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Economic Impact of Ukraine's WTO Accession[1]
First results from a Computable General Equilibrium Model

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1 Introduction

International trade is of crucial importance for Ukraine's economy. Key industries such as metallurgy or chemical manufacturing currently export more than half of their total output. Overall, the share of exports in GDP accounted for some 58% in 2003 and is projected to reach almost 66% in 2004 (State Statistics Committee of Ukraine). Similarly, also imports play an important role in Ukraine's economy. Increased availability of high-quality imports has improved the welfare of final consumers and the efficiency of domestic producers. Opportunities to import machinery have contributed to renewing the domestic capital stock. The availability of new varieties – for example on food markets – has stimulated competition in the respective sectors and induced further product development. Trade flows by country are fairly diversified by destination and origin. Roughly 1/3rd is exported to either other CIS countries, the EU (including new member states, EU25), or the rest of the world. On the import side, about 50% stems from the Russian Federation (2/3rd of which are energy fuels), the rest from either the EU25 or other countries.

Against this background, membership of the World Trade Organization (WTO) would be an economically important step to further support Ukraine's integration into the global economy. While the country officially applied for membership in 1993, policy-makers, economists and representatives of the business community still discuss controversially about potential benefits and costs of WTO accession. On the one hand, it is argued that improved market access for Ukrainian goods such as steel, agricultural and chemical products to markets in the European Union (EU) and North America will increase profits of Ukrainian exporters. Furthermore, efficiency and welfare gains from reduced tariffs on imports of e.g. machinery or food products are mentioned as benefits from WTO accession. On the other hand, critics are concerned about increased international competition that might push domestic firms out of the market, and about the ability of Ukraine's economy to fully enjoy the benefits of WTO membership in general.

This paper marks a first attempt to quantitatively assess economy-wide implications of Ukraine's accession to the WTO. Based on a standard General Equilibrium framework we explicitly study the consequences of reduced import tariffs, improved market access as well as of changes in

Ukraine's domestic tax and subsidy policy that are necessary for complying with WTO norms and standards. Our main finding is that WTO membership will significantly increase consumer welfare and GDP of the Ukrainian economy. As expected, the reduction of import tariffs is an important determinant of this result. But our analysis also highlights the positive role that the adoption of pro-competition WTO standards could potentially play for the development of Ukraine's domestic economy. Our calculations suggest that if direct and indirect support to specific industries is eliminated, this substantially broadens the tax base and allows for reduced tax levels, thereby increasing real incomes and hence welfare levels for the Ukrainian people.

The paper is organized in four parts. In section two we will describe the analytical background of our analysis, the database used for simulation of Ukraine's economy as well as the different policy scenarios. Section three presents and discusses the results of our simulations. The last section summarizes and concludes.

2 The Model

To study the economy-wide impact of Ukraine's WTO accession we use a Computable General Equilibrium (CGE) model. The literature contains a large range of different models.[2] The theoretical basis of the present modeling exercise is the applied general equilibrium framework discussed by Shoven and Whalley (1992), which is build upon profit- and utility-maximizing behavior of consumers and producers. Based on this framework, we use a standard specification as e.g. used in Harrison et al. (1997), the static model of Pavel (2001) or in the basic static specification of Jensen et al. (2003). The model explicitly considers private households, firms, investments, the government and an external sector. It is programmed in GAMS/MPSGE as described in Rutherford (1999). An overview of the model structure is given in Graph 1, an algebraic description is provided in Appendix A.

Private households receive income from lending out labor – divided into unskilled, skilled and high-skilled labor – and capital endowments to firms, and they also receive transfers from the public budget and from abroad. Income is spent for final consumption of domestically produced and imported goods to maximize utility. A constant share of private income is also invested.

Firms hire labor and capital and purchase intermediate inputs to produce and sell their output in order to maximize profits. By assumption, primary factors are fully mobile across sectors, and all firms produce under Constant Returns to Scale technology.

The government receives income from public capital endowments, and revenue from direct and indirect taxes and import tariffs. Direct taxes are modeled as an activity-specific tax on the use of labor and capital (negative

[2] See e.g. de Melo (1988), Francois and Shiells (1994) or Devarajan and Robinson (2002) for general surveys.

tax rates indicate subsidization). Indirect taxes are modeled as a commodity specific tax on private (household) and investment demand (negative tax rates indicate subsidization). Import tariffs are commodity- and region-specific and apply for all imports. The government spends its income for the provision of public goods. Since the effect of public goods on private utility is not directly modeled, the real value of public goods provision is kept constant in all scenarios. Therefore, the indirect tax rate adjusts endogenously in all scenarios.

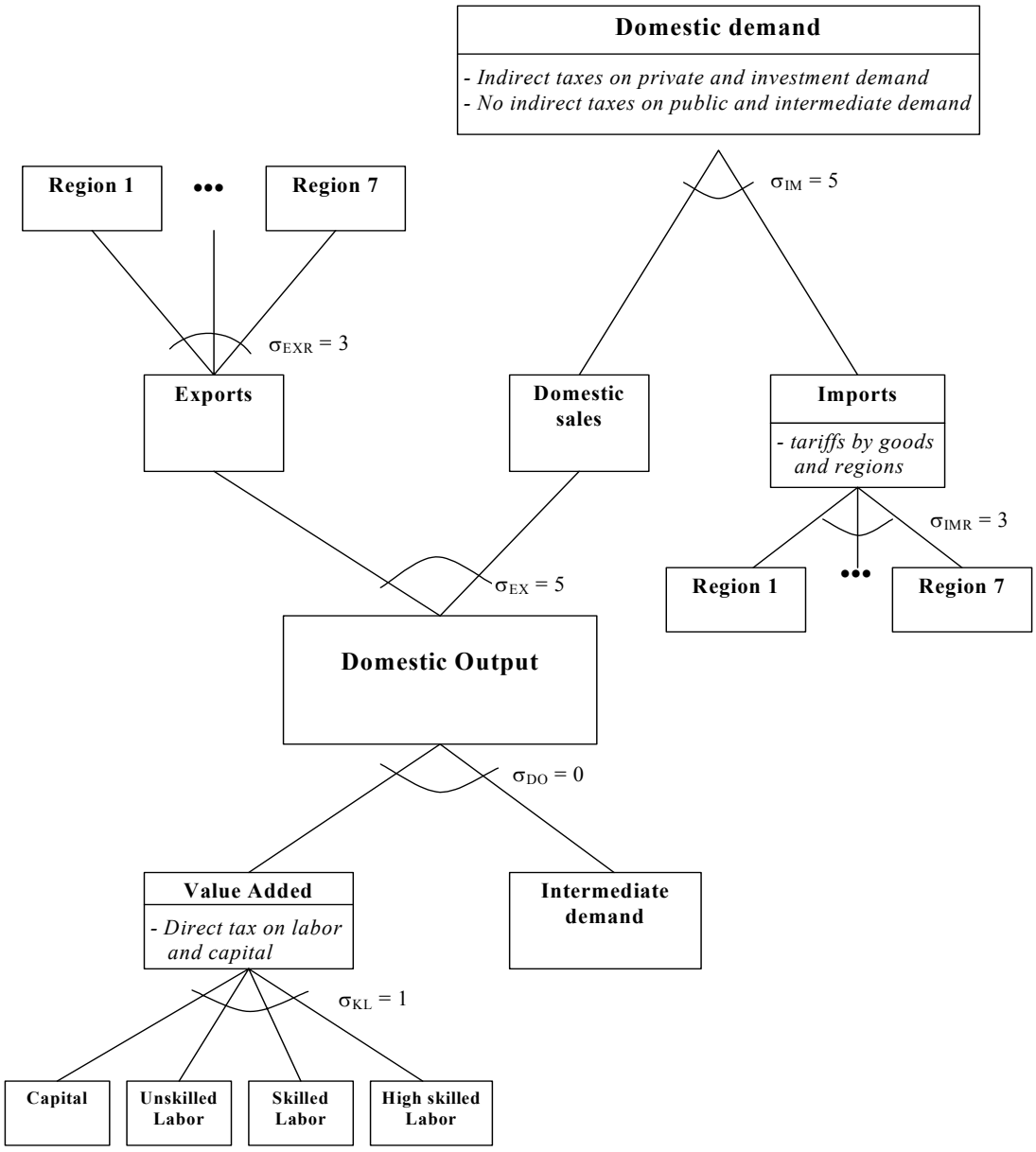
In the model, Ukraine trades with the rest of the world. World commodity prices are exogenous to the domestic economy. Exports and imports are disaggregated into different trading partners, modeled with constant elasticities of transformation and substitution. Consumers treat imported and domestically produced goods as imperfect substitutes while producers regard sales on domestic markets or exports as imperfect alternatives.[3]

Finally, total investments equal the sum of depreciation, public and private savings and the current account balance. The exchange rate adjusts such that the current account balance remains constant.

Equilibrium in our model is defined by zero profits for all producers, balanced budgets for consumers and the public budget, as well as market clearing for goods and factor markets. An overview of the model structure is given in Graph 1.

[3] This standard assumption is based on Armington (1996).

Graph 1
Structure of the Model



Parameters σ denote elasticities of substitution /transformation

Source: own graph

2.1 Data

The basis for our modeling exercise is a Social Accounting Matrix (see e.g. Pyatt and Round 1985) that we put together on the basis of Ukraine's National Accounts and Input-Output tables for 2001 at basic and consumer prices.

Remuneration for labor has been disaggregated into three different categories using the 2001 edition of Labor of Ukraine (Pratsya Ukrainy) and the Statistical Yearbook 2002 of Ukraine.

Imports and exports in the Input-Output tables have been disaggregated into different origins and destinations using Ukraine's foreign trade statistics of the State Statistics Committee.

Input-Output tables include 38 activities/commodities. They have been aggregated to 20 sectors as explained in Table B1 in the Appendix B.

Exports and imports by activity and commodity are aggregated into the seven main trading regions (EU15, the 10 New Member Countries, Russian Federation, other CIS countries, Asia, North America, Rest of the World; see Table B5 in Appendix B).

The Input-Output table contains information about two types of taxes, revenue from 'taxes/subsidies on production' (direct taxes) as well as revenue from 'taxes/subsidies on commodities' (indirect taxes).

The rates of taxes and subsidies on production are calculated in percent of labor and capital costs per industry. The specific direct taxes and subsidy rates are given in Table B4 (negative figures indicate subsidization).

