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Modeling Economic, Social and Environmental Implications of a Free Trade Agreement between the European Union and the Russian Federation

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Abstract

The EU-Russia Partnership and Cooperation Agreement, which entered into force in 1997 foresees the possible establishment of a free trade area (FTA) between the parties. The aim of our study is to evaluate the possible economic, social and environmental impact of such a free trade agreement between the European Union and Russia.

The results of the analysis indicate that an EU-Russia FTA will be beneficial to the Russian Federation and the EU27. Some sectors are expected to contract in the medium term, but their importance in total output is small. Over the long run, the majority of sectors in Russia are expected to expand, while only a few sectors in the EU27 are expected to register negligible decreases in output. We estimate that welfare losses from the environmental damages would be very small for Russia (possibly even smaller due to the implementation of greener technologies), and negligible for the EU. Despite some significant negative medium-term social implications in selected sectors in Russia, the overall increase in economic activity and wages, coupled with likely domestic policies aiming at easing the impact of transitional unemployment, are expected to allow for the overall reduction in poverty rates. Overall, the results show that significant welfare gains (2.24% of GDP for Russia) would accrue from the deep FTA scenario involving a significant reduction of NTBs along with additional flanking measures, particularly on competition, IPR protection and corruption, which would help re-branding of Russia as a safe and attractive investment location. Also a number of countries such as Finland, Ireland, Netherlands, Denmark, Estonia, Slovakia, Slovenia and Sweden are expected to see their welfare increase by around 0.5% of GDP.

1. Introduction

The EU-Russia Partnership and Cooperation Agreement, which entered into force in 1997 foresees the possible establishment of a free trade area (FTA) between the parties. The aim of our study[1] is to evaluate the possible economic, social and environmental impact of such a free trade agreement between the European Union and Russia.

The financial and economic crisis that started in the fall 2008 has radically changed the prospects of Russia's economic growth. The main challenges now facing the Russian economy are returning to macroeconomic stability and growth, restoring confidence in the rouble, preventing a systemic crisis in the banking sector, and the rising unemployment and poverty. The anti-crisis steps undertaken by the Government of Russia and the Bank of Russia at the end of 2008 and beginning of 2009 helped avoiding the financial collapse. But overcoming the crisis in Russia's economy will be possible only after stabilization of the global economy and global financial system. Domestically, the most important factor will be improvement of the overall business climate and ability to attract foreign investments and technologies to modernize the economy.

The results of our study indicate that an EU-Russia FTA will be beneficial to the Russian Federation and the EU27. Some sectors are expected to contract in the medium term, but their importance in total output is small. Over the longer run, the majority of sectors in Russia are expected to expand, while only a few sectors in the EU27 are expected to register negligible decreases in output. We estimate that welfare losses from the environmental damages will be very small for Russia (possibly even smaller due to the implementation of greener technologies), and negligible for the EU. Despite some significant negative medium-term social implications in selected sectors in Russia (textiles, coal), the overall increase in economic activity and wages, coupled with likely domestic policies aiming at easing the impact of transitional unemployment, are expected to allow for the overall reduction in poverty rates. Overall, our results show that significant welfare gains (2.24% for Russia) would accrue from the Deep FTA+ involving a significant

[1] This paper has greatly benefited from the comments and suggestions of Marek Dabrowski, David Dyker, Michael Emerson and Peter Holmes. We would also like to thank Olga Izryadnova and Nadezhda Volovik for their contributions to sections 2 and 6.

reduction of NTBs along with additional flanking measures, particularly on competition, IPR protection and corruption, which would help re-branding of Russia as a safe and attractive investment location. In the Deep FTA+ scenario a number of countries such as Finland, Ireland, Netherlands, Denmark, Estonia, Slovakia, Slovenia and Sweden are expected go see their welfare increase by at least 0.5% of GDP.

Our modeling exercise does not incorporate directly foreign direct investment flows. However, as indicated in several parts of the report, the implications of an FTA (economic, social and environmental) would have been more positive if FDI was factored in. The inflow of foreign investment would improve output potential and efficiency of production, foreign companies with their green technologies could contribute to improvement of the quality of environment in Russia and by employing local labor force in large proportion, mitigate any negative implications of the FTA on employment.

There is a considerable uncertainty surrounding our assumptions, but the analysis indicates that despite rising protectionist pressures in the current economic crisis the conclusion of a FTA with the EU would have not exacerbated existing problems, but could provide a solid contribution to long term economic growth.

2. Economic and Trade Developments in Russia and EU-Russia Economic Relations

Between 2003 and 2007 Russia's economy posted impressive growth, with average annual growth rates for GDP of 7%; for investment nearly 14%, and household consumption 11%. However during 2008, as result of the global financial crisis and accompanying collapse of commodity prices, this trend slowed from 8.5% in the 1st quarter down to 1.1% in the 4th quarter. (See Appendix 1 Table 1)[2].

By the beginning of 2009 the crisis was spreading across the economy. The construction, transportation sectors and industrial production sectors suffered most. According to Rosstat, in the 4th quarter 2008, comparing to the 4th quarter 2007, the volume of industrial output and of commercial cargo turnover in the transportation sector had declined by 6-7%. The volume of investments in December 2008 was 2.3% down compared with December 2007.

The financial and economic crisis that started in the fall 2008 has thus radically changed the prospects of Russia's economic growth. The main challenges now facing Russian economy in 2009 are:

1. The loss of the macroeconomic stability: the federal budget deficit is envisioned to be within the range of 8-10% of GDP according to the IET estimates (after a steady surplus over the past 7 years).
2. A possible systemic crisis in the banking sector: by IET estimates, the proportion of non-performing loans may reach 20-25%.
3. The loss of confidence in the Russian national currency: the dollarization of Russia's economy started to grow again in the fall 2008 and was fuelled by the CBR's policy of gradual depreciation of the ruble against the bi-currency (USD and EUR) basket. The depreciation of the ruble also contributed to inflation acceleration due to high share of consumer imports.

[2] The study was completed in July 2009 hence the discussion is based on the economic developments up to mid-2009.

4. A potential rise in unemployment and the social tension. More specifically, in the machine-building industry, the slump across some kinds of products resulted in numerous shutdowns, particularly in the so-called "mono-towns".

The anti-crisis steps currently undertaken by the Government of Russia and the Bank of Russia might help keep the economy for falling off the cliff. However, they have appeared insufficient to ensure macroeconomic stabilization and renew positive growth rates in the environment of global crisis. Overcoming the crisis in Russia's economy will be possible only after stabilization of the global economy and global financial system. Domestically, the most important factor will be improvement of the overall business climate and ability to attract foreign investments and technologies to modernize the economy.

The financial crisis has also stopped the inflow of foreign investment. While in 2001-2007 Russia became attractive for portfolio investors, and the spread on Russia's bonds fell considerably, this is now reversed. In December 2008, S&P downgraded Russia's sovereign rating from BBB+ to BBB, with the "negative" outlook. The Agency believes that the "downgrading of the rating highlights on risks associated with a sharp shrinkage of foreign reserves and other investment flows, which has resulted in rising costs of, and difficulties in meeting the nation's need in external financing".

In 2008, Russia saw an inflow of foreign investments accounting for USD 103.8bn in total. That was at 14.2% down vis-à-vis the respective 2007 level (see Appendix 1 Table 2 and Appendix 1 Figure 1). The 2008 the leading sources of foreign investments in Russia were Cyprus, UK, the Netherlands, Germany and Luxembourg (however the investments form Cyprus and Luxembourg are believed to be largely repatriated Russian flight capital). The highest rate of foreign investment growth – 2.1 times vis-à-vis the respective 2007 index – came from Germany. Investors from Cyprus mostly focused on the real estate sector, trade, financial operations and construction. Until mid-2008 the trade between Russia and the EU have been growing steadily (see Appendix 1 Figure 2 and Appendix 1 Figure 3).

The trade turnover increased by 55% over the first half of 2008 and accounted for Euro 192bn (Russian exports rose in value by 57% due to high commodity prices, and imports from the EU by 50%). But in the second half of 2008 trade turnover plummeted, with the January 2009 down by 50% compared to January 2008.

In May 2008, the Bank of Russia modified procedures of interventions on foreign exchange market. In addition to intraday operations to back the value of the bi-currency basket, the CBR began to carry out regular foreign exchange interventions, depending on the state of affairs on the financial markets in Russia and overseas.

In late-2008, the Government of RF issued a Resolution on changing custom tariffs for certain motor vehicles. The Resolution was adopted in the frame of a package of measures on mitigating the crisis effects on the domestic automakers and it raised import duties on passenger vehicles and trucks. Foreign automakers that do not have production facilities in Russia (Mitsubishi, Mazda, and Nissan) as well as luxury cars producers (Mercedes-Benz, BMW, Audi, Volvo) will most suffer from the new restrictions.

The Most Favorable Nation (MFN) clause regulates the Russia-EU trade (based on PCA) secure application of the EU Common External Tariff (CET) to EU import from Russia. These rates appear to be far lower than the so-called basic or autonomous rates of CET. In reality, since 1993 the EU has granted Russia de-facto a preferential regime with regard to the customs duties on Russian goods. Notably, this regime has not been fixed by any respective bilateral agreement, but constituted an act of good will on the part of the EU.

More positively, 1 July 2007 saw entry into force since July 1, 2007 of the EU-Russia agreements on visa facilitation and readmission signed at the EU-Summit in Sochi on May 25, 2006.

On November 14, 2008, Nice hosted the 22nd Russia-EU Summit. In addition to the review of the EU-Russia relations, the agenda included cooperation in fighting global financial crisis, the role played by the Russia-EU partnership in the Euro-Atlantic security architecture, and other international issues.

The Summit also endorsed the policy package on preventing climate changes. The parties signed a respective agreement where the EU commits to a reduction of CO_2 emissions by 20% until 2020 comparing to the 1999 level through developing renewable energy sources. Russian Federation, which ratified Kyoto Protocol, should reduce emissions of greenhouses gases not less than to 5 % from level of 1990 during the period 2008-2012.

As concerns the Russia-EU cooperation in the sphere of energy, the January 2009 gas conflict between Russia and Ukraine became a major shock for the EU, with 80% of its sag imports from Russia coming via Ukraine. Some member states totally dependent on Russian gas supplies, such as Bulgaria, were cut off for weeks. This second supply interruption involving Ukraine has reinforced the momentum in favor of the EU's internal energy policy and search for diversification.

As of December 1, 2008, Russia had completed bilateral negotiations on terms and conditions of market access for goods and services with all the members of the Working Group on Russia's accession to the WTO. The Russian side had hoped for completion of the multilateral negotiations on systemic issues by the end of 2008, in order to join in the Organization already in 2009. However, a series of political and economic developments, including the change of the US Administra-

tion, the Doha Round, and the conflict with Georgia, the global financial and economic downturn, and the tariff import measures described above have caused delays in the negotiation process. In spite of the negative global outlook, the Government of RF reiterated several times its will to join the WTO.

3. CGE Simulations

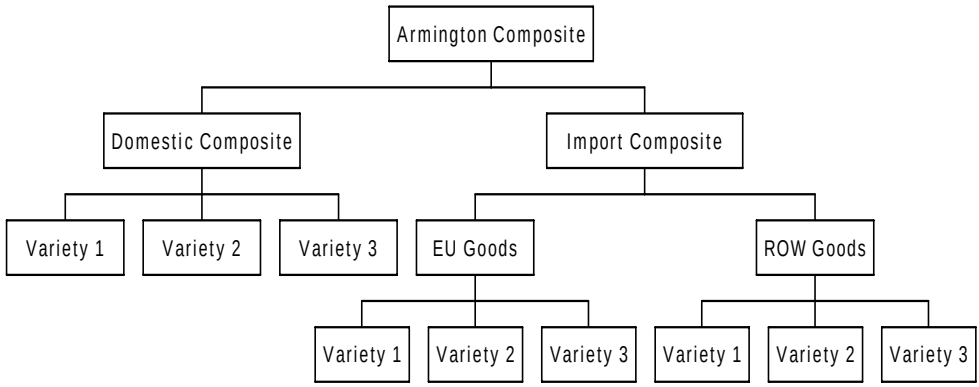
3.1. CGE Model

The model employed in this study is a standard static computable general equilibrium model. It includes several price-wedge distortions such as factor taxes in production, value-added taxes, import tariffs and export subsidies. Factor taxes in production and value-added taxes remain unchanged across simulations. Production involves a combination of intermediate inputs and primary factors (capital, skilled and unskilled labor). We assume a Constant Elasticity of Substitution (CES) function over primary factors and a Leontief production function combining intermediate inputs with factors of production composite. Primary factors are mobile across sectors within a region, but immobile internationally. Each region has a government, whose revenue is held constant at the benchmark level and a single representative consumer. The trade balance is also held constant in counterfactual simulations.

Demand for final goods arises from a Cobb-Douglas utility function. The demand structure is illustrated in Figure 3.1. Within each region, final and intermediate demands are composed of the same Armington aggregate of domestic and imported varieties. The composite supply is a nested CES function, where consumers first allocate their expenditures among domestic and imported varieties and then choose among imported varieties. In the imperfect competition case firm varieties enter at the bottom of the CES function. This approach allows for the differentiation in preferences for home and imported goods.

A detailed description of the model equations, calibration and parameters employed is provided in the Appendix 2.1. It is built on the basis of the MRT – Multiregional Trade Model – by Harrison, Rutherford and Tarr (HRT) implemented in their evaluation of the impact of the completion of the Single Market (HRT, 1996b), but has been modified in several ways to fit this analysis. The same model was employed in the 2007 study (Dabrowski, Emerson & Maliszewska, 2007). Similar analysis has been recently applied in Trade Sustainability Impact Assessment study of the Free Trade Agreement within the Enhanced Agreement between the EU and Ukraine prepared for DG Trade by Ecorys and CASE-Ukraine (2007) and in EU-Georgia and EU-Armenia FTA feasibility studies prepared by CASE and Global Insight (Maliszewska, 2008a, 2008b).

Figure 3.1. Demand structure in the IRTS scenario – firm level product differentiation within an Armington aggregate



Source: HRT (1996a).

Data originates from the GTAP7 data base benchmarked to 2004. The GTAP tariff protection data has been updated based on Trains. The benchmark data base includes Russia, Ukraine, all individual EU27 members (with Cyprus and Malta aggregated as one entity) and the Rest of the World. It includes 40 sectors out of which 12 are subject to increasing returns to scale.

In each simulation we calculate the impact of a given trade policy change assuming increasing returns to scale in selected sectors and the long run impact (allowing for the adjustment of capital stock in response to a change in return to capital). The calculation of steady state growth effects follows HRT (1996a). In the short run scenarios (not included in this analysis) the price of capital is allowed to vary within each country, while capital stock is held constant. In the steady state scenario capital stock in all countries is allowed to adjust, while the price of capital is held constant at its benchmark level. This approach assumes that there exists invariant capital stock equilibrium. It is defined as a set of prices, production and investment levels for which the economy is able to grow at a steady rate with constant relative prices.

This approach provides an upper bound of the potential welfare gains as it ignores the adjustment costs and foregone consumption necessary to increase investment. For sufficiently high discount rates the costs of forgone consumption could overturn the benefits of capital accumulation. Although in the steady state scenarios, as well as in the short run scenarios we measure welfare as equivalent variation as a share of GDP, it has to be born in mind that incorporation of the cost of the investment required to build up the capital stock may substantially reduce the estimates of welfare gains cited below. On the other hand our approach does

not incorporate the potential gains due to productivity improvements or endogenous growth theory "learning by doing" effects.

In any case the CGE simulations should not be treated as a forecast of future developments. They provide a good indications of the economic implications of the given policy change *ceteris paribus* i.e. not incorporating any other factors that might influence the economy in the future.

We first apply the CGE model to study the implications of the WTO accession, which forms the benchmark for further analysis and the Deep FTA. Each scenario is discussed in turn. We start with a presentation of the benchmark trade protection.

3.2. Status quo trade protection regime

Present Russian trade policy is based on a framework Customs Code[3] law which came into force on January 1st, 2004. This law was developed in order to modernize Russian trade legislation and to eliminate contradictions with WTO rules.

The benchmark dataset contains data on effective tariff rates for 2005. The calculation of effective tariff rates was based on the most disaggregated level imports statistics (10 digits of the HS code) and corresponding combined tariff rates.

Both import volumes and tariff revenues were aggregated according to a concordance between HS and ISIC classifications. Tariff rates were calculated as a ratio of import volumes and tariff revenues for each ISIC sector in the model. The resulting level of tariff protection is displayed in the Table 1.

Table 1. Benchmark and post-WTO tariff levels by sectors

	2005 Average weighted tariffs on imports from		Post-WTO Average weighted tariffs on imports from	
	EU27	ROW	EU27	ROW
Grains	3.9	4.4	2.9	3.3
vegetables fruit nuts	11.1	10.3	4.9	4.6
sugar cane sugar beet plant-based fibers crops NEC	6.3	5.4	6.3	5.4
forestry fishing	13.7	13.5	3.7	3.5
Coal	11.3	10.1	5.0	5.0

[3]The Customs Code of the Russian Federation (http://www.tamognia.ru/customs_code/)

	2005 Average weighted tariffs on imports from		Post-WTO Average weighted tariffs on imports from	
	EU27	ROW	EU27	ROW
Oil	5.0	5.0	5.0	5.0
Gas	5.0	5.0	5.0	5.0
Minerals NEC	5.0	5.0	3.9	3.6
Bovine cattle sheep and goat meat products	5.0	4.9	5.0	5.0
Vegetable oils and fats, processed rice, food products NEC	8.9	9.3	5.0	5.3
Dairy products	11.0	9.9	5.0	4.5
Beverages and tobacco products	16.8	17.3	5.0	5.2
Textiles	11.1	11.0	8.2	9.3
Wearing apparel	13.6	13.4	7.4	8.4
Leather products	10.0	10.1	6.1	6.0
Wood products	15.3	15.5	4.5	4.1
Paper products publishing	11.6	11.3	3.9	4.5
Petroleum coal products	5.0	5.0	4.3	3.4
Chemical rubber plastic products	8.3	8.4	4.2	3.6
Mineral products NEC	14.3	14.4	8.5	8.8
Ferrous metals	7.9	8.2	6.2	2.5
Metals NEC	11.0	10.9	6.2	2.4
Metal products	13.2	13.2	7.3	6.5
Motor vehicles and parts	7.9	7.6	3.4	3.3
Transport equipment NEC	11.3	11.3	2.9	1.7
Electronic equipment	8.3	8.3	8.1	8.1
Machinery and equipment NEC	8.5	8.6	8.1	8.1
Manufactures NEC	16.0	16.1	8.8	8.8
AVERAGE	9.9	9.8	5.5	5.2

Source: 2005 – WITS, post-WTO own calculations. NEC – not elsewhere classified.

3.3. WTO accession terms

During the bilateral stage of the negotiations process Russia's accession offers were kept secret. Even now in the stage of the multilateral negotiations Russian final accession tariff structure is not being discussed in public. Thus, the task of calculating Russia's post-WTO tariffs cannot be an exact exercise. Using some rough guidelines offered by the DG Trade for the study by Dabrowski, Emerson & Maliszewska (2007) we were able to calculate the post-WTO tariff rates as in Table 1. Average tariff rates on imports from the EU and the ROW are expected to fall from around 9% to 5%. In several sectors the average tariff on imports from

the EU and the ROW is expected to be reduced by up to 70%. These sectors include forestry and fishing, beverages and tobacco, wood and paper products, transport equipment NEC.

Modeling of Russia's WTO accession means a counterfactual experiment in which the present Russian tariff schedule is changed for the post-WTO one. Tariffs in Russian trade with Ukraine are set to zero in accordance with a FTA between the two countries. Assessment of the effects is based on the comparative statics of two equilibria: the benchmark equilibrium and a resulting equilibrium after the change of the Russian tariff structure. In addition, in the WTO scenario we assume a 25% reduction in barriers to foreign provision of services as discussed below.

3.4. WTO Accession and Deep FTA

The Russia's WTO accession is assumed to precede EU-Russia FTA creation. Thus it is the post-WTO Russian tariff structure that is changed as a result of a FTA.

One of the studies ordered by the European Commission before completion of the Single Market looked at the perception of EC producers as to the importance of barriers to be removed by the formation of the Single Market. It showed that the elimination of physical frontiers, costs and delays, harmonization of national standards and regulations, and government procurement were the most important barriers to trade before 1992. Similar conclusions were reached after a survey of barriers to exports to the EU faced by the Ukrainian exporters (see Jakubiak et. al. 2006). Elimination or lessening of these impediments to trade will also likely bring major benefits to Russia especially if it gains improved access to the Single Market thanks to the creation of the Deep FTA covering NTBs. In modeling of the Deep FTA we focus on reduction in border costs and delays, as well as reduction in costs of compliance with varying national standards and technical regulations. In addition we also study the impact of a reduction of barriers to provision of services by foreigners.

3.4.1. Border costs[4]

One of the most observable barriers to trade is due to the existence of borders and customs formalities, which involve delays and various kinds of administrative

[4] The following sections 2.4.1-2.4.3 are to a large extent based on the 2007 report.

costs. At the moment all goods from Russia exported to the EU and vice versa are stopped at the EU border for customs clearance. In the CGE exercise border costs are modeled as additional purchases of a domestic transportation service, which includes shipping, handling and warehousing for customs purchases.

It is expected that border costs in terms of time and money spent will be reduced together with implementation of the Deep FTA. Currently, export and import procedures in Russian Federation take on average nearly 40 days. It is reasonable to expect that as a result of improvement of the quality of the customs service and convergence of legislation and practices, these costs will fall to the level of Bulgaria and Romania in a year before their accession to the EU, i.e. in 2006 (see Table 2)[5]. This is to say that border costs will decrease roughly by 50%.

Table 2. Border costs in Russian Federation, Ukraine, Bulgaria and Romania in 2006

	Bulgaria	**Romania**	**Russian**	**Ukraine**
Export procedures:				
duration (days)	26	14	39	33
costs (USD)	1,233	1,300	2,237	1,009
Import procedures:				
duration (days)	25	14	38	46
costs (USD)	1,201	1,200	2,238	1,025

Note. border costs include expenses connected with preparation of documents, inland transportation and handling, customs clearance and technical control, ports and terminal handling.
Source: WB Costs of Doing Business database

For the CGE modeling, it is assumed that benchmark border costs in Russia are roughly double those for Ukraine. This is based on the comparison of border costs per shipment from Table 2. Ukrainian border costs are approximated by the costs of customs clearance faced by the Ukrainian exporters to the EU in 2006 (Jakubiak et al 2006). These costs amounted on average to 7% of the value of exports, hence the benchmark border costs for Russian exporters are assumed to be equal to 14% of the value of exports. In the Deep FTA these costs are assumed to be reduced by 50% and then further reduced in the long term to only 25% of their benchmark level. In line with the findings of the 2007 report we do not include any reductions of border on standard costs as a result of the WTO Accession.

[5] Bulgaria and Romania in 2006 – similarly as Russian Federation in the CIS – were relatively well integrated in the Balkan region (due to a network of regional FTAs), but nevertheless border controls existed. Yet, due to their accession in 2007, they have made progress in harmonizing their customs regulations with the EU. This outcome is expected in RF in some 10-15 years.

3.4.2. Standards costs

The EC has been concerned with the elimination of the technical barriers to trade since its creation. However, the major effort of elimination of barriers to trade imposed by differing national regulations and standards was undertaken with the creation of the Single Market. The differences in technical regulations and standards, which vary between domestic and the EU markets, require producers to manufacture or package goods in forms, which are different than for their domestic markets. Standardization costs therefore increase the cost of production for exports and they are modeled as additional value added in each sector where trade takes place. This approach ignores the fixed cost elements of implementation of new standards. However, these are mostly one-off investments and even though for a few companies these costs might be significant, there is no data available on their magnitude.

CASE and CASE-UA conducted a survey on NTBs faced by Ukrainian exporters to the EU (Jakubiak et al 2006). Among others, respondents (over 500 companies) were asked to assess costs associated with meeting EU technical standards and the duplication of efforts related to compliance with both national and the EU standards (existing for the majority of surveyed firms). As both countries (Russian Federation and Ukraine) are highly integrated, are at the similar level of development, and their 'national' standards are either the same (in large part they date back to the Soviet times) or alike, Ukrainian results can be used here. Costs of meeting EU standards for Ukrainian producers are given in Table 3.

Table 3. Costs of compliance with the EU norms in 2006

NACE	Industry	Survey of ukrainian firms (Jakubiak et al 2006)	
		% of production costs	number of firms that answered
01	Agriculture, hunting and related service activities	14.0	3
02	Forestry, logging and related service activities	7.0	11
14	Other mining and quarrying	n/a	0
15	Manufacture of food products and beverages	10.4	9
16	Manufacture of tobacco products	n/a	0
17	Manufacture of textiles	2.3	3
18	Manufacture of wearing apparel; dressing and dyeing of fur	34.4	8
19	Tanning and dressing of leather; manufacture of luggage, and footwear	5.3	3
20	Manufacture of wood and of products of wood and cork	20.9	22

NACE	Industry	Survey of ukrainian firms (Jakubiak et al 2006)	
		% of production costs	number of firms that answered
21	Manufacture of pulp, paper and paper products	15.0	2
22	Publishing, printing and reproduction of recorded media	0.0	0
23	Manufacture of coke, refined petroleum products and nuclear fuel	10.0	1
24	Manufacture of chemicals and chemical products	5.5	4
25	Manufacture of rubber and plastic products	5.6	5
26	Manufacture of other non-metallic mineral products	29.3	6
27	Manufacture of basic metals	5.0	1
28	Manufacture of fabricated metal products, except machinery and equipment	6.4	5
29	Manufacture of machinery and equipment n.e.c.	4.4	7
30	Manufacture of office machinery and computers	n/a	0
31	Manufacture of electrical machinery and apparatus n.e.c.	11.0	5
32	Manufacture of radio, television and communication equipment and apparatus	10.0	2
33	Manufacture of medical, precision and optical instruments, watches and clocks	20.0	1
34	Manufacture of motor vehicles, trailers and semi-trailers	12.3	3
35	Manufacture of other transport equipment	4.0	2
36	Manufacture of furniture; manufacturing n.e.c.	15.3	4
37	Recycling	5.5	2
Total/average		**13.9**	**109**

Note. * - simple average.
Source: own calculations and assumptions based on survey described in Jakubiak et al (2006).

To answer the question of whether TBTs will increase or decrease, as a result of forming the Deep FTA, it is useful to recall the experience of EU countries:

- First of all, one must note that although the EU countries share the same technical standards, the compliance with technical standards still imposes some costs on producers. It was estimated that even for the 'old' EU members the cost of TBTs was as high as 2-2.4% of the EU GDP (Cecchini 1988).
- The experience of new EU members may be particularly useful here. Central and Eastern European countries (CEECs) started to align their

standards with those of the EU in early 1990s. By 2004 the legislation concerning technical standards of the eight new EU members[6] was harmonized with the EU law. It is rational to assume that costs of TBTs faced by Russian producers to the EU market would be reduced to a level closer to the costs of the CEEC producers in early 2000s, once the harmonization of standards envisaged in a FTA is implemented.

Data provided by the WB Technical Barriers to Trade database (based on a survey, see Table 4) suggests that costs of compliance with technical regulations in the Czech Republic and Poland in early 2000s were on average 4 times lower that the costs faced now by Ukrainian firms. We believe that a reduction in the costs of compliance with technical requirements to reach the CEECs level would be excessive in a 5-10 year perspective and instead assume a reduction by 25% and a reduction by 50% in the long term perspective (10-15 years).

Table 4. Costs to comply with technical requirements as a share of sales in Poland and in Czech Republic in 2001

NACE	Product group	Costs of coping with technical requirements in % of sales	Number of firms that answered
151	Meat products	0.7%	1
15, 16	Processed food and tobacco	3.6%	5
17, 18	Textiles and apparel	0.5%	6
24	Industrial or agricultural chemicals	5.4%	5
13, 27	Primary metal and metallic ores	1.8%	1
28	Fabricated metal	7.9%	1
31	Electrical and electrical equipment	5.8%	9
32	Telecommunications and terminal equipment	0.7%	4
Total/average		**3.5%**	**32**

Note. It was impossible to distinguish between answers of 0 costs associated with the lack of a particular barrier and no answer. For this reason, only answers indicating the existence of some costs were treated as valid. The results may be thus biased upwards.
Source: own calculations based on World Bank Technical Barriers to Trade database. Results for Czech Republic and Poland averaged across industries.

The estimates in Jakubiak et. al. (2006) are based on a survey of Ukrainian exporters to the EU. We do not know of similar estimates for the other export destinations for the Russian products and in any case the impact of a Russia-EU FTA on the costs of complying with regulations of other importing partners is not clear.

[6] Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia.

Hence in the simulations we assume that these costs apply only to exports to the EU. Any harmonization of legislation with the EU, wider availability of conformity assessment centers and hence lower prices of certification that would follow an EU-Russia FTA would lead to a reduction of these costs for Russian exporters to the EU. On the other hand, for Russian firms which have been producing only for domestic market, the introduction of EU regulations, in some cases stricter than domestic regulation, may impose additional investment. A certain part of this investment will be undertaken in the normal course of replacing existing equipment over the coming years. However, in some cases the costs of compliance may be significant. Nevertheless even those firms are likely to benefit from the ability to export to the enlarged EU and wider availability of the assessment centers. Overall, it seems likely that all firms will experience some reduction in standards costs. This was certainly the case of the EU firms with completion of the internal market.

3.4.3. Barriers to trade in services

We base our estimates on the barriers to foreign direct investment in services estimated by Kimura et. al. (2004). The authors estimate tariff equivalents of barriers that discriminate against foreign providers of telecommunication, transport and financial services. We model those barriers as additional purchases of value added in the amount equal to tariff equivalents by exporters or providers of those services from all the remaining regions (Ukraine, EU27 and the ROW). Hence we assume that in order to provide transport services in Russia foreign companies face costs higher by 17% than local provides. The additional costs in communications amount to 5%, financial services 29%, insurance 68%. In simulations we assume that all foreign providers of services will gain an improved access to the Russian market following a Deep EU-Russia FTA. Hence these barriers are also reduced with respect to Ukrainian and ROW providers of services.

In the light of specific provisions for given types of services (see section on investment for details), one can expect the barriers to trade and investment in services sectors will not be fully eliminated as a result of the WTO accession. It seems that access to services markets for foreign investors could be substantially improved in a broader framework of a Deep EU-Russia FTA with a set of flanking measures improving competition, lowering corruption and improving overall business environment. Hence we assume only a 25% reduction in the barriers to foreign investment in Russia as a result of the WTO accession with further 50-75% reduction resulting from the Deep FTA with the EU depending on a time frame of the analysis i.e. 5-10 and 10-15 years respectively.

