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AUSTRIA 2020: The impact of medium-term global trends on the Austrian economy

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Abstract

This study quantifies possible impacts of medium-term structural changes in the global economy on the Austrian economy. Emphasis is placed on the effects of continued medium term growth in emerging markets, especially in Asia and Latin America, on the structure of the Austrian economy. The issues here include the identification of price effects (due to increased demand for raw materials) that can be expected, as well as how these may impact the commodity composition of both exports and imports. Underlying global trends also involve both investment patterns and total factor productivity trends at a more regional level, also impacting on the Austrian economy. Finally, these structural changes at the global level also lead to changes in household incomes and the cost of living in Austria, impacting on patterns of inequality in Austria at the household level.

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AUSTRIA 2020: The impact of medium-term global trends on the Austrian economy

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FIW – Research Centre International Economics

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AUSTRIA 2020: executive summary

The global economy is characterized by a number of underlying trends that carry important implications for the economy of Austria. These include the continued rise of China as a major economic power, the ongoing shift of economic gravity from the trans-Atlantic economies to Asia, a shift of economic gravity within Europe from West to East, and a continued tightening of markets for energy commodities. In addition, rising income levels outside the OECD, combined with shifts up the value added chains in a number of larger non-OECD economies, also means increased competitive pressure on these sectors in the OECD itself, including in Austria. This in turn has important implications for the labor market in Austria, for the prospects of labor in different skills categories, and hence also for the distribution and level of income across Austrian households as well. Ultimately, while the trends we highlight here are global in nature, how they interact and how they impact Austria at the macroeconomic level will be manifested in shifts felt at the individual household level as wage incomes, the nature of employment, and the cost of living.

This brief summarizes a recent study that quantifies possible impacts of medium-term structural changes in the global economy on the Austrian economy. Emphasis is placed on the effects of continued medium term growth in emerging markets, especially in Asia and Latin America, on the structure of the Austrian economy. The issues here include the identification of price effects (due to increased demand for raw materials) that can be expected, as well as how these may impact the commodity composition of both exports and imports. Underlying global trends also involve both investment patterns and total factor productivity trends at a more regional level, also impacting on the Austrian economy. Finally, these structural changes at the global level also lead, ultimately, to changes in household incomes and the cost of living in Austria, impacting on patterns of inequality in Austria at the household level.

Exports and Production: Services account for about 77% of total value added in the Austrian economy, with other business services, other services and trade having the biggest shares. In manufacturing, the biggest sectors are other machinery and equipment, processed foods, and chemicals. With rapid growth projected for non-OECD countries, there is a further push of Austria into higher value-added sectors, including heavy manufacturing business and services, and even further out of more intensive basic and labor intensive manufacturing, including light manufactures. The highest growth of output is projected for the metals, chemicals, mining, utilities and transport sectors. These sectors

also have the highest rates of export growth. Reasons include growth in global demand for metals, chemicals, ores and other fossils, as well as the favourable geographic location of Austria. Location means Austria is in a position to provide more transportation and utility services to the neighbouring countries as trade expands. In addition, exports are expected to grow fast in the petrochemicals and gas sectors (where Austria is expected to see a significant increase in re-exports of these commodities). Drops of real output and exports are projected for textiles, clothing, leather, and electrical machinery. This trend will be driven by the rapid increase in exports of these products by China and India and some other competitors. In exports, there will also be a fall in light manufactures trade. On the import side, Austria is projected to see increased imports in all sectors, with the highest growth rates for import values expected in the energy related sectors (coal, oil, gas, and petrochemicals), mining, and non-metallic minerals – to a large extent due to a surge in prices of these commodities. We also project a sizeable increase in imports of light manufactures, clothing, construction, and trade services.

Inequality in Austria: In terms of household income inequality as measured by the Gini coefficient, at present Austria has a level of inequality, which is rather comparable to those of the most equal societies in the world such as the Scandinavian ones. (The Gini is estimated at 27.5). However, despite a projected strong rise in average unskilled labour income due to further internationalisation, large projected price increases in sectors employing unskilled labour, and the lower supply of unskilled labour, overall inequality is expected to increase in Austria by 2020. The Main driving forces are the increase of persons in skilled labour and subsequent stronger income differentiation and the increase of capital income. Overall, we estimate that the income shares of the skilled and unskilled labour force in 2020 change from an initial ratio of 37% against 63% to an estimated 48% against 52% respectively. This relates to an increase of total skilled labour income of 24% and a drop of total unskilled labour income of 21%. However, given the strong increase in the number of skilled labour and the decrease of persons in unskilled labour, the average skilled labour income decreased by some 5% and the average unskilled labour income increased by more than 33%. On net, our projection analysis points to a slight increase of inequality to a Gini of 28.1, despite that there are sharp projected increases in wages for lower-skilled workers.

CHAPTER 1
INTRODUCTION

1. Introduction

The global economy is characterized by a number of underlying trends that carry important implications for the economy of Austria. These include the continued rise of China as a major economic power, the ongoing shift of economic gravity from the trans-Atlantic economies to Asia, a shift of economic gravity within Europe from West to East, and a continued tightening of markets for energy commodities. In addition, rising income levels outside the OECD, combined with shifts up the value added chains in a number of larger non-OECD economies, also means increased competitive pressure on these sectors in the OECD itself, including in Austria. This in turn has important implications for the labor market in Austria, for the prospects of labor in different skills categories, and hence also for the distribution and level of income across Austrian households as well. Ultimately, while the trends we highlight here are global in nature, how they interact and how they impact Austria at the macroeconomic level will be manifested in shifts felt at the individual household level as wage incomes, the nature of employment, and the cost of living.

This study quantifies possible impacts of medium-term structural changes in the global economy on the Austrian economy. Emphasis is placed on the effects of continued medium term growth in emerging markets, especially in Asia and Latin America, on the structure of the Austrian economy. The issues here include the identification of price effects (due to increased demand for raw materials) that can be expected, as well as how these may impact the commodity composition of both exports and imports. This study also reports on estimated changes in both investment patterns and total factor productivity at a regional level, the impact this has on the Austrian economy. Finally, this study also examines how these structural changes at the global level lead to changes in household incomes and the cost of living in Austria, identifying the impact of globalization trends on inequality in Austria at the household level.

The study is structured as follows. Chapter 2 focuses on the current structure of the Austrian economy. This includes the basic patterns of industrial production and trade. It also includes an assessment based on the distribution of value added and the intermediate linkages between Austrian sectors and between these and its major trading partners. Chapter 3 outlines the basic macroeconomic projection exercise, including baseline trends in GDP on a regional basis, and the impact of projected economic growth and demographic trends on the basic structure of the global economy. This is followed in Chapter 4 by a more detailed analysis of the impact of these global macroeconomic trends on the economy of Austria, including trade and production, as well as labor market impacts. Finally, Chapter 5 builds on the projected changes in labor markets (wages and the pattern of employment), as well as changes in investment income, to examine possible changes in the pattern of household inequality in Austria as well as absolute income and poverty levels.

CHAPTER 2

OVERVIEW OF AUSTRIA's CURRENT ECONOMIC STRUCTURE

2. Overview of the current economic structure

Services account for about 77% of total value added in the Austrian economy, with other business services, other services and trade having the biggest shares (see Table 2.1). In manufacturing, the biggest sectors are other machinery and equipment, processed foods, and chemicals.

Table 2.1

Structure of Austria's value added, exports and imports, %, and ranks* of industries by capital-labor ratios and ratios of skilled labor to unskilled labor in total costs in 2008¹

	Value added	Exports	Imports	Capital-labor ratio	Ratio of skilled labor to unskilled labor
primary	1.9	0.9	1.9	22	28
coal	0.0	0.0	0.2		
oil	0.0	0.0	1.2		
gas	0.0	0.0	0.2		
mining	0.3	0.2	0.4	10	12
processed foods	2.9	5.1	3.6	16	21
textiles	0.5	1.8	2.1	7	24
clothing	0.3	0.8	2.1	12	27
leather	0.2	0.8	1.1	11	25
lumber	1.0	3.3	2.0	8	26
paper and publishing	1.9	3.7	2.5	5	13
metals	1.0	4.7	4.1	21	18
fabricated metals	1.7	2.9	3.0	26	20
non-metallic minerals	1.1	1.9	1.2	19	19
motor vehicles	1.1	10.0	9.6	6	15
other transport equipment	0.4	2.4	2.2	25	14
light manufactures	1.1	1.7	1.2	9	23
chemicals rubber plastics	2.1	8.7	9.4	13	11
petrochemicals	0.1	0.2	1.5	1	3
electrical machinery	1.0	4.7	6.5	18	9
other machinery and equipment	4.7	16.3	14.4	24	10
utilities	2.1	0.7	1.2	4	1
construction	7.3	0.9	0.8	14	22
trade	15.6	2.5	2.0	15	17
transport	6.8	7.3	4.1	17	16
communications	1.8	0.6	0.5	3	7
other finance	0.6	0.6	1.0	27	4
insurance	1.7	1.8	1.1	20	5
other business services	19.3	12.4	15.9	2	6
rec and other consumer servs	2.5	1.1	1.5	23	8
other services	19.2	1.8	1.2	28	2

Source: GTAP, wiiw calculations. * Rank 1 means the highest ratio.

¹ Coal, gas and oil sectors were excluded from this analysis due to their low shares in the total value added.

As can be concluded from the country's exports structure, Austria tends to specialize in other machinery and equipment, motor vehicles, and chemicals on the manufacturing part, and in other business services and transportation on the part of services. The same sectors account for the highest shares in the imports structure.

Quite predictably, services sectors in Austria are on average relatively more skilled-labor intensive than manufacturing ones. Among manufacturing sectors, it is petrochemicals, electrical machinery, and other machinery and equipment that use skilled labor most intensively. The least skilled-labor intensive sectors are primary industry, clothing, lumber, leather and textiles.