Taxes and subsidies on commodities are split into import tariffs (commodity- and trade-region-specific; apply to all imports) and consumption taxes[4] (commodity specific on final and investment demand). To compute the respective tariff and tax rates we proceed as follows:

To specify commodity- and region-specific rates of import tariffs we use the tariff rates as specified in the 'Law on Custom Tariffs of Ukraine' and calculate weighted averages for the commodity classification used in our model. Results are presented in rows a-c in Table 1 below. Assuming that those nominal tariffs are fully applied we calculate the commodity-specific tariff revenue. Aggregating this revenue over all commodities gives a share of total tariff revenue in total revenue from indirect taxation of 25.1%. This is relatively large and clearly exceeds the level given in the 2001 Treasury report for the consolidated budget (9.6%). Apparently, this difference suggests that effective tariff rates on average have been more than 60% below their official levels. Accordingly, reducing tariff levels such that the share of aggregate tariff revenue equals its level given in the consolidated budget would mean a drastic cut of individual tariff levels. However, consolidated budget and National Accounts are not consistent sources, mainly because the former reports figures on cash or payment basis while

[4] This includes mainly VAT as well as excises and transit and road fees on specific products.

the later on accrual (legal) basis. Thus, we compromise as follows. On the one hand, we scale down all tariff rates by a uniform factor, thereby acknowledging that effective tax rates are much below their nominal levels e.g. due to inefficiencies of the customs procedures. On the other hand, we reduce tariffs only by 30% so that tariff revenue accounts for 17.6% of total revenue from indirect taxes (and 10% of the total public budget).[5]

To calculate the commodity-specific rates of taxes on consumption we subtract tariff revenue from total revenue of indirect taxation (both per commodity) to receive the commodity-specific revenue from consumption taxes. Then, consumption tax rates are expressed in percent of final and investment demand (Table B4).

2.2 Policy experiments

We assume that Ukraine's accession to WTO affects the economy through three different effects, namely tariff reduction, market access and adjustments of the domestic tax system:

I) Tariff Reduction:

In 2001 Ukraine's tariff legislation distinguished three different rates: zero tariff rates (row a in Table 1, applied to all CIS countries), Most Favored Nation (MFN) tariff rates (row b in Table 1, applied to the countries of Eastern Europe and the European Union as well as to some Asian and American countries) and full tariff rates (row c in Table 1, applied to all other countries). Joining the WTO means that first all WTO members will enjoy the MFN tariff rates, and second that MFN rates are further reduced according to the results of negotiations. The official proposal for reduction of MFN tariffs is given by decree #255/96 of the President of Ukraine ("*About the Conception of transformation of the custom tariff of Ukraine for 1996-2005 according to the GATT/WTO"*). In addition, Presidential decree #104/02 ("*On Program of Measures directed towards completion of Ukraine's accession to WTO*") expresses Ukraine's intention to join the WTO sectoral initiatives (16 initiatives for 19 different sectors[6]).

Based on these two proposals, we specify the expected MFN tariff rates under WTO membership as illustrated in Table 1. First, we calculate average tariff rates for the 13 industrial goods of our model based on the intended rates for 2005 specified in decree #255/96 (row e in Table 1). Next, we verify whether the intended tariff rate in 2005 already foresees a 'substantial reduction' – that is by at least 30% – of tariffs for the sectors specified in the *WTO Sectoral Initiative*.[7] If this is the case, we do not

[5] Without this adjustment, welfare levels from tariff reductions are about twice as high as presented below.

[6] Oilseeds, Spirits and Beer, Wood, Paper, Furniture, Chemical goods, Pharmaceutical goods, Toys, Fish, Textile and clothing, Steel, Non-ferrous metallurgy, Information technology, Agricultural machinery, Science equipment, construction equipment, and Medical equipment.

[7] Actually, the WTO sectoral initiatives foresee a tariff reduction to zero. However, the goods for which the sectoral initiatives are applied are only subgroups of the 13 industrial goods in our model. Furthermore, we do not

reduce tariff rates any further, otherwise we reduce them by approximately 50% (see row f in Table 1).[8] Then, Ukraine's expected MFN tariffs under WTO membership as given by row e and f, respectively, are summarized in row g of Table 1. Compared to the MFN rates for 2001 they imply a further reduction by between 13% (→*Other production*) and 63% (→*Food-processing*) while 2001 tariff rates for three activities have already been zero (row h).

To model the tariff reduction under WTO accession we assume that all of Ukraine's trade partners (that is the seven regions in our model) face at least the MFN tariff rates as given in row g.[9]

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have the exact codes of those goods. Thus, we assume that for the 13 industrial goods in our model the WTO sectoral initiative leads to a substantial reduction of tariffs (by at least 30%) rather than to zero tariff levels.

[8] As row f shows, a 'substantial reduction' of tariff rates is given for Oilseeds (→*Agriculture, hunting* in Table 1), Spirits and Beer (→both *Food-processing*), Wood, Paper, Furniture (→all *Forestry, wood working, pulp and paper industry, publishing*), Chemical goods, Pharmaceutical goods (→both *Manufacture of Chemicals, rubber and plastic products*) as well as Toys (→*Other production*). In contrast, further reductions are foreseen for Fish (→*Fishery* in Table 1), Textile and clothing (→*Textile and Leather*), Steel, Non-ferrous metallurgy (→both *Metallurgy and metal processing*), Information technology, Agricultural machinery, Science equipment, construction equipment and Medical equipment (→all *Manufacture of machinery and equipment*).

[9] There are of course trade partners who in 2001 face full tariff rates and are not WTO members. For them, full tariff rates will also apply after Ukraine's WTO accession. However, since such countries account only for only 3% of Ukraine's total exports and 0.03% of total imports, we do not explicitly consider them in our study.

II) Market Access:

Several of Ukraine's exports face entry barriers on foreign markets, mainly due to tariffs, quotas, and anti-dumping investigations. In particular, agricultural goods and steel face various tariff and quota regulations in the EU and North America, while numerous anti-dumping investigations further reduce market access of steel products (mainly in North America) and chemical products in North America, the EU and its accession countries as well as in South America.[10]

Ukraine's WTO membership will reduce such barriers significantly. In our simulations, we assume that as a result of WTO accession, the price received by Ukrainian exporters to the EU and North America will increase by 10% for agricultural goods and 5% for steel. Furthermore, the export price for chemical goods will increase by 1%.

[10] According to the Ministry of Economy and European Integration there have been 60 anti-dumping cases against Ukrainian exporters registered since 1997. Out of them 37 concern Steel exports and 12 exports of chemical products.

Table 1
Ukraine's Tariff regime as of 2001 and expected MFN tariffs under WTO Membership

		Agriculture, hunting	Fishery	Mining of coal and peat	Production of non-energy materials	Food-processing	Textile and leather	Forestry, wood working, pulp and paper industry, publishing	Petroleum refinement, manufacture of coke products, production of hydrocarbons	Manufacture of chemicals, rubber and plastic products	Manufacture of other non-metallic mineral products	Metallurgy and metal processing	Manufacture of machinery and equipment	Other production
	Ukraine's Tariff regime as of 2001 (tariff rates in percent):													
a)	Free	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b)	MFN	26.7*	21.2*	0.0	1.1	50.5*	8.2	8.1	0.0	7.9	11.1	3.8	7.3	9.8
c)	Full Tariff	78.7*	57.2*	0.0	7.2	68.2*	20.2	24.0	0.0	17.4	23.0	9.8	19.8	30.6
	Expected MFN tariffs under WTO membership (tariff rates in percent):													
d)	MFN rates in 2001	26.7*	21.2*	0.0	1.1	50.5*	8.2	8.1	0.0	7.9	11.1	3.8	7.3	9.8
e)	MFN rates in 2005**	19.4	20.0	0.0	1.1***	18.9	7.9	4.9	0.0	5.8	10.0	3.8***	7.3***	8.5
f)	Sectoral Initiative	-	10.0	-	-	-	4.0	-	-	-	-	1.5	3.5	-
g)	**MFN rates under WTO**	**19.4**	**10.0**	**0.0**	**1.1**	**18.9**	**4.0**	**4.9**	**0.0**	**5.8**	**10.0**	**1.5**	**3.5**	**8.5**
h)	Reduction (in %)	27%	53%	0%	0%	63%	51%	40%	0%	27%	10%	61%	52%	13%

Free Trade Agreements apply for CIS countries including the Russian Federation (see Table B5 in Appendix B).
MFN Tariffs apply for EU accession countries, Asia, EU countries, selected North America countries (see Table B5 in Appendix B).
Full Tariffs apply for all other countries (see Table B5 in Appendix B).

* Ad-valorem tariff equivalent.
** Average over intended tariff rates according to Presidential decree #255/96 as of 1996.
*** Adjusted value since MFN tariff for 2001 already below 1996 proposal.
Source: own calculations based on results of Block 1 of the present study.

III) Adjustments of Domestic Taxation:

Typically, WTO accession not only affects the rates of import tariffs. Instead, also domestic policies have to be adjusted in order to reduce protectionism by e.g. eliminating tax advantages of domestic producers vis-à-vis their foreign competitors. In particular, while WTO rules generally consider most types of regional-, industry-, and even enterprise-specific subsidies as 'actionable' and thus, do not prohibit them per se, they can still be subject to challenge through either multilateral dispute settlement or countervailing action, if they are found to cause adverse effects to the interests of other members.[11] For the case of Ukraine, various tax privileges as well as subsidies granted to specific sectors are likely to come under pressure, in particular once the seven years period, which transition economies will be granted to phase out their numerous subsidies, has expired. As shown in Table B4, especially Fishery and Mining (and to a lesser extent the power sector) have received direct subsidies in 2001. It is expected that they have to be reduced significantly.

Furthermore, Ukraine's system of direct and indirect taxation shows very different levels of overall tax rates due to a large amount of tax exemptions and other types of privileges. During the negotiations on WTO accession also such practices (e.g. the generous exemptions granted to agriculture) have to be rethought. So far however, positions have not yet been finalized. To assess the result of necessary tax adjustments, we are particularly interested in investigating the consequences of rigorous compliance with WTO standards and avoidance of costly trade disputes. This requires that policy makers not decide to simply react on complaints of other members by adjusting specific subsidy regulations, but rather that they reform the domestic tax system to ensure compliance with WTO norms and standards. Against this background, we specify that first, all direct subsidies are eliminated and direct taxes per activity are uniformly set at 5%. Second, indirect taxes are set at a constant level to ensure an equal yield for the government.[12]

Considering those three effects we model four scenarios:

- Scenario 1: Full WTO accession (effects I, II and III).
- Scenario 2: Reduction of tariffs (I)
- Scenario 2a: Reduction of tariffs without agriculture (I)
- Scenario 2b: Reduction of tariffs without food products (I)
- Scenario 3: Market access (II)
- Scenario 4: Adjustment of Taxation (III)

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[11] See e.g. www.wto.org/english/tratop_e/scm_e/subs_e.htm for more information.

[12] The direct tax rate is set in an arbitrary manner. The motivation is that if indirect taxes are set endogenously to ensure an equal yield to the government, a direct tax rate of 5% has led to the highest economic benefits. If the tax rate is below 5%, higher indirect taxes reduce welfare, while higher direct taxes reduce GDP.