Finally, the comprehensive set of reforms resulting from the Deep FTA along with more wide-ranging flanking measures e.g. on competition and corruption could lead to a re-branding of Russia as a more favorable investment location. Hence in our scenario Deep FTA with a long term perspective of 10-15 years we assume that Russia would achieve a notable reduction in the perceived risk premium on investment. We illustrate this by assuming a 2.5% decrease in the price of capital. We refer to the long run implications of the Deep FTA as a "Deep FTA+". A similar approach has been adopted in the study on the Eastern EU Enlargement (Baldwin, Francois & Portes, 1997) and in the feasibility study for the EU-Ukraine FTA (CEPS, 2006), where a reduction of the price of capital of 15% and 10% was assumed. By those standards our assumption of 2.5% is quite conservative. We look at the implications of a less conservative assumption on the improvement in the business environment in the last section of this chapter.

In the last section of this chapter we look at the potential flows of FDI into Russia following the Deep FTA trying to put our simulated capital expansion as a result of the Deep FTA+ into perspective of likely inflows of foreign capital.

The above discussion of modeling assumptions has been summarized in the Table 5.

Table 5. Summary of modeling assumptions

	Benchmark 2004	**WTO accession 0-5 years perspective**	**Deep FTA 5-10 years perspective**	**Deep FTA+ 10-15 years perspective**
Tariffs	Initial levels as described above	Post WTO tariffs	Post WTO tariffs on imports from the ROW; Zero tariffs in EU-Russia trade in industrial products 50% off EU-Russia agricultural and food products tariffs	Post WTO tariffs on imports from the ROW; Zero tariffs in EU-Russia trade in industrial products; 50% off EU-Russia agricultural and food products tariffs
Standards costs		2004 level	25 % off 2004 level	50 % off 2004 level
Border costs		2004 level	25 % off 2004 level	50% off 2004 level
Barriers to trade in services		25% off 2004 level	50% off 2004 level	80% off 2004 level + Improved business environment

3.5. Results of the CGE simulations

3.5.1. Welfare implications

Below we display major results of the CGE simulations. Apart from welfare changes, we also present changes in wages of skilled and unskilled workers. These changes assume a post-WTO scenario as a benchmark hence the simulated changes displayed below are on top of the changes simulated due to the WTO accession.

Table 6. Implications of Deep FTA and Deep FTA+ scenarios – changes relative to post-WTO benchmark (% change)

	Welfare		Skilled Workers' Wages		Unskilled Workers' Wages	
	Deep FTA 5-10 years	Deep FTA+ 10-15 years	Deep FTA 5-10 years	Deep FTA+ 10-15 years	Deep FTA 5-10 years	Deep FTA+ 10-15 years
Russia	0.55	2.24	0.47	1.36	0.64	1.91
Ukraine	0.15	-0.23	0.04	-0.49	0.05	-0.20
CIS	0.36	0.40	0.21	-0.11	0.24	0.07
Austria	0.75	0.24	0.56	0.22	0.69	0.38
Belgium	0.39	0.19	0.33	0.29	0.37	0.34
Cyprus and Malta	1.17	-0.17	0.68	-0.18	0.79	0.00
Czech Republic	0.66	0.38	0.51	0.31	0.65	0.36
Denmark	0.35	0.49	0.27	0.46	0.25	0.38
Estonia	0.46	0.48	0.40	0.49	0.39	0.38
Finland	0.85	1.11	0.60	0.88	0.65	0.86
France	0.83	0.33	0.62	0.22	0.75	0.38
Germany	0.66	0.35	0.44	0.44	0.51	0.56
Greece	0.29	0.23	0.22	0.20	0.27	0.22
Hungary	0.69	0.27	0.51	0.15	0.62	0.32
Ireland	0.85	1.22	0.37	0.87	0.37	0.70
Italy	0.87	0.35	0.75	0.45	0.78	0.44
Latvia	0.39	0.06	0.36	0.09	0.46	0.06
Lithuania	0.57	0.16	0.51	0.20	0.59	0.17
Luxem-bourg	0.28	0.05	0.28	0.17	0.32	0.18
Nether-lands	0.61	0.57	0.44	0.44	0.50	0.44
Poland	0.52	0.26	0.48	0.29	0.55	0.36
Portugal	0.24	0.25	0.24	0.26	0.25	0.25

	Welfare		Skilled Workers' Wages		Unskilled Workers' Wages	
	Deep FTA 5-10 years	**Deep FTA+ 10-15 years**	**Deep FTA 5-10 years**	**Deep FTA+ 10-15 years**	**Deep FTA 5-10 years**	**Deep FTA+ 10-15 years**
Slovakia	0.89	0.46	0.74	0.52	0.80	0.58
Slovenia	0.39	0.47	0.32	0.46	0.38	0.46
Spain	0.58	0.19	0.47	0.25	0.50	0.28
Sweden	0.48	0.67	0.30	0.51	0.35	0.48
UK	0.33	0.30	0.25	0.23	0.29	0.24
Bulgaria	0.05	0.10	0.04	0.07	0.14	0.15
Romania	0.39	0.16	0.28	0.07	0.36	0.21
Rest of the World	0.41	0.48	0.28	0.33	0.32	0.37

Source: own calculations.

Table 6 includes welfare changes and impact on real wages in the Deep FTA and Deep FTA+ scenarios. Our results indicate that halving of border and standards costs and improved access for foreign providers of services as a result of the Deep FTA will only lead to a small additional welfare gain of 0.55% of GDP for Russia. In the longer time perspective the welfare gain from the Deep FTA+ can rise to 2.24%. Wages of unskilled workers are expected to grow faster than wages of skilled workers (1.9% vs. 1.4%) as unskilled labor-intensive sectors are expected to grow at a faster paste.

In the EU welfare changes due to the Deep FTA are rather small, but positive for all EU27 member states. In the Deep FTA+ scenario many countries such as Finland, Ireland, Netherlands, Denmark, Estonia, Slovakia, Slovenia and Sweden are expected go see their welfare increase by at least 0.5% of GDP. These are the countries which experience the highest increases in the capital stock as a result of the Deep FTA+ and where capital-intensive manufacturing sectors and services sectors expand. The only regions registering a negligible welfare loss as a result of the Deep FTA+ scenario are Cyprus and Malta. This is due to a fall of output of skilled labor intensive sectors, which are being replaced by imports.

Finally, the impact on Ukraine is negative due to trade diversion. Our assumptions do not incorporate the Deep FTA between the EU and Ukraine currently under negotiations. The results of previous studies (e.g. Maliszewska, (2007), CEPS (2006)) indicate that such an FTA is going to have a strong positive welfare impact for Ukraine. Hence any negative implications of the EU-Russia FTA are likely to be outweighed by the positive implications of its own FTA with the EU.

3.5.2. Sectoral changes in the Deep FTA scenario

Appendix 2.2. Table 1 displays output changes as a result of the Deep FTA. There are several reasons why we should expect the elimination of NTBs to be beneficial to Russia and the EU. The reductions in barriers to trade and transport costs decrease the prices of goods for consumers, as well as prices of intermediates and capital goods for producers. The extent of these gains depends on the amount of trade between the trading partners and the trade creation and trade diversion effects. Apart from increased efficiency of resource allocation, as demand shifts to regions with the lowest cost suppliers, additional gains stem from increased competition. However all gains from trade also involve adjustment costs and may be associated with potentially painful restructuring in Russia or the EU and potentially significant redistribution effects.

Output changes are divided into four categories:

1. High positive impact: output growth higher than 3% of the benchmark output level.
2. Positive impact: output growth higher than 1% of the benchmark output level.
3. High negative impact: output fall higher than 3% of the benchmark output level.
4. Negative impact: output fall higher than 1% of the benchmark output level.

In all instances we only analyze output of sectors that contribute more than 1% of total output according to 2004 GTAP data. Other output changes are assumed to be negligible.

Table 7. Implications of the Deep FTA scenario – changes in output relative to post-WTO benchmark (see text)

	Positive high	Positive	Negative high	Negative
Russia	paper, ferrous metals, machinery	grains, cattle, forestry, meat, food products NEC, dairy, paper, petroleum & coal, paper & publishing, chemicals, ferrous metals, metals NEC, machinery	mineral products, financial services	mineral products, financial services, manufacturing NEC
Ukraine	none	beverages&tobacco, machinery	none	paper & publishing, chemicals, minerals NEC

	Positive high	Positive	Negative high	Negative
CIS	coal	coal, beverages&tobacco, food NEC, minerals NEC, metals NEC, vegetables	none	chemicals
Austria	none	motor vehicles, manufacturing NEC, insurance, public adm.	none	none
Belgium	textiles, electronic equip.	textiles, electronic equip., manufacturing NEC	none	none
Cyprus and Malta	none	wood, paper&publishing, machinery, manufactures NEC, construction, trade, transport, communications, business services	transport equip., electronic equip.	transport equip., electronic equip.
Czech Republic	none	textiles, mineral products, manufacturing NEC	none	none
Denmark	none	electronic equip.	none	none
Estonia	textiles, motor vehicles, manufacturing nec	textiles, motor vehicles, manufacturing NEC, textiles, apparel, chemicals, minerals NEC, metals, transport NEC	beverages&tobacco	beverages&tobacco, forestry
Finland	electronic equip.	electronic equip., chemicals, ferrous metals, metal products	none	none
France	none	none	none	none
Germany	none	business serv.	none	none
Greece	none	apparel	none	none
Hungary	none	textiles, chemicals, motor vehicles	none	none
Ireland	none	chemicals	beverages & tobacco	beverages & tobacco
Italy	none	textiles, wood, minerals, metal products, manufactures NEC, trade, business services	none	none
Latvia	textiles, apparel, metal products	textiles, apparel, metal products, wood, chemicals, ferrous metals	beverages&tobacco	beverages & tobacco
Lithuania	textiles, metal products	textiles, metal products, chemicals, ferrous metals, electronic equip.	None	dairy products
Luxembourg	none	transport NEC	None	none
Netherlands	none	chemicals	None	none
Poland	none	textiles, wood, paper &	None	none

	Positive high	Positive	Negative high	Negative
		publishing, chemicals, minerals NEC, metal products, electronic equip.		
Portugal	none		none	none
Slovakia	none	paper & publishing, minerals, metal products, electronic equip.	none	none
Slovenia	none	chemicals, electronic equip., manufacturing NEC	none	none
Spain	none	none	none	none
Sweden	none	none	none	none
UK	none	none	none	none
Bulgaria	none	none	beverages & tobacco	none
Romania	none	none	none	none
Rest of the World	none	none	none	none

Note. "NEC" = not elsewhere classified.
Source: own calculations.

Our analysis indicates that the impact of the Deep FTA on sectoral output in Russia is going to be mostly positive. All but 3 sectors are expected to register a growth of output. The products experiencing the highest growth in output (over 3%) include paper, ferrous metals and machinery. The other two sectors that are expected to experience even higher increases in output are beverages and tobacco and wearing apparel. These are sectors with very high standard costs as indicated by the Ukrainian survey, which we assume to go down by 25% in the Deep FTA scenario. As a result of the Deep FTA the production of beverages and tobacco in Russia expands and its exports to the EU increase. The increase in domestic production replaces imports from Estonia and Latvia on the Russian market, which is an important export destination for this sector (14% of exports of beverages and tobacco from Estonia and 7% from Latvia were sold in Russia in 2004). To a small extent it also replaces exports from Ireland on the EU market. The model includes an aggregate of this sector. It is quite possible that a different mix of products sold by Russia and Ireland would not in fact allow for such substitution. However these sectors contribute less than 1% to total output and hence their impact on total output is going to be very limited.

Three sectors where we expect output in Russia to contract as a result of the Deep FTA are mineral products, financial services and manufacturing NEC. The production of these sectors is replaced by imports. The fall of domestic output of

financial services is also due to their replacement by provision of financial services by foreigners as we assume that as a result of Deep FTA the barriers to such investment go down by further 25% relative to the post-WTO level. However to a large extent this fall in domestic output will be mitigated by the fact that foreign service providers tend to employ a significant proportion of local labor force and operate through local subsidiaries.

The overall impact on the EU is going to be positive too. The countries in which selected sectors are expected to experience output growth over 3% are those that trade with Russia the most. Russia is a significant export destination for Estonia, Finland, Latvia and Lithuania. On the other hand Russia's share in Cyprus's imports in selected products (grains, oil, gas, petroleum) and in exports (construction, forestry) is very high. An increase in production in the above mentioned countries is a response to a fall in Russian production of those sectors and an increase in Russian demand for imports and overall increase in economic activity in the EU27.

Only a few countries register a fall in output higher than 3% for at most a couple of sectors. Following a halving of tariffs on trade in agricultural and food products the production of beverages and tobacco in Russia expands and crowds out such production in Estonia, Ireland and Latvia, for whom Russia is a significant export market. In addition Lithuania records a small fall in the output of dairy products. One would expect more significant changes in Russian agricultural products with the elimination of tariff protection. However, this lack of big changes can be explained by the low level of initial trade in agricultural products with the EU. In the initial 2004 data set the CIS, Ukraine and the ROW were Russia's major export and import markets for agricultural products.

3.5.3. Sectoral changes in the Deep FTA+ scenario

Appendix 2.2. Table 2 presents detailed output implications of the Deep FTA+ scenario. Below we summarize the major impact on sectors across Russia and the EU. Again we only select sectors which in 2004 contributed more than 1% to total output.

Compared to the Deep FTA scenario we now allow for a significant fall in the price of capital in Russia (2.5%). We also assume that over 10-15 years following the beginning of implementation of the provisions of the Deep FTA with the EU, the non-tariff barriers in trade between Russia and the EU will be halved and provision of services by foreigners in Russia will be conducted at almost no additional cost (20% of initial 2004 value).

Table 8. Implications of the Deep FTA+ scenario – changes relative to post-WTO benchmark (see text)

	Positive high	Positive	Negative high	Negative
Russia	animal products, forestry, meat products, food products NEC, diary, paper & publishing, chemicals, ferrous metals, motor vehicles, machinery and equipment	grains, vegetables, animal products, gas, meat products, food products NEC, dairy, paper&publishing, petroleum, chemicals, ferrous metals, motor vehicles, machinery, manufactures NEC, electricity, construction, trade, communication, business services, public admin.	none	minerals NEC
Ukraine	beverages & tobacco, transport equip., machinery,	beverages&tobacco, transport equip., machinery, food products NEC, dairy,	none	minerals, chemicals, transport NEC
CIS	food products NEC, vegetables, coal	grains, food products NEC, vegetables, coal, petroleum, beverages&tobacco, machinery, minerals NEC	none	chemicals, sugar, oil, ferrous metals, metals NEC
Austria	none	chemicals, electronic equip.	none	insurance
Belgium	paper & publishing, textiles	paper & publishing, textiles, metals NEC, beverages&tobacco, manufacturing NEC, communication	none	none
Cyprus and Malta	food NEC	food NEC, chemicals, electronic equip., manufacturing NEC, financial services	none	transport equip., machinery
Czech Republic	none	Textiles, electronic equip., manufacturing NEC, financial services	none	paper & publishing
Denmark	none	beverages&tobacco	none	None
Estonia	textiles, manufacturing NEC.	textiles, manufacturing NEC., apparel, wood, ferrous metals, metals NEC, metal products, motor vehicles, transport equip., electronic equip., machinery	beverages & tobacco	beverages & tobacco, paper & publishing
Finland	none	meat products, metal products, electronic equip., construction, trade, communication, business services	none	forestry, dairy

	Positive high	Positive	Negative high	Negative
France	none	chemicals, electronic equip.	none	none
Germany	none	machinery	none	none
Greece	none	apparel	none	none
Hungary	none	textiles	none	none
Ireland	none	motor vehicles, construction, transport NEC, communication, financial services, insurance, business services, public admin.	beverages & tobacco	beverages & tobacco, machinery
Italy	none	textiles, apparel	none	wood
Latvia	textiles	textiles, apparel, chemicals, ferrous metals, metal products, business serv.	beverages & tobacco	beverages & tobacco,
Lithuania	textiles, electronic equipmn.	textiles, electronic equip., chemicals, ferrous metals, metal products	none	dairy, petroleum, electricity
Luxembourg	none	beverages&tobacco, metals NEC, communications	none	none
Netherlands	none	business services	none	beverages & tobacco
Poland	none	textiles, mineral products, transport equip.,	none	wood
Portugal	none	none	none	none
Slovakia	none	textiles, mineral products, electronic equip., machinery	none	none
Slovenia	none	electronic equip.	none	none
Spain	none	motor vehicles	none	none
Sweden	business services	business services, meat products	none	none
UK	none	none	none	none
Bulgaria	none	none	none	beverages & tobacco
Romania	none	textiles	none	none
Rest of the World	none	none	none	none

Again the impact on sectors is a mixture of the reduction of standard costs, border costs and easier provision of services on the Russian market. The capital stock in Russia is expected to increase by 5.6%. This works like an endowment effect and Russia is now able to produce more of almost everything with several sectors expected to register a growth of output over 3%. In the model the total employment is held constant because of its theoretical neo-classical specification. However this assumption is not contradicted by empirical international experience,

which indicates that trade liberalization, does not cause aggregate change in employment in the medium term. However, given full employment, the expansion of some sectors must be at the expense of the contraction of other sectors. Hence production of a few sectors does fall (minerals NEC, coal, textiles, electronic equip., metals and metal products). The reasons behind these developments differ by sectors. For example domestic outputs of textiles and wood products are being replaced by increase of imports due to the reduction of standards costs. On the other hand the production of Russian coal is being replaced by coal from the CIS. The transport margins in the exports of coal are very high. According to GTAP 2004 data 90% of Russian exports of coal originate in the CIS. The substantial lowering of border costs i.e. the costs of exporting coal to Russia leads to a replacement of domestic coal by imports from the CIS.

The significant reduction of barriers to foreign provision of services along with increase of capital stock allows for a growth of services industries. Again this growth is understated as imports of services increase significantly and they are bound to lead to an increase in domestic provision of services as well as several foreign companies are going to employ local labor force. Unfortunately, the model does not distinguish between local and foreign labor force working on the same labor market, hence we are not able to capture this.

In case of individual member states the changes in output in selected sectors can be quite significant, although the overall impact on majority of sectors is positive. Again the highest shifts in output are expected in countries for which Russia is a major export or import market. The production of textiles expands in several countries: Estonia, Latvia, Lithuania and Belgium. In addition Lithuania registers an expansion in production of electronic equipment. Swedish output of business services expands mainly through a growth in demand in other EU countries. Several other sectors register small (between 1 and 3%) output growth thanks to an increase in overall income of the EU 27 and thanks to a more efficient allocation of resources and efficiency gains. Sectors that seem to be consistently growing across the majority of EU member states include electronic equipment, motor vehicles, textiles, business services and financial services.

In terms of negative output changes, the only sectors that are expected to see their output contract by more than 3% are beverages and tobacco in Estonia, Ireland and Latvia, Netherlands and Bulgaria. Again in several countries the demand for their output in Russia decreases significantly. Several other sectors are expected to register a small fall in output e.g. paper and publishing in the Czech Republic and Estonia, dairy in Lithuania and Finland, forestry in Finland and wood products in Italy.

3.5.4. Sensitivity analysis

Our assumptions on border costs, standard costs and barriers to provision of services by foreigners originate from studies for Ukraine and Russia respectively. However, the assumption on the reduction of the risk to invest is quite arbitrary. The risk to investment is determined by several macroeconomic and political factors and it is difficult to distinguish the exact impact of the Deep FTA+. We looked at previous studies for guidance. Baldwin, Francois & Portes (1997) while looking at the implications of the EU enlargement assume that the risk to investment in the New Members States would be reduced by 15%. A similar assumption of 10% was assumed in CEPS (2006) study on the implications of a Deep FTA for Ukraine.

In the baseline scenarios we opted for the more conservative assumption of 2.5% in the Deep FTA+ scenario as a realistic assessment of the business environment in Russia in 10-15 after the signature of the Deep FTA. The review of key horizontal issues indicates that there is a long way towards a significant improvement in the business environment. However, below we consider a more optimistic assumption of a 5% improvement in the business environment following a Deep FTA+ and name this scenario Deep FTA++. The assumptions on the reduction of NTBs are the same as in our Deep FTA+ scenario. Table 9 below presents welfare and wages implications.

In the Deep FTA++ the capital stock in Russia is expected to expand by 11%. This allows for a further expansion of output and welfare. The welfare implications for Russia almost double reaching 4.24% of the benchmark GDP. The welfare implications for the EU are also slightly higher. Naturally the Deep FTA++ has also bigger implications for wages of skilled and unskilled workers. Wages of unskilled workers in Russia are expected to grow by 3.14% relative to their post-WTO level and wages of skilled workers are expected to grow by 2.32%. Wages of workers in all EU countries are expected to increase slightly as a result of the Deep FTA++. In general, we note that the patterns of welfare and factor rewards implications are very similar to those of the Deep FTA+ scenario, but their magnitude is bigger. The same conclusion applies to the output and employment[7] implications, which are highly correlated with the Deep FTA+ implications and higher by up to 50% for selected sectors. We conclude that as expected any improvements in the business environment in Russia associated with the Deep FTA+ are going to bring significant benefits for Russia and smaller for the EU and that their magnitude is directly correlated with these improvements in business environment.

[7] The results for employment and output are not reported here for the sake of clarify of the presentation, but are available from the author on request.

Table 9. Implications of a Deep FTA+ with a 5% reduction of risk to invest in Russia

	Deep FTA ++	Deep FTA++	Deep FTA++
	Welfare (% change)	Skilled Wages (% change)	Unskilled Wages (% change)
Russia	4.24	2.32	3.14
Ukraine	-0.13	-0.51	-0.19
FSU	0.78	0.05	0.26
Austria	0.74	0.60	0.86
Belgium	0.44	0.52	0.59
Cyprus and Malta	0.54	0.23	0.49
Czech Republic	0.78	0.62	0.75
Denmark	0.78	0.69	0.58
Estonia	0.67	0.65	0.62
Finland	1.61	1.22	1.22
France	0.91	0.65	0.91
Germany	0.81	0.76	0.94
Greece	0.42	0.35	0.40
Hungary	0.69	0.45	0.71
Ireland	1.93	1.21	1.05
Italy	0.92	0.96	0.96
Latvia	0.19	0.22	0.27
Lithuania	0.38	0.39	0.43
Luxembourg	0.24	0.37	0.40
Netherlands	1.02	0.76	0.81
Poland	0.55	0.55	0.68
Portugal	0.42	0.44	0.43
Slovakia	0.97	0.95	1.06
Slovenia	0.72	0.68	0.72
Spain	0.58	0.57	0.63
Sweden	1.06	0.75	0.75
UK	0.56	0.43	0.46
Bulgaria	0.21	0.11	0.33
Romania	0.41	0.23	0.45
Rest of the World	0.84	0.58	0.65

Source: own calculations.

3.6. Summary

The Deep FTA will only lead to a small welfare gain of 0.55% of benchmark GDP for Russia. In the longer time perspective the welfare gain from the Deep FTA+ can rise to 2.24%. Wages of unskilled workers are expected to grow faster than wages of skilled workers. In the EU welfare changes due to the Deep FTA are

rather small, but positive for all EU27 member states. In the Deep FTA+ scenario many countries such as Finland, Ireland, Netherlands, Denmark, Estonia, Slovakia, Slovenia and Sweden are expected go see their welfare increase by at least 0.5% of GDP. Our sensitivity analysis indicates that a greater improvement in the business environment in Russia could expand the welfare gains from the Deep FTA+ even further. Allowing for a decrease in the risk to invest in Russia by 5% would result in a welfare gain in Russia of 4.24% of the benchmark GDP.

In the long term (Deep FTA+) the capital stock in Russia is expected to increase by 5.6% allowing Russia to produce more of almost everything with several sectors expected to register a growth of output over 3%. However, the model assumes full employment, hence production of a few sectors does fall (minerals NEC, coal, textiles, electronic equip., metals and metal products). In the EU27 the highest shifts in output are expected in countries for which Russia is a major export or import market. Sectors that seem to be consistently growing across the majority of EU member states include electronic equipment, motor vehicles, textiles, business services and financial services. Several other sectors in the EU are expected to register small (between 1 and 3%) output growth.

4. Overall Social Context in Russia as Compared to the EU

The Article 74 of the Partnership and Cooperation Agreement (PCA) between Russia and the EU discusses the cooperation on social issues, which is aimed at 1) improving the level of protection of the health and safety of workers; 2) improving the functioning of the labor market; and 3) planning and implementing social protection reforms in Russia[8]. Fostering social stability in Russia is an important objective of the EU-Russia Common Spaces[9].

Russia experienced a severe transition-related output decline through most of the 1990s. The labor market adjusted with a sharp decline in real wages and contraction of the labor force. Poverty and inequality rose sharply, and health indicators deteriorated. Post-1998 economic recovery had a positive impact on the labor market and social area.

This section briefly discusses the recent developments in the Russian labor market and social area as compared to EU countries. The main indicators described below are related to: 1) labor issues, including regulations of the labor market and social area, employment, unemployment, wages, labor migration, collective bargaining and rights at work; 2) poverty and inequality, including the number of people living under poverty line, GINI index, regional effects, etc.; 3) education, including enrolment rates, access for women, etc; and 4) health and demography.

4.1. Labor issues

The EU has actively supported the ILO concept of *decent work* for all. In particular, it concerns the issues of unemployment and underemployment, rights at

[8] Source: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:21997A1128(01):EN:NOT.
[9] Source: http://ec.europa.eu/external_relations/russia/common_spaces/research_en.htm.

work including the core labor standards, gender inequality, social protection and social dialogue[10].

4.1.1. Regulations of the labor market and social area

Russian labor market regulations have been rather inefficient in addressing the decent work concept. Russian labor laws were unrealistically tight in defining most aspects of the employment relationship within the enterprise. Particular groups of employees e.g. women were given guarantees and privileges that are far beyond what is found in the EU labor laws. The Russian Labor Code has been geared heavily toward formal, permanent, open-ended contracts, whereas fixed-terms contracts have been limited.

However, the labor regulation has been restrictive in law but not in practice. For many firms and workers, it was completely bypassed, so that the labor market was virtually unregulated (World Bank, 2003). The restrictive legislation coupled with its poor enforcement resulted in low wages, wage arrears, and other contract violations among particular workers and in some regions (perhaps where workers have less bargaining power and job opportunities), poor health and safety standards, and large wage inequality.

The new Labor Code, effective since 2002, has introduced more flexible contracting practices. However, the new Code is still quite restrictive relative to many EU countries. Employers are limited in their ability to adjust their workforce in response to economic and technological change; certain categories of workers, including women, are still excessively protected; workers and employers do not have adequate opportunity to voice their concerns; contract enforcement is weak; and mechanisms for resolving workplace disputes and addressing health and safety concerns are limited (World Bank, 2003). According to the opinion survey of Russian managers in 2003, only a few managers believed that the new Code has introduced more flexible labor relations, while the majority did not expect better enforcement practices (World Bank, 2005a).

Several important pieces of legislation in the social area were enacted over the 2000-08 period. This includes changes in the Tax Code, with replacing previous contributions to various extra-budgetary funds with a single social tax of 35.6%; various laws on reforming the system of social privileges[11], aimed at transforming

[10] Source: http://ec.europa.eu/social/main.jsp?catId=323&langId=en.

[11] Social privileges include exemptions or discounts from rent or utility payments; telephone services; medicines, medical appliances and medical services; urban, commuter and long-distance transport, etc.

in-kind benefits into monetary compensation; Law on Public Social Assistance, introducing the principles of targeting; Pension Reform Package, gradually changing the pension system from the pay-as-you-go to a two-pillar system.

Has the new legislation brought Russia closer to their commitments under the PCA? In particular, has Russia succeeded in developing a system of social protection intrinsic to market economies, as stipulated by the Article 74 of the PCA? Social safety nets should be aimed at protecting the poor and vulnerable. However, the evidence suggests that few resources actually go to the Russian poor. More than 80% of the privileged citizens were not poor in 2006; only 30% of the child allowance beneficiaries and 30% of housing allowance beneficiaries were among the poorest fifth of the population; and 10% of the money accrued to beneficiaries from the richest fifth of the population (World Bank, 2009). The ineffective targeting translates into a modest impact on poverty reduction.

An attempt to reform the extensive and costly system of privileges was a failure. According to the study by the Center for Social Research and Innovation, in-kind social benefits were preserved in most of the Russian regions, with all regions continuing to provide non-monetary subsidies for rent and utility services (Gontmacher, 2005). Only 8 regions, including Vladimir, Voronez, Kaluga, Archangelsk, Vologda, Kamchatka, Karelia and Krasnodar eventually introduced monetary compensation for all social subsidies except utility services (Gontmacher, 2005).

4.1.2. Employment developments

Employment in Russia has been growing since 1999. For the first time since transition began, the rate of job creation exceeded that of destruction in the manufacturing sector. However, similarly to advanced CEE (Central and Eastern European) reformers, the employment response to growth was much smaller than that of output. Employers reallocated existing labor more productively as opposed to increasing employment, and labor productivity increased. According to Rosstat, the annual growth rates in labor productivity amounted to 5-7% in the years 2006-2008, which is similar to those found in the CEE countries after the first two years of economic recovery.

In the 1990s there had been a significant reallocation of workers across sectors. As a result, the current Russian employment structure is quite similar to that of the EU. In 2007 21% of workers were employed in industry, around two thirds were employed in services, 10% were employed in agriculture, and 7% were self-employed (Rosstat, 2008a). According to the Eurostat, the corresponding average

numbers in the EU-27 for 2007 were similar for the industry and services, lower in agriculture (6%) and higher for self-employed (17%).

This transition can be explained in part by the decline in public sector employment and employment growth in mixed, domestic, private, and foreign firms (World Bank, 2003). According to Rosstat, in 2007 the share of public sector in total employment amounted to 32%, whereas the share of private sector was equal to 56% (Rosstat, 2008a). However, it should be noted that the estimates of the private sector share of employment vary a lot by definition of employment and source of data.

The share of a particular sector in the total employment in individual regions gives an idea of regional specialization which is determined by various factors, including natural endowments. Mining and quarrying is mainly done in the Ural Federal District, in particular, in Tyumen region (around half of all Russian mining, especially oil production), and to a lesser extent in the Volga Federal District (17%). The Southern Federal District is specialized predominantly in agriculture, which employs on average one fifth of the active labor force. Manufacturing is developed in the Central, Northern-Western, Volga and Ural districts (Rosstat, 2008a).

High degrees of specialization are also typical for some EU regions. The most specialized EU regions are two Slovakian regions, Východné Slovensko (Eastern Slovakia) and Západné Slovensko (Western Slovakia), which employ over half of its workforce in manufacturing; Śląsk (Silesia in Poland), which is highly specialized in coal production; Åland (Finland), which is specialized in transport; etc. (Eurostat, 2008). The degree of regional specialization should be taken into account when estimating the social impact of employment changes because social consequences of economic downturns are exacerbated in regions with high specialization.

4.1.3. Unemployment

As employment in Russia was increasing, unemployment rates were steadily decreasing during 2000-2005. The unemployment rate in 2007 amounted to 7%, which is not high relative to the EU levels of unemployment (average level of unemployment in the EU-27 in 2007 amounted to 7.1%, according to Eurostat). However, regional variations in unemployment are large. The highest unemployment rates are registered in the Southern Federal District, where it amounted on average to 14% in 2007 (Rosstat, 2007). Some regions exhibit even higher unemployment rates, such as Ingushetia (59%), Dagestan (22%), Kabardino-Balkaria (21%), etc. (Rosstat, 2007). High unemployment regions are characterized by

lower expenditure per capita, high poverty rates, and high birth rates (Rosstat, 2008c).