Capital-labor ratios are the highest in petrochemicals, other business services, communications, utilities, and paper and publishing sectors. Thus petrochemicals and utility sectors stand out as most capital and skilled-labor intensive ones.

Table 2.2

Coefficients of correlation of the value added, export, and imports structures of Austria and other regions

	Value added	Exports	Imports
Germany	0.96	0.86	0.86
EU 13	0.99	0.89	0.86
EU 12	0.96	0.81	0.79
EEA	0.93	0.58	0.83
NAFTA	0.85	0.85	0.72
Other OECD	0.90	0.74	0.64
China	0.61	0.33	0.58
Brazil	0.86	0.47	0.76
Latin America	0.79	0.15	0.76
India	0.46	0.48	0.34
Russia	0.78	0.11	0.65
ASEAN	0.73	0.37	0.61
Middle East and North Africa	0.64	0.03	0.78
Sub-Saharan Africa	0.63	0.02	0.77
Rest of World	0.69	0.24	0.62

Source: GTAP, wiiw calculations.

As coefficients of correlation of value added, export, and imports structures of Austria and other regions suggest (see Table 2.2), the structure of the Austrian economy resembles quite a lot the structure of EU 13, and in general is close to those of the developed

economies (EEA, NAFTA, Other OECD). It is noteworthy, that EU 12 countries have quite similar to Austria structures of their economies (major difference between the two regions' economies is lower share of services in the value added of the EU 12, who instead specialize more in the production of primary industry and processed food products).

However, foreign trade structures of Austria and other regions exhibit more differences. As compared to other EU members, Austria tends to export relatively more other business, insurance and transportation services, and relatively less of electrical machinery and chemicals. Germany in contrast to Austria (and EU 13) has relatively higher shares of motor vehicles and other machinery and equipment in exports.

With regard to imports, similar differences exist: Austria has much higher share of other business services in import as compared to other EU members, while it imports less electrical machinery, chemicals, and also oil and gas.

In terms of the geographic structure, more than 60% of the Austrian foreign trade is an intra-EU one, with Germany being the major partner (see Table 2.3). BRICs countries (Brazil, Russia, India, China) account in total only for about 6% of Austria's exports and imports.

Table 2.3

Geographical structure of Austrian trade in 2008, %

	Exports	Imports
Germany	27.3	32.9
EU 13	26.0	27.7
EU 12	14.2	12.1
EEA	5.4	3.6
NAFTA	6.3	5.5
Other OECD	2.3	2.0
China	2.8	3.1
Brazil	0.6	0.5
Latin America	1.0	0.8
India	0.6	0.4
Russia	2.0	1.8
ASEAN	2.9	3.1
Middle East and North Africa	2.7	2.4
Sub-Saharan Africa	1.2	0.8
Rest of World	4.7	3.4

Source: GTAP.

CHAPTER 3

OVERVIEW OF MACROECONOMIC PROJECTIONS

3. Overview of Macroeconomic Projections

In this chapter we describe our basic macroeconomic projection modeling. This is done with a quantitative model called a CGE (computable general equilibrium) model, in which trade and production data are mapped to CGE model sectors. We proceed with a brief outline of the model, and our projection scenario. This is followed by a more detailed analysis of the impact of the projections on the structure of the global economy. More detailed analysis of the model estimates for Austria is discussed in Chapter 4. Details on the model are in Annex A: Technical Annex of CGE Model.

a. Overview of the projection model

We employ a general equilibrium model that enables us to estimate the impact of basic macroeconomic trends on global production and trade patterns. The model is based on the Francois, Van Meijl, and Van Tongeren model (FMT 2005) and is implemented in GEMPACK – a software package designed for solving large applied general equilibrium models. The model builds on Francois (2000), and its versions have recently been employed for EC-mandated studies of World Trade Organization negotiations, prospective EU-Korea and EU-MERCOSUR free trade agreements, as well as a recent large-scale Asian Development Bank assessment of regional integration schemes in Asia (Francois and Wignaraja 2008, 2009). The model is solved as an explicit non-linear system of equations, through techniques described by Harrison and Pearson (1994). Investment mechanisms are included along the lines of Francois, McDonald, and Nordstrom (1996). Social accounting data are based on the most recent Version 7 GTAP dataset (www.gtap.org). The GTAP data on protection incorporates a set of ad valorem equivalents (AVEs) of border protection across the world.

The sector and regional aggregation schemes for the model are summarized in Table 3.1 below. Our trade and production data are all valued in 2008 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 basic database is built from the GTAP7 database (benchmarked to 2004). We use the basic input-output structure of the database, combined with more recent trade and national accounts data, to re-base our dataset to 2008. This is the starting point for our analysis. In addition to the 32 sectors listed in Table 3.1, the model also includes 16 regions. These are detailed in Table 3.2. Critically, the regions include Austria's major trading partner (Germany), the remaining EU13 (old EU) and EU12 (new EU) Members, as well as other major OECD and non-OECD countries and regions. Table 3.2 also presents underlying macroeconomic trends for these regions from 2008 through 2020. The 2020 projections are based on the most recent (October) macroeconomic projections from the IMF, as reported in its World Economic Outlook. We have extended the IMF medium-term projections through 2020.

Table 3.1

Model Sectoring Scheme

primary	light manufactures
coal	chemicals rubber plastics
oil	petrochemicals
gas	electrical machinery
mining	other machinery and equipment
processed foods	utilities
textiles	construction
clothing	trade
leather	transport
lumber	communications
paper and publishing	other finance
metals	insurance
fabricated metals	other business services
non-metallic minerals	rec and other consumer servs
motor vehicles	other Services
other transport equipment	

Table 3.2

Regional Aggregation Scheme

	GDP 2008, billion euros	real growth rate, 2008-2020
Austria	283	1.46
Germany	2,509	1.04
EU 13	8,446	1.55
EU 12	1,321	3.12
EEA	662	1.29
NAFTA	11,631	2.10
Other OECD	4,768	2.07
China	3,103	9.33
Brazil	1,074	3.26
Latin America	1,801	3.49
India	824	7.51
Russia	1,145	2.92
ASEAN	863	5.10
Middle East and North Africa	1,485	4.45
Sub-Saharan Africa	678	4.98
Rest of World	1,014	10.26

source: IMF WEO, October 2009 (with projection through 2020).

b. IMF-based macro projections

The model, with its sector and regional aggregation scheme as outlined in Tables 3.1 and 3.2, is used to project the global economy through 2020. The core of the baseline projections is the real GDP growth rates reported in Table 3.2. This is combined with estimated growth in population and labor force by region (from the IMF, and also from EUROSTAT). Macroeconomic projection then involves imposing the baseline GDP and demographic 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 2008 economic structures (input-output shares), which are taken as a starting point.

Table 3.3 below reports the baseline energy price trends, valued at 2008 prices. We work with late 2008 and early 2009 energy prices, as these better reflect long-term trends than do the short-term spike in energy prices in early 2008.

Table 3.3

Energy price trends in the 2008-2020 baseline

Benchmark prices		2004	2008/9	2020
Crude oil, average	€/bbl	30.4	41.0	85.0
Natural gas, average	€/mmbtu	4.1	4.5	6.0

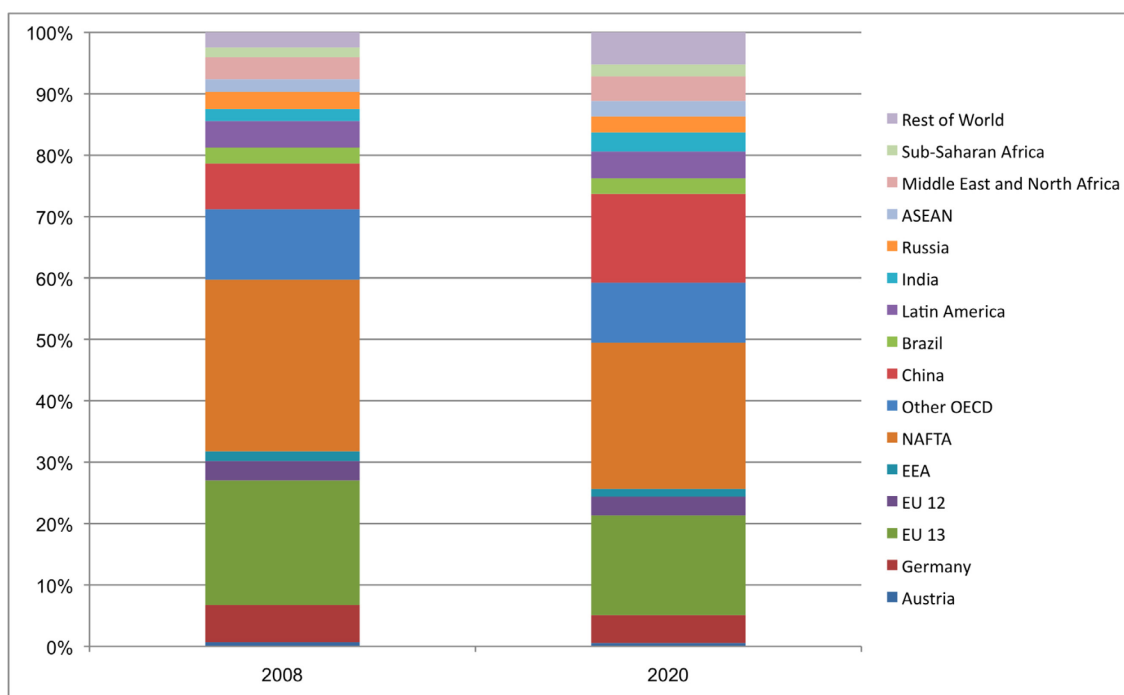
Source: World Bank *Pink Sheets* and IEA, and industry projections.

