Motorcycles and bicycles 355 Other transport equipment n. e. c.	39 OTN - Transport equipment n.e.c.
8 Other machinery	322 TV, and radio transmitters, apparatus for line telephony 323 TV, radio and recording apparatus 300 Office machinery and computers 291 Machinery for production, use of mech. power 292 Other general purpose machinery 293 Agricultural and forestry machinery 294 Machine-tools 295 Other special purpose machinery 296 Weapons and ammunition 297 Domestic appliances n. e. c. 311 Electric motors, generators and transformers 312 Electricity distribution and control apparatus 313 Isolated wire and cable 314 Accumulators, primary cells and primary batteries 315 Lighting equipment and electric lamps 316 Electrical equipment n. e. c. 331 Medical equipment 332 Instruments for measuring, checking, testing, navigating 333 Manufacture of industrial process control equipment 334 Optical instruments and photographic equipment 335 Watches and clocks	41 OME - Machinery and equipment n.e.c.
9 Metals and metal products	271 Basic iron and steel, ferro-alloys (ECSC) 272 Tubes 273 Other first processing of iron and steel	35 I_S - Ferrous metals 36 NFM - Metals n.e.c. 37 FMP - Metal products

CGE Model Sectors	NACE sectors	GTAP sectors
	274 Basic precious and non-ferrous metals 281 Structural metal products 282 Tanks, reservoirs, central heating radiators and boilers 283 Steam generators 284 Forging, pressing, stamping and roll forming of metal; powder metallurgy 285 Treatment and coating of metals; general mechanical engineering 286 Cutlery, tools and general hardware 287 Other fabricated metal products	
10 Wood and paper products	201 Sawmilling, planing and impregnation of wood 202 Panels and boards of wood 203 Builders' carpentry and joinery 204 Wooden containers 205 Other products of wood; articles of cork, etc. 211 Pulp, paper and paperboard 212 Articles of paper and paperboard 221 Publishing 222 Printing	30 LUM - Wood products 31 part PPP - Paper products, publishing
11 Other manufacturing	171 Preparation and spinning of textile fibre 172 Textile weaving 231 Coke oven products 232 Refined petroleum and nuclear fuel 233 Nuclear fuel 173 Finishing of textiles 174 Made-up textile articles 175 Other textiles 176 Knitted and crocheted fabrics 177 Jerseys/pullovers/etc 181 Leather clothes 182 Other wearing apparel and accessories 183 Dressing and dyeing of fur; articles of fur 191 Tanning and dressing of leather 192 Luggage, handbags, saddlery and harness 193 Footwear 261 Glass and glass products 262 Ceramic goods 263 Ceramic tiles and flags 264 Bricks, tiles and construction products 265 Cement, lime and plaster 266 Articles of concret, plaster and cement 267 Cutting, shaping, finishing of stone 268 Other non-metallic mineral products	27 TEX - Textiles 28 WAP - Clothing 29 LEA - Leather products 32 P_C - Petroleum, coal products 34 NMM - Mineral products n.e.c. 42 OMF - Manufactures n.e.c.

CGE Model Sectors	NACE sectors	GTAP sectors
	361 Manufacture of furniture 362 Jewellery and related articles 363 Musical instruments 364 Sports goods 365 Games and toys 366 Miscellaneous manufacturing n. e. c. 371 Recycling of metal waste and scrap 372 Recycling of non-metal waste and scrap	
12 Water transport 13 Air transport	610 Water transport 620 Air transport	49 WTP - water transport 50 ATP - air transport
14 Finance	650 Financial intermediation, except insurance and pen- sion funding 670 Activities auxiliary to financial intermediation	52 OFI - other financial services
15 Insurance	660 Insurance and pension fund- ing, except compulsory social security	53 ISR - insurance
16 Other business services	700 Real estate activities 711 Renting of transport equip- ment 712 Renting of other machinery and equipment 713 Renting of personal and household goods nec 720 Computer and related activi- ties 730 Research and development 740 Other business activities	54 OBS - other business ser- vices
17 Communications	640 Post and communications	51 CMN - communications
18 Construction	450 Construction	46 CNS - Construction
19 Personal services	920 Recreational, sporting, and cultural activities 930 Other service activities 950 Private households with employed persons	55 ROS - recreational and other consumer services
20 Other services	401 Electricity, gas, steam and hot water supply 402 Manufacture of gas; distribu- tion of gaseous fuels through mains 403 Steam and hot water supply 410 Collection, purification and distribution of water	43 ELY -Production, collection and distribution of electricity 44 GDT - Manufacture of gas; distribution of gaseous fuels through mains 45 WTR - Collection, purification and distribution of water 47 TRD - trade and distribution services
	500 repair of motor vehicles and motorcycles; retail 510 Wholesale trade and com- mission trade, except of motor vehicles an 521 Non-specialized retail trade in stores 522 Retail sale of food, bever- ages and tobacco in special- ized stores 523 Other retail trade of new goods in specializ 524 Retail sale of second-hand goods in stores 525 Retail trade not in stores 526 Repair of household and	48 OTP - other transport 56 OSG - public services 57 DWE - dwellings

CGE Model Sectors	NACE sectors	GTAP sectors
	personal goods 550 Hotels and restaurants 600 Supporting and auxiliary transport activities; activities of travel agencies 630 Land transport; transport via pipelines 750 Public administration and defense; compulsory social security 800 Education 850 Health and social work 900 Sewage and refuse disposal, sanitation and similar activi- ties 910 Activities of membership organizations n.e.c. 990 Extra-territorial organizations and bodies n.a. n.a.	

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