3 Results

In this study we use a comparative static modeling approach to quantify the typical 'gains from trade' due to improved domestic resource allocation resulting from either lower import tariffs, or from improved market access, or from reduced domestic tax distortions, or from all effects together. Before discussing the results of our model in detail, it should be stressed that those typical 'gains from trade' are not the only channels through which a country might benefit from accession to the WTO. In fact, recent contributions to economic literature suggest that additional gains can be realized through the effect of lower tariffs levels on investments and investment climate, product variety and productivity or scale effects.[13] However, almost all of those contributions are fairly theoretical and a sound basis for considering those channels in applied economic research has not yet been developed (this is particularly problematic with respect to availability of appropriate data). Therefore, the focus of our study is left on quantifying the typical 'gains from trade' due to improved domestic resource allocation.[14]

3.1 Economy-Wide Effects

Economy wide results of our comparative static estimations are given in Table 2. We estimate the static welfare gains (measured as Equivalent Variation) from full WTO accession including reduction of tariffs, improved market access and adjustments of taxation (Scenario 1) at 3.0% of Ukrainian consumption and an increase of GDP by 1.9%. Accordingly, also real wages for capital and labor increase significantly. Furthermore, consumer prices drop by around 4% due to lower relative prices for imports as well as a reduction of the indirect tax rate from 11% to 9%. Apparently, reduced consumer prices together with increased factor wages cause the higher welfare levels. Finally, exports and imports go up by around 14% each. However, for all these results it is not clear to which extent they are caused by a particular effect of Ukraine's WTO accession. Accordingly, the following scenarios decompose the results for full WTO accession into the specific impact of tariff reduction, improved market access and adjustments of domestic taxation.

If only all tariffs are reduced (Scenario 2) relative prices for imports fall and reduce domestic price levels. At the same time, however, the government has to make up for revenue losses from reduced tariffs (share in public budget falls from 9% to 5%) by rising indirect tax rates from an average level of 11% to 12% (share of indirect tax revenue increases from 50% to 55%), counteracting the reduction in consumer prices. As a consequence, the consumer price index falls only by 0.6%.

[13] See e.g. Ethier (1982), Harris (1984), Helpman and Krugman (1985), Grossman and Helpman (1991).

[14] Nevertheless, in the last section we will also compare our results with the findings of other studies that – in part – have also attempted to quantify some of the effects beyond typical 'gains from trade'.

The reduction of relative prices for imports puts domestic producers in a disadvantage vis-à-vis foreign suppliers. At the same time, however, the producer price index also declines (by 0.6%). Furthermore, the higher demand for imports also stimulates exports since additional imports need to be purchased with foreign currency. As a result, both imports and exports rise by more than 7% and GDP expands by 1.3%. Consequently, also factor wages increase, although by less than in Scenario 1. As a result of almost unchanged consumer prices and the smaller increase in real wages, consumer welfare (Equivalent Variation) increases by 1.2% of consumption only (as compared to 3.0% in Scenario 1).

In Scenario 2a and 2b we study the importance of tariff reductions for two crucial goods, agriculture and food, where WTO accession foresees reductions by 27% and 63% (Table 1), respectively. From an economy wide perspective the conclusion of these two scenarios is obvious. Excluding agricultural goods from tariff reductions does not significantly change our results (comparing scenarios 2 and 2a). On the contrary, excluding food products (where the largest tariff reduction is foreseen) diminishes almost all welfare- and efficiency-enhancing gains from trade (comparing scenarios 2 and 2b). Thus, the proposed reduction of food tariffs is a crucial condition for tariff reform to increase welfare and economy-wide efficiency. This demonstrates the high significance of food prices for welfare levels in Ukraine (food products account for a share of 27% in household expenditures).

Table 2
Impact of WTO Accession on economy wide variables

	Benchmark	Full WTO Accession	Only Tariff Reform			Only Improved market access	Only Tax Adjustments
			all goods	without agriculture	without food		
	- 0 -	- 1 -	- 2 -	- 2a -	- 2b -	- 3 -	- 4 -
Welfare (Equivalent Variation, change in %)	-	3.0	1.2	1.1	0.0	0.3	1.3
GDP Index (change in %)	-	1.9	1.3	1.3	0.1	0.3	0.3
Tariff revenue (share of public budget)	9%	6%	5%	5%	6%	9%	10%
Indirect tax revenue (share of public budget)	50%	35%	55%	54%	53%	50%	30%
indirect tax rate (weighted average*)	12%	10%	13%	13%	13%	12%	8%
Consumer Price Index (change in %)	-	-4.09	-0.61	-0.53	0.61	0.15	-3.35
Producer Price Index (change in %)	-	0.79	-0.57	-0.52	-0.13	0.01	1.59
Real exchange rate (change in %)	-	0.29	0.10	0.09	0.11	-0.47	0.90
Real factor return (change in %):							
- Return to capital	-	2.33	0.34	0.35	-0.15	0.35	1.65
- Wage rate for unskilled labor	-	3.86	1.78	1.62	0.09	0.27	1.56
- Wage rate for skilled labor	-	4.24	2.13	1.92	0.14	0.21	1.59
- Wage rate for highskilled labor	-	3.40	1.95	1.75	0.06	0.09	1.11
Aggregate exports (UAH bn)	113.24	128.51	121.83	121.36	116.53	116.76	115.22
Aggregate imports (UAH bn)	109.92	125.21	118.51	118.05	113.22	113.41	111.97
Total exports (change in %)	-	13.48	7.58	7.17	2.90	3.11	1.75
Total imports (change in %)	-	13.91	7.81	7.39	3.00	3.17	1.86

* Indirect tax rates are equal for all commodities in Scenarios 1 and 4; for all other Scenarios the figure reports the weighted average

Table 3
Impact of WTO Accession on aggregate output by activity

	Benchmark	Full WTO Accession	Only Tariff Reform			Only Improved market access	Only Tax Adjustments
			all goods	without agriculture	without food		
	- 0 -	- 1 -	- 2 -	- 2a -	- 2b -	- 3 -	- 4 -
Output							
Agriculture, hunting	1.00	0.92	0.94	0.95	0.99	1.01	0.98
Fishery	1.00	0.41	0.57	0.57	0.56	0.98	0.76
Mining of coal and peat	1.00	0.88	1.05	1.05	1.02	1.02	0.82
Production of non-energy materials	1.00	1.21	1.09	1.09	1.03	1.06	1.04
Food-processing industries	1.00	0.90	0.86	0.85	0.99	0.98	1.07
Textile and leather industry	1.00	1.22	1.35	1.32	1.23	0.84	1.16
Woodworking, pulp and paper industry, publishing	1.00	0.93	0.96	0.96	0.97	0.94	1.03
Petroleum refinement	1.00	1.01	1.04	1.04	1.01	1.00	0.96
Manufacture of chemicals, rubber and plastic products	1.00	1.28	1.06	1.05	1.02	1.12	1.05
Manufacture of other non-metallic products	1.00	1.04	1.02	1.02	1.01	1.01	1.01
Metallurgy and metal processing	1.00	1.34	1.16	1.16	1.07	1.15	0.99
Manufacture of machinery and equipment	1.00	0.82	0.95	0.95	0.94	0.92	0.94
other	1.00	1.20	1.09	1.09	1.06	0.97	1.14
Electric energy	1.00	1.06	1.04	1.03	1.01	1.03	0.99
Public utilities	1.00	1.08	1.02	1.01	1.01	1.02	1.04
Construction	1.00	1.00	1.01	1.01	1.01	1.00	0.98
Trade	1.00	1.03	1.00	1.00	1.00	1.01	1.02
Hotels and restaurants	1.00	1.34	1.23	1.22	0.98	0.90	1.20
Transport	1.00	1.00	1.00	1.00	0.99	0.95	1.05
Post and telecommunications	1.00	0.99	1.00	1.00	0.99	0.99	1.00
Other services	1.00	0.98	1.00	1.00	1.00	0.99	0.99

Improving market access for exporters of chemical products as well as agricultural and steel products in EU and North America does not lead to significant macroeconomic effects (Scenario 3). But, since main beneficiaries (chemical and steel producers as well as agricultural farmers) account for more than 40% of initial total exports, improved market access leads to higher total exports and imports (both rise by more than 3%).

Scenario 4 presents the results of adjusting domestic taxation. If all subsidies are cancelled and direct tariffs are set to 5%, the uniform level of indirect taxes can be reduced to 8% to still guarantee an equal yield for the public budget. According to our projections, this tax harmonization reduces consumer prices by around 3%. As a consequence, welfare increases by 1.3% of consumption.

3.2 Industry-Specific Results

The impact of different policies on each sector depends on their production structure and initial protection levels. Obviously, a general tariff reduction will benefit sectors that initially are relatively unprotected or have a large share of intermediate demand (and thus, can benefit from lower input prices). In addition, also sectors with a large export share are likely to benefit since increasing demand for imports also requires larger exports, as foreign currency for purchases of imports needs to be obtained through exports.

Consequently, reduction of all tariffs in Scenario 2 mainly benefits Ukraine's Textile and leather industry, and Metallurgy and metal processing (Table 3). Both industries use a large share of intermediate inputs (60% and 78%, respectively, Table B3) in total inputs and export a large part of their output (71% and 79%, Table B3). Furthermore, Production of non-energy materials as well as the residual 'Other Industrial Production' expand their production due to similar reasons. In addition to those industries, also Hotels and Restaurants can expand since they are not initially protected, particularly benefit from reduced import tariffs for food products and export almost 60% of their services (on the contrary, other service sectors have also not been protected by tariffs initially but also do not export their services[15]).

On the contrary, sectors that have enjoyed a high level of protection through tariffs and sell most of their output on domestic markets are likely to loose from tariff reductions. Accordingly, this explains the output decline for five sectors, Fishery, Food-processing, Agriculture and Hunting, Manufacture of Machinery and Equipment, as well as Woodworking, Pulp and Paper industry, Publishing.

As can be expected, development of exports and imports show a similar pattern. Exports mainly increase for Textile and Leather industry, Metallurgy and Metal processing, Production of Non-energy materials, 'Other Industrial Production' and Hotels and Restaurants (Table 4). On the

[15] With the exemption of Transportation. However, transportation cannot expand as it faces high indirect tax rates for energy transit fees that are excluded from the endogenous adjustment of indirect taxation in all scenarios.

contrary, we find the largest increase of imports for Agriculture and Hunting, Food-processing, and Fishery (Table 5).

Interestingly, if Agricultural goods are exempted from tariff reduction the industry-specific, results of our simulations do not differ significantly from the previous scenario (Scenario 2a). Even if it maintains its protection levels, agricultural production still declines in line with food production, which consumers replace by cheaper imports. This however is different if food products are excluded (Scenario 2b). In this case, Food processing industries maintain their high level of protection as well as their initial output level (Table 3). As a consequence, agricultural production declines by only 1% instead of by 6% in Scenario 2 while the output of all other beneficiaries of tariff reduction, mainly Metallurgy and metal processing, Producers of non-energy materials, and 'Other Production' increases at lower rates than under full tariff reduction. Finally, exclusion of food products from tariff reduction also hurts Hotels and restaurants that face higher relative prices for their intermediates.