Underlying growth trends through 2020 mean an increased shift in the center of global economic activity, with Asia in particular accounting for a rising share of global production and trade. This illustrated in Figure 3.1 below, which highlights the basic changes in shares of global production. The high income (OECD) economies account for 70% of global economic activity in 2008. This share drops to 58% by 2020, driven especially by rapid growth in China, which rises from 7.5% of global GDP in 2008 to 14.5% in 2020. NAFTA drops from 29.9% to 23.9%, while the EU drops from 30.2% to 24.4%. The EU aggregate masks a difference between old and new Members. The new Members more or less keep their share of global output, estimated at 3.2% in 2008 and 3.1% in 2020, while the old Members see their share drop from 27.0% to 21.3%. Austria, linked both to

old and new Members through trade (Germany and the new Members are both important) sees its share drop from 0.68% to 0.53% of global GDP, following the basic trend for old EU Members. Even so, Austria's economy is estimated to be 19% higher by 2020 than its level in 2008.

Figure 3.1

Regional Shares of Global GDP: 2008 & 2020



Source: CGE projection-based estimates

The projected economic growth trends in our 2008-2020 baseline are realized through a combination of extensive growth (physical investment and growth in the labor force) as well as intensive growth linked to total factor productivity. Table 3.4 below summarizes the changes in physical capital stock and total factor productivity, as estimated in the model, for Austria and the rest of the EU. In the new Members (EU12), rapid growth in physical investment and TFP are both projected, with a 47.7% increase in physical capital stock and a 20.2% increase in TFP in our 2008-2020 baseline. In contrast, TFP is projected to grow at between 3.1% (Austria) and 5.2% (rest of old EU Members –EU13) over the same period, with physical capital projected to grow between 26.7% (Germany) and 32.9% (rest of old EU Members –EU13) in the old Members, but 47.7% in the new Members. This mix of rapid TFP growth and physical investment drives a continued process of income convergence between old and new EU Members.

Table 3.4

Cumulative increases in physical capital and TFP: 2008-2020

	TFP, % change	Physical capital, % change
Austria	3.14	28.76
Germany	4.55	26.73
EU13	5.20	32.87
EU12	20.18	47.71

Source: World Bank *Pink Sheets* and IEA, and industry projections.

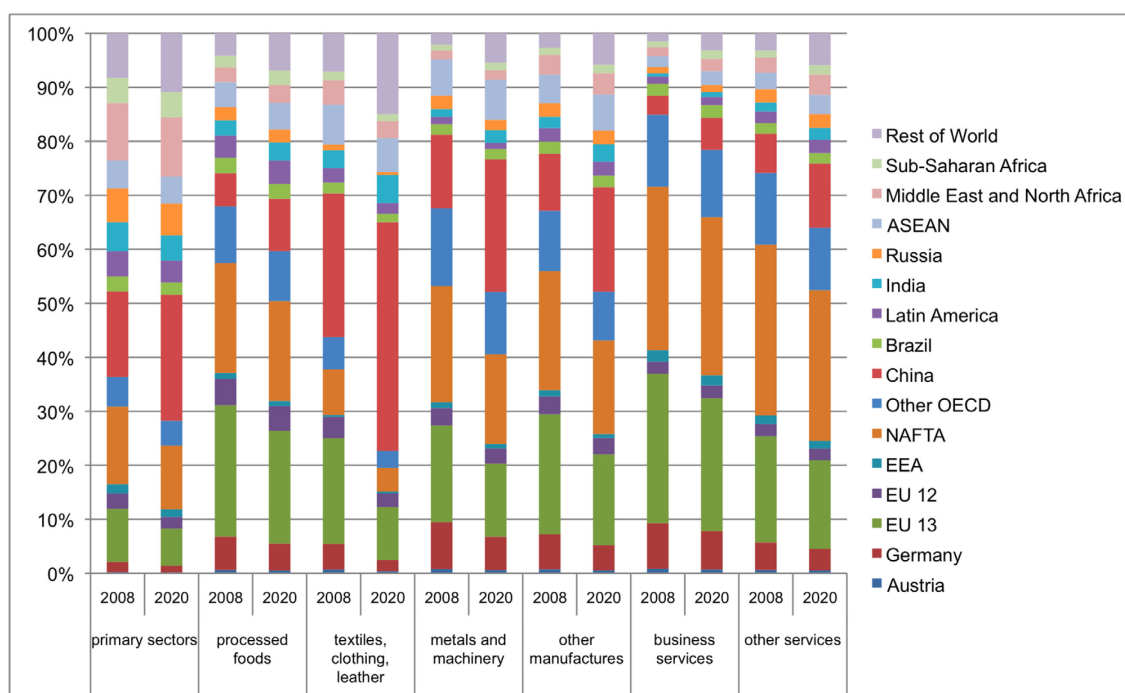
c. Shifts in the global economy

We next turn to projected changes in the structure of the global economy through 2020. Figure 3.2 presents shares of gross output, by major industry groupings, in the 2008 and 2020 benchmarks. Underlying data are reported in Annex Table A.2. The European Union is dominant share of gross world output for business services (finance, insurance, communications, and other business services) as well as other commercial services. However, these shares drop through 2020 – from 39.2% to 34.8% for business services and from 27.7% to 23.1% for other commercial services. The same pattern of falling shares is even more striking for manufacturing. For example, the metals and machinery sectors of the EU represent 30.6% of global gross output in 2008, and 23.1 percent by 2020.

China's continued growth through the projected baseline is reflected in dramatic increasing in the Chinese share of global manufacturing. China's textile and clothing sector, for example, is projected to expand from 26.6% of global gross output to 42.4% of global gross output. Its share of metals and machinery production roughly doubles over the same period, projected to grow from 13.5% of global gross output to 24.6%. In North America, the NAFTA share of business services remains relatively constant from 2008 (30.2%) to 2020 (29.3%). However, like Europe, North America also experiences a sharp decline in manufacturing shares. The NAFTA share of metals and machinery production drops from 21.5% in 2008 to 16.7% in the 2020 baseline.

Figure 3.2

Regional Shares of Global Output by gross value: 2008 & 2020

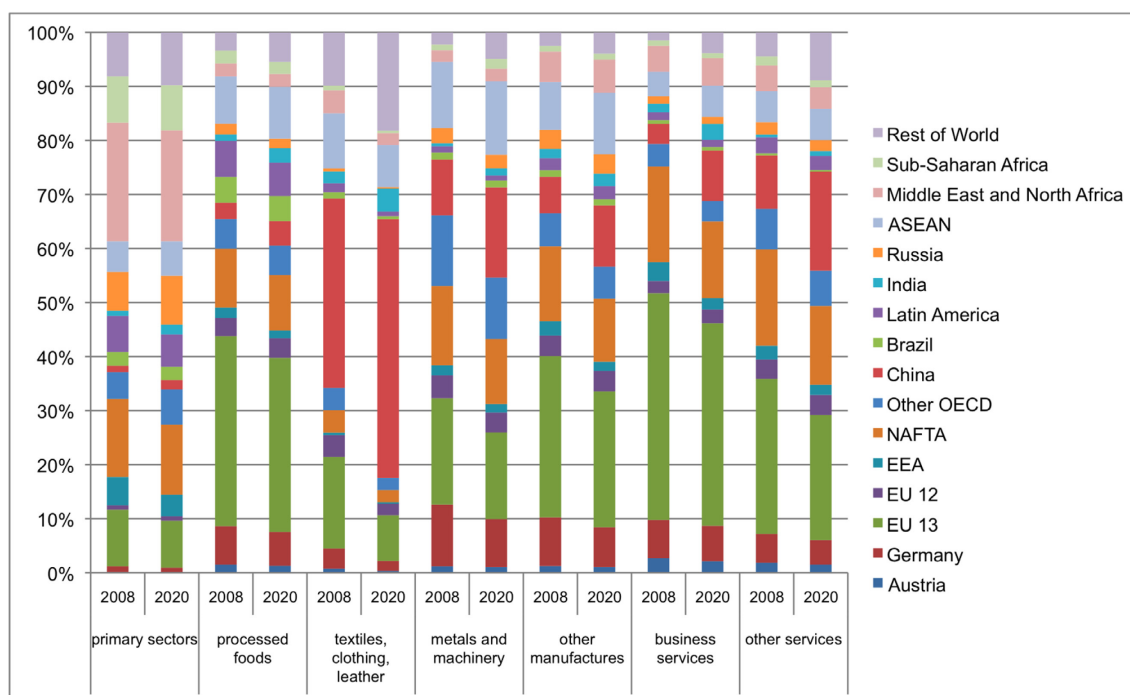


Source: CGE projection-based estimates

Figures 3.3 and 3.4 present a different breakdown on the changing structure of the world economy. Underlying data in shares, are reported in Annex Tables A.4 and A.4. In Figure 3.3 we focus on the regional composition of exports across broad sectors. In Figure 3.4 we focus on regional imports by sector. A number of changes stand out in the export data. One is the continued rise in the importance of China as a manufacturing exporter. Indeed, China's share of textile and clothing exports grows from 35.1% to 47.8% of global exports. For metals and machinery, the export share rises from 10.3% to 16.7% of world exports. In the service sectors, the OECD remains the dominant exporters. The EU accounts for 53.9% of business service exports in the 2008 benchmark, and is still 48.7% in the 2020 baseline. The NAFTA block, on the other hand, sees its share of business service exports drop from a 17.7% share to a 14.2% share of global exports. Overall, the OECD remains the dominant exporter of processed food products: 65.4% in 2008 and 60.5% in 2020. In textiles and clothing, export shares for the OECD drop by half, from 34.2% to 17.6% of global exports, with a drop mirrored by the Chinese increase in the same sectors. For other manufactures: metals and machinery, and also other manufactures, the OECD remains, collectively, the main exporter, though there is a substantial drop in shares: from roughly 66% in 2008 to 56% in 2020.