Unemployment rates are higher and duration of unemployment is longer for younger, less-educated and less-skilled workers. In 2006 the unemployment rate amounted to 30% for those younger than 20, and to 14% in the age group of 20-24, as compared to 15% for ages less than 25 for the EU-27 (Rosstat, 2007 and Eurostat).

4.1.4. Wages

It is widely acknowledged that the adjustment to shocks on the Russian labor market occurred mainly through real wage reduction, including in the form of holding wage arrears, which is in contrast to the adjustment pattern of most Eastern European countries (Denisova et al, 2005). Between 1990 and 2000 average real wages declined by nearly 70%, much more than noticed in most CEE countries during this critical period of transition (World Bank, 2003). However, since 2000 the negative trend has been reversed. In 2006 average annual gross wages amounted to approximately 3000 Euros, which is higher than in Bulgaria, similar to Romania, roughly half of the level in Slovakia, and one tenth of wages in Sweden (See Table 10). The wage share of worker remuneration has increased, as the initially large fringe benefits (e.g. kindergartens, medical care) have declined over time.

Like in other CEE countries, the private sector pays more than the public sector, signaling higher worker productivity in that sector. According to the Russian Longitudinal Monitoring Survey (RLMS), in 2004 the average monthly wage in the private sector was 30% higher than in the public sector. The public sector is known for a compressed formal wage structure and a number of low-paid jobs. Every third employee in the education sector and every fifth employee in the health sector (both sectors are mainly public) earned less than the minimum subsistence level in 2007 (Rosstat, 2007).

There is a significant gender gap, with women in some occupations (e.g. managers, skilled workers in industry, construction, workers in services) earning around 30% less than men with similar characteristics (Rosstat, 2007). Skilled workers earn about 65% more than the unskilled workers (Sabirianova, 2003). Returns to one year of schooling were estimated at 8% in 2002 for Russia, as compared to 10% for Poland and Hungary, and to 5% for Czech Republic and Slovak republic (Flabbi et al, 2007).

Table 10. Average gross annual earnings in Russia and some EU countries in 2006

Countries	Earnings (EUR)
Russia	3032
EU (27 countries)	31302
Bulgaria	2195
Czech Republic	8284
Denmark	48307
Germany	42382
Ireland	40462
Greece	16739
Spain	21150
France	31369
Latvia	5211
Hungary	7840
Austria	36673
Poland	6270
Portugal	15930
Romania	3713
Slovakia	7040
Finland	34080
Sweden	35084
Croatia	9634
Switzerland	46058

Note. for some countries the data is from earlier years; for Russia, Ireland, Poland and Croatia (2005), Greece (2003).
Source: Eurostat and Eurostat-Rosstat (2007).

4.1.5. Labor migration

Russian labor market is characterized by very low interregional labor mobility, despite substantial differences in wages and unemployment rates across regions. Explanations offered in the literature include the remnants of the Soviet style registry system (*propiska*); underdevelopment of the financial and property markets, which causes problems for people in selling and renting their houses; in-kind payments; and liquidity constraints, i.e. when people are unable to finance the cost of moving.

However, labor migration is much higher between Russia and other CIS countries. According to Rosstat, the number of workers from the CIS countries who were employed in Russia surged from 130 thousand in 1995 to over 1 million in 2007. The actual numbers could have been much higher because a large share of labor inflows to Russia (estimated to be 2-5 million) are not reflected in official statistics (IMF, 2006).

These significant labor force inflows suggest that labor markets in Russia or at least some its segments may have been considerably more flexible than previously thought.

4.1.6. Collective bargaining and rights at work

There is an intricate bargaining apparatus in the law, but there has been actually little real collective negotiations determining wages and working conditions at the workplace (World Bank, 2003). Trade unions do not adequately reflect the interests of employees, and employers' organizations lack support from employers.

Despite, in 2004-2005 the number of strikes had substantially increased. More than 200 thousand of teachers, doctors, and other state-paid workers across Russia, according to Rosstat, (or around 1 million, according to some expert estimates), took to the streets in 2004 to protest low salaries. In the beginning of 2005 thousands of Russians, mainly pensioners and students, protested against the monetization of social privileges.

Russian health and safety in the workplace is poor. The International Labor Organization estimates that about 6,000 fatal accidents, 118,000 disease cases, and 131,000 Russian deaths in 2001 were work related (World Bank, 2005b). However, likely underreporting of accidents on the job makes comparisons with the EU difficult. Paradoxically, the reported number of accidents in the workplace in Russia was ten times lower than in the EU-15[12].

International research has demonstrated that worker voice, embodied in the true representation of workers and employers in the bargaining process, can improve training and health and safety in the workplace, thereby contributing to productivity gains and improvements in worker welfare (World Bank, 2003).

4.2. Poverty and inequality

Russia's economic growth resulted in a consumption increase for everyone, which has led to a dramatic reduction in poverty since 1999. A challenging goal of cutting poverty in half by 2007 from its level in 2002 was in fact achieved. Ac-

[12] According to Rosstat, the number of accidents in the workplace for Russia amounted to 4 out per 1000 workers in 2007. The corresponding number for EU-15 was 4 out of 100 (Eurostat, 2008).

cording to Rosstat, 19 million had money incomes below subsistence minimum level in 2007, down from 35 million in 2002 (Rosstat, 2008a). Yet, one out of every nine people was still poor in 2007.

Poverty is widespread but shallow in Russia. The average poor person's consumption was about 30% below the official poverty line (defined as the subsistence minimum level) in 2007 (Rosstat, 2008b). Large number of people is concentrated along the poverty line. This implies that even a small shock can increase poverty substantially. The majority of the poor consists of working families with children, with secondary and vocational education, who live in urban areas. Thus, poverty is a consequence of low wages and low productivity in sectors such as agriculture, culture, health and other public services.

There are large regional differences in the incidence of poverty. In 2007 the number of poor varied from 6% in Yamalo-Nenetski region (the main oil and natural gas producer) to 57% of population in Ust-Ordynski region (Rosstat, 2008b). In general, the poorer regions are those that are more rural, have fewer households with multiple earners and more households with unemployed adults, and have households with large number of people (World Bank, 2005a). Regional differences in incomes for Russia are found to be larger than the ones for the EU-15 and EU-25 (Wilhelmsson, 2009).

The aggregate changes in poverty are driven by changes in incomes as well as changes in the inequality in incomes. Inequality in income has been rather stable in Russia since 1999. However, the level is situated at the high end as compared to the EU countries. The Gini coefficient of incomes distribution amounted to 42% in 2007, compared to the EU-27 average of 30% (Rosstat, 2008b and Eurostat). Although the Gini coefficient remained constant in Russia in 1999-2005, the welfare share of bottom quintile continued to increase, thus leading to pro-poor growth in this period (World Bank, 2005a). It appears that changes in the unemployment rate and in real wages are important determinants of changes in inequality.

It is noteworthy to mention that inequality in Russian incomes or assets are higher than consumption inequality. There is also evidence on underreporting of income, implying that actual inequality might be higher than the reported one (World Bank, 2005a).

Children from poor households have less access to pre-school and post-compulsory education, which is increasingly determined by income and wealth (World Bank, 2005a). The lowest income adult populations had two to three years of schooling less that the highest income populations. The World Bank (2005a) report has shown that access to computers, to the internet, to challenging curricula and to foreign languages was found to be lower among low income families. Russian poor cannot afford better schools and programs and quality, mainly private, health care.

Access to basic infrastructure services (i.e. running water, hot water, sewage system, etc.) is also characterized by inequalities, to the benefit of urban areas and richer households.

4.3. Education

Education is one of the policy cooperation areas between Russia and the EU. The objective of this "common space" is to encourage closer cooperation within the framework of the new European Higher Education Area in accordance with the main provisions of the Bologna process (European Commission, 2009).

Russia inherited a fairly well-developed, mature education system from the former Soviet Union. An important legacy of the Soviet period is that nearly 100% of Russian children continue to complete compulsory education (World Bank, 2005a). Enrolment rates to higher education are high relative the other countries. Public spending on education is not low as compared to European countries. In 2007 the public spending on education amounted to 4% of GDP in Russia, as compared to 5% for EU-27 (Rosstat, 2008a and Eurostat).

Russian women attain higher educational levels than men. Women made up a half or more of students (pupils) at various educational institutions: 50% at comprehensive schools, 52% at secondary vocational institutions, and 58% at higher educational institutions in 2005 (Rosstat, 2008a). It appears that women are provided with opportunities to realize their right for education.

Recent changes connected to Russia's involvement in the Bologna Process include introduction of a two-level system of university education, optimization of education management system, introduction of the Unified State Exam, restructuring the system of educational establishments, and provision of schools with E-learning technologies (OECD, 2004). These developments are directed at eliminating territorial and income inequality in education.

4.4. Health and demography

Despite economic recovery and rising public expenditures on health, the health picture in Russia remains grim. Low fertility and high mortality have caused further demographic decline in Russia.

In 2007, life expectancy in Russia at birth was 67.5 years, of which 62 for men (Rosstat, 2008b). Thus, Russia's life expectancy at birth lags behind the European Union average by 10 years. Russian adults also experience lower healthy life expectancy (years of life spent in full health) than EU countries. According to the World Health Organization (WHO), the healthy life expectancy in Russia was less than 60 years in 2002, as compared to more than 70 years in United Kingdom, Germany, France, and Italy (World Bank, 2005b).

The current low level of life expectancy is driven largely by increasing mortality among those of working age, with a singular rise in mortality at young adult ages and with the greatest contribution from cardiovascular diseases and injuries (World Bank, 2005b). The mortality rates from cardiovascular diseases and injuries in Russia were three and five times, respectively, and higher than those in the European Union (Eurostat/Rosstat, 2007). Russia's road traffic mortality rate is higher than that of other former Soviet states, and nearly double that of the other G-8 countries (World Bank, 2005b). According to the World Bank (2005b), alcohol abuse is a major risk factor and public health problem in Russia. Other causes of poor health indicators include environmental degradation, poor living conditions and lifestyles, and, increasingly, the spread of HIV-AIDS.

There is evidence that access to quality medical care has declined for much of the population since 1990 and that this aggravates Russia's health problems (OECD, 2006). Public health infrastructure has too many beds and too many physicians, which drains resources away from needed equipment, supplies and pharmaceuticals. The number of hospital beds in Russia in 2004 was almost double of the corresponding average number in the EU-27, and Russian physicians also substantially outnumbered the European ones (Eurostat/Rosstat, 2007).

4.5. Expected developments in the social sphere in the coming years

The developments in Russia's social sphere in the coming years will be determined by the consequences of the current global financial crisis.

Labor markets have been adjusting to the economic downturn through all channels: employment, wages and arrears. According to Rosstat, the unemployment rate (ILO definition) has climbed from the annual average of 6.3% in 2008 to 8.1% in January 2009. Growth in real wages came to a halt in January-February 2009, following double-digit increases in previous years. The stock of wage arrears as of March 1, 2009 amounted to 8 billion rubles or about USD 240 million (as compared to 2.6 billion rubles or about USD 108 million as of January, 2008),

and is expected to increase with the crisis. The arrears are estimated to affect up to 450,000 people by the end of 2009, or less than 1% of total employment (World Bank, 2009). Rising unemployment and worsening enterprise finances resulted in real disposable income decline by 5.8% in the 4th Quarter of 2008, compared with the same period in 2007 (World Bank, 2009).

WB experts estimate that by the end of 2009 the unemployment rate (ILO definition, including unregistered unemployed) will reach 10-12%. Some regions with already high unemployment and poverty will be particularly hard hit. The sectors most affected will likely be manufacturing, construction and retail trade. The World Bank projects losses in employment in 2009 of 9% in manufacturing; 14% in construction; and 4% in retail and agriculture. The number of poor people in Russia will likely increase by 4.7 million in 2009, wiping out part of the gains in reducing poverty in recent years (World Bank, 2009).

The recent government's anti-crisis plan is focused, among others, on improving the labor market situation and ensuring social protection to vulnerable. The planned active labor market measures include providing on-the-job training and re-training, creating temporary work programs for the unemployed, ensuring direct support to households and facilitating internal labor mobility. However, implementation of the active labor market policies is likely to be difficult. There is no all-Russian database on available job vacancies. Re-training programs are poorly developed, and the available capacities are limited.

The government also plans to increase unemployment benefits, pensions and other social expenditures. The unemployment benefits will be increased to 4,900 rubles a month, up from 3,124 rubles a month in January 2009. Given the small initial benefits, the increase is unlikely to provide much cushion against the ongoing shock.

5. Social Impact of the FTA

The social impact of the Free Trade Agreement (FTA) on the EU and Russia is analyzed by means of the CGE model presented in Chapter 3. We study the social consequences of the FTA for Russia and assess the most significant impacts on selected Member States and industries.

In particular, the analysis is based on the expected changes in employment and wages for unskilled and skilled workers across sectors and countries. Changes in employment and wages of unskilled workers are a good indicator of poverty implications. They also indicate the possible unemployment outcomes if the regional specialization is taken into account.

In addition, we study the possible effect of a FTA *on working conditions*. The descriptive analysis takes into account the expected level of legal approximation in the area of work safety and health and the likely outcomes of general improvement of working conditions resulting from modernization of (particularly) export oriented industries. We also discuss the expected impact of a FTA on health. Finally, we note the possibilities for cooperation between the EU and Russia in *education* that could accompany a FTA.

5.1. Wages of skilled and unskilled labor

A first result to note is that a FTA is likely to increase wages relative to the benchmark (post-WTO) level for Russia and all EU countries (see Table 11).

We estimate that during 5-10 years after FTA (Deep FTA scenario) the increase in wages for Russia amounts to 0.47% for a skilled labor and 0.64% for unskilled labor relative to the benchmark (post-WTO) level. Impact of a FTA on wages for some countries such as Italy, France and Slovakia is similar to the one for Russia.

However, during 10-15 years after FTA (Deep FTA+ scenario) the increase in wages for Russia is expected to be much higher than for other countries. We estimate that the wage rate of skilled labor will rise by more than 1% and the wage rate of unskilled labor will rise by almost 2%. Approximately 1% increases in

wages are expected for Finland and Ireland, whereas for other countries the positive changes in wages are smaller. Larger gains for Russia relative to other countries as a result of the Deep FTA+ might be explained by the economic growth triggered by more efficient allocation of resources.

Wages for Ukraine as a result of a FTA between Russia and EU are expected either to decrease in case of the Deep FTA+, or remain unchanged in case of Deep FTA, but likely changes are small. Again our exercise does not incorporate the EU-Ukraine FTA, which is likely to be positive and outweigh any negative implications of the EU-Russia FTA.

In the model the labor inputs are divided into skilled and unskilled. Both categories are based on the International Labor Organisation (ILO) classification. The skilled labor (professional workers) includes managers, administrators and professionals. Trade persons, salespersons, clerks and personal service workers, plant and machine operators, laborers and drivers as well as farm workers comprise the unskilled labor (production workers) category (Dimaranan and Narayanan, 2008).

As a result of the Deep FTA wages of unskilled workers rise relatively faster than wages of skilled workers. This is especially true in the shorter run. For Deep FTA+ for some countries increases in skilled wages are in fact bigger than for unskilled, but the wage gaps between skilled and unskilled are small. The fact that skilled wages increase at the same pace as unskilled wages might be explained by the fact that both skilled labor-intensive (such as insurance) and unskilled sectors (e.g. food manufacturing) are likely to expand as a result of Deep FTA+.

Expected wage increases for unskilled and skilled labor can have important implications for poverty and inequality reduction in Russia. This is especially true because Russian poverty is shallow, and small changes in incomes lead to substantial changes in the number of poor. The likely changes in wages of 1-2% are considered rather moderate for Russia, where wages considerably lag behind the ones in European countries. It should be stressed, however, that the direction of changes, and not the absolute amount, is instructive, given the fact that modeling exercise is subject to an error.

The social impact of wage increases on the EU-27 countries would be positive but rather small as a result of Deep FTA+ with Russia. Trade liberalization with Russia would bring only very small (if any) increase in the living standards of the EU-27 countries, which reflects the fact that the Deep FTA+ is postulated to work primarily through improved economic governance in Russia, with no equivalent change in the EU.

5.2. Impact on the sectoral employment

5.2.1. Expected changes in employment: Russia

Overall, employment in Russia is expected to grow across most of the sectors (see Appendix 2.2. Tables 3 and 4). However, some production and services sectors will contract, especially in the medium term (Deep FTA scenario). We estimate that 14 sectors out of 41 will contract in the FTA scenario, as compared to 7 sectors in the longer time perspective (Deep FTA+).

Which sectors are found to be *most affected* in terms of employment? We define *most affected sectors* as sectors with more than 3% increase (decrease) in employment of unskilled labor and the ones that account for 1 or more percent of the total employment in 2004.

We also include coal and textiles in most affected sectors (they account for 0.7% and 0.6% of total employment, correspondingly) as those sectors are considered important for social implications (we discuss this in the next Section). Beverages and tobacco and insurance also belong to this group as we estimate big increases in employment for these sectors.

Sectors that are expected to contract most in terms of employment of unskilled labor in the medium term include textiles (7.4%) and mineral products (6%). In the long run (Deep FTA+), the highest decline in unskilled labor is expected in the coal industry (6%), followed by textiles (4%)[13]. In case of the coal industry, the expected decline in unskilled labor is due to the reduction of border costs; in case of textiles, it is due to the reduction of standard costs (please, see discussion in the Section 3.5.3).

However, the growth in employment is expected to be more pronounced and wide-spread. In the medium term, we estimate that employment of unskilled labor will most expand in manufacturing of ferrous metals (4%) and machinery and equipment not elsewhere classified (NEC) (4%). In the long term (Deep FTA+), the average growth in unskilled labor will amount to 3%, with beverages and tobacco growing at 19%, insurance – at 11%, meat products – at 10%, and others (please, see the complete list in the Table 18 below).

Interestingly, the insurance sector is characterized by one of the largest declines in skilled labor in the medium term, and one of the largest increases in the long run. These results are explained by very high costs of provision of services by foreigners and high capital intensity of this sector. It might be the case that the

[13] Here and below all percentages are given comparing to the post-WTO level.

Deep FTA would not affect much the size of foreign investment in the sector, which is currently highly protected. Whereas in the Deep FTA+ scenario, FDI would increase because of the better business environment, and that in turn would create the demand for Russian skilled workers in these sectors. This is because multinationals that invest in Russia in these sectors employ between 90 and 98% Russian labor. Hence the positive impact on employment in services is likely to be underestimated as the model does not take account of the fact that foreigners mainly use local labor force.

It is noteworthy that the public administration sector, which also includes education and health, is expanding, especially in the longer term (Deep FTA+) at 2% (relative to the post-WTO level). In terms of employment this is the biggest sector in Russia, employing more than 18 million in 2006, or 16% of the total employment (Rosstat, 2007).

5.2.2. Social implications

As far as social implications for Russia are concerned, such a significant growth in employment across sectors would need to some extent accommodate the decline in employment in other sectors. This is especially true given that the biggest employer - public administration sector - is expected to grow. It also should cause increases in real wages in the economy, which in turn might reduce inequality. However, the unemployment rate should be taken into account, as it also has an impact on inequality.

Given limited interregional labor mobility in Russia and high regional specialization, trade liberalization is likely to result in the increased transitional unemployment. According to the model, sectors of high risks include coal industry, textiles and metal products. Moreover, production in these sectors is often concentrated in mono-cities i.e. cities with one factory as main employer, and that will further exacerbate social consequences of the unemployment. According to the estimates by the Institute of Regional Politics ('Institut Regionalnoi Politiki'), there are more than 400 mono-cities in Russia, mainly located in the Urals and in the central Russia (Zyrianova, 2009).

The 6% decline of employment (relative to the post-WTO level) in the coal industry could result in layoff of approximately 13 thousand workers[14]. For most coal mine workers, who lost jobs, it will be extremely difficult to find new ones

[14] To express increases/decreases in employment in workers, we multiply % increase (decline) by the employment level in 2007 (the most recent employment numbers that are available to proxy the post-WTO level), according to the Rosstat data.

because they are employed in the mono-cities. Russian coal is mainly produced in Kemerovo oblast (where 'Kuzbass' i.e. Kuznetsk coal deposit is located) and Krasnoyarsk region.

For textiles the estimated reduction of personnel will be equal to approximately 17 thousand in case of the Deep FTA+[15]. This is not a large number for the entire country but might be critical for some cities/regions. The textiles sector is located in the Central Federal District, mainly in the Ivanovo region. Moreover, the sector mainly employs female labor, estimated at 80%, according to the Russian Ministry of Industry and Energy. Thus, the likely decline in employment in textiles would mostly concern the female labor.

Therefore, government safety nets could be very important in helping with the transitional unemployment. Mono-cities and particular regions with high regional specialization should be taken into account when designing programs of social protection. A special focus should be given to the active labor market policies, in particular to the retraining of unemployed.

We are unable to estimate the impact on the number of unemployed as a result of FTA, as in the model the total employment is held constant because of its theoretical neo-classical specification. However this assumption is not contradicted by empirical international experience, which indicates that trade liberalization, does not cause aggregate change in employment in the medium term. All the estimates may also suffer from a margin of error, due to parameter specification and modeling assumptions.

5.2.3. Expected changes in employment: EU-countries

For the EU-countries we expect that some sectors would grow, while others would contract.

In case of the Deep FTA scenario, the most negatively *affected sector* in terms of employment of unskilled labor is beverages and tobacco sector in Estonia -(18%) (here and below all percentages are relative to the post-WTO levels). In case of the Deep FTA+ scenario, the decline in unskilled employment in the Estonian beverages and tobacco sector is expected to be more pronounced, of 25%. The decrease in Latvian beverages and tobacco sector would amount to 9% and in Ireland would decline by 8% (Deep FTA+). Please, note that in both countries employment in the beverages and tobacco sector accounts for less than 1% of total employment.

[15] According to Rosstat, the textiles sector employed 431 thousand workers in 2007.

High positive impact of the FTA in the medium term is expected for textiles and motor vehicles in Latvia, where employment of unskilled labor would grow by 4 and 3% correspondingly, relative to the post-WTO level. In the long term, textiles would expand in Latvia (5%) and Lithuania (4%). The complete list of the *most affected sectors* of the EU is presented in the Table 11 below.

Overall, it appears that unskilled-labor intensive sectors expand more, and unskilled labor wages increase more. This is consistent with an increased demand for these sectors' products.

Table 11. Overall social impact and most affected sectors for Russia and EU-countries (Deep FTA+ scenario)

Country	Overall social impact	Most affected sectors	
		High positive impact	High negative impact
Russia	High	- Agriculture (forestry fishing, animal products NEC) - Manufacturing (meat products, vegetable oils and fats, beverages and tobacco products*, chemical rubber plastic products, paper products, ferrous metals, motor vehicles and parts, transport equipment NEC, machinery and equipment NEC; manufactures NEC) - Services (insurance*)	Coal*, textiles*
Estonia	Medium	Textiles	beverages and tobacco products
Lithuania	Medium	textiles electronic equipment	-
Finland	Medium	electronic equipment	-
Ireland	Medium	-	-
Latvia	Low	Textiles	-
Sweden	Low	business services NEC	-
Poland	Low	Metals NEC	-
Austria, Belgium, Bulgaria, Cyprus and Malta, Czech Republic, UK Denmark, France, Germany, Greece, Hungary, Italy, Luxembourg, Netherlands, Portugal, Slovakia, Slovenia, Romania	Low	-	-

Note. Column 1 "Overall social impact" is defined as *high* if more than five sectors are affected in terms of employment (as defined below) and the wage increase is more than

1%; as *medium* if two or more sectors are affected in terms of employment (as defined below) or the wage increase is close to 1%; and *low* if one or none of the sectors are affected in terms of employment (as defined below) or the wage increase is not close to 1%.

Columns 3 and 4 "Most affected sectors" are defined as more than 3% increase (decrease) in employment of unskilled labor and the sector accounts for 1 or more% of total employment; sectors with * account for less than 1% of total employment, but are considered important in terms of social implications.

5.2.4. Social implications

What is the social impact of the expected decreases in employment for particular countries?

In case of Latvia, the likely impact on the unemployment will be negligible. This is because the size of two contracting sectors – beverages and tobacco and petroleum coal products – is very small. The former sector employs around 3000 workers, and the later – 500 out of total 165 thousand employed in manufacturing (Central Statistical Bureau of Latvia)[16]. So, even the decline of 9% in the beverages and tobacco (Deep FTA+) will result in only 270 laid offs, or less than 1% employed in manufacturing. The contraction of Irish beverages and tobacco is also small in absolute numbers. It equals to approximately 350 workers, out of 220 thousand employed in the manufacturing sector[17]. The Estonian beverages and tobacco is expected to lay off approximately 1000 workers, out of 129 thousand employed in manufacturing, or less than 1%[18]. This is not a negligible number, given that every fourth employee of the sector would be laid off.

To summarize, the biggest layoffs are expected for Estonia. Therefore, there could be a need in public policy in Estonia to help those with social risks to adjust to the transition. For other EU countries the expected decline in employment as a result of FTA with Russia is rather small, and, therefore, would not significantly affect the unemployment levels and poverty.

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[16] To calculate persons employed in beverages and tobacco sector of Latvia (approximately 3300), we use percentage of the sector in the wage bill of the manufacturing sector (2%) and the total employment in manufacturing (165 thousand, according to Central Statistical Bureau of Latvia); average wages are assumed to be constant across manufacturing sectors.

[17] To calculate persons employed in beverages and tobacco sector of Ireland (approximately 4400), we use percentage of the sector in the wage bill of the manufacturing sector (2%) and the total employment in manufacturing (220 thousand in 2006, according to Eurostat).

[18] To calculate persons employed in beverages and tobacco sector of Estonia (approximately 5000), we use percentage of the sector in the wage bill of the manufacturing sector (4%) and the total employment in manufacturing (129 thousand, according to Central Statistical Bureau of Estonia).

5.3. Overall Social Impact

We summarize the overall social impact of FTAs in the Table 11. We distinguish *high*, *medium* and *low* overall social impact, defined in the following way. Overall social impact is defined as *high* if more than five sectors are affected in terms of employment (as defined below) and the wage increase is more than 1%; as *medium* if two or more sectors are affected in terms of employment or the wage increase is close to 1%; and *low* if one or none of the sectors are affected in terms of employment or the wage increase is not close to 1%. *Most affected sectors* are defined as more than 3% increase (decrease) in employment and the sector accounts for 1 or more percent of total employment.

We expect high overall social impact for Russia, medium overall social impact for Estonia, Lithuania, Finland and Ireland (the last two countries exhibit wage increases of approximately 1%), and low overall social impact for other EU countries.

5.4. Impact on the working conditions

The FTA would stipulate minimum requirements for the working conditions, similar to the one written in the European Economic Area Agreement (1994). This includes minimum safety and health requirements for the workplace of various occupations, also for fixed-term contracts and temporal jobs; establishing limits of exposure to dangerous substances; application of the principle of equal treatment of men and women; approximation of some aspects of the Labor law; etc. (Annex 18 of the EEAA).

The major Russian regulations in the field of work safety and health include Constitution of the Russian Federation, the Labor Code and Acts on Occupational Safety and Health of Subjects of the Russian Federation. There exist some 3,000 regulations on occupational safety and health requirements (Academy of the Safe Workplace). The legal approximation of the Russian safety and health legislation should address issues of compatibility with EU Occupational Safety and Health (OSH) regulations; the excessive rigidity of some mandatory technical requirements; clear differentiation of various legal issues; and continuity when using normative technical documents.

The FTA is also expected to speed up ongoing restructuring and modernization in sectors such as metallurgy, machinery & electronics, transport and coal partly because of improved competition and new technologies. This coupled with in-

flows of FDI would lead to an upgrading of machine parks, introduction of cleaner production methods, increased worker safety, and increased health standards at the workplace.

5.5. Impact on health

Expected improvement of working conditions following the Deep FTA and Deep FTA+ are also expected to result in decline of work related accidents, injuries and deaths. Increased living standards, partly because of income gains, should improve key health indicators.

However, income increases alone are not likely to improve the Russian health situation. Research shows that even if income differences are taken into account, Russian adult mortality rates are still substantially higher than those of countries with similar per capita incomes (World Bank, 2005b). Governmental intervention is needed in Russia to develop health-enhancing policies and programs to address the high mortality rates among the working-age population. Developed-country experience suggests that prevention policies and interventions should be oriented to the population at risk of illness and injury rather than solely at individuals who are already ill or disabled.

5.6. Impact on education

The FTA between Russia and the EU is expected to further improve cooperation between the EU and Russia in education.

The Roadmap for the Fourth Common Space on Research, Education and Culture, agreed at the EU-Russia Summit in Moscow in May, 2005 is aimed at encouraging closer co-operation in the area of non-formal education; promoting the development of life skills education; and making the European Higher Education Area a reality, in accordance with the principles of the Bologna Process.

These objectives are realized through a number of projects such as EU study weeks; the recently created European Studies Institute at MGIMO; participation of the Russian students in the Erasmus Mundus program; establishing quality monitoring systems for Russian curricula and institutions, as well as internal university quality-control systems. Master courses at the European Studies Institute at

MGIMO provide training for Russian government officials and post-graduate students. Since the opening of the Institute in 2007, around 150 students completed Master program, where students learn law, economy and politics of the European Union. We expect more Russia-EU joint projects on education as a result of Deep FTA and Deep FTA+.

5.7. Summary

We evaluate the overall social impact of the Deep FTA and Deep FTA+ for Russia as positive and significant. Expected wage increases for unskilled and skilled labor coupled with the pronounced and widespread growth in employment could result in the increase of living standards and reduction in poverty in Russia. New jobs would be created mainly in manufacturing, but also in services and agriculture. However, we also expect that some sectors, in particular coal and textiles, could contract as a result of the Deep FTA+. This could result in layoffs of mostly female labor in the Central Federal District and of coal workers in Kemerovo oblast and Krasnoyarsk region. The impact of expected layoffs will be exacerbated in the mono-cities, where alternative employment opportunities are limited.

In addition, the working conditions are expected to improve because of the approximation of Russian safety and health legislation and improved competition and new technologies. Likely decline of work related accidents, injuries and deaths coupled with better living standards would enhance key health indicators. Russia-EU Deep FTA and Deep FTA+ are expected to improve cooperation in the area of education.

The overall social impact of the Deep FTA+ is expected to be moderate and positive for Lithuania, Finland, Ireland; moderate and negative – for Estonia; and low and positive for other EU-countries. Estimated wage increases of approximately 1% would bring moderate increase in the living standards in Finland and Ireland. Lithuania and Finland would experience expansion in particular sectors, which will result in creation of new jobs and new firms. Wages and employment are expected to increase in other European countries as well, but on a smaller scale. In Estonia we expect that beverages and tobacco sector will contract significantly, while in textiles only few jobs will be created. Therefore, for Estonia there might be a need for social protection nets to help with transitional unemployment.