Table 4
Impact of WTO Accession on exports

	Benchmark	Full WTO Accession	Only Tariff Reform			Only Improved market access	Only Tax Adjustments
			all goods	without agriculture	without food		
	- 0 -	- 1 -	- 2 -	- 2a -	- 2b -	- 3 -	- 4 -
Exports							
Agriculture, hunting	1.00	0.97	0.96	0.96	0.98	1.12	0.91
Fishery	1.00	0.35	0.58	0.58	0.57	0.95	0.67
Mining of coal and peat	1.00	0.48	1.05	1.05	1.02	0.99	0.46
Production of non-energy materials	1.00	1.22	1.10	1.10	1.04	1.03	1.07
Food-processing industries	1.00	0.93	0.92	0.91	1.00	0.95	1.06
Textile and leather industry	1.00	1.28	1.42	1.39	1.28	0.81	1.19
Woodworking, pulp and paper industry, publishing	1.00	0.92	0.98	0.98	0.99	0.91	1.03
Petroleum refinement	1.00	0.94	1.04	1.04	1.01	0.98	0.91
Manufacture of chemicals, rubber and plastic products	1.00	1.38	1.08	1.08	1.04	1.17	1.06
Manufacture of other non-metallic products	1.00	1.01	1.02	1.02	1.01	0.98	1.01
Metallurgy and metal processing	1.00	1.39	1.18	1.17	1.08	1.18	0.99
Manufacture of machinery and equipment	1.00	0.80	0.96	0.96	0.94	0.90	0.93
other	1.00	1.27	1.12	1.12	1.09	0.95	1.20
Electric energy	1.00	0.88	1.04	1.03	1.00	1.00	0.85
Construction	1.00	0.98	1.02	1.02	1.01	0.97	1.00
Trade	1.00	1.14	1.00	1.00	0.99	0.97	1.18
Hotels and restaurants	1.00	1.46	1.32	1.31	0.97	0.87	1.26
Transport	1.00	0.99	1.00	0.99	0.98	0.92	1.08
Post and telecommunications	1.00	0.90	0.99	0.99	0.98	0.95	0.96
Other services	1.00	0.92	0.99	0.99	0.99	0.96	0.97

Table 5
Impact of WTO Accession on imports

		Benchmark	Full WTO Accession	Only Tariff Reform			Only Improved market access	Only Tax Adjustments
		- 0 -	- 1 -	- 2 -	- 2a -	- 2b -	- 3 -	- 4 -
	Imports							
b01	Agriculture, hunting	1.00	1.53	1.42	0.94	1.52	1.03	1.07
b03	Fishery	1.00	1.35	1.52	1.52	1.52	1.02	0.91
b04	Mining of coal and peat	1.00	1.72	1.05	1.05	1.02	1.06	1.53
b06	Production of non-energy materials	1.00	1.31	1.17	1.16	1.09	1.14	0.97
b07	Food-processing industries	1.00	2.06	1.86	1.87	0.99	1.03	1.08
b08	Textile and leather industry	1.00	1.04	1.09	1.08	1.07	0.99	0.99
b09	Woodworking, pulp and paper industry, publishing	1.00	1.04	1.02	1.01	1.04	1.01	1.01
b11	Petroleum refinement	1.00	1.12	1.03	1.03	1.01	1.04	1.04
b12	Manufacture of chemicals, rubber and plastic products	1.00	1.03	1.02	1.02	1.02	1.01	1.00
b13	Manufacture of other non-metallic products	1.00	1.09	1.03	1.03	1.02	1.05	1.00
b14	Metallurgy and metal processing	1.00	1.10	1.05	1.05	1.02	1.03	1.00
b15	Manufacture of machinery and equipment	1.00	1.06	1.05	1.05	1.04	1.02	0.99
b16	other	1.00	1.01	1.01	1.01	1.01	1.04	0.95
b17	Electric energy	1.00	1.29	1.03	1.03	1.02	1.07	1.16
b21	Construction	1.00	1.01	1.01	1.01	1.01	1.03	0.97
b22	Trade	1.00	0.93	1.00	1.00	1.02	1.05	0.89
b23	Hotels and restaurants	1.00	0.94	0.93	0.93	1.00	1.03	0.98
b24	Transport	1.00	1.04	1.01	1.01	1.03	1.08	0.95
b25	Post and telecommunications	1.00	1.09	1.00	1.00	1.01	1.04	1.05
b26	Other services	1.00	1.05	1.01	1.01	1.01	1.04	1.01

Improving access for agricultural goods, steel products and chemical goods (Scenario 3) naturally leads to increased exports of those sectors (by more than 10% each, Table 4). On the other hand, exports of the Textile and leather industry – the main beneficiary of tariff reduction – declines the most, as tariffs are not reduced. Since Producers of steel, chemical goods as well as Textiles also export a large share of their domestic production, such changes in exports also imply significant output expansions for the former and an output decline for the latter (Table 3). In contrast, since agriculture exports only 9% of its production (Table B3), total output increases only by about 1% despite an increase in exports of about 12%.

Setting direct tax rates for all sectors on a uniform level within the adjustments of taxation (Scenario4) in particular reduces output of those sectors that initially benefited from subsidies. This is the case for Fishery that received subsidies of 7% as well as for Mining of coal and peat that received subsidies of 21%. Those industries decline by 24% and 18%, respectively (Table 3). In turn, the drop in mining output leads to a dramatic increase in imports by about 53%.

Equalizing indirect tax rates stimulates demand for goods with a high share in final and investment consumption (which is subject to indirect taxation) and high initial tax rates. This is in particular the case for food products with a tax rate of 23% (Table B4). Accordingly, higher demand stimulates both, domestic production (7%) as well as imports (8%). Furthermore, also Hotels and Restaurants that face an initial tax rate of 17% benefit.

As a consequence of increased import demand the real exchange rate rises by about 1%. This in turn stimulates exports so that adjusting domestic taxation also leads to higher output and export levels of the Textile and leather industry (by 16% and 19%) and Other Industrial Production (14% and 20%).

3.3 Higher Initial Agricultural Tariffs

As outlined above, commodity- and region-specific rates of import tariffs are weighted ad-valorem[16] tariffs calculated from the information given in the Custom tariffs of Ukraine. While such tariffs are the main instrument for almost all import regulations, this is different for agricultural commodities. In fact, the Cabinet of Ministers started in 1996 to implement specific duties[17] along with ad-valorem duties, thereby making combined tariffs[18] a common practice for agricultural commodities. By 2001 most of ad-valorem duties were abandoned leaving specific and combined tariffs as a prevalent means of import control. According to the OECD (2003), product groups such as wheat, beef, pork, butter, eggs and barley were subject to specific import duties in 2001, while imports of poultry meat, maize, sunflower seeds, fats and oils, and raw sugar were taxed by combined tariffs. Table 6 shows import duties (MFN) on main groups of

[16] Ad-valorem duty depends on value but not on quantity of an imported good; for example, 20%.

[17] Specific duty depends on quantity of imported good; for example, 2 €/kg.

[18] Combined duty is mix of ad-valorem and specific duty; for example 20% but no less than 2 €/kg.

agro-food imports, recalculated in ad-valorem terms as given in OECD (2003). Weighted by the share of each product group in total imports of agricultural commodities (column 1) this implies an average combined tariff equivalent of 67.4%, which is more than twice the level used in the study so far (27%, derived from own estimations of ad-valorem equivalents). The large magnitude of this difference – most likely due to availability of data, in particular for detailed commodity prices – demonstrates that the 'true' level of protection of agriculture is rather difficult to assess. To account for this problem, we re-calculate all our four scenarios based on the larger initial tariffs for agriculture as reported by the OECD.[19] Results from these additional calculations might serve as an upper limit.

Table 6
MFN Tariffs for Agricultural Commodities

Main groups of agro-food imports	Share in agricultural imports	Ad-valorem import duty (average by groups)	Combined import tariffs (ad-valorem terms, average by groups)	Weighted average
	-1-	-2-	-4-	-5-
Tobacco and products	14%	-	-	-
Cocoa and products	7%	-	-	-
Fats and oils	8%	30%	461%	36.9%
Meat and meat products	7%	40%	150%	10.5%
Fish and fish products	7%	-	-	-
Sugar and confectionery	12%	50%	135%	16.2%
Spirits and beverages	3%	-	-	-
Coffee, tea, spices	5%	-	-	-
Fruit	6%	-	-	-
Cereals	4%	60%	65%	2.6%
Eggs	2%	-	59%	1.2%
Other products	25%	0%	-	-
	100%			**67.4%**

Source: OECD (2003), own calculations

The results of this exercise are presented in Appendix C. For comparability, we report both, our previous results (denoted Situation A) as well as new

[19] Unfortunately, the OECD report only reports MFN tariff rates while no information for full tariffs is given. Since in principle, full tariffs account for about twice the level of the MFN rates, we set the full tariffs for imports of agricultural commodities at 120% (quantitatively, MFN rates are the more important ones since only about 10% of total imports of agricultural commodities are subject to full tariff rates).

results with higher initial tariffs on agricultural commodities (denoted Situation B). The most significant differences between old and new results are highlighted in the tables.

In principle, higher initial import tariffs for agriculture imply an additional level of protection for agricultural producers. Consequently, if those higher initial tariffs are reduced to the level intended by Ukrainian policy makers (to 19.4% according to Table 1), this leads to stronger quantitative effects as compared to Situation A. As our results show, this is the case for both, economy-wide as well as sector-specific effects.

First, GDP and welfare augments are higher when the initial tariffs on agricultural imports are higher: the GDP is increased by 2.7%, and welfare by 3.8%. The GDP increase is due to a higher rise in output in several industries (see the discussion below) and welfare gains are especially determined by higher wages for all groups of labour. Also, the consumer price index falls further and the real exchange rate depreciates slightly in situation B.

Second, agricultural producer suffer the most from reducing higher initial tariffs. Stronger competition causes agricultural output to fall by 14% (in situation B) rather than by 8% (in situation A). Agricultural imports magnifies dramatically (by 480% in situation B compared to 153% in situation A).

Third, textile and leather industry – which we already found to benefit most under WTO accession – further benefits if the initial protection levels for agriculture turn out to be even higher than assumed in Situation A. As we found, production and exports of leather and textile rise considerably in Situation B (145% comparing to 122% for output, and 155% comparing to 128% for exports).

Forth, food-processing industries faces a dual effect from WTO accession as they suffer from stronger competition but benefit from cheaper inputs of agricultural commodities. Hence, with prices for agricultural goods lower in Situation B (as compared to Situation A), overall effects on the food-processing sector are better in situation B. In particular, output falls less (5% reduction compared to 10%) and exports even change from a 7% reduction in Situation A to a 5% increase.