Figure 3.3

Regional Shares of Global Exports by value: 2008 & 2020



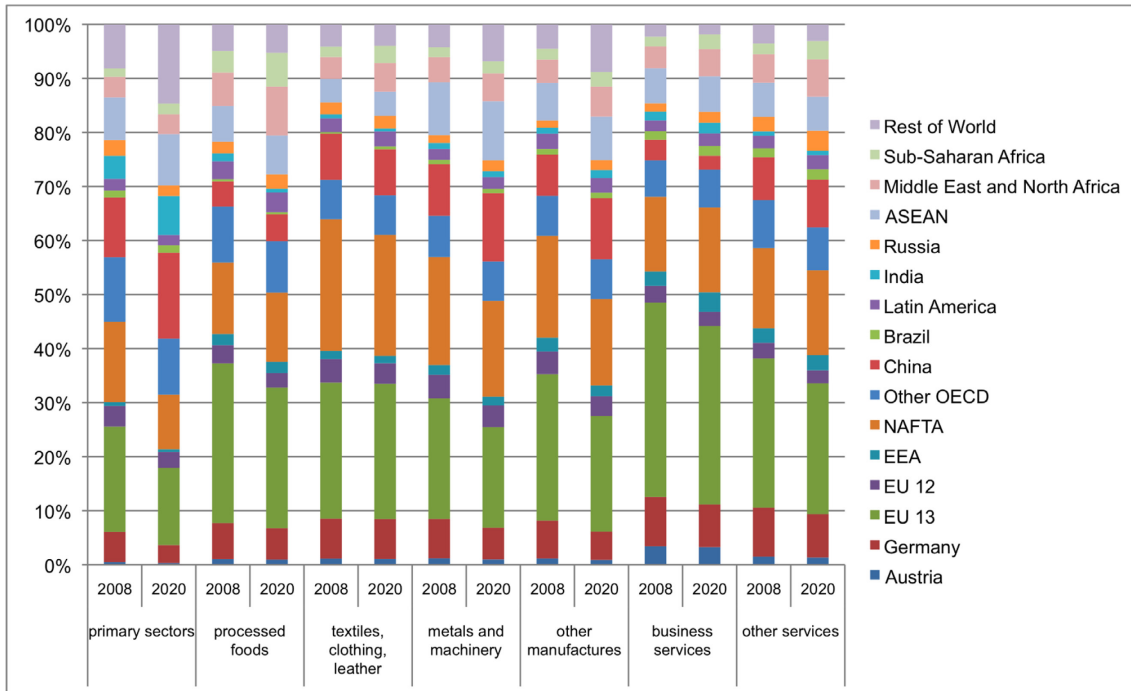
Source: CGE projection-based estimates

On the import side, one striking shift is the importance of non-OECD countries as primary commodity importers. This sector includes primary energy, as well as primary food stuffs (grains, fish, etc.) Though the OECD accounted for 56.9% of imports in 2008, we project this share to drop to 41.9% by 2020, with the non-OECD markets becoming the dominant importers for primary sector raw materials. For metals, machinery, and other manufactures, the OECD also sees a drop in its share of global imports, from about 66% to 56% of global imports. In textiles and clothing, the OECD remains the major destination market. The OECD was 71.2% of imports in 2008, and thus is projected to remain high at 68.3% in 2020. For business services, the OECD also remains both the major exporter and importer of services.

Table 3.5 presents another view of changes in global trade – the impact of shifts in production and demand on relative global commodity prices. In the table, “real” prices are presented, measured in 2008 euros. What is clear in the table is that while, for manufacturing and services, the mix of increased investment and TFP growth drives a drop in real prices across most of manufacturing and services, there is a sharp increase in

Figure 3.4

Regional Shares of Global Imports by value: 2008 & 2020



Source: CGE projection-based estimates

energy commodity prices (oil and coal) and related petro-chemical prices. There is also a sharp increase in prices for ores (mining) as well as metals. Natural gas prices are moderated by the impact of recent innovation in the extraction of gas from traditionally unproductive fields. Overall, the pattern is one of sharp increased in industrial raw materials and energy prices, though productivity growth and manufacturing help to offset the impact of these increases on more advanced industrial products, consumer products, and services.

Table 3.5**Cumulative % increases in real global commodity prices: 2008-2020**

primary	1.90	light manufactures	-11.35
coal	216.42	chemicals rubber plastics	6.98
oil	107.42	petrochemicals	85.73
gas	30.02	electrical machinery	-11.84
mining	182.81	other machinery and equipment	-2.48
processed foods	-2.73	utilities	14.03
textiles	-11.00	construction	0.95
clothing	-19.02	trade	-17.72
leather	-12.07	transport	6.33
lumber	-4.99	communications	-14.88
paper and publishing	-2.02	other finance	-10.95
metals	19.88	insurance	-7.89
fabricated metals	2.68	other business services	-11.11
nonmetallic minerals	15.73	rec and other consumer servs	-7.20
motor vehicles	-1.34	other Services	-6.83
other transport equipment	-2.89		

Source: World Bank *Pink Sheets* and IEA, and industry projections (for energy), and CGE model projections (for other).

Finally, we turn in the next chapter to the impact of global economic trends on the Austrian economy.

CHAPTER 4

STRUCTURAL CHANGE IN AUSTRIA

4. Overview of Macroeconomic Projections

In this chapter we describe major structural changes in the Austrian economy that will occur as a result of global shifts in demand patterns.

a. Changes in production and commodity trade structure

During 2008-2020, Austrian economy will experience noticeable structural shifts, which will resemble to a large extent the patterns of structural changes in other EU and OECD countries.

Drops of real output and exports will occur only in textiles, clothing, leather, and electrical machinery. This trend will be driven by the rapid increase in exports of these products by China and India and some other competitors. In exports, there will also be decrease in light manufactures trade.

The highest growth of output is forecasted in metals, chemicals, mining, utilities and transports sector. These sectors have also ones of the highest rates of exports growth. Reasons for such a dynamics are primarily the surge in global demand for metals, chemicals, ores and other fossils, and favourable geographic location of Austria, which will let to provide more transportation and utility services to the neighbouring countries. In addition, exports are expected to grow fast in petrochemicals and gas sectors (since fast imports increase in these sectors is expected, Austria will be likely to re-export the bulk of these commodities).

Austria will increase imports in all the sectors, with the highest growth rates expected in the energy related sectors (coal, oil, gas, and petrochemicals), mining, and non-metallic minerals – to a large extent due surge in prices of these commodities. Besides, the model forecasts fast increase in imports of light manufactures, clothing, construction, and trade services.

The resulting changes in the structure of the Austria's value added and trade are presented in the annex tables.

Table 4.1

Change in the real output, value of exports and imports in Austria over 2008-2020, %

	Output	Exports	Imports
primary	21.7	65.1	12.6
coal	14.9	--	276.5
oil	25.9	--	146.0
gas	26.1	59.4	94.1
mining	37.0	408.7	283.1
processed foods	13.6	10.8	25.7
textiles	-21.4	-32.7	32.3
clothing	-29.1	-43.7	53.4
leather	-21.7	-25.3	33.4
lumber	3.9	1.4	35.0
paper and publishing	9.4	8.7	32.5
metals	127.9	179.7	39.4
fabricated metals	18.8	28.3	35.3
non-metallic minerals	33.6	88.6	61.4
motor vehicles	18.3	19.0	23.9
other transport equipment	6.4	4.2	30.3
light manufactures	5.7	-6.2	64.5
chemicals rubber plastics	45.9	69.2	22.9
petrochemicals	13.5	169.0	129.8
electrical machinery	-25.2	-24.7	21.0
other machinery and equipment	13.1	15.1	28.6
utilities	32.2	106.7	20.4
construction	22.1	25.8	61.1
trade	14.0	3.3	64.4
transport	30.6	43.9	42.8
communications	12.8	0.2	46.8
other finance	9.7	4.4	24.1
insurance	15.5	8.5	24.1
other business services	11.4	6.6	28.7
rec and other consumer servs	15.3	12.2	30.2
other services	17.2	16.5	49.9

Source: CGE model projection-based estimates.

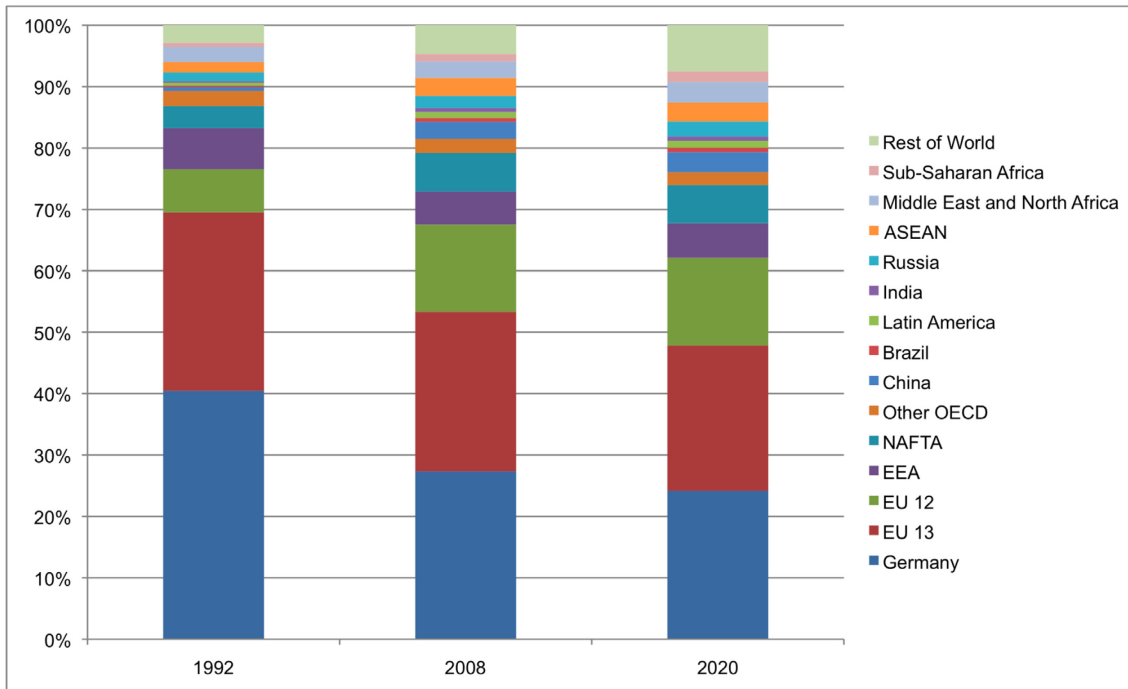
b. Changes in geographic trade structure