6. Environmental Quality in Russia and Cooperation with the EU

6.1. Introductory remarks

Russia recognizes the need for government intervention in, and control over the ecosystem's exploitation and appreciates the importance of pursuing a consistent environmental policy in conformity with the effective international standards and principles. The environmental policy is exercised through employment of the following organizational and legal mechanisms:

1. fees for using natural resources;
2. regulatory actions;
3. environmental audit;
4. standardization;
5. technical regulations;
6. certification;
7. ecological passport of an enterprise;
8. assessment of the impact of every given project on environment;
9. the government and public environmental evaluation;
10. others

It should be noted that these are economic mechanisms appropriate for market economy conditions, with fees charged for using natural resources, and for allowable and non-allowable pollution, airborne emission and the discharge of polluting substances in water and for encouragement of environmentally useful activities. The governmental supported the principle of businesses "going green".

6.2. The State of Environment in Russia in 2007

Overall, the 2007 state of environment in Russia was characterized by the following indicators:

Water resources. In 10 regions, the rate of sewage dilution varied between 50 and 100, while in another 16 regions it was between 10 and 50. The worst sewage dilution rates (under 10) were noted in 5 regions.

Open air. The quality of open air in urban locations is still unsatisfactory:

- in 135 cities (67% of the sample of cities wherein the tests were run) a high or very high level of pollution was noted;
- the list of the most polluted cities comprises 38 cities with the aggregate population of 14.9m. More specifically, it includes 10 cities with metallurgical plants, 7 cities with chemical and petrochemical production, oil production and transportation facilities;
- in 30 cities with the total population of 11.7m the emission concentration rate was over 10 MAC;
- in 210 cities with the total population of 65.9m, the average emission concentration of a particular substance was over 1 MAC, which did not change comparing to the 2003 indicator;
- in all the cities of the sample open air is polluted with benzopyrene as a result of fuel combustion. The average annual concentration rates of this particular substance are over 1 MAC nearly in all these cities;

The largest zones of the permanent man-made pollution were located in the Siberian Federal District, mostly in the cities of Krasnoyarsk, Irkutsk, Novosibirsk and Kemerovo, and also at Norilsk in North West Russia. The discharge rates of copper, nickel and sulphuric acid in Norilsk area accounted for 67%, 33% and 82% of the total volume of discharges of these substances nationwide.

Table 12. The main indicators that characterize the impact of economic activity on environment and natural resources

	1992	1995	2000	2002	2003	2004	2005	2006	2007
Water intake from natural water objects for use as m^3 bn	99.6	86.6	75.9	72.7	72.2	69.2	69.3	70.1	69.6
Discharge of foul water, as m^3 bn	27.1	24.5	20.3	19.8	19.0	18.5	17.7	17.5	17.2
Pollutants discharge from stationary sources into open air, as m.t.	28.2	21.3	18.8	19.5	19.8	20.5	20.4	20.6	20.6

Source: The Federal Service for Statistics of the Russian Federation.

The highest fluoride soil contamination rates were noted in the areas around aluminum plants in the radius of up to 20 km. High rates of soil contamination with oil products are noted in the areas of oil production, transportation, distribution, and around oil refineries. Nearly in all the examined industrial centers, there are land sites polluted with oil products. The concentration of nitrates and sulphates in land examined in 2007 was mostly on the level noted over the prior years.

Farmland. In 2007, the farmland contaminated by a residual quantity of pesticides was found in the 15 regions compared to 17 regions reported in 2006. There was a minor decreasing trend in the proportion of soil polluted with the residual quantity of pesticides, chiefly in terms of the aggregate DDT, Treflan, and 2.4D.

Water. Economic activity has also had an adverse impact on the quality of headwater, which is a major source of water supply to the population (see Table 13). The following minor rivers were found in the most critical condition: Sukhona, Vologda, and Pelshma in the Northern Dvina basin; minor rivers of the Kola Peninsula; the majority of rivers and lakes located in the territory of the Altay Republic and Altay krai; Iset and Miass rivers in the Ob basin; Ust-Ilimskoye reservoir, the Vikhorev Bay in the Yenisei basin; Schuchya river near Norilsk; Chapaevka river and the Volga's delta in the Volga basin; Silinka, Kholdomi, Bereyzovaya, Argun, Ingoda, Chita rivers, and the Kenon lake in the Amur basin (see Table 14).

Table 13. Input of Contaminants with Untreated Sewage into Water Reservoirs

	1990	1995	2000	2001	2002	2003	2004	2005	2006
The volume of discharge of untreated sewage, as m^3 bn	75.2	59.9	55.6	54.7	54.7	52.3	51.3	50.9	51.4
Including discharged:									
sulphates, m.t.	52.9	3.7	2.7	2.6	3.1	2.4	2.4	2.2	2.1
chlorides, m.t.	55.0	8.6	7.3	7.7	8.1	7.5	6.8	6.7	6.3
Ammonium nitrogen, thous.t.	202.5	215.1	84.5	81.2	79.8	78.0	71.7	69.0	68.8
Total nitrogen, thous.t.	151.8	57.6	41.3	42.7	43.2	41.6	34.6	34.5	40.6
nitrates, thous. t.	77.8	179.6	208.5	201.3	237.2	274.4	288.2	374.7	379.5
Fats and oils, thous. t.	48.5	25.1	15.2	13.8	14.9	13.0	9.1	8.1	7.2
Total phosphorous, thous. t.	57.6	38.1	26.4	24.9	25.1	23.6	23.3	23.4	23.4
Phonic acid, t.	264.6	85.9	66.6	53.1	53.6	47.7	46.2	42.9	39.9
lead, t	144.8	50.5	34.9	26.7	25.0	23.5	16.8	14.8	15.7
pesticides, t.	16.1	1.5	2.7	4.8	2.4	2.7	1.7	1.2	1.9
mercury, t.	13.9	0.6	0.2	0.2	0.2	0.2	0.1	0.1	0.1

Source: The Federal Service for Statistics of the Russian Federation.

Table 14. The Volume of Pollutants Discharge Across Basins of Individual Seas and Rivers (as cub.m. bn)

	1990	1995	2000	2001	2002	2003	2004	2005	2006
Total	27.8	24.5	20.3	19.8	19.8	19.0	18.5	17.7	17.5
The Baltic Sea	2.7	2.3	2.2	2.1	2.0	2.0	2.0	2.0	1.9
Including the basin of Neva	1.6	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.5
The Black Sea	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2
The Sea of Azov	3.9	3.5	2.0	1.9	2.0	2.1	2.1	1.6	1.7
Including basins of:									
The Don	0.9	1.3	0.8	0.7	0.9	0.8	0.7	0.7	0.7
The Kuban	1.7	1.3	0.6	0.7	0.6	0.7	0.7	0.5	0.5
The Caspian Sea	11.8	10.4	9.2	8.9	9.2	8.4	8.3	8.0	7.8
Including the Volga basin	11.1	9.2	8.3	8.1	8.5	7.7	7.6	7.3	7.2
The Kara Sea	6.2	5.2	4.2	4.2	4.1	4.0	3.8	3.8	3.8
Including basins of rivers:									
The Yenisei	3.1	1.8	1.4	1.4	1.3	1.3	1.2	1.2	1.1
The Ob	2.8	3.1	2.6	2.6	2.5	2.5	2.4	2.4	2.4
The White Sea	1.1	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8

Source: The Federal Service for Statistics of the Russian Federation.

At water courses located downstream to urban areas, surface water is characterized as “foul” or “polluted”. According to official statistics, standardized purification procedures are applied to less than 20% of the foul sewage water, while in the basin of the Volga, the most polluted large Russian river that runs through the most populated regions of the country, the rate is below 10%. In the lower reach of the river its water is characterized as “polluted”. Frequent mishaps at the Astrakhan gas condensate plant have given rise to extremely negative changes in the local environment in the Volga-Akhtuba plain and the Volga’s delta.

It is minor courses that prove to be the most polluted ones, as they face a considerable anthropogenic stress caused by sewage waters from versatile enterprises. For many years the quality of their water has been falling under class 4 (“foul” and “very foul” water) and class 5 (“extremely foul” water) of quality. The hydro biological monitoring data on freshwater courses have indicated the absence of a significant improvement of the quality of water and state of water ecosystems.

The hydro biological monitoring data on freshwater objects have proved the absence of a significant improvement of the quality of water and state of water ecosystems.

The control over the state of hydrobionts in the southern part of the lake Baikal and in its northern part, in the area where the Baikal-Amur railway hits the lake, showed that in 2007 the polluted area shrank compared to 2006. But the rise in the values of the oligochaetous index indicates the presence of a sizeable antropogenic stress on the controlled parts of the lake's water zone.

The quality of water within shelf zones of Russia's seas has lately changed from "moderately foul" to "polluted". As a rule, the "polluted" water is noted around coastal ports and large river deltas, while the cleanest one is represented by the Arctic seas, where the pollution content rate over many years has been within the range of the regional background and has not exceed the MAC rates set for fishery water bodies.

Overall, results of the monitoring showed that the rate of concentration of main groups of pollutants in the area where the settlement of Barenzburg (the Svalbard archipelago) is located are typical for areas of the coal-mining industry, and does not appear a critical one. In 2007, a certain drop in the level of pollution was observed (open air, sea water, water bodies, soil, and cover crop) compared to the prior period of 2002-2006.

In 2007, results of the hydrobiological monitoring of the south-eastern part of the Baltic Sea showed no substantial changes in quantitative characteristics of microorganisms' development compared to previous years.

Results of the monitoring of the nuclear pollution with technogenic radionuclide recently carried out on Russian territory beyond the boundaries of individual zones contaminated due to disasters, have shown no dramatic changes in the situation. Overall, the concentration rate of radionuclide in open air, soil, surface water of water bodies and in the sea water has tended to diminish very slightly.

The quality of environment in the hinterland of Russia, which account for over 90% of the total territory, has been stable over the past 20 years. More specifically, the precipitation mineralization is still dominated by hydrocarbons and sulphates (60%-plus of the sum of ions), followed by chlorides and nitrates.

Like in the previous years, 2007 saw the concentration of chemical substances in precipitation, soil and surface water in biosphere reserves basically remain on the same low level. Overall, the rate of pollution of open air in urban locations and surface water across Russia has remained high and required urgent measures to improve the situation.

The situation with emission of polluting substances into the open air by types of economic activity has not undergone any substantial changes over the last three years (Table 15). Manufacturing industries continue to make the greatest contribution (some 35%) to the overall volume of pollution to open air (see Figure 6.1), followed by the mining sector (30%), electricity generation and distribution (some

20%), transport and communication (11%). Meanwhile the contribution of other types of economic activity to the overall volume of pollution in 2007 accounted for less than 4%.

Table 15. The Aggregate Volume of Pollutants Discharge from Stationary Sources into Open Air across Types of Economic Activity, as thous.t.

Types of economic activity	2005	2006	2007
By the Russian Federation, total	**20425.4**	**20568.4**	**20636.9**
Agriculture, hunt and forestry	*134.1*	*129.3*	*118.2*
– Agriculture, hunt and delivery of services in these areas	110.8	103.2	100.7
– Forestry and delivery of services in this area	23.3	26.1	17.5
Mining operations	*6148.1*	*6027.1*	*6244.8*
Extraction of fuel and energy minerals	5629.3	5509.3	5737.9
– Coal mining, lignite mining and peat cutting	875.2	904.0	1063.0
Including coal mining	853.5	877.0	1028.7
Coal cleaning and agglomeration	12.5	12.4	22.6
– Crude oil and natural gas production; delivery of services in these areas	4737.0	4585.9	4655.8
Including production of crude oil and oil well gas; recovery of petroleum fractions from OWG	4155.3	3673.4	3705.5
Production of natural gas and gas condensate	492.2	473.4	507.6
– Production of uranium and thorium ore	17.2	19.4	19.2
Mineral production, less fuel and energy minerals	518.8	517.8	507.0
– Production of metal ore	445.2	433.6	418.1
– Production of other minerals	73.6	84.2	88.8
Processing production	*7249.8*	*7167.9*	*7205.1*
Production of food stuffs, including drinks, and tobacco	147.0	144.6	146.1
Textiles and garment manufacture	17.2	14.3	11.3
Production of leather, leather items and footwear	3.3	3.5	3.7
Wood working	87.8	84.2	85.5
Paper and pulp production, publishing and printing operations	172.1	162.2	152.9
– Production of cellulose, pulp, cardboard and items from them	171.3	161.4	151.6
Production of coke coal and petroleum derivatives	840.5	764.4	829.8
Including: production of coke coal	36.7	36.9	35.3
Production of petroleum derivatives	803.8	727.5	794.5
Chemical production	349.1	368.9	374.3
Production of resin and plastic goods	20.0	18.2	18.4
Production of other nonmetallic mineral items	465.9	497.6	520.8
Metallurgical production and production of final products	4816.2	4787.9	4751.4
– Metallurgical production	4785.1	4756.3	4722.3
Including: production of cast iron, ferroalloys, steel, hot-	1696.8	1668.6	1636.3

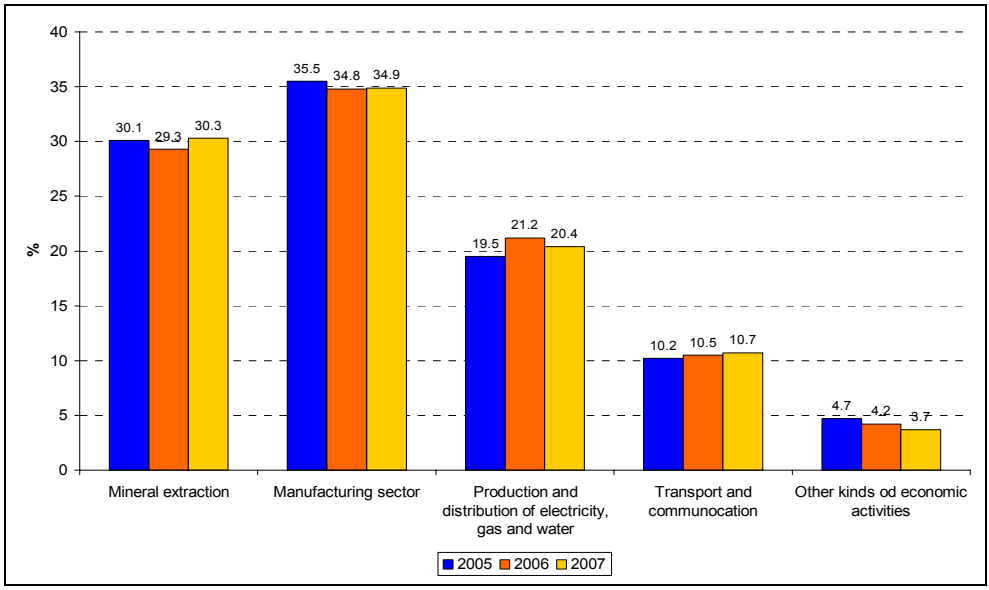
Types of economic activity	2005	2006	2007
rolled and cold-rolled flat mill products			
Production of non-ferrous metals	3052.6	3052.6	3048.9
– production of final products	31.0	31.6	29.1
Production of machinery and equipment	111.3	102.6	106.0
Production of electric, electronic and optical equipment	54.1	53.7	48.3
Production of transportation means and equipment	114.3	116.4	108.3
Other kinds of production	20.5	20.5	18.5
– processing of the secondary raw materials	5.5	5.6	5.7
Production and distribution of electricity, gas and water	*3982.6*	*4352.9*	*4206.0*
– production, transmission and distribution of electricity, gas, steam and hot water	3932.3	4303.4	4162.7
Including production and transmission of electricity	2906.8	3155.2	2923.5
Production and distribution of fluid fuel	5.2	18.4	37.5
– Water intake, reclamation and distribution	50.3	49.5	43.1
Transport and communication	*2085.3*	*2150.2*	*2211.1*
– operations of ground transport	1903.8	1954.6	1986.8
Including pipeline transportation	1776.1	1837.8	1851.5
Of which pipeline transportation of oil and oil products	127.1	108.1	110.1
Pipeline transportation of natural gas and gas conversion products	1648.7	1729.6	1739.5
Real estate operations, lease, and provision of services	*474.3*	*390.2*	*283.7*
– Operations with real estate	288.4	238.6	174.7
Provision of other communal, social and personal services	*61.9*	*59.1*	*55.2*
– Discharge of residential water, waste and analogous operations	55.6	55.0	52.0

Source: The Ministry for Natural Resources and Ecology of the Russian Federation.

The disposal of pollutants into water courses by sectors of the economy has equally not experienced any drastic changes over the period between 2005 and 2007 (see Figure 6.2). It is electricity generation and distribution that tops the list of the greatest contributors in this respect (over 50% of the total volume of water pollution). The proportions of other sectors of economic activity combined account for under 20% of the overall volume of water pollution.

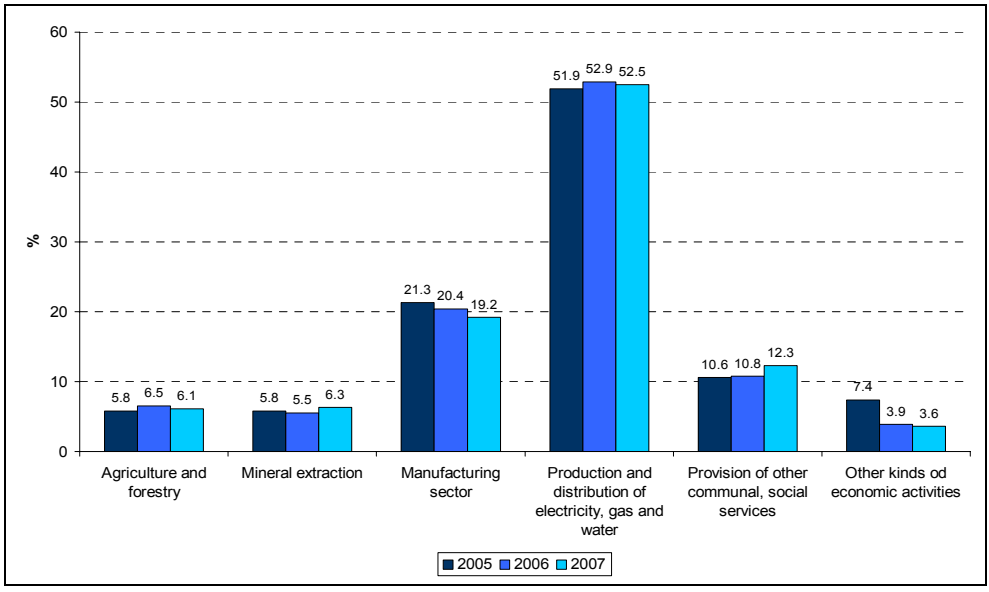
Further details on the environmental quality in Russia regarding emission of greenhouse gases, pollutant substances in water and soil, as well as the Russian Federation agenda regarding environmental policy can be found in the Appendix 3.

Figure 6.1. Contribution of main kinds of activity to the aggregate volume of emission of repugnant substance by stationary sources in the Russian Federation



Source: The Ministry for Natural Resources and Ecology of the Russian Federation.

Figure 6.2. Contribution of main kinds of activity in the aggregate waste water disposal into water objects of the Russian Federation



Source: The Ministry for Natural Resources and Ecology of the Russian Federation.

6.3. International convergence of Russia's environmental standards

The central issues that need to be tackled with a view to harmonization of the environmental law and law enforcement in Russian Federation with those of EU are as follows:

- An insufficient coordination of the functioning of government institutions and invariance of the law,
- Drawbacks in legal regulation, where a uniform procedure of granting permits is applied to all corporations, regardless of their size and pollution capability,
- Procedural drawbacks: opacity of the procedure of granting permits for emissions, discharges, waste placements, which is further aggravated by the lack of amenability of government agencies for a failure to comply with statutory requirements,
- Absence of incentives to modernization of the technological process.

In 1997, Russia and the EU promulgated the fundamental partnership and Cooperation Agreement (PCA). Subsequently in June 1999 the two parties adopted the Common Strategy under the title "Common Challenges on the European Continent", in which they maintained that "environment constitutes a common property for the peoples of Russia and the European Union. A sustainable use of natural resources, utilization of nuclear waste and struggle against pollution of air and water, especially those spreading beyond a single country's borders, constitute priority challenges in this particular region". Main avenues of the partnership were considered at the 2003 St. Petersburg Summit. Two years after, at the Russia-EU Summit in Moscow, the parties adopted roadmaps on four common spaces including the economic one; freedom security and justice; external security and the common space; research and education, including cultural aspects. The environmental issues were directly included in Section 6 "Environment" of the Roadmap on the General Economic Space.

On October 10 2006, in Helsinki, the RF Ministry of Natural Resources (the RF Minister Yu. Trutnev) and the European Commission for Environment (Commissioner Dimas) signed the "Statute on formation of dialogue in the area of environment". The parties have agreed to develop common approaches to the environmental policy and governance, including convergence of laws and standards; to develop cooperation within the framework of multilateral environmental forums and international agreements in the environmental sphere. In addition, the document called for intensification of cooperation between the parties on trans-border environmental matters, exchange of information on, and promotion of public

awareness of environmental challenges, and assistance to development of the environmental education.

Environment was named a priority for the PCA program. The dialogue is conducted through PCA sub-commissions on ecology, energy and nuclear safety. The parties have formed consensus on a joint working program, with the following areas identified as priority ones:

- accommodation of environmental standards and legislation;
- international and regional projects (including the Black Sea and the Baltic Sea);
- assistance to investment in environment in Russia;
- cooperation in monitoring and environmental data supply;
- climate change; reducing gas emissions that cause the greenhouse effect;
- safety of nuclear facilities and utilization of nuclear waste;
- general matters, such as raising public awareness, integration of environmental issues in other sectors, bolstering institutions' capacity.

In an effort to promote and maintain international cooperation in the environmental spheres between government structures, business and the civil society, the Russian Regional Environmental Center (RREC) was established. The Center has partnered with both the Commission for Environment of the European Commission and Russian government agencies in order to execute provisions of the dialogue.

In 2007, a project entitled 'Support of, and technical assistance to completion of objectives of working subgroups formed in the frame of the Russia-EU dialogue on environment" was launched. The project was intended to support organization and conduct of measures as per working plans of the dialogue's sub-groups, to launch an informational component of the project which would include design and publication of materials on the Russia-EU environmental cooperation.

The EU has in the past supported Russia chiefly by means of TACIS. Support was extended to some environmental projects of common interest, for example, a shared contribution to funding investment in utilities, more specifically, in sewage water treatment in St. Petersburg, which is of manifest interest to all Baltic states. Some other environmental projects, particularly regional and intergovernmental ones that involved Russia were also supported through other TACIS programs.

In order to secure harmonization of Russia's environmental legislation in the industrial sector with that of EU, under the auspices of TACIS there was launched a project entitled "Harmonization of Ecological Standards (Phase 1)" implemented between 2002 and 2004. Evaluation of the 1st phase of the project the EC completed in the early-2005 proved the need for a detailed development of an Ecologi-

cal Harmonization Strategy in Russia, which should comprise the legislative, institutional and economic aspects, as well as a real medium- and longer-term plan of its implementation. In the meantime, implementation of the second phase of the "Harmonization of Ecological Standards" program is underway.

In accordance with conclusions of the EC in Stockholm in March 2001, the European Community decided to extend a guarantee to the European Investment Bank to enable it to fund individual environmental projects associated with the Baltic Sea, involving some Russian regions, such as St. Petersburg and Kaliningrad, in particular.

The EIB teams up with other international financial institutions under the aegis of the Northern Dimension Environmental Partnership program. The Program forms the ground for selecting priorities by the European Commission, bilateral and multilateral sponsors, international financial institutions, and Russia.

In addition Russia now has access to grant funding by the European Neighborhood and Partnership Instrument (ENPI), which was put into effect since 2007 and replaced a number of previous programs, such as TACIS. This initiative has been part of the development of the EU's European Neighborhood Policy (ENP), under way since 2003. While Russia is not part of the ENP, since its relations with the EU are organized under its Strategic Partnership agreement made in 2005 for the four 'common spaces', it nonetheless participates in the ENPI as a technical financing facility.

Russia is also a partner of the EU in the framework of multilateral environmental agreements and international forums and initiatives that address the common environmental challenges. This concerns notably:

- the UN framework Convention on climate change and the Kyoto protocol;
- the Convention on biological diversity;
- the "Ecology for Europe" process, regional European conventions known as UNECE;
- northern dimensions, including NDEP;
- multilateral program on the nuclear ecology for Russia;
- regional seas, including the Baltic Sea (the Helsinki Convention), the Black Sea (the Bucharest Convention) and the Atlantic (OSPAR), as well as regional fishery corporations in the Baltic countries and the north-western part of the Atlantic.

6.4. The civil nuclear sector

Today, a renewed interest in utilization of nuclear energy has become a worldwide phenomenon. Many nations have revised their attitude towards nuclear energy and begun to build or plan new nuclear power plants. Russia, too, acknowledges a critical role to be played by nuclear energy. In compliance with the Federal Target Program "Development of the nuclear energy-industrial complex of Russia for 2008-2010 and with the prospect for 2015" (approved by Resolution of the RF Government # 605 of October 6, 2006), the capacity of Russian nuclear power plants should increase by 2GWt annually from 2012, and by 3GWt annually from 2014, with the ultimate goal of ensuring that the total installed nuclear capacity of Russia's nuclear power plants will reach 40GWt by 2020.

During their operational lifespan, Russian nuclear power plants have generally demonstrated their reliability and safety, including environmental safety, although in Soviet times there were some serious nuclear accidents in the Urals-Chelyabinsk region in addition to the major Chernobyl disaster. Preservation and improvement of the natural environment for future generations is a political imperative for the advance of the national nuclear power sector.

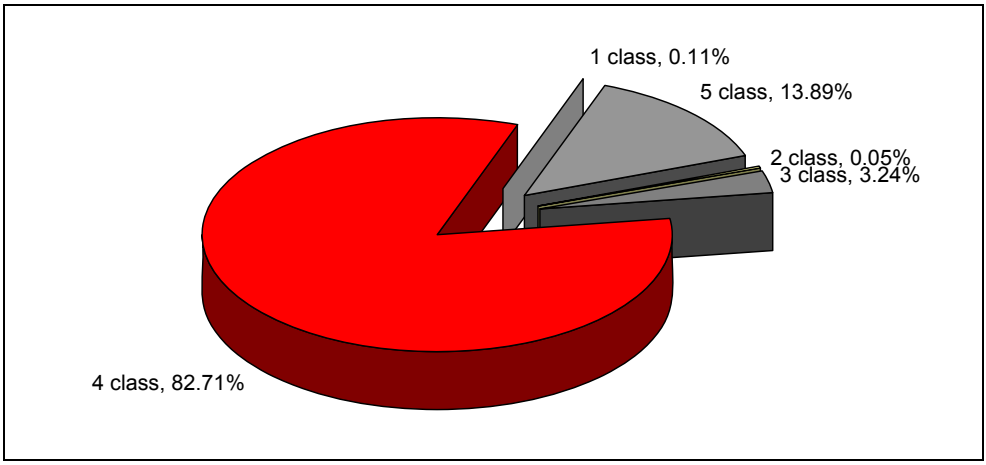
The nuclear power sector is the third (after thermal power and hydro-electric power plants) major source of electricity generation sector in Russia. With the world now facing the formidable challenge of global warming, the ability of nuclear power plants to pollute environment minimally compared with regular power plants that run on organic fuel has gained a new significance. While requirements to land use and rational consumption of natural resources are getting tighter, the nuclear energy sector enjoys the advantage of generating a great capacity within a relatively small area. In addition they can be located far from major cities and occupy plots hardly suitable for other important uses.

Russia's authorities exercise control over the radiation situation through on-the-spot Automated Radiation Control Systems (ARCS) that operate at Rosatom's 23 sites. The network comprises 294 ARCS outposts that combined have 341 channels for measuring radiation, chemical and meteorological parameters, of which the largest number are controlling the intensity of gamma-radiation. Rosgydromet's stationary monitoring network supplies radiation monitoring and meteorological data are every day supplied to the "SKTS Rosatoma". More specifically, the gamma-radiation intensity data are being supplied to the latter by 222 meteorological stations of the Rosgydromet's stationary network.

NPPs accumulate production and consumption waste, which is disposed of by duly licensed operators in compliance with the environmental law. Non-

radioactive waste is classified in five classes of hazard. The bulk of that (over 95%) is formed by waste of the 4th and 5th classes, which are practically safe.

Figure 6.3. Waste Production by NPPs in 2008, by Class of Danger



Source: Federal State Unitary Enterprise "Concern for the Production of Electrical and Thermal Energy at Nuclear Power Plant".

All waste is placed at specially equipped sites, in special storage facilities, and controlled by NPP environmental divisions assigned with the task of observance of environment quality standards. Most of the waste (about 65%) consists of recoverable resources and is passed on for waste reprocessing. In 2008, NPPs produced 48,752t of waste, or 1,450t less than in the preceding year. The waste of the 4th category (low-hazard waste) and the 5th category (practically nonhazardous waste) - 40,323t and 6,771t, respectively - formed the bulk (over 96%) of the total amount of waste produced in 2008. As a result of their 2008 waste-treatment operations, Russia's NPPs used 2,660t of waste, detoxified 519t, passed over to other enterprises 38,334t, buried 3,270t, leaving a year-end balance of 22,892t.

All the nuclear power plants annually design and realize organizational and technical measures with the aim of diminishing the final volume of radioactive waste. Rosenergoatom currently develops a concept for the creation of a specialized enterprise whose mission will be treating radioactive waste, so as to enable nuclear power plants to relinquish this particular production task.

The analysis of the 2008 environmental operations by the NPPs records that as in the previous years, they complied with the environmental law and remained environmentally clean enterprises of a high level of safety.

7. Environmental Quality and Welfare Impacts of the FTA

Regulation or any exogenous change might involve various kinds of environmental impacts that are associated either with changes in environmental state (e.g. in emission level) or pressures (e.g. airborne concentrations). Both changes, in environmental state or pressures result in changes in environmental burden. If environmental burden is an object of our focus, in principle, we can identify four possible drivers of changes in environmental burden. These drivers represent changes in i) scale of the economy, ii) output mix, iii) input mix and iv) the state of technology; actually total change in environmental burden can be decomposed into each of these effects (see e.g. de Bruin et al., 1997; Ang, 2004)[19]. Any regulation or policy changes, including changes in trade policy that are of our concern, can activate each of these drivers.

The first driver of changes in environmental quality is change in the scale of production, or of the economy. Basically it means that an increase in the scale of production implies expanding production at a given factor, output mix, and state of technology. Because there is no change in factors or technology, the change in the scale of production also changes burden proportionally; i.e. 1% increase in production leads, *ceteris paribus*, to 1% increase in the burden. This is called *the scale or the level effect*.

However, different industries have different pollution and resource intensities. If economic activity was reallocated from pollution (resource) more intensive industries to less intensive ones with lower emissions (resource used) per unit of production, overall environmental burden would decline. This is referred to as *the composition or the structure effect*.