4 Summary and Conclusions

We have estimated economy-wide effects of Ukraine's accession to the WTO. Overall, we find that full WTO accession leads to welfare gains for around 3.0% of Ukrainian consumption and an increase ins GDP by 1.9%. This is mainly due to higher factor wages and lower consumer prices. While reduction of tariffs and the adjustments of domestic taxation are the main driving force behind our results, we find no significant economy-wide impact from improved market access for steel, agricultural and chemical goods. As for industry-specific results, output development under full WTO accession is largely driven by the effects of tariff reduction. Only for Metallurgy and Metal Processing as well as for Manufacture of chemicals, rubber and plastic products improved market access has a significant

impact on output levels under full WTO accession. On the contrary, Agriculture and hunting can benefit only little from improved market access because it looses much more from tariff reduction and adjustments of domestic taxation. Thus, agriculture faces an output reduction. Finally, we observe that the strong reduction of Mining of coal and peat under full WTO accession is mainly due to the loss in subsidies.

How do these results compare to the findings of other modeling exercises concerned about quantifying the impact of trade liberalization? Recently, CGE models have been frequently used to access the impact of changes in international trade policy such as the Uruguay round, the NAFTA, Mercosur, the Common European Market ("1992"), the Asia-Pacific Economic Cooperation (APEC), or the accession of single countries to the WTO. All models consistently find that reduction of trade barriers such as quotas and tariffs increases welfare as well as GDP, typically in a range of between 1% and 5%. However, comparing results of different models is difficult since they not only differ by the number of countries or the nature of the specific policies they cover, but also by several model characteristics such as static or dynamic contemplation, perfect or imperfect competition, explicit consideration of indirect effects of trade liberalization, e.g. on total factor productivity etc. For this reason, we concentrate on the results of two models that are similar to ours as they both report static economy-wide effects of WTO accession for a single country.

Ianchovichina and Martin (2001) model China's WTO accession. They concentrate attention on the changes in China's trade regime, in particular the elimination of entry barriers for foreign imports on Chinese markets, the reduction of weighted average tariffs by almost two third, and the reduction of China's aggregate measure of domestic support. They find that with such policy measures Chinese households will gain about 2.2% of their income (compared to not joining the WTO). Those changes will come along with an even larger increase of exports and imports. On a sectoral level, Chinese automobile sector and several high-tech sectors experience substantial export growth while imports of oilseeds, meat, and various food products increase significantly, reflecting a shift in comparative advantage away from agriculture. Finally, wages of both skilled and unskilled workers rise.

Jensen et al. (2003) studied the impact of Russia's WTO accession. In the comparative static estimation based on a Constant Returns to Scale model very similar to the one we use, they focus on tariff reduction as well as on improved market access for Ferrous metallurgy, Chemical producers and some other sectors.[20] Jensen et al. estimate static welfare gains of 0.5% of Russian consumption once tariffs are reduced by 50%. This is relatively similar to the welfare gains that we find under tariff reduction (Scenario 2). While we find somewhat larger welfare effects (1.3%), our simulation also foresees a bigger reduction of food tariffs (by 63%), which we find to be of crucial importance (see Scenario 2b). Furthermore, both studies suggest

[20] In a second model version Jensen et al. (2003) use a model specification with increasing returns to scale and product differentiation to study the effect of scale economies under tariff reduction and improved market access as well as implications for investments. Results from those exercises however are not further commented here as they are not comparable to ours.

that gains from trade (tariff reduction) for Russia as well as for Ukraine have greater welfare implications than improved market access.

Thus, results of our model appear to be consistent with the findings of other, similar studies that focus on quantifying the typical 'gains from trade' due to improved domestic resource allocation. But how are our results to be interpreted in comparison with the findings of studies that quantify further effects of WTO accession, in particular through improved factor productivity or reduced barriers for trade/foreign direct investment in services? As already stated at the beginning of the previous section, most of such arguments are so far built upon purely theoretical work. Nevertheless, first results derived from rather stylized models such as Brown and Stern (2001), Markusen et al. (2002) or Dee et al. (2003) indicate that the quantitative importance of those effects is significant and most likely even more important than the standard 'gains from trade' as estimated in our model. In line with such arguments, Jensen et al. (2003) estimate the total gains to Russia from WTO accession at 7.4% of Russian consumption in the medium run (comparable to our modeling horizon), and at up to 24% in the long run. According to the authors, almost three-quarters of those welfare gains are due to FDI liberalization. Nevertheless, such results are still rather indicative since they are based on several critical assumptions. Furthermore, they crucially depend on availability of quantitative information such as the extent of barriers to FDI, which is not readily available for the case of Ukraine. For this reasons, an elaboration of welfare gains from FDI liberalization under Ukraine's WTO accession would have gone beyond the limits of the present study and was therefore left to future research.

Some further critical comments on our estimates of 'gains from trade' from Ukraine's WTO accession are in order. First, while from the perspective of the model replacing domestic mining activities with imports once subsidies are eliminated (Scenario 4) is straightforward, the real picture is quite a different one. The weak performance of the mining (in particular coal) industry, which needs to be compensated for by means of direct subsidies, is not a purely economic outcome but rather the consequence of policy failures. In particular, state regulation intends to keep domestic coal prices at levels below their costs (as well as below world market prices) and to directly compensate coal mines for their losses. This system is further eroded through various rent seeking activities.[21] Thus, elimination of coal subsidies also requires that output prices be freed at the same time (current political developments go slowly towards this direction). Within the model this means that the relative output price for mining increases exogenously, to the benefit of Ukraine's mining industry. However, a serious quantification of the extent to which benefits from increased relative prices compensate mines for losses in subsidies, as well as an estimation of economy-wide effect of higher coal prices on industries and

[21] For more details on the problems of Ukraine's coal industry see e.g. German Advisory Group (2004): Ukrainian steam coal: Not competitive or just mismanaged? Advisory Paper T19, Kiev (available at http://www.ier.kiev.ua/English/advis_eng.cgi). The World Bank (2003): The Major Problems of Development of the Coal Sector and the Donbas Region. Concise Report, Kiev.

households requires deeper empirical work that goes much beyond the scope of this study.

A further problem concerns the modeling of agriculture, the second sector that stands to loose in almost all scenarios. Here, while the results might still be valid on aggregate, a more detailed analysis should distinguish between livestock and crop production, as well as between different types of farms. Such a specification will help to more accurately identify potential winners and losers from WTO accession in agriculture. Given the social and political importance of this sector, such results are a necessary input for the WTO discussion in Ukraine.

Finally, a more elaborate assessment of economy-wide effects of Ukraine's WTO accession should also consider further particularities of Ukraine's economy such as unemployment and rigidities on factor markets, economies of scale in e.g. key industries such as steel, or the impact of reduced cross-subsidization of energy prices and utility tariffs for households by industries. Also, a separation of households by income would be desirable more accurately address social issues or WTO accession.

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Appendix A:

The Model

Consumers:

There are *n* identical consumers in the economy. Utility of a representative consumer is given by a Cobb-Douglas utility function:

$$U = \sum \theta_j \log(C_j), \quad (1)$$

where C_j is consumption of good *j* and θ_j denotes its share in total consumption.

Consumers are endowed with capital ($\overline{K}$) and labor ($\overline{L}_s$), and receive transfers from the government (T_{hh}^G) and from abroad (T_{hh}^a). Labor is divided into three types (subscript *s*): unskilled (*us*), skilled (*sk*), and high-skilled (*hs*). Consumers rent out their capital and labor endowments to production and receive the following income (*M*):

$$M = \sum_s w_s \overline{L_s} + r\overline{K} + T_{hh}^G + T_{hh}^a, \quad (2)$$

where w_s and *r* are prices of labor (by skill level) and capital.

The optimization problem of the representative consumer is to choose non-negative levels of consumption to maximize its utility at given level of income:

$$\max_{C_j \geq 0, \forall j} U \qquad \text{st.} \qquad \sum_j p_j(1+\tau_j)C_j \leq \theta M, \quad (3)$$

where p_j is the market price index for good *j* net of consumption tax, τ_j is the rate of consumption tax for good *j*, and θ denotes the constant share of consumption in total income (with $0 < \theta < 1$), while (1-θ) is the share of private savings (SAV^{hh}).

Producers:

Each sector (industry) *i* in our model produces one good *j* (*i,j* ∈ *I*). Sectors use capital (k_i), labour (l_i) and intermediate inputs (ID_{ij}) for production. All production factors are perfectly mobile and all sectors use a nested Leontieff production function:

$$y_i = \min\left\{VA_i, ID_{ij}\right\}, \tag{4}$$

where ID_{ij} is the intermediate demand for good *j* by industry *i*, and VA_i is value added given by the Cobb-Douglas function $VA_i = xk_i^{\left(1-\sum_s \alpha_{s,i}\right)} \prod_s l_{s,i}^{\alpha_{s,i}}$ (with $0 \le \alpha_{s,i} \le 1$ and $\sum_s \alpha_{s,i} \le 1$ and $x>0$).

Each sector maximizes its profits by choosing non-negative values of inputs (capital, labor, and intermediate inputs) subject to its production function (4):

$$\max_{l_{s,i},k_i,ID_{ij}} \hat{p}_i y_i - \left(rk_i + \sum_s w_s l_{s,i}\right)(1+\tau_i) - \sum_j p_j ID_{ij}, \tag{5}$$

where $\hat{p}_i$ denotes the price index for output[22] of sector *i*, τ_i is the rate of direct taxes on capital and labor inputs in sector *i*, and p_j is the price for intermediate inputs of good *j*.

External sector:

Domestic supply of good *j* consists of domestically produced (D_j) and imported goods (IM_j). The substitution possibilities are described by the following constant-elasticity-of-substitution (CES) function:

$$DS_j = \psi_j \left(\beta D_j^{\rho_{IM}} + (1-\beta) IM_j^{\rho_{IM}}\right)^{\frac{1}{\rho_{IM}}}, \quad \psi_j > 0, \quad 0 < \beta < 1 \tag{6}$$

[22] Total output of a sector consists of sales on domestic markets plus exports.

with $\rho_{IM} = (\sigma_{IM} - 1)/\sigma_{IM}$, where σ_{IM} denotes the elasticity of substitution. The index of the domestic market price for good *j* is determined by the import price ($p_{IM,j}$), import tariffs ($\tau_{IM,j}$), and the domestic sales price ($p_{D,j}$):

$$p_j = f\left(p_{D,j}, p_{IM,j}(1+\tau_{IM,j})\right), \tag{7}$$

where the import price equals the (foreign-currency denominated) CIF world market price ($\overline{p}_{IM,j}$) times the price index of foreign exchange ($p_{IM,j} = \overline{p}_{IM,j} p_{fx}$).