Figures 4.1 and 4.2 below present a breakdown of the regional direction of trade for Austria's imports and exports, for 1992, 2008, and 2020. Underlying data are reported in the annex tables. Starting from 1992, there is a marked drop in the importance of Germany as a trading partner. Germany was responsible for 40.4% of Austria's exports in 1992, and for 57.5% of imports. The EEA Members overall (German, the EU, and EFTA)

accounted for 83.2% of exports in 1992, projected to drop to 67.8% by 2020. Within the OECD, North America is projected to become increasingly important as a destination market. The NAFTA block accounted for 3.6% of Austrian exports, projected to increase to 6.2% in 2020. This is similar to the current share, meaning basically that the NAFTA maintains its position even as Europe becomes relatively less important as a destination market. Non-OECD markets are projected to grow increasingly important as destination markets for Austrian exports – from 10.7% in 1992 and 18.5% in 2008 to 23.9% by 2020. China, which accounted for only 0.7% of exports in 1992, is projected to account for 3.3% of exports by 2020. Even with these shifts, the European OECD countries remain the most important set of markets (67.8% in 2020) in our projections to 2020, with Germany being the single most important partner (24.1%).

Figure 4.1

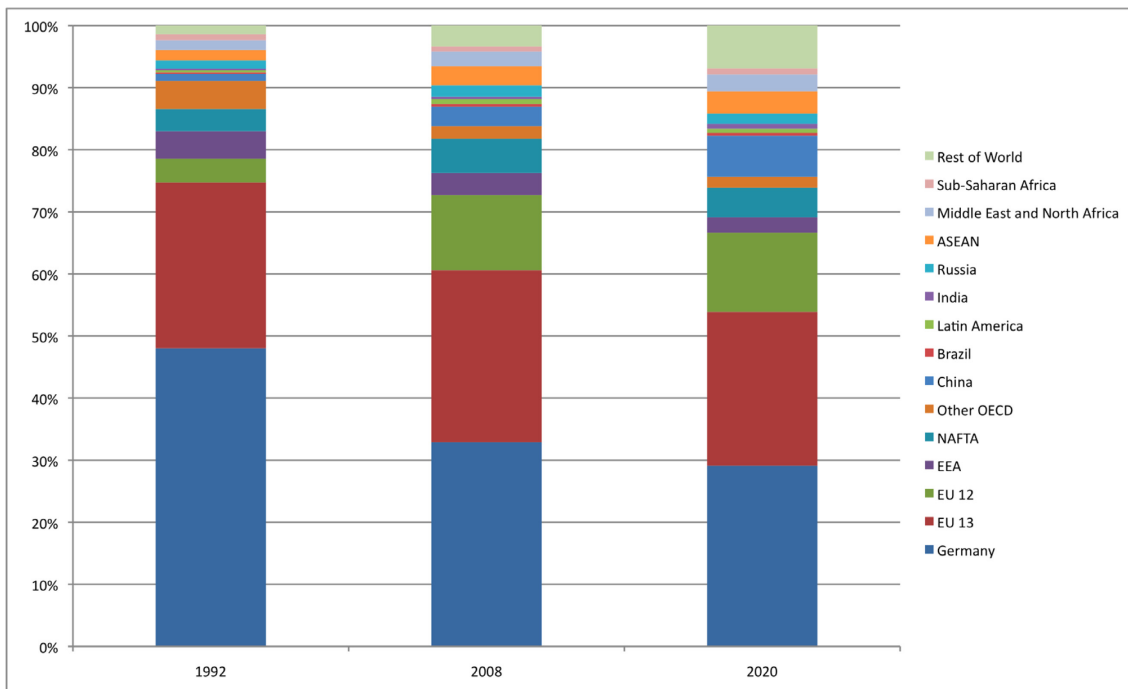
Regional Shares of Austrian Exports by value: 1992, 2008, & 2020



Source: COMTRADE and CGE projection-based estimates

Figure 4.2

Regional Shares of Austrian Imports by value: 1992, 2008, & 2020



Source: COMTRADE and CGE projection-based estimates

c. Reallocation of factors of production

As Table 4.3 shows, all the sectors of the Austrian economy apart from mining will increase their capital-labor ratios as well as ratios of skilled to unskilled labor. These trends will be caused by increase in supply of the skilled labor (see Chapter 5) and capital accompanied by fall in real returns on these factors of production: real returns on skilled labor will decline by 4.1%, on capital – by 9.3%.

Table 4.3
Changes in capital-labor ratio and ratio of skilled labor to unskilled labor in Austria during 2008- 2020*, %²

	Capital-labor ratio	Ratio of skilled labor to unskilled labor
primary	4.5	4.3
mining	-2.5	2.8
processed foods	26.3	28.8
textiles	29.8	32.3
clothing	31.1	31.6
leather	30.1	33.5
lumber	31.7	32.9
paper and publishing	27.6	32.6
metals	32.3	32.5
fabricated metals	30.2	32.8
non-metallic minerals	30.6	32.7
motor vehicles	28.5	32.8
other transport equipment	28.1	32.8
light manufactures	29.9	33.0
chemicals rubber plastics	26.1	32.6
petrochemicals	3.9	14.4
electrical machinery	23.2	32.5
other machinery and equipment	24.9	32.7
utilities	18.6	32.7
construction	34.3	36.6
trade	39.6	44.3
transport	41.2	44.3
communications	19.3	32.9
other finance	19.8	32.5
insurance	19.3	32.7
other business services	19.1	32.7
rec and other consumer servs	19.4	32.8
other services	18.8	32.7

Source: CGE model projection-based estimates.

*Accounting for change in returns on factors of production.

² Coal, gas and oil sectors were excluded from this analysis due to their low shares in the total value added.

CHAPTER 5

HOUSEHOLD INEQUALITY IN AUSTRIA

5. Household Inequality in Austria

There has been a great deal of research on the effects of trade on the Austrian economy. Much of this has been conducted in the context of the analysis of the EU enlargement (see e.g. Breuss, 2002). Many of these studies find Austria to be among the winners of the increased international division of labour at the aggregate level. However, Fink (2009) points out that the average Austrian wage earner did not necessarily participate in these gains from trade. In the last decades the wage share in the Austrian economy declined constantly. A few studies have analysed the distributional effects of trade on Austrian wages (see e.g. Pointner, 2009). Specifically, Hofer and Huber (2003) found that trade affects mostly wages of blue-collar workers only. Only very few studies have analysed trade effects on the Austrian economy by the means of a Computable General Equilibrium (CGE) model. Typically these studies have used a single country CGE model for Austria simulating an increase of trade after liberalisation (see Breuss and Tesche, 1991, Keuschnigg and Kohler, 1994 and Brocker and Schneider, 2002).

In this Chapter, we want to add to this literature by applying our CGE-based projection model to look at the effects of further internationalisation on the distribution of household incomes due to changes in skilled labour, unskilled labour and capital income. To our knowledge this was never before done in such a setting of a multi-country and multi-sector CGE model for Austria before. Indeed the literature is focused almost exclusively in developing countries (see e.g. Decaluwe, Dissou, and Robichaud, 2004). We proceed in this chapter as follows. We will first describe the data and the assumptions chosen. Then we describe the household micro data mapping exercise using the outcomes of the CGE model. Here we will also present the results of this exercise. Finally we summarise and present some policy conclusions.

a. *Data and assumptions*

One of the main assumptions influencing our results of income distribution effects is the assumption on the future change of the composition of skilled and unskilled labour in Austria. Using the current (2008) occupational split for the EU countries from the Eurostat Labour Force Survey (LFS) and the projections of skilled and unskilled labour for the EU countries in the year 2020 from CEDEFOP (2009) we came up with an estimate of a decrease of unskilled labour in Austria of 7% by 2020 and an increase of

skilled labour of 23%. These estimates seem to be quite realistic given that currently the share of skilled labour in Austria seems to be below potential and given that the offer of academic programmes has been increased substantially more recently.

From our GTAP model exercise we receive forecasts of 2020 value added by factor income in 2008 prices. The main result being a forecasted growth of unskilled labour net factor income of 11% for the period 2008-2020, a growth of 18% for skilled labour net income and a growth of 22% for capital income in Austria. Thus, consistent with earlier research as summarised above, the wage share in the Austrian economy can be expected to further decline in the years to come. This will also have its effects on the results of our household income distribution mapping exercise. Also we assumed that the Austrian post-world-financial-crisis state will have to decrease budget deficits in the years to come. Thus, those transfers that are work related such as the unemployment benefit will be increased by a 50% of the growth rate of total wages only, while the other transfers such as family and children allowances will only increase by 25% of the growth rate of total wages by 2020.