Next two drivers of environmental changes are related to changes in technology, which lead to changes in emission (resource) intensity. Environmental intensity of production might be affected either by changes in input mix – when less

[19] As shown in relevant economic papers (e.g. de Bruin et al. 1997, or Brůha and Ščasný, 2005) any change in environmental indicator might be then decomposed into the scale effect, the intensity effect, or composition effect. In the case of emission indicators, Torvanger (1991) or Ang (2004) introduce also other two effects measured by changes in emission coefficients and fuel share effect.

environmentally damaging inputs substitute more damaging inputs, for instance using low sulphur coal or natural gas instead of dirty lignite, or by changes in the state of technology when innovations in process or product result in less resource use or pollutant released per unit of production keeping input mix even constant. This used to be called as *the intensity effect*.

Changes to burden on the environment do not necessarily need to have an impact on utility or welfare of humans. However, following the economic perspective, changes in the quality of environment shall be reflected in welfare or utility of humans. In principle, one can distinguish two ways of assessing the environmental effects. The first – ecologic perspective – considers any changes in environmental burden that are measured mostly in physical terms and that we have presented above. Although, change in, for instance, certain pollutant is a useful proxy indicator of potential damage, it does not provide any information about welfare impact. The second – economic – one tries to link the changes in burden further with the effects on welfare. While the former approach can provide clear picture about changes in each measured state or pressure, it can be hardly linked with other results measured in terms of income or utility. On the other hand, results from the later approach might be linked and thus add up to the estimates from other approaches such as macro modeling allowing in such a way to draw a more integrated picture. The detailed look at each measured environmental state and pressures might be hidden in the final aggregate generated by the later approach. We consider the advantage of the later approach in our study and thus utilize the approach that allows us to link the estimates from CGE modeling with environmental impact assessment.

This study therefore goes beyond a standard evaluation of environmental "impacts", which in fact usually assesses the effect on state or pressures on the environmental quality. Benefiting from the results from ExternE project series, namely from EU funded projects NEEEDS and CASES, we quantify impacts of changes in airborne pollution on welfare[20]. This approach has several advantages: first, it allows considering several changes in state simultaneously by expressing damage in terms of money that reflects corresponding welfare changes. Secondly, expressing the impacts in monetary terms allows us to directly compare involved changes on the environment with other welfare changes coming from CGE model simulations of Chapter 3.

The study is structured as follows: first, we describe the method we used to quantify changes in environmental burden, specifically in pollution. Then, we describe the method for quantification damage, i.e. the external cost and how these

[20] See Appendix 4.1 for detailed explanation of this approach.

values are linked with predicted changes in pollution and other results from CGE model (see also Appendix 3 for more details on the method to calculate the external costs).

7.1. The Methodology and Data

7.1.1. Changes in environmental burden

Assessment of environmental impacts in this study complements macro analyses preformed in general equilibrium framework by a CGE model. Evaluation of environmental impacts is basically based on the results from the CGE model that are exogenous to our exercise. On the other hand, the effects due to changes in environmental quality do not affect endogenous variables in the CGE model.

Quantitative assessment of changes in environmental quality is therefore based on analysis of *the scale effect*. Our approach is following. We first derive emission intensities for main pollutants such as green-house gasses, SO_2, NOx, NMVOC, ammonia and particulate emissions. These intensities, in fact, describe the amount of emissions needed to be released due to production of one unit of economic output. The emission intensities, EQC, are derived for each pollutant and country as follows

$$EQC_{ij}^{0} = \frac{e_{ij}^{0}}{Y_j^{0}} \tag{1}$$

where the upper subscript denotes the base year (0), or scenario in later cases respectively, and the lower subscripts denotes the respective country (j) and pollutant (i). e_{ij} are the emissions of given pollutant released in base year by country *j*, and *Y* is the economic output and is taken from the CGE model (GTAP database).

New level of emission *i* in any country j for the benchmark and two FTA scenarios is given as

$$E_{ij}^{sc} = EQC_{ij}^{0} \cdot Y_j^{0} \cdot \left(1 + g_j^{sc}\right) \tag{2}$$

where *g* is the change in the output of the country *j* for given scenario *sc* as simulated by the CGE model in this study. This formula can be also rewritten as

$$E_{ij}^{sc} = e_{ij}^{0} \cdot \frac{Y^{sc}}{Y^{0}} \tag{3}$$

and it basically shows that the new level of emissions for given scenario equals to the initial level of emissions multiplied by the change in the output of the scenario compared with the base year output.

The composition effect modeling simulates changes on environmental variable due to changes in economic structure. This analysis can be only performed if economic variables and environmental data are disaggregated according to the same classification. Standard case would be to disaggregate sectors by industries – according to NACE classification– or by product categories for that the analyst would assume certain level of homogeneity (e.g. same emission intensities within the industry, but different among the industries).

In this approach, total emission for pollutant i in any country j for given scenario would equal to:

$$E_i^{sc} = \sum_k \frac{e_{ik}^0}{y_k^0} \cdot y_k^{sc} \tag{4}$$

where e_{ik} denotes the emission of pollutant i released by sector k, and y_k is the economic output of sector k. Multiplying this equation by total output of given country, Y, we get

$$E_i^{sc} = \sum_k \left(e_{ik}^0 \cdot \frac{w_k^{sc}}{w_k^0} \cdot \frac{Y^{sc}}{Y^0} \right) \tag{5}$$

where w_k describes the share of sector output on total economic output of the country that we mark as Y. It means that new level of total emissions is given by changes in the output shares and by the change in the level of output. If one assumed no change in the economic structure, i.e. $w_k^{sc} = w_k^0$ for any k, and because $\sum_k e_k = e$, the eq. (5) would relax in the eq. (3).

As mentioned above the analysis of composition effect would require having environmental data identically disaggregated as economic data; i.e. one would need to gather emissions for each pollutant disaggregated into 40 economic sectors used in the CGE model applied in this study. Due to specific sector structure of the CGE model and data availabilities, this was not possible to perform. To document the effect of changes in economic structure on overall level of pollution we reduce number of CGE sectors and following this structure we gather emission data at least for some countries, particularly for those which contribute to pollution relatively more.

Alternative approach on analyzing the composition effect might be however to define the sectors based on (geographical) region, rather than on economic sectors or products. In this case, one would neglect any difference among industries

within the region, but consider the differences among the regions. Analyzing the scale effect in each EU Member State might represent such approach; in fact, in this approach, one would neglect heterogeneity among industries, but consider differences among Member States. Then any change in the regional composition of EU production involved by trade regime would be reflected in such a model. This is exactly what we are doing in the analysis of the scale effect that is performed for each EU Member State separately.

Further, we analyze changes in production in several specific industries; first, in order to examine the effect on resource depletion and related pollution we look at three sectors that extract natural resources (coal mining, gas and oil extraction); second, we examine changes in production of power sector that is main driver of environmental impacts (electricity generation /40.1/, and gas distribution /40.3/); lastly, we report the changes in output of several relatively more energy-intensive sectors (mineral production – NACE 26, ferrous metals and other metals production – both in NACE 27) and in forestry due to possible implications of the expansion of this sector on deforestation.

7.1.2. Improvement of environmental quality due to technology effect

Change in environmental burden might be caused by changes in output or in output mix, or by changes in technology either on input side, in the process or on the product side. The effect of state of the technology is named as *the intensity, or technology, effect* (see e.g. de Bruin et al., 1997). Modeling changes in environmental state would require incorporating the environmental variables properly into in an ideal case within a dynamic-type model. One possible solution would be attributing emission intensities for each factor (i.e. fuel type) in each sector for each country in the model. Such exercise would require, however, having environmental data in a very detailed disaggregation, which is not usually available in standard data sources, and then extend adequately the model[21]. Moreover, the effect of induced technological change or innovation transfer would require using very specific and dynamic type model. This modeling is however beyond the scope of this project. Therefore we can assess any possible effects on the environment due to technology change and/or improvements in product quality only quantitatively.

[21] In fact, most of recent macro models are endowed with GHGs emissions and land use data. There are only few CGE or Keynesian macro-econometric models extended by classical pollutants (for instance, GEM-E3 or E3ME model are such examples).

Usual primary concern of the environmental lobby is that further trade liberalization will have adverse consequences on the environment. This adverse effect on the environment might come either through an incentive to lower domestic environmental regulations or stimulating the shift of pollution-intensive industries to Russia, i.e. the country with relatively lower environmental standards compared with the EU ones. This phenomenon is commonly known as *"pollution haven hypothesis*". Based on the review by Vutha & Jalilian (2008) who assess the environmental impacts of the ASEAN-China FTA they conclude that environmental regulations seem to have limited effects on location decisions for most sectors because environmental compliance costs are too small to be a significant decision factor compared to other factors such as natural resources, market size, access to international markets, human capital or investment incentives that have greater influence on investment decisions.

The adverse effect on the environment of "more free" trade might be also mediated by a prohibition to discriminate imports that would be based solely on the methods of production (that might further induce foreign producers to use the cheapest processes and thus technologies. On the other hand, preference for environmentally (and socially) friendly goods in importing countries (say in the EU27) might generate demand for more strict environmental (and social) regulation in the countries that wish to export their goods to countries with greener preferences (*"pollution hallo hypothesis"*).

There would have to be several fundamental questions answered if one liked to assess whether any technology effect will arise and, if so, how large this effect might be.

First, more general one, is **whether FTA will involve any effect on production quality meaning that the emission and resource intensities per value of product will be improved?** The final effect will depend on whether Russia would yield to temptation of keeping less strict environmental standards or even making them less strict (i.e. making the pollution haven from Russia).

Overall effect will be therefore determined by two factors:

- How and, if in a favor of the environment, with what stringency the environmental policy in Russia react to new market conditions involved by Deep FTA.
- Whether Deep FTA involves in- and out-flows of innovations and patents that might induce resource-saving technological progress?

The answer to these questions requires proper investigation. The effect of more strict environmental policy on environmental quality is straightforward. Moreover, there is general consensus provided by empirical research that the stringency and the characteristics of the environmental policy framework can affect the rate and

direction of innovation in abatement technologies. For instance, the role of environmental policy stringency on technological innovation has been assessed empirically by Johnstone & Labonne (2008). Although, the evidence which instrument evokes the innovation the most is mixed (see based on a review by Jaffe, Newell & Stavins (2002), irrespective of nature of the instrument applied, some innovations are likely to be induced (Johnstone & Haščič 2009).

Innovation efforts might be also evoked by the policy stability. Except the area of renewable power development where the policy stability has played at least as important a role as policy stringency (e.g. Soederholm et al., 2005; Wiser & Pickle, 1998; Barradale, 1998), the role of policy uncertainty on innovation with respect to environmental technologies has not been assessed empirically in great detail so far. A very recent study by Johnstone & Haščič (2009) is the only exception; using patent counts as a measure of environmental innovation, they conclude that the more „unstable" a policy regime, the less innovation takes place. Moreover, they argue that in some cases policy instability can arise from the acquisition of information. We might therefore conjecture that Deep FTA policies might significantly reduce costs of these acquisitions that might consequently induce environmental improvement through the technology channel.

Moreover, one can hypothesizes that the convergence of market conditions after implementing FTA policies might also involve convergence of product quality, technological processes. As a consequence, the convergence in energy efficiency and resource and emission intensities might be enhanced. For instance, Markandya et al. (2006) investigates the relationship between energy intensities in the 12 countries of Eastern Europe and the EU15. They found that in terms of per capita growth there is evidence of convergence between the transition and EU15 countries with the rate of converge of about 1.7% per annum over the period 1992 to 2002. A casual look at the data on energy intensity shows that, on average, a 1% decrease in the per capita income gap between developed and transition economies leads to a decrease in the energy intensity growth rate of a transition country by 1.02%. Indeed, the energy intensity cuts in CEE countries were induced by stricter environmental policies as well as increasing economic efficiency. The convergence need not however lead to the convergence of concerned indicator in any matter. In the same vein as the Markandya et al. study (2006), Bigano (2009) analyses energy efficiency in the EU15+Norway. Although, he confirms a sensible catching–up of less performing countries in terms of reducing energy intensity, particularly in the agricultural and in the industrial sector (-convergence), he also found there is no conclusive evidence that the dispersion among countries is being reduced (-convergence). We draw conclusion from this review that overall effect of the Deep FTA between the EU and Russia on the environment will most likely enhance cuts in energy and emission intensities due to the convergence in markets

if the convergence in environmental policies will be also enhanced externally. The environmental effect of Deep FTA will therefore depend on future progress in environmental policy in the EU as well as in Russia.

To conclude, there might be a potential of Deep Free Trade Agreements for technological progress enhancement and boosting trade with environmental R&D. If this is the case, then our approach provides conservative results and yields an upper bound of possible negative impacts of the Deep FTA on the environment quality.

7.1.3. Welfare Impacts

Damage due to changes in environmental burden is related to the externalities. Utilizing economic theory we quote here Verhoef (1994) who argues that '…an external effect exists when an actor's (the receptor's) utility (or profit) function contains a real variable whose actual value depends on the behavior of another actor (the supplier), who does not take these effects of his behavior into account in his decision making process…'. Basically it means that "…the social or economic activities of one group of persons have an impact on another group and these impacts are not fully accounted or compensated for, by the first group".

We are using the results of the external costs quantification by ExternE method that is using Impact Pathway Approach; see Appendix4- 1 for more detail. The external cost due to emission of certain pollutant released in certain country is a product of monetized effects for each impact category. In total the external costs for all analyzed pollutants is a sum of these products:

$$\sum_p \sum_i \sum_c IMPACT_{pic} \times COST_{ic}$$

where the lower subscript p denotes pollutant substance, c is a country which residents are or will be exposed to change in concentration, dose, on intake, and i is impact category. Due to differences in income level and preferences in each country c, one can expect the costs will vary too. Similarly as in other impact assessments of EU policies (see e.g. assessment of CAFÉ program) and in line with the ExternE guide, we assume in this impact assessment the only one EU average monetary values of damages.

The impacts due to classical pollutants might be grouped in several impact categories, which are related with the effects on

- human health (from regional and North Hemispheric model),
- loss of biodiversity,

- crops,
- building materials.

Generic external costs are available for following emission of classical pollutants:

- NH3
- NMVOC
- NOX
- PPMcoarse[22]
- PPM2.5
- SO2.

Generic values of external costs for classical air pollutants depend on height of release and time of release. For our case, we assume the values as derived for *"Unkno_Height of Release"* and *f*or the period of 2010. Any detail on how generic values of external cost per unit of pollutant were derived is provided by the NEEDS report T1_4 and D1_1 both prepared in WP1 of RS3a NEEDS project.

Valuation of *impacts due to climate* change needs to be based on estimation of marginal social costs of carbon (or Social Costs of Carbon)[23]. We benefit from the estimations based on updated FUND model and a review of marginal abatement costs that were used in NEEDS project in order to suggest a possible range of values for climate change damage. We follow here this recommendation and assume following values in our impact assessment: we use 6 USD_{2000} as the lower bound of damage due to climate change, 20 USD_{2000} in our assessment. Then, to cover wider range covered in discussion of potential damage due to climate change, we assume 40 USD_{2000} per tonne of CO_2 to be our upper bound.

In total, five impact categories (health, loss of biodiversity, crops, building materials, and climate change) involved by five classical pollutants (SO_2, NOx, NH_3, NMVOC and two fractions of PM) plus impacts due to climate change caused by GHGs are considered in our impact assessment.

[22] If emission data are not available for specific fractions of particulates, we suggest using 75% share of $PPM_{2.5}$ and 20% of PPM_{coarse} respectively on TSP aggregate; see Appendix for the explanation.

[23] Marginal social costs of carbon are estimated by integrated assessment models (see for instance the models FUND, RICE, PAGE or WITCH). The estimation results provide for instance the EU funded projects MethodEx or NEEDS, more recently the impacts of climate change are analysed within the project ClimateCost.

7.2. Data

Base value of output describes economic performance of the year 2004 and reported in USD 2004 prices. Economic data for the base year are taken from the GTAP database. Predictions of output for baseline (WTO Accession) and for the counter-factual scenarios come from CGE model performed in this study.

Emission data for Europe are taken from EUROSTAT, sectoral disaggregation from Air NAMEA by Eurostat. GHG emission and emission of SOx, NOx and NH3 for Ukraine are taken from UNFCCC database complied from National Inventory Reports (data reported there are also used to cross check data taken from Eurostat). Emission of NMVOC and particulate fractions for Russia and Ukraine are taken from EMEP database as used for EMEP modeling; this is also data source for SOx and NH3 for Russia. Sector disaggregated of a part of emission discharged in Russia is based on data taken from Ministry of Natural Resources and Ecology of Russia and provided by the IET.

External costs per unit of pollutant are based on recent results from the NEEDS project and recalculated from $Euro_{2000}$ into USD_{2004}; the value of external costs for damage related to release of 1 tone of respective pollutant in Russia, Belgium, Czech Republic, Finland, Germany and the EU as average are shown in Appendix 4.2. Table 2. As can be seen, it matters where the emission is released. Difference is due to changes in background concentration and meteorology above the region where the emission was released and receptor density around the site the emission was released from. For instance, damages of emission released in Finland are higher than damage due to emission released in Belgium. This might be explained by relatively low population density, and potentially exposed and affected people, than the density in the heavily populated area around Belgium.

7.3. Environmental Quality in the EU and Russia in the baseline: Airborne Pollution

Since 1990, air quality in the EU has been significantly improved. In both the EU15 as well as the EU12 emission of SO2 were reduced by 70% and emission of particulates by more than 20%. Although emissions of other pollutants such as NMVOC and NOx were also reduced (by 50% in the EU15 and 8% in the NMS, or by 30% and 40% respectively), these emissions started to rise again in the NMS in last years. Emissions of ammonia were reduced mostly during 90's in the member states MS (by 40%), then emission of ammonia were more or less at constant

level. We can however see a different picture for GHG emissions. During the entire period of 1990-2006, GHG emission in the EU15 were roughly at the same level; moreover during 2000 to 2004 they were growing and reached 105% of 1990-level. In the NMS, GHG emissions were mostly decreasing till 2000 down to 70% of 1990 level, then GHG emissions began to increase slightly.

Table 16. Emission discharged in the EU, Russia and Ukraine in 2004, thousand tones

	CO_2	GHG	SOX	NOX	NH_3	NMVOC	PM_{10}	$PM_{2.5}$	PM_{COARSE}
	Kt	*kt*	*kt*	*kt*	*kt*	*kt*	*kt*	*kt*	*Kt*
AT	77 529	91 663	27	233	66	176	44	23	20
BE	126 776	146 154	157	299	76	205	45	31	14
BG	53 270	70 548	929	216	54	130	99	64	35
CY	7 742	9 858	45	18	6	12	1	1	0
CZ	126 605	146 614	227	328	70	203	47	35	12
DE	899 819	1 027 584	592	1 532	625	1 402	201	117	83
DK	53 954	67 858	26	193	98	116	36	26	10
EST	17 103	20 037	89	37	10	40	30	22	8
ES	351 950	426 039	1 360	1 529	425	1 027	180	137	42
FI	68 455	80 791	84	205	33	140	57	38	18
FR	411 932	552 265	488	1 431	751	1 505	527	347	180
GR	110 202	133 726	529	317	73	332	63	46	17
HU	60 401	79 444	248	185	74	157	47	27	20
IE	45 992	68 701	72	123	111	63	11	9	2
IT	491 055	578 039	496	1 180	423	1 259	185	149	36
LT	13 596	21 715	42	55	33	67	11	9	2
LU	12 167	13 403	3	3	5	6	3	2	1
LV	7 642	10 833	4	40	14	60	15	13	2
MT	2 590	3 086	18	9	1	4	2	1	1
NL	181 091	217 731	64	338	134	168	39	21	17
PL	316 873	384 207	1 241	804	317	888	280	134	145
PT	66 414	84 999	203	288	66	289	142	114	28
RO	112 142	158 752	754	372	191	359	47	38	9
SE	55 189	69 676	41	188	53	203	49	37	12
SI	16 427	20 092	54	48	17	46	8	6	2
SK	41 065	49 999	97	98	27	88	36	28	8
UK	555 297	657 564	836	1 659	322	1 002	153	97	57
EU15	3 507 820	4 216 193	4 977	9 518	3 261	7 892	1 735	1 195	539
EU12	775 432	975 185	3 748	2 210	813	2 056	622	340	282
EU27	4 283 252	5 191 378	8 724	11 728	4 074	9 948	2 357	1 535	822
RUS	1 520 743	2 119 773	1 858	4 890	621	2 675	1 366	762	604
UA	319 990	417 187	1 380	838	550	535	458	278	180

Emissions for each pollutant relevant for our impact assessment for the base year 2004 are reported in Table 16. Emission intensities measured by emission per unit of GDP and per capita are then reported in Appendix 4.3. Table 2 (per GDP) and Appendix 4.3. Table 3 (per capita). Emission intensities for GDP in the EU27 are smaller for each pollutant than in Russia. For instance, on average, the economy of EU27 produced 470 t of CO2, or about 1 t of SOx per million USD of GDP, while Russian economy emitted 4,630 t of CO2, or 5,650 t of SOx respectively, per million USD produced. Among EU member states (MS), most intensive economies are in the newest MS, in Bulgaria and Romania. Per unit of GDP, the intensities in EU MS are larger than the intensities in Russia only in few cases mostly in Bulgaria, Romania or in Lithuania (NH3), Estonia (Sox, PM2.5) or Poland (SOx); see Table 17 for the average values and Appendix 4.3. Table 2 for the intensities for each EU Member State. We draw, however, different picture if emissions are expressed per capita. EU27 economy pollutes less per capita than Russia only in the case of GHG and CO2, NOx and both fractions of particulates. Moreover there is only one EU state that emits less of NH3 and 10 or 11 that discharge less pollutants of SOx and NMVOC; see Table 18 or Appendix 4.3. Table 3 for more details.

Table 17. Emission intensities in the EU27 and Russia, per mil. USD of GDP in 2004

	CO_2	GHG	SOX	NOX	NH_3	NMVOC	PM_{10}	$PM_{2.5}$	PM_{COARSE}
	kt	*kt*	*kt*	*kt*	*Kt*	*kt*	*kt*	*kt*	*kt*
RUS	**4.63**	**6.45**	**5.65**	**14.88**	**1.89**	**8.14**	**4.16**	**2.32**	**1.84**
EU27	**0.47**	**0.58**	**0.97**	**1.30**	**0.45**	**1.10**	**0.26**	**0.17**	**0.09**
EU27mean	0.94	1.18	4.97	2.83	0.94	2.44	0.86	0.61	0.26
EU27min	0.21	0.26	0.13	0.12	0.20	0.24	0.09	0.05	0.02
EU27max	3.46	4.58	60.31	14.00	4.07	8.42	6.41	4.14	2.27

Note. EU27mean, EU27min and EU27max reports (simple) average, minimum and maximum value of the emission intensities among all 27 EU Member States.

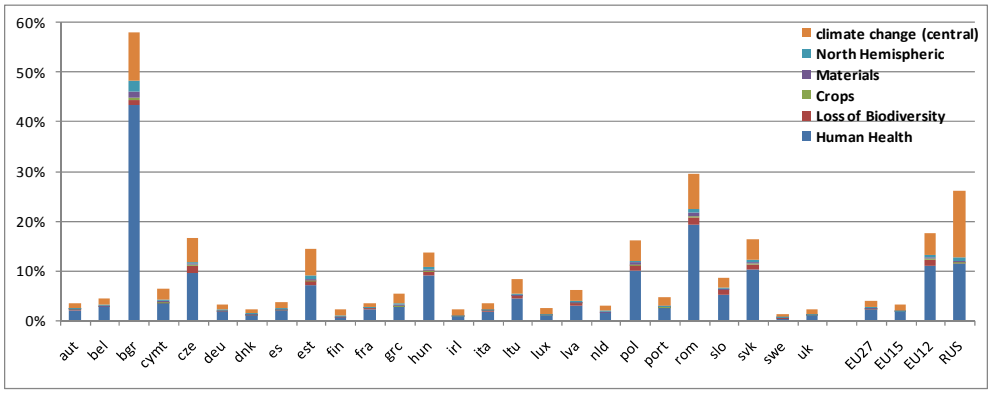
Table 18. Emission per capita in the EU27 and Russia, 2004

	CO_2	GHG	SOx	NOx	NH_3	NMVOC	PM_{10}	$PM_{2.5}$	PM_{coarse}
	t p.c.	*t p.c.*	*kg p.c.*	*kg p.c.*	*Kg p.c.*	*kg p.c.*	*kg p.c.*	*kg p.c.*	*kg p.c.*
RUS	**10.57**	**14.74**	**12.92**	**34.00**	**4.32**	**18.60**	**9.50**	**5.30**	**4.20**
EU27	**8.74**	**10.60**	**17.81**	**23.94**	**8.32**	**20.31**	**4.81**	**3.13**	**1.68**
EU27mean	9.30	11.40	24.88	24.35	8.60	20.15	6.11	4.31	1.80
EU27min	3.30	4.68	1.66	5.96	2.09	9.52	1.19	0.68	0.43
EU27max	26.56	29.26	119.43	39.14	27.18	29.99	22.13	16.50	5.63

Note. EU27mean, EU27min and EU27max reports (simple) average, minimum and maximum value of the emission intensities among all 27 EU Member States.

Damage due to emission discharged in the year 2004 ranges – assuming a central value of MSC of 20 USD per t of CO2 – between 6% (Latvia) to 58% of GDP (Bulgaria) with a mean of 18% in 12 New Member States, while it presents a range of 1.2% (in Sweden) to 5.3% (in Greece) with the mean of 3.1% of GDP in EU15; see Figure 7.1 (disaggregation by impact categories) and Figure 7.2. (by pollutant). Damages in Russia present 26% of GDP of Russia.

Figure 7.1. External costs of emission 2004, % GDP - impact categories



There is less variance in the value of external costs due to pollution if expressed per capita. Damages vary between 280 USD to 1,150 USD per capita in NMS and between 350 USD to 1,200 USD in EU15. Russian economy generates the external costs of 597 USD per capita, while Ukrainian resident contributes by damage of 624 USD, see Figure 7.3 and Figure 7.4.

Figure 7.2. External costs of emission 2004, % GDP – per pollutant

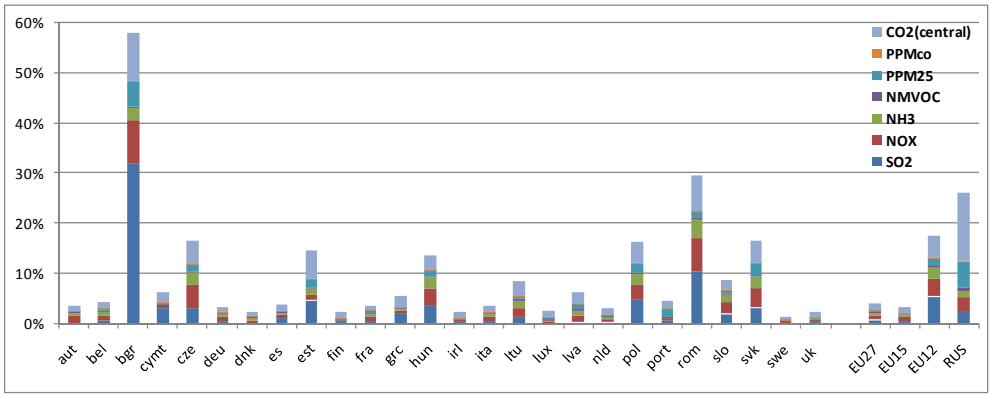


Figure 7.3. External costs of emission 2004, in USD per capita - impact categories

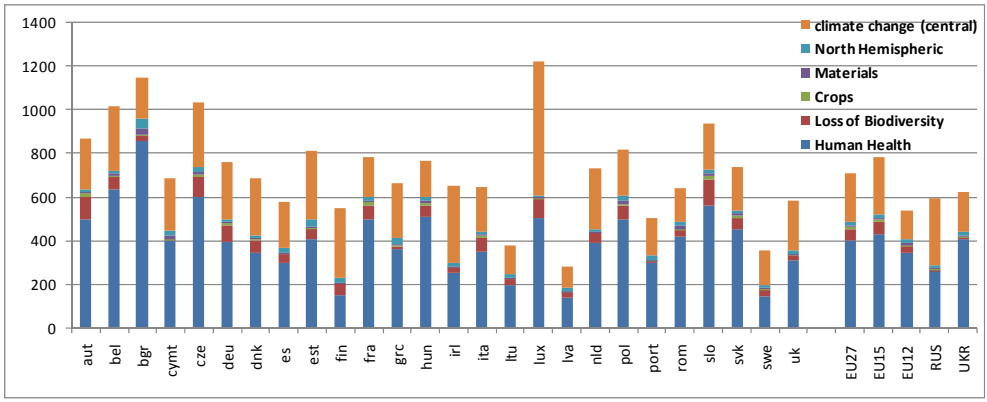
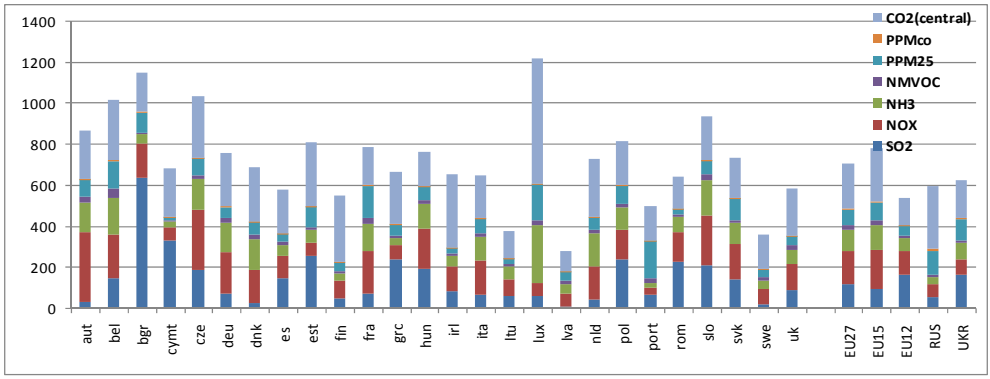


Figure 7.4. External costs of emission 2004, in USD per capita – per pollutant



7.4. Environmental Impacts due to FTA EU-Russia

7.4.1. The Scale Effect

Considering the effect of scale, Deep FTA will lead to the external costs in EU27 region of 358.3 billion. USD and Deep FTA+ of 357.4 billion USD. FTA scenarios would so lead to the external costs in the EU 2.08 billion. USD (Deep FTA) or 1.18 billion. USD (Deep FTA+) larger than in damage estimated for the benchmark (WTO). In relative terms, damage would be higher by 0.58% in the Deep FTA, or 0.33% in the Deep FTA+ respectively. The external costs in the EU15 and the EU12 would however differ. Absolutely as well as relatively damage would be larger in the EU15 than in New Member States; see Table 19.

In Russia, the Deep FTA – thanks to increase in output level but also due to higher output-emission ratios – would result in damage of about 0.48 billion. USD (Deep FTA), or 2.08 billion USD (Deep FTA+) higher than in the benchmark. In relative terms, FTA would increase damage due to increase in pollution by 0.55% (Deep FTA), or 2.4% (Deep FTA+) respectively.