Domestic production can be either sold on domestic markets (H_i) or abroad (EX_i). The transformation possibilities are described by the following constant-elasticity-of- transformation (CET) function:

$$Y_i = \psi_i \left(\gamma H_i^{\rho_{EX}} + (1-\gamma) EX_i^{\rho_{EX}}\right)^{\frac{1}{\rho_{EX}}}, \quad \psi_i > 0, \quad 0 < \gamma < 1 \tag{8}$$

with $\rho_{EX} = (\sigma_{EX} - 1)/\sigma_{EX}$, where σ_{EX} denotes the elasticity of transformation. The output price index of sector *i* is determined by domestic ($p_{H,i}$) and export prices ($p_{EX,i}$):

$$\hat{p}_i = f\left(p_{H,i}, p_{EX,i}\right), \tag{9}$$

where the export price equals the (foreign-currency denominated) FOB world market price ($\overline{p}_{EX,i}$) times the price index of foreign exchange ($p_{EX,i} = \overline{p}_{EX,i} p_{fx}$).

Investments:

Aggregate investment (INV) is a Cobb-Douglas composite over goods *j*:

$$INV = \Psi \prod_j INV_j^{\phi_j}, \quad \phi_j \geq 0, \quad \sum_j \phi_j = 1, \quad \Psi > 0 \tag{10}$$

The corresponding weighted price index for one unit of the aggregate investment good is given by $p_{inv} = f\left(p_j\left(1+\tau_j\right)\right)$.

Government:

The government receives revenues from direct and indirect taxes and import tariffs, and from transfers from abroad (T_G^a). It uses income for savings ($p_{inv}SAV^G$), transfers to households (T_{hh}^G) and to provide public goods ($\sum_j p_j G_j$). Thus, the public budget constraint is given by

$$\begin{aligned}&\sum_i \tau_i\left(rk_i + \sum_s w_{s,i} l_i\right) + \sum_j \tau_{IM,j} p_{IM,j} IM_j + \sum_j \tau_j p_j \left(C_j + INV_j\right) + T_G^a \\ &= \sum_j p_j G_j + p_{inv} SAV^G + T_{hh}^G\end{aligned} \qquad (11)$$

where consumption levels of public goods (G_j) are derived from a Cobb-Douglas function so that the expenditure shares for each commodity *j* are constant.

Market Clearing:

Market clearing on factor and commodity markets means that for each market demand fully equals supply. In particular:

- Total labor endowments by skill equal aggregate demand for labor by industry and skill level:

$$\overline{L}_s = \sum_i l_{s,i} \qquad (12)$$

- Total capital endowment equals the demand for capital by industry:

$$\overline{K} = \sum_i k_i \qquad (13)$$

- For each good j, the sum of imports plus domestic sales equal intermediate demand, final household demand, public demand plus investment demand:

$$\mathrm{I}M_{\mathrm{j}} + \mathrm{D}_{\mathrm{j}} = \sum_i \mathrm{ID}_{\mathrm{ij}} + \mathrm{C}_{\mathrm{j}} + \mathrm{G}_{\mathrm{j}} + \mathrm{I}NV_j \tag{14}$$

Model Closure:

Aggregate investment equals the sum of public and private savings minus the current account balance:

$$p_{inv}\left(SAV^G + SAV^{hh}\right) - CA = p_{inv} INV \tag{15}$$

Aggregate public savings (SAV^G), the current account balance (CA), transfers between government and households (T_{hh}^G), as well as transfers between government or households and abroad (T_G^a, T_{hh}^a) are constant.

The real value of public goods ($\sum_j p_j G_j$) remains constant. This is ensured by endogenous adjustment of the indirect tax rate (τ_j) in equation (11).

The CIF value of imports plus the (constant) current account balance (CA) equal the FOB value of exports plus (constant) transfers from abroad:

$$\sum_j \overline{p}_{IM,j} IM_j + CA = T_{hh}^a + T_G^a + \sum_i \overline{p}_{EX,i} Ex_i \tag{16}$$

Normalization:

Since all supply and demand functions are homogenous of degree zero in prices, one price (the so-called numeraire) has to be fixed exogenously while all other endogenous price variables define the change relative to this numeraire. The choice of the numeraire as such has no impact on the results. In our model, we choose the price index for investment goods (p_{inv}).

Appendix B:

Table B1 Classification of Activities and Goods in the Model and in Ukraine's Input-Output Tables

Table B2 Structure of Ukraine's economy (2001)

Table B3 Structure of output and input (2001)

Table B4 Structure of value added and taxation (2001)

Table B5 Aggregation of countries into major trading partner

Table B1
Classification of Activities and Goods in the Model and in Ukraine's Input-Output Tables

Model Classification	Input-Output Classification
a01 Agriculture, hunting	**a01** Agriculture, hunting
a03 Fishery	**a03** Fishery
a04 Mining of coal and peat	**a04** Mining of coal and peat
a06 Production of non-energy materials	**a06** Production of non-energy materials
a07 Food-processing	**a07** Food-processing
a08 Textile and leather	**a08** Textile and leather
a09 Forestry, wood working, pulp and paper industry, publishing	**a09** Wood working, pulp and paper industry, publishing **a02** Forestry
a11 Petroleum refinement, manufacture of coke products, production of hydrocarbons	**a11** Petroleum refinement **a10** Manufacture of coke products **a05** Production of hydrocarbons
a12 Manufacture of chemicals, rubber and plastic products	**a12** Manufacture of chemicals, rubber and plastic products
a13 Manufacture of other non-metallic mineral products	**a13** Manufacture of other non-metallic mineral products
a14 Metallurgy and metal processing	**a14** Metallurgy and metal processing
a15 Manufacture of machinery and equipment	**a15** Manufacture of machinery and equipment
a16 Other production	**a16** Other production
a17 Electric energy	**a17** Electric energy
a20 Utility supply (water, gas, heat)	**a20** Water supply **a18** Gas supply **a19** Heat supply
a21 Construction	**a21** Construction
a22 Trade	**a22** Trade
a23 Hotels and restaurants	**a23** Hotels and restaurants
a24 Transport	**a24** Transport
a25 Post and telecommunications	**a25** Post and telecommunications
a26 Other services	**a26** Financial intermediation **a27** Real estate transactions **a28** Renting **a29** Informatisation activities **a30** Research and development **a31** Services to legal entities **a32** Public administration **a33** Education **a34** Health care and social assistance **a35** Sewage, cleaning of streets and refuse disposal **a36** Socail activities **a37** Recreational, entertainment, cultural and sporting activities **a38** Other activities **a39** Financial intermediation services indirectly measured

Explanations:

- Service sectors (Financial intermediation, Real estate transactions, Renting, Information activities, Research and development, Services to legal entities, Public administration, Education, Health care and social assistance, Sewage, cleaning of streets and refuse disposal, Social activities, Recreational, entertainment, cultural and sporting activities, Other service activities) are added to a single service activity / commodity.
- "Manufacture of coke products" (Activity/Commodity 10) has been added to "Production of hydrocarbons" and "Petroleum refinement" (Activity/Commodity 5 and 11, respectively) because of negative return to capital for "Manufacture of coke products".
- "Heat supply" (Activity/Commodity 19) has been added to "Water supply" and "Gas Supply" (Activity/Commodity 20 and 18, respectively) because of negative return to capital for "Heat supply".
- "Forestry" (Activity/Commodity 2) has been added to "Wood working, pulp and paper industry, publishing" (Activity/Commodity 9) since a separation of exports and imports of "Forestry" by destination and origin is not possible.

Table B2
Structure of Ukraine's economy (2001)

Activities / Commodities	Share in … value added	total exports (by activity)	total imports (by commodity)
Agriculture, hunting	0.16	0.05	0.01
Fishery	0.00	0.00	0.00
Mining of coal and peat	0.02	0.01	0.02
Production of non-energy materials	0.01	0.03	0.02
Food-processing industries	0.05	0.07	0.05
Textile and leather industry	0.01	0.04	0.06
Woodworking, pulp and paper industry, publishing	0.02	0.02	0.04
Petroleum refinement	0.03	0.05	0.31
Manufacture of chemicals, rubber and plastic products	0.02	0.08	0.11
Manufacture of other non-metallic products	0.01	0.01	0.01
Metallurgy and metal processing	0.04	0.30	0.08
Manufacture of machinery and equipment	0.05	0.12	0.18
other	0.00	0.03	0.00
Electric energy	0.05	0.00	0.00
Public utilities	0.01	0.00	0.00
Construction	0.04	0.00	0.02
Trade	0.12	0.00	0.00
Hotels and restaurants	0.01	0.01	0.01
Transport	0.10	0.16	0.02
Post and telecommunications	0.03	0.00	0.00
Other services	0.22	0.02	0.06
Total	**1.00**	**1.00**	**1.00**

Source: National Accounts / Input Output table for 2001; own calculation

Table B3
Structure of output and input (2001)

Code			Output (in %)			Input (in %)			
			Domestic sales	Exports	Total	intermediate demand	Value added	Depreciation	Total
a01	b01	Agriculture, hunting	0.91	0.09	**1.00**	0.56	0.44	0.00	**1.00**
a03	b03	Fishery	0.83	0.17	**1.00**	0.65	0.30	0.05	**1.00**
a04	b04	Mining of coal and peat	0.95	0.05	**1.00**	0.70	0.29	0.01	**1.00**
a06	b06	Production of non-energy materials	0.54	0.46	**1.00**	0.75	0.25	0.00	**1.00**
a07	b07	Food-processing industries	0.83	0.17	**1.00**	0.82	0.18	0.00	**1.00**
a08	b08	Textile and leather industry	0.29	0.71	**1.00**	0.60	0.27	0.13	**1.00**
a09	b09	Woodworking, pulp and paper industry, publishing	0.65	0.35	**1.00**	0.64	0.36	0.00	**1.00**
a11	b11	Petroleum refinement	0.80	0.20	**1.00**	0.81	0.17	0.02	**1.00**
a12	b12	Manufacture of chemicals, rubber and plastic products	0.35	0.65	**1.00**	0.78	0.22	0.00	**1.00**
a13	b13	Manufacture of other non-metallic products	0.82	0.18	**1.00**	0.68	0.32	0.00	**1.00**
a14	b14	Metallurgy and metal processing	0.21	0.79	**1.00**	0.78	0.19	0.03	**1.00**
a15	b15	Manufacture of machinery and equipment	0.41	0.59	**1.00**	0.60	0.36	0.04	**1.00**
a16	b16	other	0.44	0.56	**1.00**	0.87	0.13	0.00	**1.00**
a17	b17	Electric energy	0.98	0.02	**1.00**	0.53	0.47	0.00	**1.00**
a20	b20	Public utilities	1.00	0.00	**1.00**	0.75	0.25	0.00	**1.00**
a21	b21	Construction	0.99	0.01	**1.00**	0.60	0.40	0.00	**1.00**
a22	b22	Trade	1.00	0.00	**1.00**	0.43	0.57	0.00	**1.00**
a23	b23	Hotels and restaurants	0.43	0.57	**1.00**	0.56	0.44	0.00	**1.00**
a24	b24	Transport	0.46	0.54	**1.00**	0.42	0.58	0.00	**1.00**
a25	b25	Post and telecommunications	0.94	0.06	**1.00**	0.33	0.67	0.00	**1.00**
a26	b26	Other services	0.97	0.03	**1.00**	0.41	0.59	0.00	**1.00**