General population growth estimates were taken from the Eurostat EUROPOP 2008 forecasts. For Austria the forecast is a growth of almost 5% until 2020. Total change in labour is expected to be of similar size. Detailed household data was received from the European Union Statistics on Income and Living Conditions (EU-SILC) database for the most recent year of 2007. The database contains microdata on income, poverty, social exclusion and living conditions. For the purpose of our research, education information is obtained for persons aged 16 and over. Income at very detailed component level is mainly collected at personal level but a few components are included in the household part of SILC. With these data and assumptions at hand we started our household income distribution mapping exercise.

b. Mapping exercise and results

Using the data and the assumptions as described above we had to assign due to the forecasted increase of employment in 2020 a number of individuals currently inactive to the new labour force. For this purpose we picked those persons from the current group of inactive that according to an hours-worked-regression including explanatory variables such as sex, age and education had the largest deviation from their

forecasted level. From a similar regression, using standard explanatory variables we allocated these additional persons to either the skilled or the unskilled group. Also the average hourly incomes of the two labour groups were attached to the additional work force according to their skill assignment. Two stylised tax rates of 40% and 30% respectively were assumed.

As a result the income shares of the skilled and unskilled labour force in 2020 change from an initial ratio of 37% against 63% to an estimated 48% against 52% respectively. This relates to an increase of total skilled labour income of 24% and a drop of total unskilled labour income of 21%. However, given the strong increase in the number of skilled labour and the decrease of persons in unskilled labour, the average skilled labour income decreased by some 5% and the average unskilled labour income increased by more than 33%.

In terms of household income inequality as measured by the Gini coefficient we find in the initial state a level of income inequality of 27.5. This is a level of inequality, which is comparable to those of the most equal societies in the world such as the Scandinavian ones. Adding the effects of the change in the ratio of skilled and unskilled labour and the change of skilled and unskilled labour income increases the Gini inequality index by less than one point to the new level of 28.3. Although unskilled labour incomes increase, the estimated increase in overall inequality is inter alia due to the fact that the incomes of the inactive fall behind more strongly. The expected inequality increase from the introduction of a rise in capital income is only flimsy, because capital income makes up only a small share of total Austrian household income. At that stage the new Gini coefficients amounts to 28.5. Finally, we also include the below average wage increases of the transfers. This leads to a minor decrease of the Gini coefficient to 28.1.

c. *Summary and policy conclusions*

Despite the strong rise in average unskilled labour income due to further internationalisation, the massive price increases in sectors employing unskilled labour and the lower supply of unskilled labour, overall inequality is expected to increase in Austria by 2020. Main driving forces are the increase of persons in skilled labour and subsequent stronger income differentiation and the increase of capital income.

In order to make all segments of the population to benefit from internationalisation, the state could seek for the compensation of groups being relatively worse off. This goal can be achieved on the government revenue side by advancing capital taxation to international levels and increasing the income taxation of the top earners. With regard to government expenditures, transfers targeting the poor could be increased.

ANNEXES

ANNEX A

Annex Tables

Annex A Tables

Annex Table A.1

Regional Breakdown of GDP, shares

	primary sectors	
	2008	2020
Austria	0.7	0.5
Germany	6.0	4.5
EU 13	20.3	16.2
EU 12	3.2	3.1
EEA	1.6	1.2
NAFTA	28.0	23.9
Other OECD	11.5	9.7
China	7.5	14.5
Brazil	2.6	2.5
Latin America	4.3	4.3
India	2.0	3.1
Russia	2.8	2.6
ASEAN	2.1	2.5
Middle East and North Africa	3.6	4.0
Sub-Saharan Africa	1.6	1.9
Rest of World	2.4	5.2

Source: CGE model projection-based estimates.

Annex Table A.2

Regional Shares of gross output values

	primary sectors		processed foods	
	2008	2020	2008	2020
Austria	0.23	0.15	0.63	0.53
Germany	1.85	1.23	6.15	4.95
EU 13	9.86	6.92	24.34	20.91
EU 12	2.85	2.13	4.85	4.56
EEA	1.70	1.40	1.13	0.95
NAFTA	14.34	11.81	20.33	18.51
Other OECD	5.50	4.59	10.53	9.27
China	15.86	23.36	6.14	9.68
Brazil	2.77	2.27	2.84	2.77
Latin America	4.69	4.06	4.14	4.30
India	5.36	4.66	2.83	3.38
Russia	6.24	5.86	2.41	2.36
ASEAN	5.17	5.04	4.62	5.00
Middle East and North Africa	10.62	10.96	2.71	3.23
Sub-Saharan Africa	4.69	4.69	2.19	2.72
Rest of World	8.26	10.88	4.16	6.89

	textiles, clothing, leather		metals and machinery	
	2008	2020	2008	2020
Austria	0.70	0.37	0.77	0.61
Germany	4.72	2.05	8.68	6.16
EU 13	19.61	9.85	17.94	13.54
EU 12	3.93	2.68	3.22	2.79
EEA	0.35	0.14	1.06	0.83
NAFTA	8.46	4.41	21.52	16.66
Other OECD	5.96	3.16	14.40	11.51
China	26.62	42.36	13.64	24.56
Brazil	2.02	1.54	1.96	1.91
Latin America	2.69	2.00	1.34	1.13
India	3.29	5.23	1.46	2.39
Russia	1.07	0.53	2.49	1.90
ASEAN	7.38	6.25	6.73	7.42
Middle East and North Africa	4.49	3.16	1.68	1.76
Sub-Saharan Africa	1.62	1.31	1.02	1.43
Rest of World	7.10	14.97	2.12	5.43

Source: CGE model projection-based estimates.

Annex Table A.2 -- continued

Regional Shares of gross output values

	other manufactures		business services	
	2008	2020	2008	2020
Austria	0.74	0.55	0.84	0.71
Germany	6.50	4.66	8.44	7.09
EU 13	22.22	16.82	27.64	24.63
EU 12	3.30	3.03	2.28	2.34
EEA	1.15	0.73	2.10	1.89
NAFTA	22.08	17.35	30.28	29.30
Other OECD	11.14	9.00	13.33	12.46
China	10.54	19.36	3.54	5.92
Brazil	2.28	2.16	2.18	2.37
Latin America	2.51	2.54	1.32	1.49
India	2.07	3.27	0.63	0.92
Russia	2.53	2.51	1.14	1.30
ASEAN	5.26	6.66	2.01	2.55
Middle East and North Africa	3.64	3.95	1.66	2.28
Sub-Saharan Africa	1.37	1.60	1.14	1.62
Rest of World	2.68	5.81	1.47	3.13

	other services	
	2008	2020
Austria	0.64	0.54
Germany	5.06	3.96
EU 13	19.70	16.42
EU 12	2.25	2.15
EEA	1.56	1.46
NAFTA	31.64	27.90
Other OECD	13.31	11.58
China	7.24	11.86
Brazil	1.94	1.97
Latin America	2.20	2.42
India	1.66	2.22
Russia	2.44	2.57
ASEAN	3.05	3.54
Middle East and North Africa	2.83	3.73
Sub-Saharan Africa	1.32	1.81
Rest of World	3.16	5.87

Source: CGE model projection-based estimates.

Annex Table A.3

Regional Shares of export values

	primary sectors		processed foods	
	2008	2020	2008	2020
Austria	0.14	0.11	1.50	1.28
Germany	1.06	0.80	7.12	6.27
EU 13	10.44	8.69	35.16	32.22
EU 12	0.83	0.83	3.36	3.61
EEA	5.23	3.98	1.90	1.45
NAFTA	14.46	12.96	10.92	10.24
Other OECD	4.94	6.56	5.47	5.47
China	1.18	1.72	3.03	4.50
Brazil	2.57	2.44	4.81	4.67
Latin America	6.69	5.98	6.67	6.18
India	0.94	1.85	1.15	2.67
Russia	7.21	9.04	1.98	1.77
ASEAN	5.62	6.35	8.79	9.59
Middle East and North Africa	21.99	20.55	2.40	2.38
Sub-Saharan Africa	8.56	8.35	2.35	2.23
Rest of World	8.14	9.79	3.40	5.46

	textiles, clothing, leather		metals and machinery	
	2008	2020	2008	2020
Austria	0.73	0.34	1.20	1.01
Germany	3.75	1.84	11.43	8.91
EU 13	16.94	8.47	19.69	16.02
EU 12	4.04	2.24	4.22	3.69
EEA	0.46	0.16	1.82	1.58
NAFTA	4.14	2.25	14.69	12.02
Other OECD	4.15	2.27	13.08	11.38
China	35.05	47.84	10.32	16.70
Brazil	1.13	0.59	1.30	1.27
Latin America	1.65	0.84	1.18	0.91
India	2.23	4.28	0.54	1.32
Russia	0.54	0.24	2.85	2.49
ASEAN	10.20	7.79	12.23	13.65
Middle East and North Africa	4.27	2.20	2.10	2.30
Sub-Saharan Africa	0.84	0.45	1.07	1.81
Rest of World	9.87	18.21	2.27	4.93

Source: CGE model projection-based estimates.