Figure 7.5. External costs for the base, reference case and both of scenarios, in billion USD

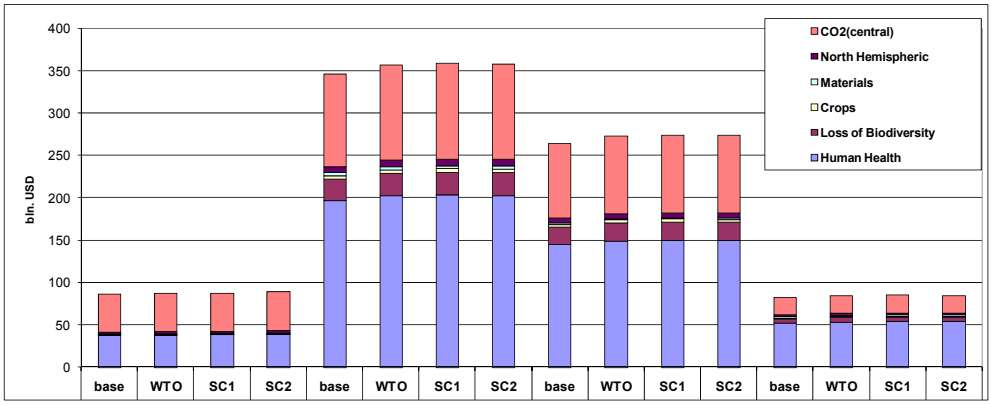


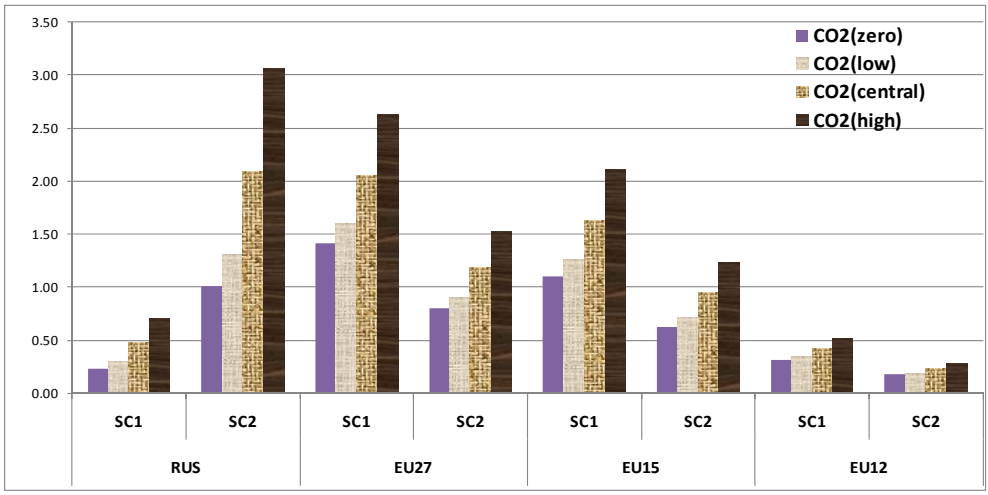
Table 19. External costs due to Deep FTA per region

	RUSSIA		EU27		EU15		EU12	
	Deep FTA	Deep FTA+	Deep FTA	Deep FTA+	Deep FTA	Deep FTA+	Deep FTA	Deep FTA+
FTA –WTO, in billion USD	0.48	2.08	2.05	1.18	1.63	0.95	0.42	0.23
FTA/WTO, in % of WTO case	0.55%	2.40%	0.58%	0.33%	0.60%	0.35%	0.50%	0.27%

The external costs calculated for the changes in income are more or less the same as the externalities calculated for the changes in economic output. For instance, for the EU27, compared with the benchmark, the Deep FTA scenario would lead to an increase in the external costs by 2.1 billion USD (+0.59%) or by 1.06 billion. USD (+0.30%) for the Deep FTA+ scenario respectively; see Appendix 4.3. Table 6.

Although different assumptions on climate change damage affects the magnitude of overall damage as shown in Figure7.6, relative damage compared with the benchmark is almost the same if compared to damages based on calculations using the central value of climate change impacts.

Figure 7.6. Sensitivity analysis of the external cost magnitude for various assumptions on valuation of climate change impacts, the change from post-WTO in billion USD



Note. SC1 indicates Deep FTA, and SC2 marks Deep FTA+.

External costs due to changes in airborne pollution incurred by Deep FTA and Deep FTA+ scenarios compared with the reference case (WTO) for each EU MS, Russia and Ukraine are then displayed in Figure 7.7 and Figure 7.8 (in billion USD), or Figure 7.9 and Figure 7.10 (in % of the benchmark). Damage related to the benchmark is expected to range between 0.4% to 0.8% of the benchmark level in Deep FTA and 0.2% to 0.4% for Deep FTA+. There are however country differences; damages relative to the benchmark would be the lowest in Ukraine and Bulgaria for both scenarios. Scenario 2 again results in the highest damages in Russia (2.4% of the benchmark) and also in Finland. In the scenario 1, Finland, France, Italy and Slovakia would be affected the most (about 0.80% of the benchmark).

In absolute terms, higher impacts would be involved by Deep FTA in Russia, France, Germany and Italy. Scenario Deep FTA+ generally decreases the impacts – if compared with Deep FTA – but not in Russia where damage would be 2.1 billion USD higher than in the benchmark. Among EU countries, the damage would be in absolute terms highest except already mentioned France, Germany and Italy, also in the UK and Poland.

Damage related to the benchmark would range between 0.4 to 0.8% of the benchmark level in the Deep FTA and 0.2% to 0.4% for Deep FTA+. There are however country differences; damages relative to the benchmark would be the lowest in Ukraine and Bulgaria for both scenarios. Deep FTA+ again results in the highest damages in Russia (2.4% of the benchmark) and also in Finland. In the Deep FTA, Finland, France, Italy and Slovakia would be affected the most (about 0.80% of the benchmark).

Figure 7.7. External costs of Deep FTA compared with post-WTO benchmark, in billion. USD

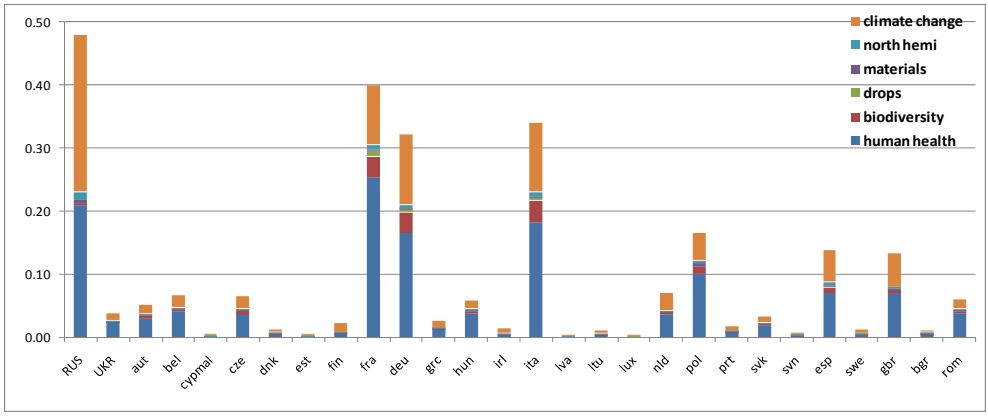


Figure 7.8. External costs of Deep FTA+ compared with post-WTO benchmark, in billion. USD

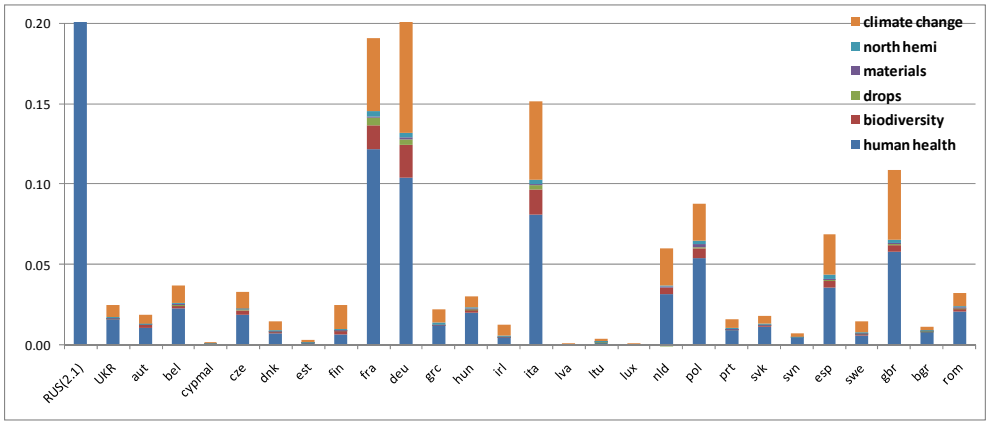


Figure 7.9. External costs of Deep FTA, % of damage of post-WTO reference

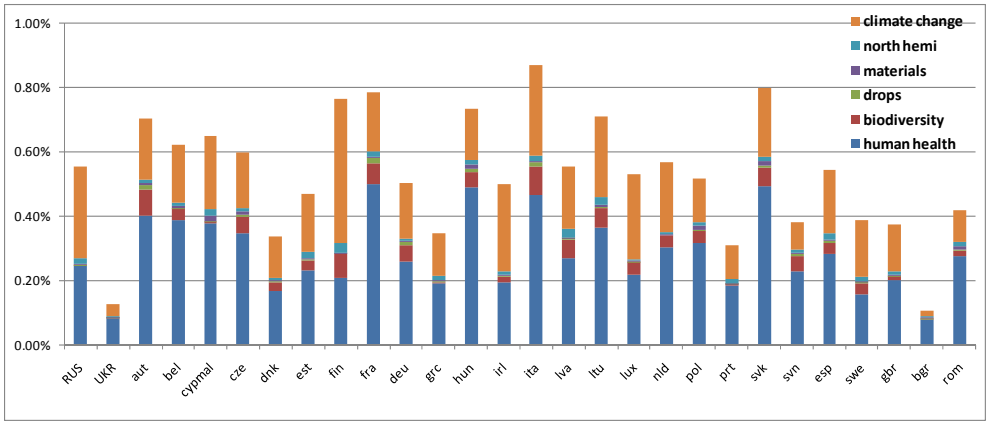
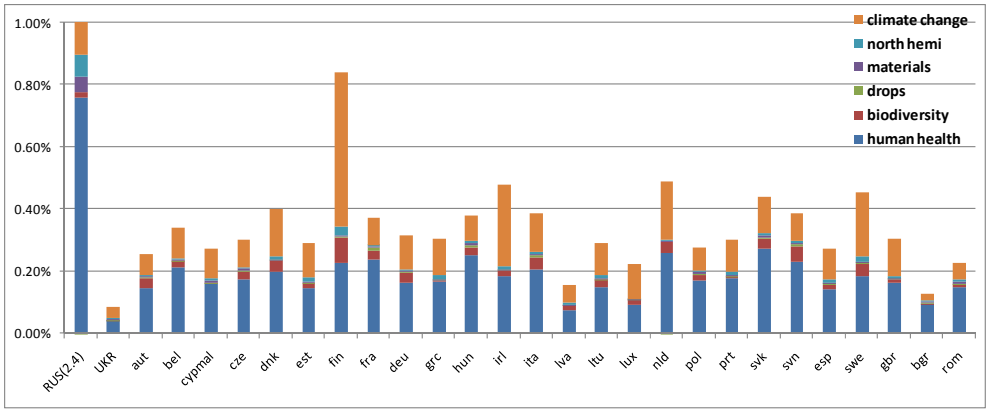
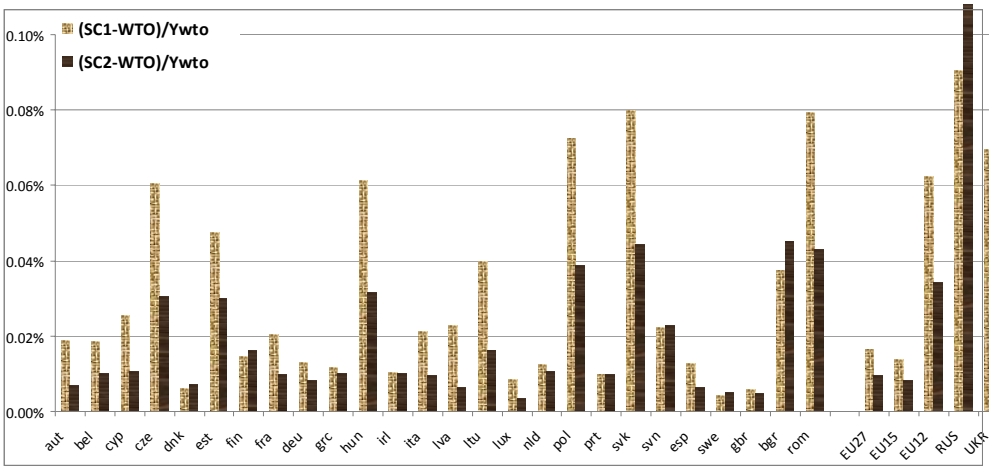


Figure 7.10. External costs of Deep FTA+, % of damage of post-WTO reference



In the EU27, compared with the benchmark, damage is higher by 0.017% of total income (GDP) in the Deep FTA scenario, or 0.009% respectively in the Deep FTA+. Damage is relatively higher in NMS in Deep FTA, particularly in Slovakia, Poland, Romania, Czech Republic and Hungary (about +0.06% of total income in the benchmark). In Russia, damage is larger by 0.09% of total benchmark income in Deep FTA and even by 0.39% of income in the Deep FTA+.

Figure 7.11. Difference in damage between the scenario and the benchmark as % of benchmark income



Note. The difference in damages in Russia for Deep FTA+ is 0.393% of benchmark income.

Since we measure in our approach welfare changes due to change in environmental quality, we can directly compare environmental impacts with welfare effects as predicted by the CGE model.

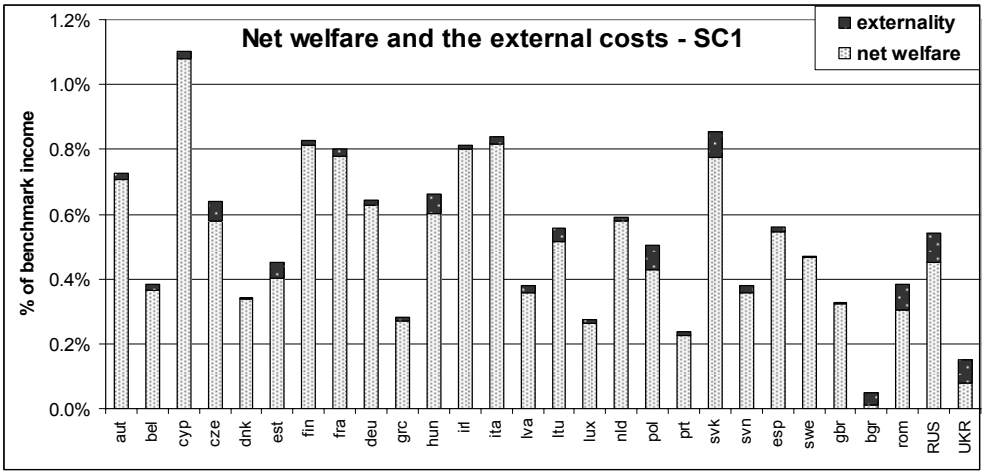
Table 20 reports the externalities as the share of economic welfare; we can see the share varies significantly among countries and by scenarios. We conclude that the external costs are higher – relatively to involved economic welfare – particularly in Bulgaria and Ukraine, followed by Romania and Russia. External costs relative to economic welfare are also higher in other New Member States than in the EU15.

Table 20. External costs as the share on economic welfare (predicted by CGE)

	Externality/welfare Deep FTA			Externality/welfare Deep FTA+		
	min	mean	max	min	mean	max
EU15	0.9%	2.5%	4.9%	0.8%	2.9%	6.9%
EU10	2.3%	8.3%	14.5%	-6.7%	8.0%	15.5%
ro,bg	20.7% , 79.0%			27.3% , 47.1%		
rus,ua	16.7% , 46.4%			17.8% , -20.1%		

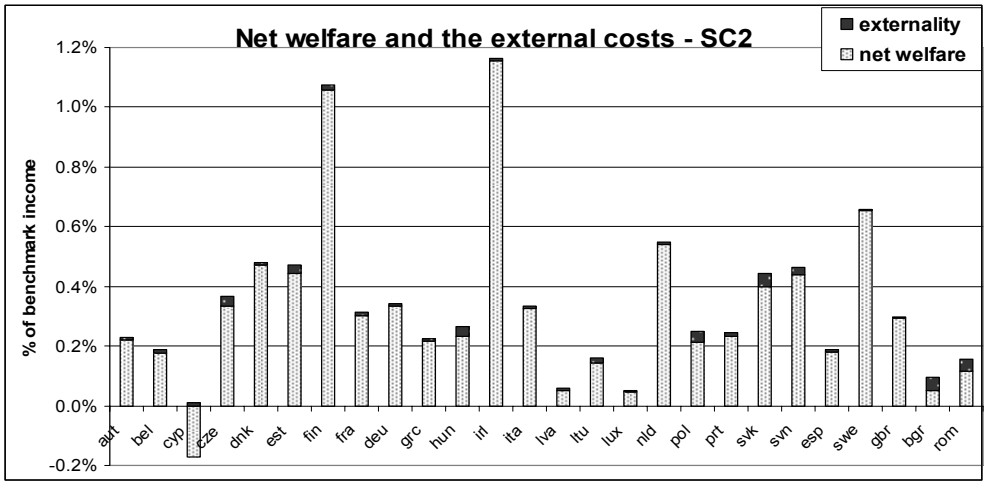
Following figures display the share of environmental damage on economic welfare for each analyzed country. Figure 7.12 reports net welfare of the Deep FTA scenario, while Figure 7.13 shows net welfare of the Deep FTA+. For better visualization of the result we exclude Russia and Ukraine from Figure 7.13. The reason is that the Deep FTA+ results in much higher welfare changes in Russia than in other countries. The Deep FTA+ would involve welfare 2.2% higher than the benchmark out of which environmental damages comprise 0.39 percentage-points. On the other hand, the Deep FTA+ would decrease welfare in Ukraine by -0.23% that is then decreased again by environmental damage of 0.046% of the benchmark level of welfare.

Figure 7.12. Net welfare of Deep FTA



Note. Net welfare of the Deep FTA scenario is given by difference between economic welfare as predicted by CGE model and the external costs of FTA estimated in the impact assessment.

Figure 7.13. Net welfare of Deep FTA+



Note. Net welfare of the Deep FTA+ is given by difference between economic welfare as predicted by CGE model and the external costs of FTA estimated in the impact assessment.

7.4.2. Sectoral Analysis

7.4.2.1. Sectoral Decomposition

In principle, the composition effect would contribute significantly to predicted values of emissions and damages if economic structure would reallocate resources from relatively more polluting sectors to or from less polluting sectors. To check whether this is the case, we gather sector disaggregated emissions data at least for some EU countries.

Table 21. Percentage change in emission if the scale effect or both the scale and the composition effects were considered

	CZE	DE	ITA	ESP	GBR
WTO					
GHG	-0.245%	0.025%	-0.477%	0.419%	-0.474%
NH3	n.a.	0.134%	-2.373%	0.824%	-0.195%
NMVOC	0.016%	-0.539%	0.110%	-1.314%	-0.733%
NOx	-0.115%	0.126%	-0.278%	0.443%	-0.443%
PMcoarse	-0.123%	n.a.	n.a.	n.a.	n.a.
PM2.5	-0.123%	n.a.	n.a.	n.a.	n.a.
SO2	-0.252%	-0.062%	-0.296%	0.574%	-0.501%
Deep FTA					
GHG	-0.243%	0.046%	-0.605%	0.514%	-0.524%
NH3	n.a.	0.027%	-2.949%	0.899%	-0.295%

	CZE	DE	ITA	ESP	GBR
NMVOC	0.094%	-0.648%	0.113%	-1.524%	-0.916%
NOx	-0.046%	0.162%	-0.358%	0.532%	-0.510%
PMcoarse	-0.042%	n.a.	n.a.	n.a.	n.a.
PM2.5	-0.042%	n.a.	n.a.	n.a.	n.a.
SO2	-0.242%	-0.066%	-0.448%	0.732%	-0.522%
Deep FTA+					
GHG	-0.167%	0.015%	-0.372%	0.492%	-0.500%
NH3	n.a.	0.003%	-1.847%	0.462%	0.022%
NMVOC	-0.001%	-0.555%	0.087%	-0.689%	-1.141%
NOx	-0.050%	0.106%	-0.222%	0.477%	-0.534%
PMcoarse	-0.065%	n.a.	n.a.	n.a.	n.a.
PM2.5	-0.065%	n.a.	n.a.	n.a.	n.a.
SO2	-0.146%	-0.123%	-0.326%	0.659%	-0.395%

We first predict emission levels if only the scale effect was considered (assuming no change in economic structure) and then the levels assuming the structure that results from the simulations by CGE model. Table 21 documents this result for the Czech Republic, Germany, Italy, Spain and the UK. Change in economic structure contributes to emission levels the most in the case of emission of NMVOC (by about -1.0% in the UK or -0.7% and -1.5% in Spain), NH3 (-1.8% to 2.9% in Italy). In other cases, the effect of changes in economic structure is smaller than 1% of predicted values by considering the scale effect only.

Table 22. Change in the external costs if the scale, or if both the scale and the composition effects were considered, in % of damage calculated only for the scale effect

	CZE	DE	ITA	ESP	GBR
WTO_{both} / WTO_{scale}	-0.19%	0.06%	-0.72%	0.46%	-0.47%
Deep FTA_{both} / Deep FTA_{scale}	-0.15%	0.05%	-0.91%	0.57%	-0.52%
Deep $FTA+_{both}$ / Deep $FTA+_{scale}$	-0.11%	0.01%	-0.57%	0.53%	-0.46%

Table 22 then reports difference in magnitudes of damages, i.e. the external costs, for both these approaches. We find the composition effect is relatively stronger for Deep FTA scenario; in fact, damage might be larger up to 1% of calculated damage if the scale effect was considered in the impact assessment only. While, FTA scenarios would lead to less clean economic structure in Germany and Spain, it would result in less dirty structure of production in the Czech Republic, the UK and especially in Italy. The effect of changes in economic structure is the strongest in Italy and particularly for Deep FTA, but still lower than -1.0% of damage predicted only for the scale effect. In other cases, the differences are about -0.5%, in Germany and the Czech Republic the effect of changes in economic structure is negligible (between 0.01% and 0.15%).

To provide a rough estimate of the sectoral effect of a FTA at the EU level we predict emission levels and then quantify the external costs assuming one generic value of emission intensity per unit of output for each sector included in our impact assessment. Due to data availabilities we assume the intensities as there are derived for Germany for CO2, NOx, NH3, NMVOC and SO2 pollutant for the base year (based on NAMEA Air 2003 by Eurostat). Following formula (5) we then quantify the external costs due to changes in predicted emission level of each of these five pollutants for 28 sectors in each EU state. We find that taking into account the composition effect reduced negative environmental damage – compared to damage of WTO reference case – in the Deep FTA and Deep FTA+ scenarios. We therefore conclude that the Deep FTA will change the economic structure towards more resource saving.

Table 23. External costs due to the scale and composition effects

	EU27		**Russia**	
	Deep FTA	**Deep FTA+**	**Deep FTA**	**Deep FTA+**
FTA –WTO, in bil. USD				
- the scale effect only	2.05	1.18	0.48	2.08
- the scale and the composition effect (excl. PM fractions)	1.09	0.66	0.09	0.45
FTA/WTO, in % of WTO case				
- the scale effect only	0.58%	0.33%	0.55%	2.40%
- the scale and the composition effect (excl. PM fractions)	0.48%	0.29%	0.35%	1.77%

Figure 7.14 documents the results for Deep FTA and Deep FTA+ scenarios; Deep FTA would increase environmental impacts particularly in manufacturing sectors textile, wearing apparels and leather products (NACE DB and DC), then followed by mineral products (DI), manufactures (DN) and metals (DJ). Deep FTA+ scenario would generate damages mostly due to increase in output in the same sectors is it was the case in Deep FTA plus in resource extraction (*omn* - CB and *coal* - CA). External costs would be relatively smaller due to Deep FTA+ in wood sector (NACE DD) and petro chemistry (NACE DF).

Figure 7.15 reports the external costs generated by each EU sector – compared to the benchmark level – as a percentage of respective sector output. Power sector (NACE E) generates the highest damage relative to its output among all sectors in both FTA scenarios. Extraction of fossil fuels (CA), other minerals (omn - CB) and agriculture and forestry (A,B) and manufacturing of minerals (NACE DI) then follow.

Figure 7.14. External costs for the EU27 – sectoral disaggregation, % of damage in the benchmark

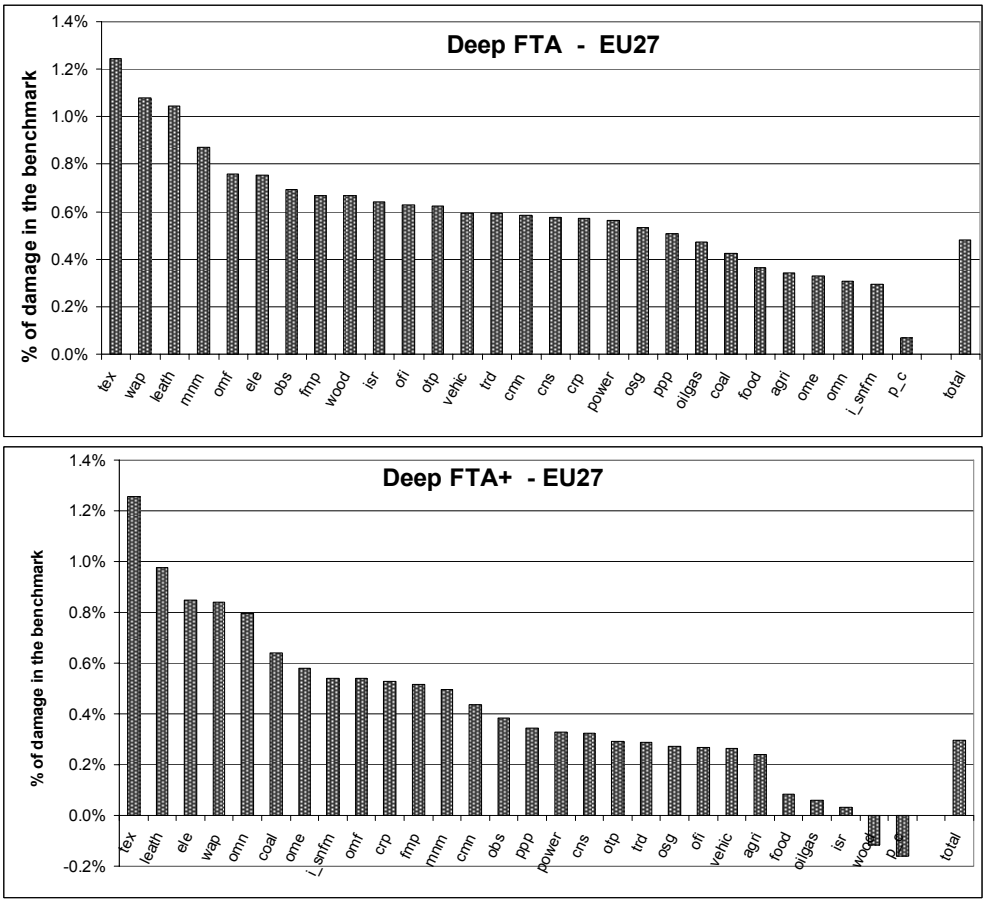
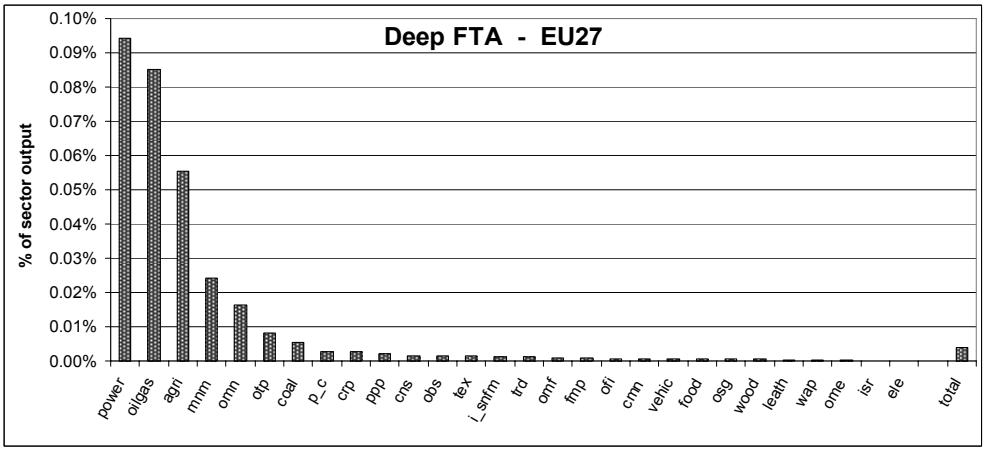
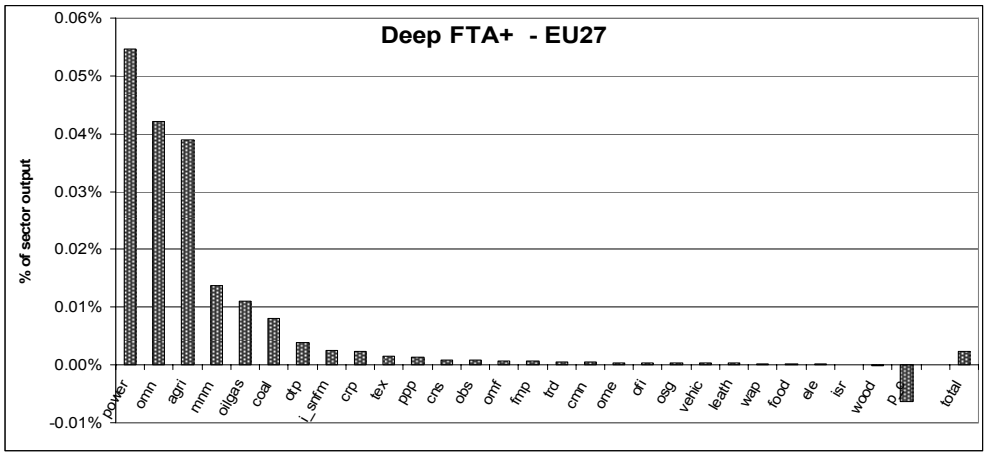


Figure 7.15. External costs for the EU27 – sectoral disaggregation, % of sector output





7.4.2.2. Mining, power and main energy-intensive sectors

To analyze possible effects of a FTA, we examine changes in output of mining and power sectors that are one of key drivers of environmental burden. Then, we also examine the effects of FTA policies on changes in output of (mineral production - NACE 26, ferrous metals and other metals production – both in NACE 27).

FTA policy would lead to decrease in output of coal mining sector in Russia that is mostly replaced by coal extracted in the CIS (see Figure 7.16). On the other hand, gas extraction is increased in both scenarios. Increased electricity production in Russia will be therefore most likely relatively more generated from burning gas than coal. Electricity generation will increase in the EU as a whole in both scenarios. This increase would be relatively smaller in the NMS, which will lead to convergence of electricity intensity between the EU15 and the NMS.