Source: National Accounts / Input-Output table for 2001; own calculations

Table B4
Structure of value added and taxation (2001)

	Structure of value added (in %):					
Activities / Commodities	**capital**	**unskilled labor**	**skilled labor**	**highskilled labor**	**Direct tax (activities)**	**Indirect tax (commodities)**
Agriculture, hunting	0.81	0.15	0.02	0.02	0.00	0.05
Fishery	0.29	0.47	0.14	0.10	-0.07	0.09
Mining of coal and peat	0.24	0.43	0.18	0.15	-0.21	0.31
Production of non-energy materials	0.12	0.50	0.21	0.18	0.06	-0.18
Food-processing industries	0.49	0.29	0.12	0.10	0.04	0.23
Textile and leather industry	0.44	0.32	0.13	0.11	0.03	0.00
Woodworking, pulp and paper industry, publishing	0.47	0.30	0.13	0.11	0.02	0.01
Petroleum refinement	0.76	0.13	0.06	0.05	0.05	0.41
Manufacture of chemicals, rubber and plastic products	0.39	0.34	0.14	0.12	0.04	-0.03
Manufacture of other non-metallic products	0.30	0.40	0.17	0.14	0.03	0.21
Metallurgy and metal processing	0.43	0.32	0.14	0.11	0.04	-0.13
Manufacture of machinery and equipment	0.33	0.38	0.16	0.13	0.02	0.05
other	0.23	0.43	0.18	0.15	0.07	0.10
Electric energy	0.74	0.15	0.06	0.05	-0.01	0.10
Public utilities	0.15	0.48	0.21	0.16	0.04	0.24
Construction	0.40	0.37	0.12	0.10	0.03	0.09
Trade	0.57	0.17	0.15	0.10	0.07	0.13
Hotels and restaurants	0.50	0.25	0.16	0.09	0.05	0.17
Transport	0.56	0.28	0.09	0.07	0.03	1.55
Post and telecommunications	0.61	0.21	0.10	0.08	0.01	0.13
Other services	0.32	0.18	0.18	0.31	0.02	0.04

Source: National Accounts / Input-Output table for 2001; own calculations

Table B5
Aggregation of countries into major trading partner

Region	Country
1. New EU Member Countries	
Free Trade	Estonia
	Latvia
	Lithuania
MFN tariff rates	Poland
	Slovenia
	Hungary
	Slovakia
	Czech Republic
Full tariff rates	Malta
	Cyprus
2. Asia	
MFN tariff rates	Vietnam
	Sri Lanka
	Israel
	Iran
	China
	Korea (North)
	South Korea
	Lebanon
	Mongolia
	United Arab Emirates
	India
	Indonesia
	Turkey
	Syria
	Japan
3. CIS (excl. Russia)	
Free trade	Azerbaijan
	Belarus
	Kyrgyzstan
	Moldova
	Armenia
	Georgia
	Kazakhstan
	Tajikistan
	Uzbekistan
	Turkmenistan
4. Russia (Free trade)	Russian Federation
5. EU15	
MFN tariff rates	Luxemburg
	UK
	Greece
	Ireland
	Belgium
	Denmark
	Spain
	Netherlands
	Portugal
	Austria
	Italy
	Sweden
	Finland
	France

Table B5 (cont.)
Aggregation of countries into major trading partner

	Germany
6. North America	
MFN tariff rates	USA
	Canada
7. Rest of the World	
Full tariff rates	**All other countries**

Appendix C:

Table C1 Impact of WTO Accession on economy wide variables

Table C2 Impact of WTO Accession on aggregate output by activity

Table C3 Impact of WTO Accession on exports

Table C4 Impact of WTO Accession on imports

Table C1
Impact of WTO Accession on economy wide variables

Initial results (Situation A)

	Benchmark	Full WTO Accession	all goods	Only Tariff Reform without agriculture	without food	Only Improved market access	Only Domestic Tax Reform
	- 0 -	- 1 -	- 2 -	- 2a -	- 2b -	- 3 -	- 4 -
Welfare (Equivalent Variation, change in %)	-	3.0	1.2	1.1	0.0	0.3	1.3
GDP Index (change in %)	-	1.9	1.3	1.3	0.1	0.3	0.3
Tariff revenue (share of public budget)	9%	6%	5%	5%	6%	9%	10%
Indirect tax revenue (share of public budget)	50%	35%	55%	54%	53%	50%	30%
indirect tax rate (weighted average*)	12%	10%	13%	13%	13%	12%	8%
Consumer Price Index (change in %)	-	-4.09	-0.61	-0.53	0.61	0.15	-3.35
Producer Price Index (change in %)	-	0.79	-0.57	-0.52	-0.13	0.01	1.59
Real exchange rate (change in %)	-	0.29	0.10	0.09	0.11	-0.47	0.90
Real factor return (change in %):							
- Return to capital	-	2.33	0.34	0.35	-0.15	0.35	1.65
- Wage rate for unskilled labor	-	3.86	1.78	1.62	0.09	0.27	1.56
- Wage rate for skilled labor	-	4.24	2.13	1.92	0.14	0.21	1.59
- Wage rate for highskilled labor	-	3.40	1.95	1.75	0.06	0.09	1.11
Aggregate exports (UAH bn)	113.24	128.51	121.83	121.36	116.53	116.76	115.22
Aggregate imports (UAH bn)	109.92	125.21	118.51	118.05	113.22	113.41	111.97
Total exports (change in %)	-	13.48	7.58	7.17	2.90	3.11	1.75
Total imports (change in %)	-	13.91	7.81	7.39	3.00	3.17	1.86

Higher agricultural tariffs (Situation B)

	Benchmark	Full WTO Accession	all goods	Only Tariff Reform without agriculture	without food	Only Improved market access	Only Domestic Tax Reform
	- 0 -	- 1 -	- 2 -	- 2a -	- 2b -	- 3 -	- 4 -
Welfare (Equivalent Variation, change in %)	-	3.8	2.0	1.1	0.9	0.3	1.3
GDP Index (change in %)	-	2.7	2.1	1.2	0.9	0.3	0.3
Tariff revenue (share of public budget)	10%	6%	6%	6%	7%	10%	10%
Indirect tax revenue (share of public budget)	49%	34%	54%	54%	52%	49%	30%
indirect tax rate (weighted average*)	12%	9%	13%	13%	12%	12%	8%
Consumer Price Index (change in %)	-	-4.55	-1.23	-0.54	-0.08	0.15	-3.19
Producer Price Index (change in %)	-	0.67	-0.81	-0.54	-0.41	0.01	1.75
Real exchange rate (change in %)	-	0.60	0.27	0.07	0.30	-0.47	1.05
Real factor return (change in %):							
- Return to capital	-	2.39	0.49	0.35	-0.02	0.35	1.58
- Wage rate for unskilled labor	-	5.27	3.11	1.59	1.51	0.27	1.60
- Wage rate for skilled labor	-	6.06	3.80	1.89	1.93	0.22	1.66
- Wage rate for highskilled labor	-	5.10	3.51	1.72	1.74	0.09	1.18
Aggregate exports (UAH bn)	113.24	131.78	124.84	121.34	119.90	116.76	115.32
Aggregate imports (UAH bn)	109.92	128.50	121.54	118.03	116.60	113.41	112.08
Total exports (change in %)	-	16.36	10.24	7.15	5.88	3.11	1.83
Total imports (change in %)	-	16.90	10.57	7.37	6.08	3.17	1.96

Source: own estimations.

Table C2

Impact of WTO Accession on aggregate output by activity

Initial results (Situation A)

	Benchmark	Full WTO Accession	Only Tariff Reform			Only Improved market access	Only Domestic Tax Reform
			all goods	without agriculture	without food		
	- 0 -	- 1 -	- 2 -	- 2a -	- 2b -	- 3 -	- 4 -
	Output						
a01	Agriculture, hunting	1.00	0.92	0.94	0.95	0.99	1.01	0.98
a03	Fishery	1.00	0.41	0.57	0.57	0.56	0.98	0.76
a04	Mining of coal and peat	1.00	0.88	1.05	1.05	1.02	1.02	0.82
a06	Production of non-energy materials	1.00	1.21	1.09	1.09	1.03	1.06	1.04
a07	Food-processing industries	1.00	0.90	0.86	0.85	0.99	0.98	1.07
a08	Textile and leather industry	1.00	1.22	1.35	1.32	1.23	0.84	1.16
a09	Woodworking, pulp and paper industry, publishing	1.00	0.93	0.96	0.96	0.97	0.94	1.03
a11	Petroleum refinement	1.00	1.01	1.04	1.04	1.01	1.00	0.96
a12	Manufacture of chemicals, rubber and plastic products	1.00	1.28	1.06	1.05	1.02	1.12	1.05
a13	Manufacture of other non-metallic products	1.00	1.04	1.02	1.02	1.01	1.01	1.01
a14	Metallurgy and metal processing	1.00	1.34	1.16	1.16	1.07	1.15	0.99
a15	Manufacture of machinery and equipment	1.00	0.82	0.95	0.95	0.94	0.92	0.94
a16	other	1.00	1.20	1.09	1.09	1.06	0.97	1.14
a17	Electric energy	1.00	1.06	1.04	1.03	1.01	1.03	0.99
a20	Public utilities	1.00	1.08	1.02	1.01	1.01	1.02	1.04
a21	Construction	1.00	1.00	1.01	1.01	1.01	1.00	0.98
a22	Trade	1.00	1.03	1.00	1.00	1.00	1.01	1.02
a23	Hotels and restaurants	1.00	1.34	1.23	1.22	0.98	0.90	1.20
a24	Transport	1.00	1.00	1.00	1.00	0.99	0.95	1.05
a25	Post and telecommunications	1.00	0.99	1.00	1.00	0.99	0.99	1.00
a26	Other services	1.00	0.98	1.00	1.00	1.00	0.99	0.99

Higher agricultural tariffs (Situation B)