Annex Table A.3 -- continued

Regional Shares of export values

	other manufactures		business services	
	2008	2020	2008	2020
Austria	1.25	1.02	2.66	2.12
Germany	9.01	7.37	7.09	6.56
EU 13	29.82	25.18	41.98	37.50
EU 12	3.83	3.77	2.24	2.51
EEA	2.65	1.69	3.50	2.13
NAFTA	13.83	11.66	17.71	14.18
Other OECD	6.14	5.95	4.15	3.78
China	6.76	11.35	3.71	9.35
Brazil	1.21	1.11	0.71	0.66
Latin America	2.22	2.46	1.47	1.32
India	1.70	2.29	1.56	2.94
Russia	3.56	3.57	1.39	1.30
ASEAN	8.82	11.39	4.55	5.80
Middle East and North Africa	5.63	6.12	4.79	5.10
Sub-Saharan Africa	1.06	1.11	1.01	0.92
Rest of World	2.51	3.95	1.49	3.85

	other services	
	2008	2020
Austria	1.86	1.50
Germany	5.33	4.50
EU 13	28.70	23.19
EU 12	3.56	3.71
EEA	2.54	1.87
NAFTA	17.86	14.58
Other OECD	7.49	6.54
China	9.89	18.36
Brazil	0.39	0.27
Latin America	2.96	2.60
India	0.48	0.90
Russia	2.30	2.04
ASEAN	5.74	5.80
Middle East and North Africa	4.77	3.98
Sub-Saharan Africa	1.70	1.28
Rest of World	4.44	8.88

Source: CGE model projection-based estimates.

Annex Table A.4

Regional Shares of import values

	primary sectors		processed foods	
	2008	2020	2008	2020
Austria	0.49	0.33	1.01	0.94
Germany	5.57	3.32	6.71	5.81
EU 13	19.50	14.30	29.56	26.03
EU 12	3.81	2.94	3.35	2.69
EEA	0.70	0.48	2.06	2.09
NAFTA	14.91	10.11	13.22	12.81
Other OECD	11.94	10.39	10.39	9.51
China	11.06	15.86	4.65	4.98
Brazil	1.28	1.39	0.39	0.39
Latin America	2.14	1.93	3.31	3.66
India	4.25	7.19	1.45	0.68
Russia	2.95	1.97	2.19	2.67
ASEAN	7.88	9.48	6.61	7.16
Middle East and North Africa	3.82	3.66	6.17	9.05
Sub-Saharan Africa	1.54	2.00	3.97	6.27
Rest of World	8.16	14.66	4.95	5.26

	textiles, clothing, leather		metals and machinery	
	2008	2020	2008	2020
Austria	1.14	1.06	1.20	0.96
Germany	7.40	7.39	7.27	5.89
EU 13	25.15	25.04	22.31	18.60
EU 12	4.34	3.82	4.37	4.03
EEA	1.55	1.34	1.81	1.60
NAFTA	24.37	22.41	20.00	17.74
Other OECD	7.29	7.28	7.61	7.28
China	8.50	8.55	9.55	12.63
Brazil	0.32	0.51	0.84	0.83
Latin America	2.54	2.81	2.02	2.17
India	0.74	0.50	1.08	1.08
Russia	2.21	2.35	1.45	2.02
ASEAN	4.37	4.50	9.82	10.92
Middle East and North Africa	4.05	5.29	4.63	5.18
Sub-Saharan Africa	1.93	3.19	1.79	2.22
Rest of World	4.10	3.98	4.27	6.85

Source: CGE model projection-based estimates.

Annex Table A.4 -- continued

Regional Shares of import values

	other manufactures		business services	
	2008	2020	2008	2020
Austria	1.17	0.89	3.39	3.27
Germany	7.00	5.22	9.18	7.88
EU 13	27.10	21.42	35.94	33.03
EU 12	4.18	3.66	3.12	2.61
EEA	2.55	1.98	2.63	3.62
NAFTA	18.86	15.99	13.83	15.69
Other OECD	7.39	7.36	6.75	7.00
China	7.65	11.30	3.83	2.56
Brazil	1.06	1.03	1.56	1.83
Latin America	2.79	2.71	1.99	2.32
India	1.13	1.46	1.63	1.97
Russia	1.33	1.84	1.53	2.02
ASEAN	6.96	8.06	6.51	6.57
Middle East and North Africa	4.30	5.53	4.05	5.01
Sub-Saharan Africa	2.02	2.72	1.77	2.74
Rest of World	4.52	8.81	2.29	1.88

	other services	
	2008	2020
Austria	1.50	1.32
Germany	9.08	8.04
EU 13	27.61	24.23
EU 12	2.87	2.41
EEA	2.67	2.78
NAFTA	14.88	15.70
Other OECD	8.86	7.93
China	7.91	8.87
Brazil	1.68	1.91
Latin America	2.30	2.60
India	0.83	0.83
Russia	2.70	3.71
ASEAN	6.31	6.28
Middle East and North Africa	5.25	6.91
Sub-Saharan Africa	1.99	3.40
Rest of World	3.55	3.08

Source: CGE model projection-based estimates.

Annex Table A.5

Regional Percent Shares of Austria's Exports: 1992, 2008, 2020

	1992	2008	2020
Germany	40.44	27.31	24.14
EU 13	29.08	26.00	23.68
EU 12	7.03	14.20	14.30
EEA	6.67	5.39	5.63
NAFTA	3.60	6.30	6.20
Other OECD	2.51	2.28	2.10
China	0.66	2.77	3.25
Brazil	0.16	0.63	0.73
Latin America	0.48	0.98	1.11
India	0.22	0.64	0.73
Russia	1.44	1.95	2.42
ASEAN	1.71	2.93	3.08
Middle East and North Africa	2.42	2.71	3.38
Sub-Saharan Africa	0.68	1.17	1.69
Rest of World	2.88	4.71	7.54

Source: COMTRADE and CGE model projection-based estimates.

Annex Table A.6

Regional Percent Shares of Austria's Imports: 1992, 2008, 2020

	1992	2008	2020
Germany	57.54	35.00	32.24
EU 13	31.96	29.52	27.43
EU 12	4.60	12.91	14.17
EEA	5.30	3.80	2.71
NAFTA	4.26	5.86	5.30
Other OECD	5.44	2.16	1.95
China	1.44	3.32	7.32
Brazil	0.20	0.50	0.51
Latin America	0.44	0.82	0.73
India	0.26	0.42	0.87
Russia	1.59	1.94	1.85
ASEAN	2.02	3.29	3.96
Middle East and North Africa	1.91	2.53	3.01
Sub-Saharan Africa	1.13	0.86	1.08
Rest of World	1.68	3.57	7.65

Source: COMTRADE and CGE model projection-based estimates.

Annex Table A.7

Structure of the value added, exports and imports in Austria in 2020, %

	Value added	Change in shares in value added compared with 2008, p.p.	Exports	Change in shares in exports compared with 2008, p.p.	Imports	Change in shares in imports compared with 2008, p.p.
primary	2.0	0.1	1.2	0.3	1.6	-0.3
coal	0.0	0.0	0.0	0.0	0.6	0.4
oil	0.2	0.2	0.0	0.0	2.2	1.0
gas	0.0	0.0	0.0	0.0	0.3	0.1
mining	1.9	1.6	1.0	0.8	1.2	0.8
processed foods	2.8	-0.1	4.5	-0.6	3.4	-0.2
textiles	0.3	-0.2	0.9	-0.9	2.0	-0.1
clothing	0.2	-0.1	0.4	-0.4	2.4	0.3
leather	0.1	-0.1	0.5	-0.3	1.1	0.0
lumber	0.9	-0.1	2.6	-0.7	2.0	0.0
paper and publishing	1.7	-0.2	3.1	-0.6	2.5	0.0
metals	2.0	1.0	10.3	5.6	4.2	0.1
fabricated metals	1.7	0.0	2.9	0.0	3.0	0.0
non-metallic minerals	1.3	0.2	2.7	0.8	1.4	0.2
motor vehicles	1.1	0.0	9.3	-0.7	8.8	-0.8
other transport equipment	0.4	0.0	1.9	-0.5	2.1	-0.1
light manufactures	1.0	-0.1	1.3	-0.4	1.5	0.3
chemicals rubber plastics	2.6	0.5	11.6	2.9	8.6	-0.8
petrochemicals	0.0	-0.1	0.4	0.2	2.5	1.0
electrical machinery	0.6	-0.4	2.8	-1.9	5.8	-0.7
other machinery and equipment	4.5	-0.2	14.7	-1.6	13.6	-0.8
utilities	2.2	0.1	1.1	0.4	1.0	-0.2
construction	7.6	0.3	0.9	0.0	1.0	0.2
trade	14.9	-0.7	2.0	-0.5	2.4	0.4
transport	7.6	0.8	8.3	1.0	4.4	0.3
communications	1.6	-0.2	0.5	-0.1	0.6	0.1
other finance	0.6	0.0	0.5	-0.1	1.0	0.0
insurance	1.6	-0.1	1.5	-0.3	1.0	-0.1
other business services	16.9	-2.4	10.4	-2.0	15.1	-0.8
rec and other consumer servs	2.4	-0.1	1.0	-0.1	1.4	-0.1
other services	19.3	0.1	1.6	-0.2	1.3	0.1

Source: CGE model projection-based estimates.

ANNEX B

Overview of the CGE Model

ANNEX B - Overview of 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 models³. 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.

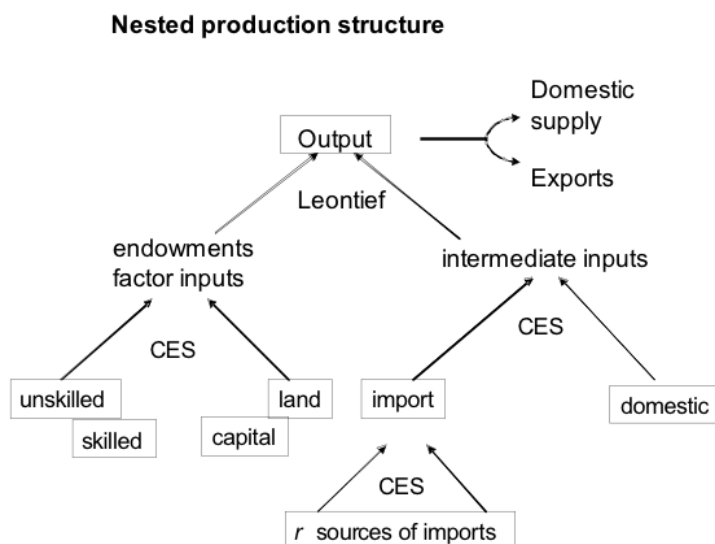
All demand sources combine imports with domestic goods to produce a composite good. In constant returns sectors, these are Armington composites. In increasing returns sectors, these are composites of firm-differentiated goods. Relevant substitution and trade

³ 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.

elasticities 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 modeled 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 modeled 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 expenditures⁴.