Environmental impact due to resource depletion is predicted for the rest of the world; see Figure 7.17.

Figure 7.16. Change in output of mining and power sectors

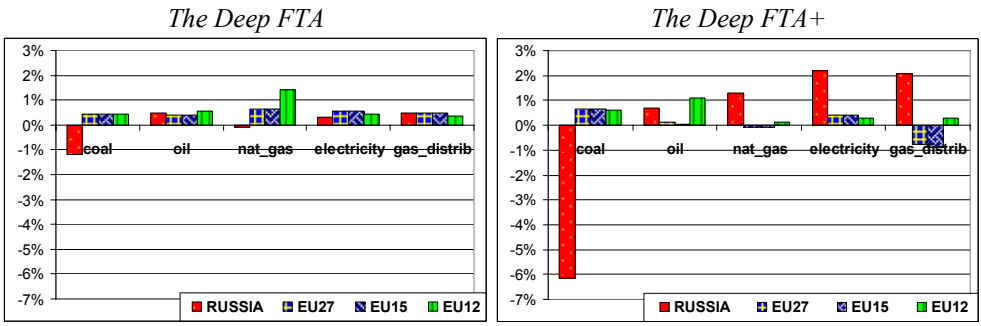
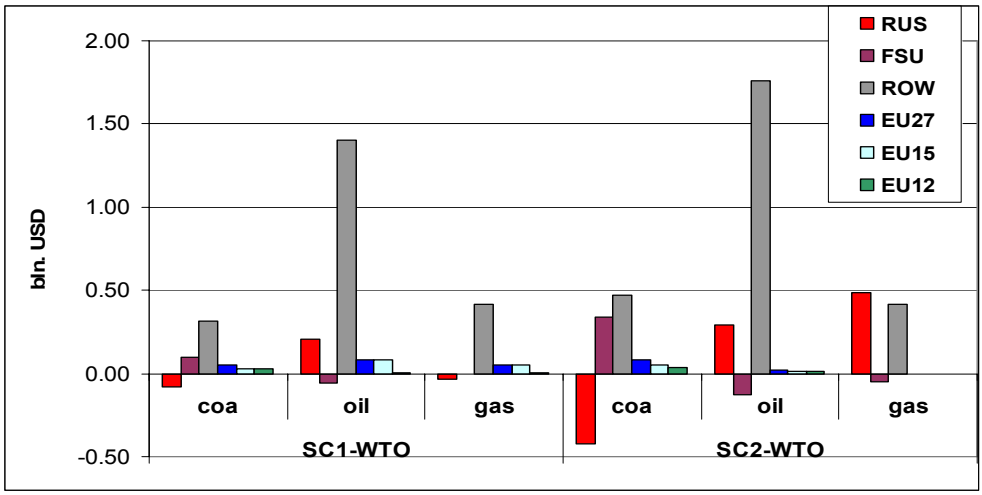
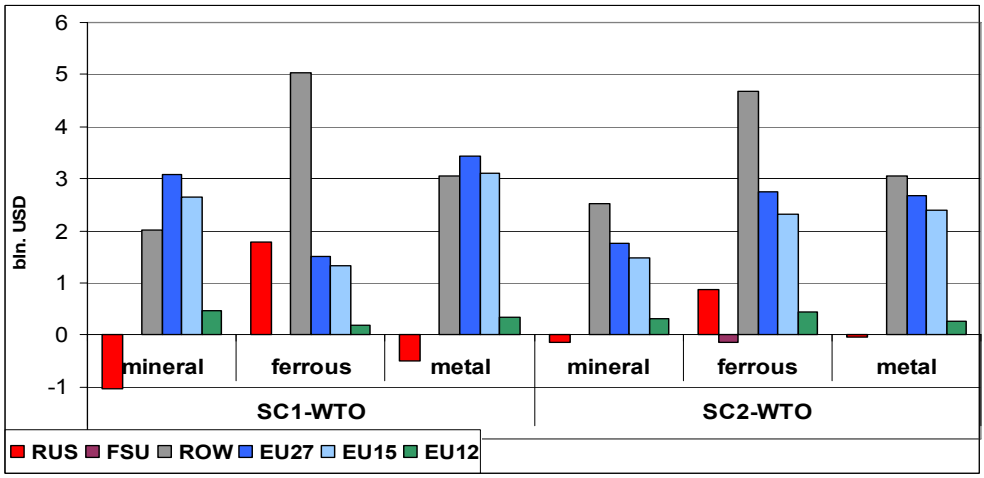


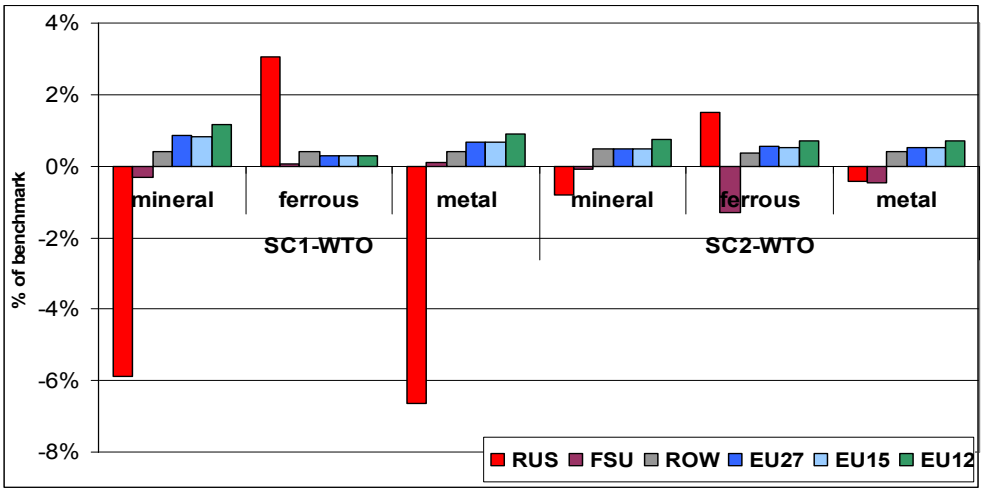
Figure 7.17. Change in output of mining sectors in the EU, Russia, CIS and ROW



The Deep FTA will lead to reduction in economic activity in manufacturing of mineral and metal products (NACE 26 and 28) in Russia, whereas this effect is almost diminishing in the Deep FTA+ scenario. Due to this effect we can expect positive impact on the environment. On the other hand, production of these products will be boost almost in all regions, except manufacturing of ferrous and metal products in the CIS. Manufacturing of these products particularly of mineral and metals due to Deep FTA+ is expected to grow relatively faster in the NMS compared to the EU15. This is expected to result in relatively larger negative impacts on the environment in the NMS. This can be however avoided if modern and more efficient technologies will be installed.

Figure 7.18. Output change in energy mineral, ferrous and metal manufacturing





7.4.2.3. Forestry

In order to support domestic producers of wood products, the Russian government has been raising public measures in the form of the export tariff (see also the impact of a FTA on wood industry in chapter 8.4). Since January 2008, the export tariff has amounted to 25% with a prospect to further raise it to 80%. As a consequence of the Deep FTA, the export of unprocessed timber from Russia is expected to grow. In fact, the model simulations suggest that the output of forestry will rise in Russia by 1.5% in Deep FTA scenario, or by 3.3% respectively in the case of Deep FTA+. On the other hand, post-WTO average weighted tariff on imports from the EU will be mostly reduced for the sector of forestry; the tariff drops from 13.7% level in 2005 to 3.7% (see Table 1).

As a consequence, Deep FTA is expected to lead to an increase of output of forestry in Russia, the EU27 as well as in the ROW by 0.17, 0.32 and 0.82 billion USD respectively. Deep FTA+ would increase the output of this sector only in Russia and the ROW and even more, by 0.37, or 1.09 billion USD respectively, whereas the output in the EU27 would be slightly lower by 0.02 billion USD. While Deep FTA would decrease the output in six EU Member States, Deep FTA+ would reduce the output in 13 of them. In both scenarios, the forestry output would be decreased in all three Baltic States and Finland.

Increase in the output of forestry would therefore involve further adverse effects on the environment due to resource extraction. The effect on deforestation is not however straightforward and will depend on national forestry policies. The reason is that these policies might require reinvesting a part of revenues in foresta-

tion keeping forestry area unchanged or even increase the area. Again, overall effect on the environment will depend on stringency of environmental policies rather than on Deep FTA policies only.

7.4.3. Sectoral Analysis in Russia

Using sector disaggregated emission of classical pollutants from Ministry of Natural Resources and Ecology of Russia (Table 24), emission of GHG from UNFCCC (when missing data where based on emission coefficients as derived for Eastern countries by using Eurostat NAMEA Air), we predict changes in emission of CO2, NOx, SO2, VOC and NH3. External costs due to FTA are calculated by multiplying predicted changes in emission and generic value of damage for emission released by sources in Russia within ExternE project series, particularly in the EU funded NEEDS project.

Table 24. Emission in Russia, 2004 in kt

Industry	SO2	Nox	VOC	CxHy	CO
agriculture industry	8.8	10.0	2.4	8.1	33.9
coal industry	20.8	12.6	3.2	0.2	26.3
oil industry	1 164.3	825.9	2.9	2.4	2 590.7
food industry	10.4	7.2	0.2	660.7	61.6
light industry	153.8	92.0	7.6	28.4	9.4
timber, woodworking	39.8	39.1	41.1	3.3	110.9
oil-refining industry	197.6	49.7	342.6	54.2	41.4
chemical and petrochemical ind	48.9	43.1	92.6	21.6	133.2
iron industry	76.6	30.1	38.8	108.6	1 499.2
nonferrous-metals industry	4.9	3.3	1.3	0.1	362.4
building materials industry	25.0	66.6	4.1	32.5	103.0
manufacturing and metal working	234.6	137.7	8.6	1.6	152.4
power industry	174.1	1 830.5	0.0	1 746.6	245.3
gas industry	42.3	47.8	686.1	530.7	367.1
transport	2 618.2	48.3	5.6	3.2	11 877.1
housing and communal services	27.5	16.9	10.0	1.2	402.2

Environmental impacts are determined mainly by sectors which output is expected to expand relatively faster as a result of a FTA. In the case of the Deep FTA, damage would be relatively higher in light manufacturing sectors (apparel, manufacturing NEC, paper-publishing, food) and in processing metal products (i_snfm) and petroleum and coal (p_c). On the other hand, due to reduction in output some sectors will release less emission and generate thus less environmental damage. Due to reduction in coal mining sector in the Deep FTA+, emission and damage will be re-

duced in this sector. While the first figures report changes in environmental damage as the percentage of benchmark damage, the second next figures display these changes as percentage of benchmark sector output.

Figure 7.19. External costs due to FTA – sectoral decomposition, % of benchmark damage

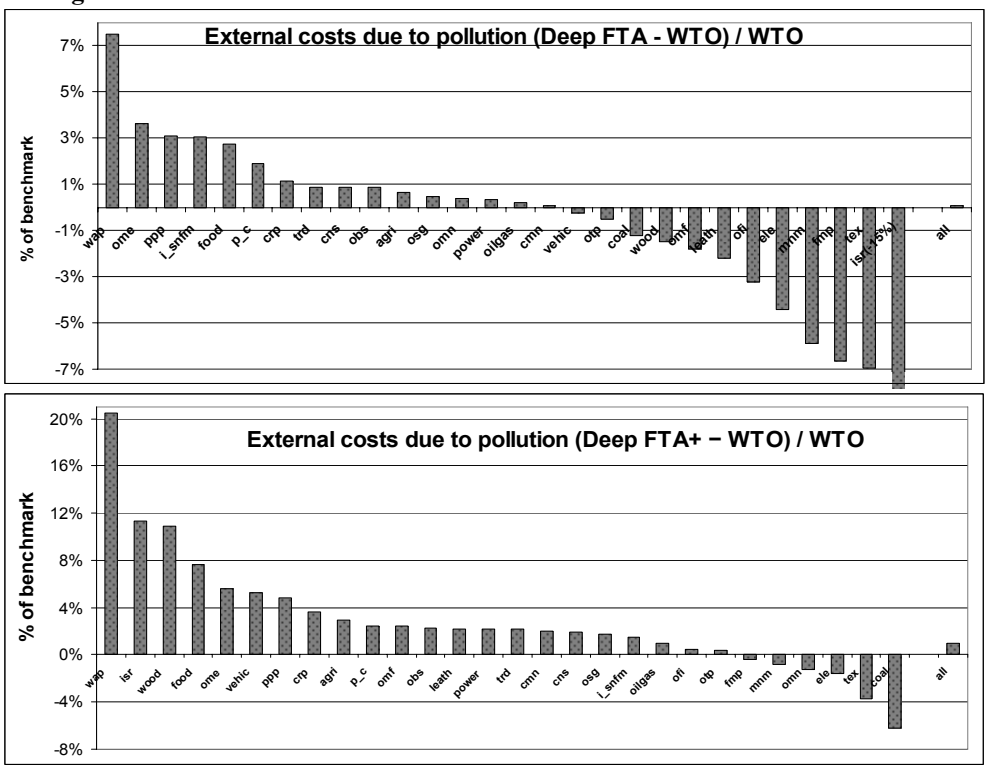
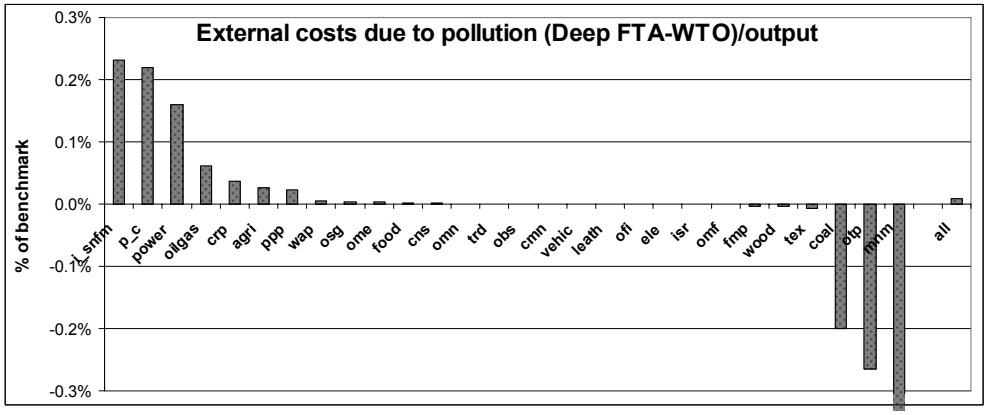
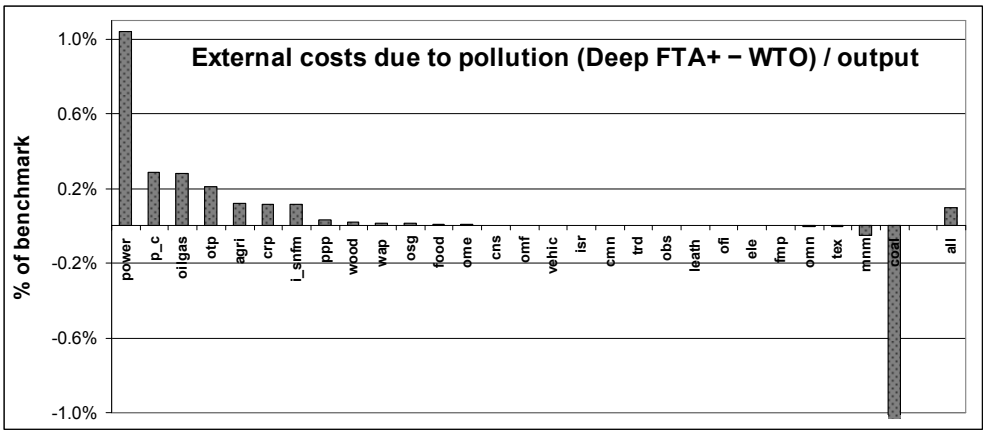


Figure 7.20. External costs due to FTA – sectoral decomposition, % of benchmark output





7.5. Summary of findings

We predict changes in airborne emission due to changes in output and changes in economic structure that might result from the Deep FTA and the Deep FTA+. Our approach goes beyond standard environmental impact assessment due to the fact that we quantify the external costs, i.e. damage or welfare equivalents involved by changes in quality of the environment. Specifically we utilize so called ExternE method with impact pathway analysis as its core method. This approach allows us to compare environmental impacts directly with welfare estimates derived in the CGE modeling framework.

In the EU27, compared with the benchmark, damage due to FTA scenarios is higher by 0.017% of total income in the Deep FTA, or by 0.009% respectively in the Deep FTA+. Damage is relatively higher in the NMS and in Deep FTA scenario, particularly in Slovakia, Poland, Romania, Czech Republic and Hungary (about +0.06% of total income in the benchmark). In Russia, damage is larger by 0.09% of total benchmark income in the Deep FTA and by 0.39% of income in the Deep FTA+.

The Deep FTA would increase environmental impacts particularly in manufacturing sectors such as textile, wearing apparel and leather products (NACE DB and DC), then followed by mineral products (DI), manufactures (DN) and metals (DJ). The Deep FTA+ scenario would generate damages mostly due to increased output in the same sectors as in the case of the Deep FTA and in resource extraction (*omn* - CB and *coal* - CA). External costs would be relatively smaller due to the Deep FTA+ in wood sector (NACE DD) and petro chemistry (NACE DF). Power sector

(NACE E) generates the highest damage relative to its output among all sectors in both FTA scenarios. Extraction of fossil fuels (CA), other minerals (*omn* - CB) and agriculture and forestry (A,B) and manufacturing of minerals (NACE DI) then follow.

FTA policies would also lead to decrease in output of coal mining sector in Russia that is mostly replaced by coal extracted in the CIS. On the other hand, gas extraction is increased in both scenarios. Increased electricity production in Russia will be therefore most likely relatively more generated from burning gas than coal. Electricity generation is expected to increase in the EU27 in both scenarios, while this increase would be relatively smaller in the NMS, which is expected to lead to convergence of electricity intensity between the EU15 and the NMS.

FTA will lead to reduction in economic activity in manufacturing of mineral and metal products (NACE 26 and 28) in Russia in the Deep FTA, whereas this effect is almost diminishing in the Deep FTA+ scenario. Due to this effect we can expect positive impact on the environment. On the other hand, production of these products is expected to expand almost in all regions, except manufacturing of ferrous and metal products in the CIS. Overall effect on the environment and consequently health welfare would depend on the scale of installations of modern and more efficient technologies in the future and the necessary accompanying measures to address the pollution effects should be considered in a future FTA.

8. Summary and Conclusions

The preceding chapters of this report have examined in some detail key aspects of the Russian economy, including several social and environmental indicators and possibilities of its integration with the EU. Below we summarize our major findings and conclusions with regard to a deep and comprehensive free trade between the EU and Russia. We analyze the impact of the Deep FTA in medium (5-10 years) and long (10-15 years) term perspective. We refer to those scenarios respectively as the Deep FTA and the Deep FTA+. The Deep FTA assumes elimination of tariffs on industrial products, halving of tariffs on food and agricultural goods in bilateral EU-Russia trade and a substantial elimination of non-tariff barriers to trade and investment throughout various sectors of the economy. Finally, the comprehensive set of reforms resulting from the **Deep FTA** along with more wide-ranging flanking measures e.g. on competition and corruption could lead to re-branding of Russia as a favorable and safe investment location leading to the **Deep FTA+** scenario in which we assume that Russia would achieve a notable improvement in the business environment.

The **CGE estimates** are based on a multiregional trade model including 40 sectors and all EU member states, Ukraine, the CIS and the Rest of the Word. The estimates of the initial level of NTBs included in the modeling exercise (namely technical barriers, border costs and barriers to provision of services by foreigners) are based on surveys for Ukraine and Russia. We expect that the Deep FTA will only lead to a small welfare gain of 0.55% for Russia. In the longer term perspective the welfare gain from the Deep FTA+ is expected to rise to 2.24%. Wages of unskilled workers are expected to grow faster than wages of skilled workers. In the EU, welfare changes due to the Deep FTA are rather small, but positive for all EU27 member states. In the Deep FTA+ scenario many countries such as Finland, Ireland, Netherlands, Denmark, Estonia, Slovakia, Slovenia and Sweden are expected go see their welfare increase by at least 0.5% of GDP. In the sensitivity analysis we assume a bigger improvement in the business environment in Russia. A reduction of the price of capital by 5% leads to much bigger welfare gain for Russia (4.24%).

In the Deep FTA scenario, the impact on sectoral output in Russia is going to be mostly positive. All but 3 sectors are expected to register a growth in output. Products experiencing the highest growth (over 3%) are paper, ferrous metals and

machinery, with the increase in domestic production replacing imports from Estonia and Latvia. The production of mineral products, financial services, and manufacturing NEC is expected to be fall, with the compensating increase in imports. The overall impact on the EU is expected to be positive, but small. Those countries for which Russia is a significant export destination i.e. Estonia, Finland, Latvia and Lithuania are expected to experience output growth of over 3% in textiles and metal products and smaller increases in several other sectors. Only a few countries will register a fall in sectoral output higher than 3%: Estonia, Ireland and Latvia report a fall in the production of beverages and tobacco; and Lithuania records a small fall in the output of dairy products.

Output gains for Russia are larger and more widespread **in the Deep FTA+ scenario**, with several sectors registering a growth of output of over 3%. However, production of some sectors is expected to fall (minerals, coal, textiles, electronic equipment, metals and metal products). In the EU27, the highest shifts in output are expected in countries for which Russia is the major trading partner overall or in selected sectors, namely Estonia, Finland, Latvia and Lithuania. Sectors that seem to be consistently growing across the majority of EU member states include electronic equipment, motor vehicles, textiles, business services and financial services. Several other sectors in the EU are expected to register small (between 1 and 3%) output growth.

The developments in the Russia's social sphere in the coming years will be affected by the current global financial crisis. Labor markets have been adjusting to the economic downturn through all channels: employment, wages and arrears. The rising unemployment and worsening enterprise finances resulted in the 5.8% annual decline of real disposable income in the 4th Quarter of 2008, World Bank experts estimate that unemployment rate will reach 10-12% by the end of 2009. Some regions with already high unemployment and poverty rates will be particularly hard hit.

We evaluate the **overall social impact of the FTA** for Russia as positive and significant. Expected wage increases for unskilled and skilled labor, coupled with the pronounced and widespread growth in employment, could result in an increase of living standards and a reduction in poverty in Russia. New jobs could be created mainly in manufacturing, but also in services and agriculture. However, we also expect that some sectors, in particular coal and textiles, could contract as a result of the FTA. This could result in increased unemployment rates for females in the Central Federal District and for coal workers in Kemerovo oblast and Krasnoyarsk region. The expected unemployment will be exacerbated in the monocities, where alternative employment opportunities are limited.

In the EU, the overall social impact of a Deep FTA+ is expected to be moderate and positive for Lithuania, Finland, Ireland and Bulgaria, moderate and negative for Estonia, and low and positive for other EU-countries. Wages and employment are expected to increase in other European countries as well, but on a smaller scale. In Estonia, we expect that beverages and tobacco sector will contract significantly, while the textile sector will stagnate. Therefore, for countries with contracting sectors, social protection might be needed to mitigate the impact of transitional unemployment.

Overall, **the rate of airborne pollution** in urban locations and surface water across Russia remains high and requires urgent measures to improve the situation. The largest zones of the permanent man-made pollution were located in the Siberian Federal District, mostly in the cities of Norilsk, Krasnoyarsk, Irkutsk, Novosibirsk and Kemerovo. In terms of emission of polluting substances into open air, manufacturing industries make the greatest contribution (some 35%), followed by the mining sector (30%), electricity generation and distribution (some 20%), transport and communication (11%).

The report includes estimates of **changes in airborne emission** due to changes in output and changes in the economic structure as a result of the Deep FTA and the Deep FTA+. We quantify welfare implications of changes in the quality of the environment. In Russia, the loss is estimated at 0.09% of the total benchmark income under the Deep FTA, and at 0.39% of income under the Deep FTA+. In the EU27, compared with the benchmark, losses are equivalent to 0.017% of the total income under the Deep FTA, and 0.009% of the income under the Deep FTA+. The loss is relatively higher in the New Member States and in the medium run (Deep FTA scenario), particularly in Slovakia, Poland, Romania, Czech Republic and Hungary (about +0.06% of the total benchmark income).

Environmental impacts of the Deep FTA would stem from increased production in manufacturing sectors: textile, wearing apparels and leather products, mineral products, manufactures NEC, and metals. Additional losses under the Deep FTA+ would be from further output increases in the same sectors, and in resource extraction.

Overall, we conclude that an EU-Russia FTA will be beneficial to the Russian Federation and the EU27. Some sectors are expected to contract in the medium term, but their importance in total output is small. Over the longer run, the majority of sectors in Russia are expected to expand, while only a few sectors in the EU27 are expected to register negligible decreases in output. We estimate that welfare losses from environmental damages will be very small for Russia (possibly even smaller due to the implementation of greener technologies), and negligible for the EU. Despite some significant negative medium-term social implications

in selected sectors in Russia (textiles, coal), the overall increase in economic activity and wages, coupled with likely domestic policies aiming at easing the impact of transitional unemployment, are expected to allow for an overall reduction in poverty rates. Our results show that significant welfare gains would accrue from the Deep FTA+, involving a significant reduction of NTBs along with additional flanking measures, particularly on competition and corruption, which would help re-branding of Russia as a safe and attractive investment location. In the Deep FTA+ scenario, many countries, such as Finland, Ireland, Netherlands, Denmark, Estonia, Slovakia, Slovenia and Sweden, are expected go see their welfare increase by at least 0.5% of GDP.

We find that the effect on environment is not too large, especially if compared with the economic benefits involved in both the EU as well as in Russia. Overall effect on the environment will depend on stringency of environmental policies rather than on Deep FTA/Deep FTA+ policies only. Overall effect on the environment and consequently health welfare would depend on the scale of installations of modern and more efficient technologies in the future and the necessary accompanying measures to address the pollution effects should be considered in a future FTA. There is a considerable uncertainty surrounding our assumptions, but the analysis indicates that despite rising protectionist pressures in the current economic crisis the conclusion of a FTA with the EU would not have exacerbated existing problems, but could provide a solid contribution to long term economic growth.

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Appendix 1. Economic, Trade and Investment Indicators

Appendix 1. Table 1. Indexes of Main Macroeconomic Indicators in 2005 -2008, as % to the prior year

	2005	2006	2007	2008	2008- by quarters			
					1	2	3	4
Gross domestic product	106.4	107.4	108.1	105.6	108.5	107.5	106.2	101.1
Actual final consumption by households	110.5	109.8	111.0	111.5	114.1	112.2	112.4	109.7
Investment in capital assets	110.9	116.7	121.1	109.8	123.6	117.4	111.7	97.7
Volume of industrial output	105.1	106.3	106.3	102.1	106.2	105.5	104.7	93.9
Agricultural output	102.4	102.8	103.3	110.8	104.5	104.2	108.5	59.2
Commercial cargo turnover in the transportation sector	102.7	102.5	102.2	100.6	105.1	102.9	101.5	93.0
Volume of communication services	115.7	124.0	112.8	-	-	-	-	-
Retail trade turnover	112.8	114.1	116.1	113.0	116.7	114.4	114.4	108.2
Paid services to the population	106.3	107.6	107.9	104.9	107.7	105.6	105.3	102.0
Foreign trade turnover	131.5	127	120.8	132.2	148.8	147.9	149.3	95.4
Real disposable money income	112.4	113.5	112.1	102.7	107.8	106.0	106.6	94.2
Real salaries and wages	112.6	113.3	117.2	109.7	113.4	112.5	112.2	102.5
Real pensions due	109.6	105.1	104.8	118.1	119.0	113.7	122.7	116.9
The average annual number of the employed in the economy	100.6	100.6	101.3	100.6	100.8	101.2	100.8	99.7
The number of the unemployed	90.2	96.0	84.9	104.3	96.5	94.2	105.6	123.0
Consumer price index	110.9	109.0	111.9	113.3	104.8	103.8	101.7	102.5
Producer price index	113.4	110.4	125.1	93.0	103.0	113.6	100.5	79.1

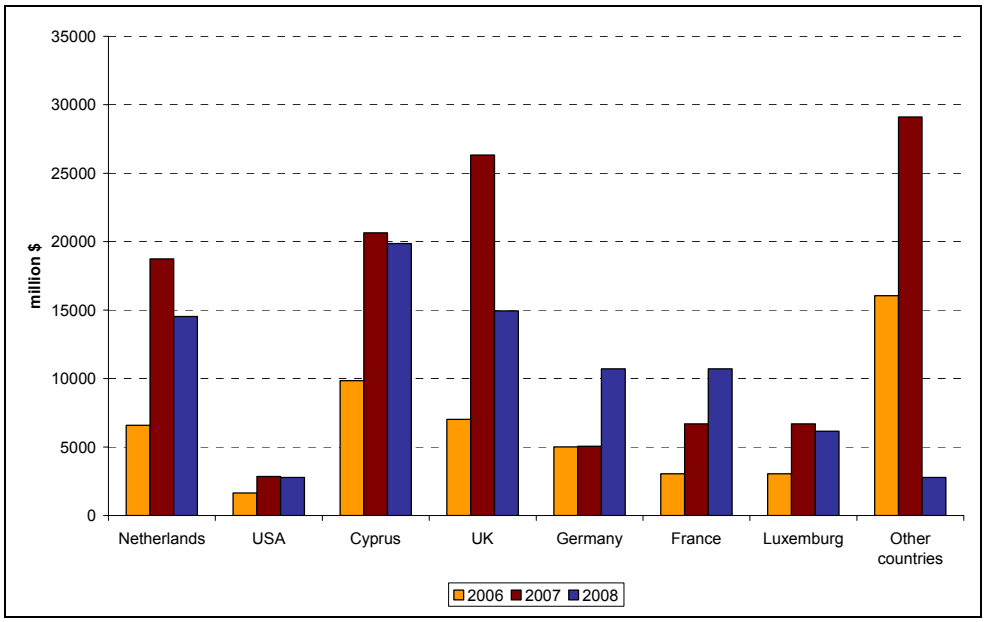
Source: The Federal State Statistics Service of the Russian Federation.