	Benchmark	Full WTO Accession	Only Tariff Reform			Only Improved market access	Only Domestic Tax Reform
			all goods	without agriculture	without food		
	- 0 -	- 1 -	- 2 -	- 2a -	- 2b -	- 3 -	- 4 -
	Output						
a01	Agriculture, hunting	1.00	0.86	0.89	0.95	0.93	1.01	0.97
a03	Fishery	1.00	0.41	0.57	0.57	0.57	0.98	0.76
a04	Mining of coal and peat	1.00	0.89	1.06	1.05	1.03	1.02	0.82
a06	Production of non-energy materials	1.00	1.22	1.10	1.09	1.04	1.06	1.04
a07	Food-processing industries	1.00	0.95	0.90	0.85	1.04	0.98	1.07
a08	Textile and leather industry	1.00	1.45	1.58	1.32	1.43	0.84	1.18
a09	Woodworking, pulp and paper industry, publishing	1.00	0.94	0.98	0.96	0.99	0.94	1.03
a11	Petroleum refinement	1.00	1.02	1.05	1.03	1.02	1.00	0.96
a12	Manufacture of chemicals, rubber and plastic products	1.00	1.29	1.07	1.05	1.03	1.12	1.05
a13	Manufacture of other non-metallic products	1.00	1.04	1.02	1.02	1.02	1.01	1.01
a14	Metallurgy and metal processing	1.00	1.36	1.17	1.16	1.09	1.15	0.99
a15	Manufacture of machinery and equipment	1.00	0.82	0.94	0.95	0.93	0.92	0.94
a16	other	1.00	1.20	1.09	1.09	1.07	0.97	1.14
a17	Electric energy	1.00	1.07	1.04	1.03	1.02	1.03	0.99
a20	Public utilities	1.00	1.09	1.02	1.01	1.01	1.02	1.04
a21	Construction	1.00	1.00	1.02	1.01	1.01	1.00	0.99
a22	Trade	1.00	1.04	1.01	1.00	1.01	1.01	1.02
a23	Hotels and restaurants	1.00	1.44	1.32	1.22	1.05	0.90	1.20
a24	Transport	1.00	1.01	1.01	1.00	1.00	0.95	1.05
a25	Post and telecommunications	1.00	0.99	1.00	1.00	1.00	0.99	1.00
a26	Other services	1.00	0.98	1.00	1.00	1.00	0.99	0.99

Source: own estimations

Table C3

Impact of WTO Accession on exports

Initial results (Situation A)

		Benchmark	Full WTO Accession	all goods	Only Tariff Reform without agriculture	without food	Only Improved market access	Only Domestic Tax Reform
		- 0 -	- 1 -	- 2 -	- 2a -	- 2b -	- 3 -	- 4 -
	Exports							
b01	Agriculture, hunting	1.00	0.97	0.96	0.96	0.98	1.12	0.91
b03	Fishery	1.00	0.35	0.58	0.58	0.57	0.95	0.67
b04	Mining of coal and peat	1.00	0.48	1.05	1.05	1.02	0.99	0.46
b06	Production of non-energy materials	1.00	1.22	1.10	1.10	1.04	1.03	1.07
b07	Food-processing industries	1.00	0.93	0.92	0.91	1.00	0.95	1.06
b08	Textile and leather industry	1.00	1.28	1.42	1.39	1.28	0.81	1.19
b09	Woodworking, pulp and paper industry, publishing	1.00	0.92	0.98	0.98	0.99	0.91	1.03
b11	Petroleum refinement	1.00	0.94	1.04	1.04	1.01	0.98	0.91
b12	Manufacture of chemicals, rubber and plastic products	1.00	1.38	1.08	1.08	1.04	1.17	1.06
b13	Manufacture of other non-metallic products	1.00	1.01	1.02	1.02	1.01	0.98	1.01
b14	Metallurgy and metal processing	1.00	1.39	1.18	1.17	1.08	1.18	0.99
b15	Manufacture of machinery and equipment	1.00	0.80	0.96	0.96	0.94	0.90	0.93
b16	other	1.00	1.27	1.12	1.12	1.09	0.95	1.20
b17	Electric energy	1.00	0.88	1.04	1.03	1.00	1.00	0.85
b21	Construction	1.00	0.98	1.02	1.02	1.01	0.97	1.00
b22	Trade	1.00	1.14	1.00	1.00	0.99	0.97	1.18
b23	Hotels and restaurants	1.00	1.46	1.32	1.31	0.97	0.87	1.26
b24	Transport	1.00	0.99	1.00	0.99	0.98	0.92	1.08
b25	Post and telecommunications	1.00	0.90	0.99	0.99	0.98	0.95	0.96
b26	Other services	1.00	0.92	0.99	0.99	0.99	0.96	0.97

Higher agricultural tariffs (Situation B)

		Benchmark	Full WTO Accession	all goods	Only Tariff Reform without agriculture	without food	Only Improved market access	Only Domestic Tax Reform
		- 0 -	- 1 -	- 2 -	- 2a -	- 2b -	- 3 -	- 4 -
	Exports							
b01	Agriculture, hunting	1.00	0.96	0.96	0.96	0.98	1.12	0.91
b03	Fishery	1.00	0.36	0.59	0.58	0.57	0.95	0.67
b04	Mining of coal and peat	1.00	0.48	1.05	1.05	1.02	0.99	0.46
b06	Production of non-energy materials	1.00	1.22	1.10	1.10	1.04	1.03	1.06
b07	Food-processing industries	1.00	1.05	1.02	0.91	1.10	0.95	1.06
b08	Textile and leather industry	1.00	1.55	1.69	1.39	1.52	0.81	1.21
b09	Woodworking, pulp and paper industry, publishing	1.00	0.94	1.00	0.98	1.01	0.91	1.04
b11	Petroleum refinement	1.00	0.95	1.06	1.04	1.03	0.98	0.91
b12	Manufacture of chemicals, rubber and plastic products	1.00	1.40	1.10	1.08	1.05	1.17	1.06
b13	Manufacture of other non-metallic products	1.00	1.01	1.03	1.02	1.02	0.98	1.01
b14	Metallurgy and metal processing	1.00	1.41	1.19	1.17	1.10	1.18	0.99
b15	Manufacture of machinery and equipment	1.00	0.79	0.95	0.96	0.94	0.90	0.93
b16	other	1.00	1.28	1.13	1.12	1.09	0.95	1.20
b17	Electric energy	1.00	0.89	1.05	1.03	1.02	1.00	0.85
b21	Construction	1.00	0.99	1.02	1.02	1.01	0.97	1.00
b22	Trade	1.00	1.16	1.01	1.00	1.00	0.97	1.18
b23	Hotels and restaurants	1.00	1.60	1.44	1.31	1.07	0.87	1.26
b24	Transport	1.00	1.00	1.01	0.99	0.99	0.92	1.08
b25	Post and telecommunications	1.00	0.91	1.01	0.99	0.99	0.95	0.96
b26	Other services	1.00	0.91	0.99	0.99	0.98	0.96	0.97

Source: own estimations

Table C4
Impact of WTO Accession on imports

Initial results (Situation A)

		Benchmark	Full WTO Accession	Only Tariff Reform		Only Improved market access	Only Domestic Tax Reform
				all goods	without agriculture	without food		
		- 0 -	- 1 -	- 2 -	- 2a -	- 2b -	- 3 -	- 4 -
	Imports							
b01	Agriculture, hunting	1.00	1.53	1.42	0.94	1.52	1.03	1.07
b03	Fishery	1.00	1.35	1.52	1.52	1.52	1.02	0.91
b04	Mining of coal and peat	1.00	1.72	1.05	1.05	1.02	1.06	1.53
b06	Production of non-energy materials	1.00	1.31	1.17	1.16	1.09	1.14	0.97
b07	Food-processing industries	1.00	2.06	1.86	1.87	0.99	1.03	1.08
b08	Textile and leather industry	1.00	1.04	1.09	1.08	1.07	0.99	0.99
b09	Woodworking, pulp and paper industry, publishing	1.00	1.04	1.02	1.01	1.04	1.01	1.01
b11	Petroleum refinement	1.00	1.12	1.03	1.03	1.01	1.04	1.04
b12	Manufacture of chemicals, rubber and plastic products	1.00	1.03	1.02	1.02	1.02	1.01	1.00
b13	Manufacture of other non-metallic products	1.00	1.09	1.03	1.03	1.02	1.05	1.00
b14	Metallurgy and metal processing	1.00	1.10	1.05	1.05	1.02	1.03	1.00
b15	Manufacture of machinery and equipment	1.00	1.06	1.05	1.05	1.04	1.02	0.99
b16	other	1.00	1.01	1.01	1.01	1.01	1.04	0.95
b17	Electric energy	1.00	1.29	1.03	1.03	1.02	1.07	1.16
b21	Construction	1.00	1.01	1.01	1.01	1.01	1.03	0.97
b22	Trade	1.00	0.93	1.00	1.00	1.02	1.05	0.89
b23	Hotels and restaurants	1.00	0.94	0.93	0.93	1.00	1.03	0.98
b24	Transport	1.00	1.04	1.01	1.01	1.03	1.08	0.95
b25	Post and telecommunications	1.00	1.09	1.00	1.00	1.01	1.04	1.05
b26	Other services	1.00	1.05	1.01	1.01	1.01	1.04	1.01

Higher agricultural tariffs (Situation B)

		Benchmark	Full WTO Accession	Only Tariff Reform		Only Improved market access	Only Domestic Tax Reform
				all goods	without agriculture	without food		
		- 0 -	- 1 -	- 2 -	- 2a -	- 2b -	- 3 -	- 4 -
	Imports							
b01	Agriculture, hunting	1.00	4.80	4.52	0.94	4.83	1.03	1.06
b03	Fishery	1.00	1.36	1.52	1.52	1.52	1.02	0.91
b04	Mining of coal and peat	1.00	1.75	1.06	1.05	1.03	1.06	1.53
b06	Production of non-energy materials	1.00	1.33	1.18	1.16	1.12	1.14	0.97
b07	Food-processing industries	1.00	1.99	1.80	1.86	0.95	1.03	1.08
b08	Textile and leather industry	1.00	1.08	1.13	1.08	1.10	0.99	0.99
b09	Woodworking, pulp and paper industry, publishing	1.00	1.06	1.03	1.01	1.05	1.01	1.02
b11	Petroleum refinement	1.00	1.12	1.03	1.03	1.02	1.04	1.04
b12	Manufacture of chemicals, rubber and plastic products	1.00	1.04	1.02	1.02	1.02	1.01	1.00
b13	Manufacture of other non-metallic products	1.00	1.11	1.04	1.03	1.03	1.05	1.00
b14	Metallurgy and metal processing	1.00	1.11	1.05	1.05	1.03	1.03	1.00
b15	Manufacture of machinery and equipment	1.00	1.06	1.05	1.05	1.04	1.02	0.99
b16	other	1.00	1.01	1.02	1.01	1.02	1.04	0.95
b17	Electric energy	1.00	1.29	1.03	1.03	1.02	1.07	1.16
b21	Construction	1.00	1.02	1.02	1.01	1.02	1.03	0.97
b22	Trade	1.00	0.93	1.00	1.00	1.01	1.05	0.89
b23	Hotels and restaurants	1.00	0.92	0.91	0.93	0.99	1.03	0.98
b24	Transport	1.00	1.03	1.01	1.01	1.02	1.08	0.95
b25	Post and telecommunications	1.00	1.09	1.00	1.00	1.01	1.04	1.06
b26	Other services	1.00	1.06	1.01	1.01	1.02	1.04	1.01

Source: own estimations