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:

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

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 ,

⁴ 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.

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.

B.6. Projections

Macroeconomic projections are based on productivity parameters in the core model. In particular, in standard applications of the CGE model for policy simulations, GDP is endogenous, while policy variables and underlying productivity parameters are exogenous. For projections analysis, we implement a ‘‘closure swap,’’ meaning we have instead made GDP exogenous, while making TFP at the national level endogenous. We then impose changes in GDP on the model based on IMF projects (see the main text) and allow the model to identify the set of TFP coefficients needed to fit the theoretical structure of the model, the estimated changes in economic relationships (trade, consumer demand, etc) and the imposed changes in GDP. We also impose additional TFP in the primary food production sector, based on estimates of long run TFP growth in food production from Coelli and Rao (2003).

Annex Table B.1

Model Coefficients

	elasticity of substitution in value added	trade substitution elasticity
primary	0.22362	4.76636
coal	0.20000	6.10000
oil	0.20000	10.40000
gas	0.20000	34.40000
mining	0.20000	1.80000
processed foods	1.12000	4.94139
textiles	1.26000	7.50000
clothing	1.26000	7.40000
leather	1.26000	8.10000
lumber	1.26000	6.80000
paper and publishing	1.26000	5.90000
metals	1.26000	7.11715
fabricated metals	1.26000	7.50000
non-metallic minerals	1.26000	5.80000
motor vehicles	1.26000	5.60000
other transport equipment	1.26000	8.60000
light manufactures	1.26000	7.50000
chemicals rubber plastics	1.26000	6.60000
petrochemicals	1.26000	4.20000
electrical machinery	1.26000	8.80000
other machinery and equipment	1.26000	8.10000
utilities	1.26000	5.60000
construction	1.40000	3.80000
trade	1.68000	3.80000
transport	1.68000	3.80000
communications	1.26000	3.80000
other finance	1.26000	3.80000
insurance	1.26000	3.80000
other business services	1.26000	3.80000
rec and other consumer servs	1.26000	3.80000
other Services	1.26000	3.80000

Annex Table C.1

Mapping of Model Sectors to NACE and GTAP Sectors

CGE Model Sectors	NACE sectors	GTAP sectors
1 Primary	11 Growing of crops; market gardening; horticulture	1 PDR - Paddy rice 2 WHT - Wheat GRO - Cereal grains 3 n.e.c. V_F - Vegetables, fruit, nuts 4 5 OSD - Oil seeds C_B - Sugar cane, sugar beet 6 7 PFB - Plant-based fibers 8 OCR - Crops n.e.c.
	12 Farming of animals	9 CTL - Bovine cattle, sheep and goats, horses OAP - Animal products 10 n.e.c. 11 MLK - Raw milk WOL - Wool, silk-worm cocoons 12
	20 Forestry, logging and related services activities	13 FRS - Forestry
	50 Fishing, operation of fish hatcheries and fish farms	14 FSH - Fishing
2 Coal	101 Anthracite,not agglomrtd	15 COA - Coal
	101 Bitum.coal not agglomrtd	
	101 Oth coal,not agglomerat.	
	101 Briquettes etc (coal)	
	102 Lignite,not agglomerated	
	102 Lignite,agglomerated	
	103 Peat	
3 Oil	111 Extraction of crude petroleum and natural gas	16 OIL - Oil
4 Gas	111 Extraction of crude petroleum and natural gas	17 GAS - Gas
5 Mining	120 Mining of uranium and thorium ores	18 part OMN - Minerals n.e.c.
	131 Mining of iron metals Mining of non-ferrous metal ores, except uranium and thorium ores	18 part OMN - Minerals n.e.c.
	132 Mining of iron metals Mining of non-ferrous metal ores, except uranium and thorium ores	18 part OMN - Minerals n.e.c.
	141 Quarrying of stone	18 part OMN - Minerals n.e.c.
	142 Quarrying of sand and clay	18 part OMN - Minerals n.e.c.
	143 Mining of chemical and fertilizer minerals	18 part OMN - Minerals n.e.c.

CGE Model Sectors	NACE sectors	GTAP sectors
	144 Production of salt	18 part OMN - Minerals n.e.c.
	145 Other mining and quarrying n.e.c.	18 part OMN - Minerals n.e.c.
6 Processed Foods, beverages, tobacco	151 Meat products	19 CMT - Bovine meat prods
	152 Fish and fish products	20 OMT - Meat products n.e.c.
	153 Fruits and vegetables	21 VOL - Vegetable oils and fats
	154 Vegetable and animal oils and fats	22 MIL - Dairy products
	155 Dairy products; ice cream	23 PCR - Processed rice
	156 Grain mill products and starches	24 SGR - Sugar
	157 Prepared animal feeds	25 OFD - Food products n.e.c.
	158 Other food products	26 part B_T - Beverages and tobacco products
	160 Tobacco products	26 part B_T - Beverages and tobacco products
7 Textiles	171 Preparation and spinning of textile fibre	27 TEX - Textiles
	172 Textile weaving	
	173 Finishing of textiles	
	174 Made-up textile articles	
	175 Other textiles	
	176 Knitted and crocheted fabrics	
	177 Jerseys/pullovers/etc	
8 Clothing	181 Leather clothes	28 WAP - Clothing
	182 Other wearing apparel and accessories	
	183 Dressing and dyeing of fur; articles of fur	
9 Leather	191 Tanning and dressing of leather	29 LEA - Leather products
	192 Luggage, handbags, saddlery and harness	
	193 Footwear	
10 lumber	201 Sawmilling, planing and impregnation of wood	30 LUM - Wood products
	202 Panels and boards of wood	
	203 Builders' carpentry and joinery	
	204 Wooden containers	
	205 Other products of wood; articles of cork, etc.	
11 Pulp, paper and publishing	211 Pulp, paper and paperboard	31 part PPP - Paper products, publishing
	212 Articles of paper and paperboard	
	221 Publishing	
	222 Printing	

CGE Model Sectors	NACE sectors	GTAP sectors
12 Metals	271 Basic iron and steel, ferro-alloys (ECSC) 272 Tubes 273 Other first processing of iron and steel 274 Basic precious and non-ferrous metals	35 I_S - Ferrous metals 36 NFM - Metals n.e.c.
13 Fabricated metal products, except machinery and equipment	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	37 FMP - Metal products
14 Other non-metallic mineral products	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	34 NMM - Mineral products n.e.c.
15 Motor vehicles, trailers and semi-trailers	341 Motor vehicles 342 Bodies for motor vehicles, trailers 343 Parts and accessories for motor vehicles	38 MVH - Motor vehicules and parts
16 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.
17 Other manufacturing	361 Manufacture of furniture 362 Jewellery and related articles	42 OMF - Manufactures n.e.c.

CGE Model Sectors	NACE sectors	GTAP sectors
	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	
18 Chemicals, chemical products, rubber, plastics	241 Basic chemicals 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	33 part CRP - Chemical, rubber, plastic products
19 Petrochemicals	231 Coke oven products 232 Refined petroleum and nuclear fuel 233 Nuclear fuel	32 P_C - Petroleum, coal products
20 Electronic equipment	321 Electronic valves and tubes, other electronic comp. 322 TV, and radio transmitters, apparatus for line telephony 323 TV, radio and recording apparatus 300 Office machinery and computers	40 ELE - Electronic equipment
21 Machinery and equipment n.e.c.	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	41 OME - Machinery and equipment n.e.c.

CGE Model Sectors	NACE sectors	GTAP sectors
	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	
22 Utilities	401 Electricity, gas, steam and hot water supply 402 Manufacture of gas; distribution 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
23 Construction	450 Construction	46 CNS - Construction
24 Trade	500 repair of motor vehicles and motorcycles; retail 510 Wholesale trade and commission trade, except of motor vehicles an 521 Non-specialized retail trade in stores 522 Retail sale of food, beverages and tobacco in specialized 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 personal goods 550 Hotels and restaurants	47 TRD - trade and distribution services
25 Transport	600 Supporting and auxiliary transport activities; activities of travel agencies 630 Land transport; transport via pipelines 610 Water transport 620 Air transport	48 OTP - other transport 49 WTP - water transport 50 ATP - air transport
26 Communications	640 Post and communications	51 CMN - communications
27 Financial services	650 Financial intermediation, except insurance and pension funding 670 Activities auxiliary to financial intermediation	52 OFI - other financial services

CGE Model Sectors		NACE sectors		GTAP sectors	
28	Insurance	660	Insurance and pension funding, except compulsory social security	53	ISR - insurance
29	Other business services	700	Real estate activities	54	OBS - other business services
		711	Renting of transport equipment		
		712	Renting of other machinery and equipment		
		713	Renting of personal and household goods nec		
		720	Computer and related activities		
		730	Research and development		
		740	Other business activities		
30	Recreational and other consumer services	920	Recreational, sporting, and cultural activities	55	ROS - recreational and other consumer services
		930	Other service activities		
		950	Private households with employed persons		
31	Other services	750	Public administration and defense; compulsory social security	56	OSG - public services
		800	Education		
		850	Health and social work		
		900	Sewage and refuse disposal, sanitation and similar activities		
		910	Activities of membership organizations n.e.c.		
		990	Extra-territorial organizations and bodies		
		n.a.	n.a.	57	DWE - dwellings

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