Appendix 1. Table 2. The structure of Foreign Investments in Russian Economy

	million USD				in % to the prior year			
	All	**Direct**	**Portfolio**	**Others**	**All**	**Direct**	**Portfolio**	**Others**
2004	40 509	9 420	333	30 756	136.4	138.9	83.0	136.6
2005	53 651	13 072	453	40 126	132.4	138.8	136.3	130.5
2006	55 109	13 678	3 182	38 249	102.7	104.6	700.0	95.3
2007	120 941	27 797	4 194	88 950	219.5	203.2	131.8	232.6
2008	103 769	27 027	1 415	75 327	85.8	97.2	33.7	84.7

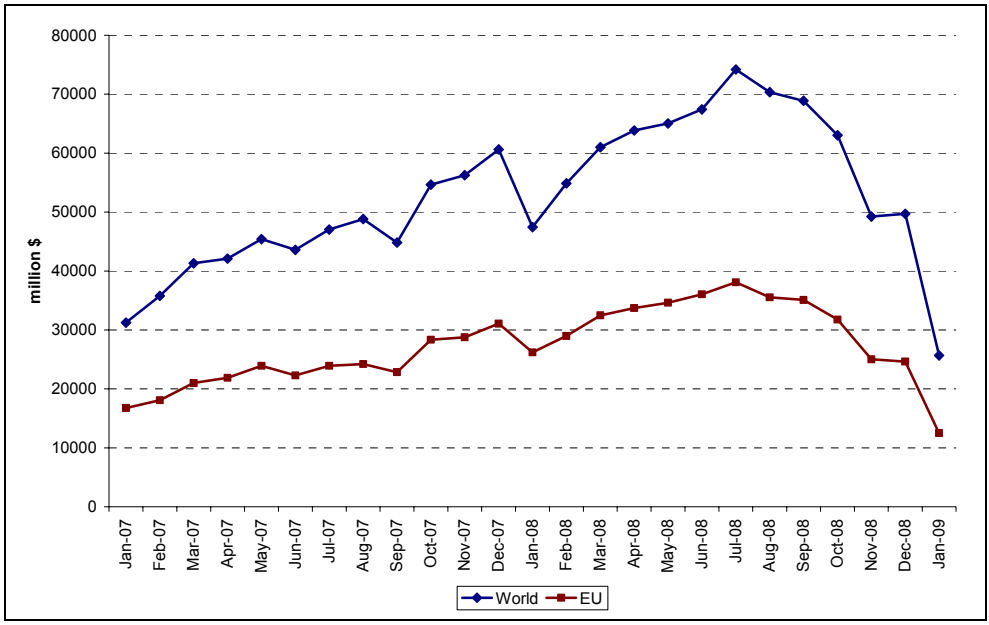
Source: The Federal State Statistics Service of the Russian Federation.

Appendix 1. Figure 1. The Geographical Structure of Foreign Investments in Russian Economy in 2008-2009



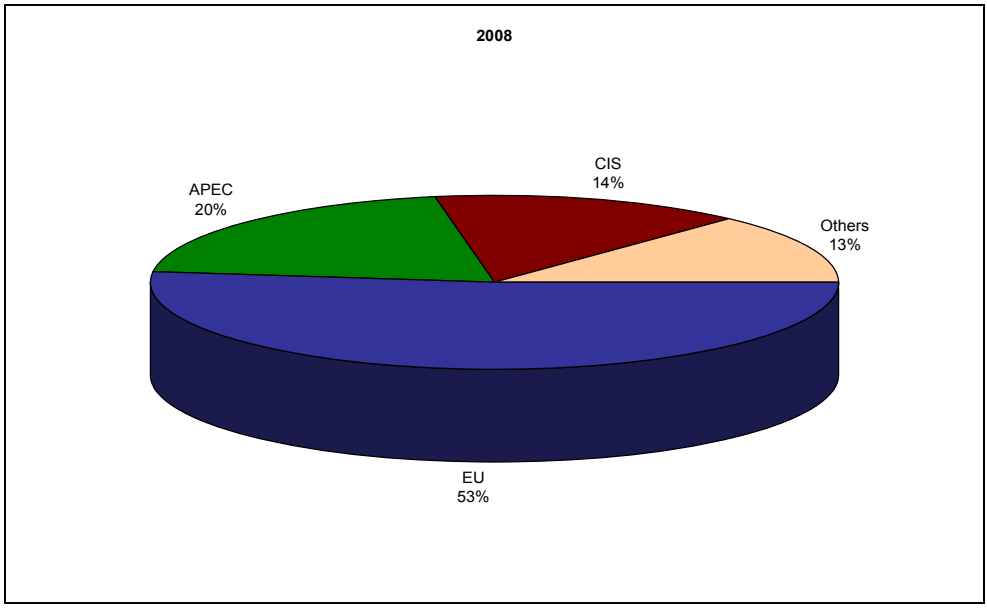
Source: The Federal State Statistics Service of the Russian Federation.

Appendix 1. Figure 2. The Dynamic of Russia's Foreign Trade in 2007-2009



Source: The Federal Customs Service of the Russian Federation.

Appendix 1. Figure 3. Geographic Structure of Russia's Foreign Trade in 2008



Source: The Federal Customs Service of the Russian Federation.

Appendix 2.1. CGE Model Equations

Model structure

This model is based on the MRT - Multiregional Trade Model - by Harrison, Rutherford and Tarr (HRT) used in their evaluation of the Single Market (HRT, 1994)[24].

Markets and prices

The following notational conventions are adopted:

i, j – indexes of goods

r, s – indexes of regions

f – primary factors

p – market price index, 1 in the benchmark

$\overline{x}$ - benchmark value of quantity variable X.

The following market prices are included in the model:

PC_r – price index for final consumption in region r

PG_r - price index for government provision in region r

PA_{ir} – price index for the Armington aggregate of good i in region r, inclusive of all applicable tariffs, border costs and monopolistic markups

PY_{ir} - supply price (marginal cost) of good i from region r, excluding fixed costs associated with the production of goods in industries subject to IRTS

PF_{ir} - price index for factor inputs in sector i, region r

PT - price index for transport services.

[24] Their code was obtained from Anders Hoffmann with the permission of Thomas Rutherford and our modelling exercise uses large parts of this code. This model in turn is based on the code employed in their evaluation of the Uruguay Round in HRT (1995, 1996a), which is available for public access on Harrison's Web site.

Summary of the equilibrium relationships

Final demand in each region arises from a representative agent, maximizing a Cobb-Douglas utility function subject to a budget constraint. Income is composed of returns to primary factors and tax revenue directed to the consumer as a lump sum.

Within each region, final and intermediate demands are composed of the same Armington aggregate of domestic and imported varieties. The composite supply is a nested CES function, where consumers first allocate their expenditures among domestic and imported varieties and in the second level the consumers choose among imported varieties. In the imperfect competition case firm varieties enter at the bottom of the CES function.

There is no distinction between goods produced for domestic market and for exports. Goods are produced with the use of intermediate inputs and primary factors. Primary factors are mobile across sectors, but not across regions. We assume a CES function over primary factors and a Leontief production function for intermediate inputs and factors of production composite. Exports are not differentiated by the country of destination.

All distortions are represented as ad valorem price-wedges. They consists of factor and intermediate input taxes in production, output tax, import tariffs, export subsidies, taxes on government and private consumption.

Equations

Markets

- Regional output

(1) $$Y_{ir} = \sum_{s} X_{irs}$$

where Y_{ir} is output of good i in region r, X_{irs} is export of good i from region r to s and if r=s, X_{irs} represents domestic sales.

- Regional demand

(2) $$A_{ir} = C_{ir} + \sum_{j} a_{ijr} Y_{jr} + T_{ir}$$

where A_{ir} is total supply (production plus imports), C_{ir} is total final consumption, a_{ijr} is intermediate demand coefficient and T_{ir} is demand for good i in transport costs.

- Value added

$$V_{ir} = a^{V}_{ir} Y_{ir} + f_{ir} N_{ir} \tag{3}$$

where V_{ir} is total sector i value added, a^{V}_{ir} is value added demand coefficient, f_{ir} is the fixed cost per firm and N_{ir} is the number of firms in IRTS sectors.

- Primary factor markets

$$\overline{F}_{fr} = \sum_{i} a^{F}_{fir} V_{ir} \tag{4}$$

where $\overline{F}_{fr}$ is the endowment of factor f in region r and a^{F}_{fir} is the price-responsive demand coefficient for factor f in sector i.

- Armington supply

$$A_{ir} = \overline{A}_{ir} \left(\alpha^{D}_{ir} \left(\frac{X_{irs}}{\overline{X}_{irs}} \right)^{\rho_{DM}} + \left(1 - \alpha^{D}_{ir}\right) \left\{ \sum_{r \neq s} \theta^{M}_{irs} \left(\frac{X_{irs}}{\overline{X}_{irs}} \right)^{\rho_{M}} \right\}^{\rho_{DM}/\rho_{M}} \right)^{1/\rho_{DM}} \tag{5}$$

where $\overline{A}_{ir}$ is the benchmark supply, α^{D}_{ir} is the value share of domestic supply, $\overline{X}_{irs}$ is benchmark exports of good i from region r to s, θ^{M}_{irs} is the benchmark value share of region r exports in region s imports and ρ_{DM} and ρ_{M} are determined by Armington elasticities of substitution σ_{DM} and σ_{M}: $\rho = \frac{\sigma}{\sigma - 1}$

- Value added supply

$$V_{ir} = \overline{V}_{ir} \left\{ \sum_{f} \alpha^{F}_{fir} \left(\frac{a^{F}_{fir}}{\overline{a}^{F}_{fir}} \right)^{\rho^{F}_{ir}} \right\}^{1/\rho^{F}_{ir}} \tag{6}$$

where $\overline{V}_{ir}$ is benchmark value-added, α^{F}_{fir} is the benchmark value share of factor f, $\overline{a}^{F}_{fir}$ is the benchmark input coefficient and ρ^{F}_{ir} is determined by the elasticity of substitution.

- Border/transport costs

$$T_{ir} = \begin{cases} \sum_{js} \beta_{jrs} X_{jrs} & i = i_{\tau} \\ 0 & i \neq i_{\tau} \end{cases} \tag{7}$$

where τ is the index of single commodity used for transport services and β_{jrs} is the transportation cost coefficient.

- Welfare index

$$W_r = \prod_i \left(\frac{C_{ir}}{\overline{C}_{ir}} \right)^{\alpha_{ir}} \tag{8}$$

where $\overline{C}_{ir}$ is benchmark final demand for good i in region r.

Profit conditions

- Value added

$$PV_{ir} = \frac{1 + t^F_{ir}}{\overline{PV}_{ir}} \left(\sum_f \alpha^F_{fir} PF^{1-\sigma^F_{ir}}_{fr} \right)^{\frac{1}{1-\sigma^F_{ir}}} \tag{9}$$

where f^F_{ir} is the ad valorem factor tax rate, $\overline{PV}_{ir}$ is the benchmark (tax-inclusive) price.

- Marginal cost

$$PY_{ir} = a^V_{ir} PV_{ir} + \sum_j a_{jir} PA_{jr} \tag{10}$$

- Armington composite supply price

$$PA_{ir} = \left\{ \alpha^D_{ir} \left(\frac{PD_{ir}}{\overline{PD}_{ir}} \right)^{1-\sigma_{DM}} + (1 - \alpha^D_{ir}) \left(\frac{PM_{ir}}{\overline{PM}_{ir}} \right)^{1-\sigma_{DM}} \right\}^{\frac{1}{1-\sigma_{DM}}} \tag{11}$$

where $\overline{PA}_{ir} = 1$

$$PD_{ir} = (1 + \mu_{irs}) PY_{ir} \tag{12}$$

and

$$PM_{ir} = \left\{ \sum_{r \neq s} \theta^M_{irs} \left[(1 + \mu_{irs})(1 + \hat{t}_{irs})(PY_{is} + \beta_{irs} PT_s) \right]^{1-\sigma_M} \right\}^{\frac{1}{1-\sigma_M}} \tag{13}$$

and

$$PT_{ir} = PA_{i_\tau r} \tag{14}$$

where μ_{irs} is the mark-up on marginal cost on sales of good i from a firm in region r in region s, $\hat{t}_{irs}$ is the ad valorem tax rate which incorporates import tariffs and export subsidies $\overline{PD}_{ir}$ is the benchmark supply price for goods from domestic producers, $\overline{PM}_{ir}$ is the benchmark supply price for imports.

- Regional income

Regional income is a sum of factor income, indirect taxes, taxes on intermediate demand, factor tax revenue, public tax revenue, consumption tax revenue, export tax revenue and tariff revenue net of investment demand, public sector demand and net capital outflows:

$$M_r = \sum_f PF_{fr} F_{fr} + \sum_i t_{ir}^Y PY_{ir} Y_{ir} + \sum_{ij} t_{ijr}^{ID} PY_{ir} Y_{jr} a_{ijr} + \sum_{fi} t_{fir}^F PF_{fr} V_{fir} + \sum_i t_{ir}^G PG_{ir} G_{ir} +$$
$$+ \sum_i t_{ir}^C PC_{if} C_{ir} + \sum_{is} t_{irs}^X PY_{ir} X_{irs} + \sum_{is} t_{irs}^M (PY_{is} X_{isr} (1 + t_{isr}^X) + p^T T_{isr}) - \sum_i p_{ir}^D I_{ir} -$$
$$\sum_i PG_{ir} (1 + t_{ir}^G) G_{ir} - p_n^C CAPFLOW_r \quad (15)$$

- Final demand

Public sector output consists of Cobb-Douglas aggregation of market commodities:

$$G_r = \Gamma_r \prod_i G_{ir}^{\theta_{ir}^G} \quad (16)$$

A representative agent determines demand in each region. He is endowed with primary factors, tax revenue and exogenous capital flows from other regions. He allocates his income to investment (exogenous), public demand (held constant in real terms) and private demand. Private demand is determined by the maximisation of Cobb-Douglas utility function:

$$U_r = \sum_i \theta_{ir}^C \log(C_{ir}) \quad (17)$$

Aggregate final demand is then determined by regional expenditures and the unit price of aggregate commodities gross of tax:

$$C_{ir} = \frac{\alpha_{ir}^C E_r}{p_{ir}^C (1 + t_{ir}^C)} \quad (18)$$

where E_r is regional expenditure, which equals income (M_r) net of investment and public expenditures.

- Bilateral trade flows.

There are two tax margins (import and export tax) and transport costs in the model. Transport costs are proportional to trade. Transport costs are defined by a Cobb-Douglas aggregate of international transport inputs supplied by different countries:

$$\sum_{irs} T_{irs} = \psi_T \prod_{i,r} TD_{ir}^{\theta_{ir}^T} \tag{19}$$

Bilateral trade flows are determined by cost-minimizing choice given the *fob* export price of commodity from region r (PY_{ir}), the export tax rate (t_{ir}^X), and the import tariff rate (t_{ir}^M), where the export tax applies on the *fob* price net of transport margins, while the import tariff applies on a *cif* price.

- Free entry zero-profit condition for monopolistic firms

$$N_{ir} = \frac{\sum_s \left[\mu_{irs}(1+\hat{t}_{irs})(PY_{ir} + \beta_{irs} PT_r) X_{ir}\right]}{PV_{ir} f_{ir}} \tag{20}$$

Monopolistic competition

- Goods are distinguished by firm, by region and area of origin (domestic or imported).
- Demands arise from a nested CES function with a supply from firms in a single region at the lowest level of the CES aggregate. At the next level, the firms compete with supplies from other regions from the same area and at the top level consumers choose between goods from different areas. Demand for final composite arises from a Cobb-Douglas utility function.
- Producers compete in quantities based on a Cournot model with fixed conjectural variations. Markups over marginal costs are based on the profit maximization. There is free entry, so profits in equilibrium are zero. Markup covers the fixed costs, which are fixed at the firm level and as the markup revenue in a region changes, so does the number of firms.
- The model does not incorporate gains from variety, only the rationalization gains. A reduction in tariffs leads to loss of the market share by domestic firms. Domestic producers reduce the markup on marginal costs, some domestic firms exit, the remaining firms slide down their average cost curves and output per firm increases.

Algebraic relations

The equilibrium conditions for each market where there are IRTS are estimated separately. The following notation is adopted:

X – Aggregate demand

Yk – Supply from are k

Sr – Supply from region r

qfr – Supply from firm f in region r

P – Price index for aggregate demand

Pk- Price index for supply from area k

wr – Price index for supply from region r

πfr – Sales price for supply from firm f in region r.

CES aggregators are used to create the composite goods:

$$X = \left[\sum_k \alpha_k^{1/\sigma} Y_k^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \tag{21}$$

$$Y_k = \left[\sum_{r \in \eta_k = k} \beta_{rk}^{1/\eta} S_r^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}} \tag{22}$$

$$S_r = \left[\sum_f q_{fr}^{\frac{\varepsilon-1}{\varepsilon}} \right] \tag{23}$$

The associated price indices:

$$P = \left(\sum_k \alpha_k p_k^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \tag{24}$$

$$p_k = \left(\sum_{r \in \eta_k = k} \beta_{rk} w_r^{1-\eta} \right)^{\frac{1}{1-\eta}} \tag{25}$$

(26) $$w_k = \left(\sum_f \pi_{fr}^{1-\varepsilon} \right)^{\frac{1}{1-\varepsilon}}$$

and associated demand functions:

(27) $$Y_k = \alpha_k \left(\frac{P}{p_k} \right)^{\sigma} X$$

(28) $$S_r = \beta_{rk} \left(\frac{p_k}{w_r} \right)^{\eta} Y_k \quad \text{for } k = k_r$$

(29) $$q_{fr} = \left(\frac{w_r}{\pi_{fr}} \right)^{\varepsilon} S_r$$

Behavior of firms

The profit of firm f in region r selling into a given market is as follows:

(30) $$\Pi_{fr}(q) = \pi_{fr} q - C_{fr}(q)$$

where C is total cost. First order conditions for profit maximization may be written as follows:

(31) $$c_{fr} = \pi_{fr}(1 - m_{fr})$$

in which c_{fr} is the marginal cost of supply and m_{fr} is a markup over marginal cost (on gross basis):

(32) $$m_{fr} = -\frac{1}{e_{fr}} = -\frac{\partial \pi_{fr} q_{fr}}{\partial q_{fr} \pi_{fr}}$$

where e_{fr} is the perceived elasticity of demand. The expression for the elasticity of demand arises from the nested CES structure of demand and depends on the assumed reaction of other producers.

The perceived elasticity of demand

Derivation of the perceived elasticity of demand begins with the inverse demand function:

(33) $$\pi_{fr} = \left(\frac{S_r}{q_{fr}}\right)^{\frac{1}{\varepsilon}} w_r$$

Then compute the derivative:

(34) $$\frac{\partial \pi_{fr}}{\partial q_{fr}} = -\frac{1}{\varepsilon}\frac{\pi_{fr}}{q_{fr}} + \frac{1}{\varepsilon}\frac{\pi_{fr}}{S_r}\frac{\partial S_r}{\partial q_{fr}} + \frac{\pi_{fr}}{w_r}\frac{\partial w_r}{\partial q_{fr}}$$

Here, HRT develop further derivations with the simplifying assumption of unitary conjectural variations (Cournot conjectures). The non-unitary conjectures are introduced to reconcile the estimates of the economies of scale in production with the estimates of elasticities of substitution in demand. Under Cournot conjectures:

(35) $$\frac{\partial S_r}{\partial q_{fr}} = \left(\frac{S_r}{q_{fr}}\right)^{\frac{1}{\varepsilon}}$$

and the term $\frac{\partial w_r}{\partial q_{fr}}$ is computed using the chain rule the second time:

(36) $$\frac{\partial w_r}{\partial q_{fr}} = \frac{\partial w_r}{\partial S_r}\frac{\partial S_r}{\partial q_{fr}}$$

Substituting (34) and (35) into (33) we get:

(37) $$\frac{\partial \pi_{fr} q_{fr}}{\partial q_{fr} \pi_{fr}} = -\frac{1}{\varepsilon} + \frac{1}{\varepsilon}\frac{q_{fr}}{S_r}\left(\frac{S_r}{q_{fr}}\right)^{\frac{1}{\varepsilon}} + \frac{q_{fr}}{w_r}\left(\frac{S_r}{q_{fr}}\right)^{\frac{1}{\varepsilon}}\frac{\partial w_r}{\partial S_r}$$

Then using (32):

(38) $$\left(\frac{S_r}{q_{fr}}\right)^{\frac{1}{\varepsilon}} = \frac{\pi_{fr}}{w_r}$$

make the substitution to obtain:

(39) $$\frac{1}{e_{fr}} = -\frac{1}{\varepsilon} + \frac{1}{\varepsilon}\frac{\pi_{fr} q_{fr}}{w_r S_r} + \frac{\partial w_r}{\partial S_r}\frac{S_r}{w_r}\frac{\pi_{fr} q_{fr}}{w_r S_r}$$

Applying the same steps at the next level we get an analogous expression:

$$\frac{\partial w_r S_r}{\partial S_r w_r} = -\frac{1}{\eta} + \frac{1}{\eta}\frac{w_r S_r}{p_k Y_k} + \frac{\partial p_k}{\partial Y_k}\frac{Y_k}{p_k}\frac{w_r S_r}{p_k Y_k} \tag{40}$$

Applying the same operations again at the highest level of the CES, given that the demand elasticity for the aggregate X is unity, we get:

$$\frac{\partial p_k Y_k}{\partial Y_k p_k} = -\frac{1}{\sigma} + \frac{1}{\sigma}\frac{p_k Y_k}{PX} + \frac{p_k Y_k}{PX} \tag{41}$$

When equations (39)-(41) are assembled, we obtain an expression for the optimal Cournot markup as follows:

$$m_{fr} = \frac{1}{\varepsilon} + \left(\frac{1}{\eta} - \frac{1}{\varepsilon}\right)\frac{1}{N_{fr}} + \left(\frac{1}{\sigma} - \frac{1}{\eta}\right)\frac{\theta_{fk}^{Y}}{N_{fr}} + \left(1 - \frac{1}{\sigma}\right)\frac{\theta_k^X \theta_{rk}^Y}{N_{fr}} \tag{42}$$

where the share of supply from region *r* in the supply from area *k* is denoted as:

$$\theta_{rk}^{Y} = \frac{w_r S_r}{p_k Y_k} \qquad \text{for } k = k_r \tag{43}$$

and the supply from area *k* in total supply of a given good is denoted as:

$$\theta_k^X = \frac{p_k Y_k}{PX} \tag{44}$$

In our model we assumed that products of different firms are imperfect substitutes in demand. The elasticity of demand depends on the country of origin. There are three elasticities of substitution associated with the nested CES structure of demand discussed earlier:

σ_{DD} – elasticity of substitution between varieties supplied by domestic firms

σ_{MM} – elasticity of substitution between products of any two foreign suppliers

σ_{DM} – elasticity of substitution between domestic and imported varieties.

We assume that domestically produced goods are more easily substitutable among themselves than products from different countries and that σ_{DD} is 15. In addition imported goods are assumed to be better substitutes to each other than domestic and foreign goods. The elasticity of substitution between imported goods is assumed to be equal 10, while domestic and foreign goods enter the demand function with the elasticity of substitution of 5. These are priors used by HRT (1994).

Further let θ_{rs} denote the market share of region r firms in region s. Then we can apply equation (42) to represent the optimal markup applied in the domestic market and in the foreign markets:

$$\tilde{m}_{rs} = \begin{cases} \frac{1}{\sigma_{DD}} + \left(\frac{1}{\sigma_{DM}} - \frac{1}{\sigma_{DD}}\right)\frac{1}{N_r} + \left(1 - \frac{1}{\sigma_{DM}}\right)\frac{\theta_{rr}}{N_r} & r = s \\ \frac{1}{\sigma_{MM}} + \left(\frac{1}{\sigma_{DM}} - \frac{1}{\sigma_{MM}}\right)\frac{\theta_{rs}}{N_r\theta_s^M} + \left(1 - \frac{1}{\sigma_{DM}}\right)\frac{\theta_{rs}}{N_r} & r \neq s \end{cases} \quad (45)$$

These are the optimal markups expressed as a function of elasticities of substitution, market shares, θ^M_r the market share of imports in region r and N_r the number of firms producing in the region r.

Estimation of the equilibrium conditions in ITRS sectors

This paper adopts a simplification by estimating the equilibrium conditions in IRTS industries for each commodity in separate models. Demands and supplies for all regions are included into these calculations, but factor markets, intersectoral linkages and income effects are ignored. In each iteration of the IRTS models, regional demand functions are calibrated to the most recently estimated equilibrium conditions of the general model including all GE interactions. Given constant marginal cost, sales prices are determined by the markup equations.

The single commodity models are estimated as follows. The markup pricing equation (44) is specified given the benchmark elasticities of substitution, the number of firms and an adjustment parameter, the conjectural variation. First, the values of elasticities of substitution at all nests of the CES function, as well as the number of firms and therefore their market shares are specified. Further, the value of production at consumer prices at the benchmark combined with the estimates of the cost disadvantage ratio taken from the literature (see next section), determine the value of fixed costs, i.e. $FC_{ir} = CDR_{ir}YC_{ir}$. Given the assumption of zero profits, the markup over marginal cost generates the revenue equal exactly to the fixed costs. This condition appears as a constraint in a non-linear least squares calculation.

The objective in the estimation is to calibrate the conjectural variations, which are as close as possible to one. This value is consistent with pure Cournot-Nash behavior of players. Therefore a sequence of least-squares problems is solved for each commodity subject to IRTS. These problems look for implicit numbers of firms (N_r) which results in calibrated conjectural variations (CV_{rs}) which are as close as possible to 1. This looks as follows:

$$\min_{CV^i_{rs}, N_{ir}} \sum_{rs} (CV^i_{rs} - 1)^2 \quad (46)$$

subject to:

$$
\begin{aligned}
& FC_{ir} = \sum_{rs} X^{i}_{rs} M^{G}(CV^{i}_{rs}, N_{ir}, \sigma, \theta) \\
& 0 \le N_{ir} \le 100 \\
& CV^{i}_{rs} \ge 0
\end{aligned}
\tag{47}
$$

where M^G is a markup equation, i.e. equation (44), and X^i_{rs} represents sales of i from region r in region s.

Therefore, the conjectural variations act as parameters, which allow reconciliation of the benchmark data with the estimates of the elasticities of substitution and CDR taken from the literature. In the majority of sectors calibrated conjectural variations are less than 1 indicating a more competitive behavior than predicted by the Cournot model.

For sectors, where the assumption of free entry and zero profits in the benchmark, given values of the elasticity of substitution, is consistent with pure Cournot-Nash type behavior, a second calculation is performed. It looks for the number of firms as small as possible subject to the consistency of conjectures with the Cournot behavior.

$$
\min_{r} N_{ir} \tag{48}
$$

subject to:

$$
\begin{aligned}
& FC_{ir} = \sum_{rs} X^{i}_{rs} M^{G}(CV^{i}_{rs}, N_{ir}, \sigma, \theta) \\
& 0 \le N_{ir} \le 100 \\
& CV^{i}_{rs} = 1
\end{aligned}
\tag{49}
$$

Calibrating the Cost Disadvantage Ratio

The calibration of the cost disadvantage ratio (CDR) in IRTS sectors is based on the assumption of constant marginal cost. The total cost function is specified as follows:

$$
c = f + mq \tag{50}
$$

where f is fixed cost, m is constant marginal cost and q denotes the output level. Average cost function looks as follows:

$$
ac = \frac{f}{q} + m \tag{51}
$$

Assuming zero profits, the benchmark data provides the information on the industry total costs (C) and output (Q). If there are n representative firms in the initial equilibrium (1), then $nc_1=N$ and $nq_1=Q$. Since

$$\frac{c_1}{q_1}=\frac{nc_1}{nq_1}=\frac{C_1}{Q_1} \tag{52}$$

given the initial data we know already one point on the firm's average cost curve i.e.:

$$\frac{c}{q_1}=\frac{f}{q_1}+m \tag{53}$$

Given the assumption about a specific form of the average cost curve, we only need a second point in order to calibrate it. This is done with the use of information from the engineering estimates on changes in average cost accompanying changes in output. If output declines to αq_1 then average costs increase to $\beta\left(\frac{c_1}{q_1}\right)$ where $0<\alpha<1$, $\beta>1$ is required for the marginal cost to be nonnegative. Given the values of α and β we know the second point on the industry average cost curve:

$$\beta\frac{c}{q_1}=\frac{f}{\alpha q_1}+m \tag{54}$$

By multiplying the nominators and denominators of the last two equations we obtain equations on the total output and costs of industry, on which the data is available. The equations look as follows:

$$\frac{C}{Q_1}=\frac{F}{Q_1}+m \text{ and} \tag{55}$$

$$\beta\frac{C}{Q_1}=\frac{F}{\alpha Q_1}+m\,. \tag{56}$$

where F is the fixed cost. Further, we solve the above equations for the fixed and marginal costs:

$$F=C_1(\beta-1)\frac{\alpha}{\alpha-1} \text{ and} \tag{57}$$

$$m=\left(\frac{C_1}{Q_1}\right)\left(\frac{\beta\alpha-1}{\alpha-1}\right). \tag{58}$$

Since the cost disadvantage ratio is defined as f/c, which by symmetry equals F/C, we know that at the initial equilibrium:

$$\text{CDR} = \frac{(\beta - 1)\alpha}{1 - \alpha}. \tag{59}$$

We obtain the values of α and β from Pratten (1988). Since there are no estimates of the economies of scale for all 3-digit sectors according to NACE classification or the available estimates are not representative, we used a rage of estimated parameters for each GTAP sector. Based on those parameters we constructed three values of the CDRs i.e. low and high using the lowest and highest values of the estimated parameters and middle one. The only exception was the food sector, where the economies of scale differ a lot by products, so we used the average production values to aggregate the CDRs for more finely defined sectors. The allocation of Pratten's NACE sectors to GTAP sectors, as well as the final CDRs are presented in below.

Following others such as Gasiorek, Smith and Venables (1994) or HRT (1994), we are assuming that in the benchmark equilibrium firms operate at the minimum efficient scale (MES). Firms should have difficulties competing, if they were operating at less than MES. Given the function form used in this study, at the MES further expansion of output reduces average cost of production. If initially output is lower than the MES, then the CDRs will be underestimated since the slope of the average cost curve increases in absolute value for decreases in output. In all scenarios we assume low values for the economies of scale. We intend to use high and medium CDRs in the sensitivity analysis

Appendix 2.1. Table 1. Data on CDR values

	Share of MES (α)	Percentage Cost Increase at Output Level (β)	Implied CDR			Source of Data
			Low	Medium	High	
Column	**1**	**2**	**3**	**4**	**5**	**6**
Agriculture	0	0	0	0	0	
Raw materials	0	0	0	0	0	
Food, Beverages, Tobacco			7.7	11.1	14.5	
Meat	0.67	5				412
Dairy	0.67	2				413
Other food	0.67	4 to 9				414, 416, 420, 422
Tobacco	0.33	2.2 to 5				429
Textiles	0.5	2 to 10	2	6	10	43
Clothing	0	0	0	0	0	

	Share of MES (α)	Percentage Cost Increase at Output Level (β)	Implied CDR			Source of Data
			Low	Me-dium	High	
Leather	0.33	1.5	0.7	0.7	0.7	451
Wood	0	0	0.0	0.0	0.0	
Paper	0.5	8 to 13	8.0	10.5	13.0	471, 472
Petroleum	0.33	4	2.0	2.0	2.0	14
Chemicals	0.33	4 to 19	2.0	5.7	9.4	25
Non-metallic Minerals	0.33	10 to 26	4.9	8.9	12.8	241-247
Iron, steel	0.33	10 to 11	4.9	5.2	5.4	22
Other metals	0.33	11 to 11	4.9	5.2	5.4	224
Metal prod.	0.33	10	4.9	4.9	4.9	221
Motor vehicles	0.5	11	11.0	11.0	11.0	35
Other transport	0.5	8 to 20	8.0	14.0	20.0	361
Electronics	0.33	5 to 15	2.5	4.9	7.4	23, 344, 345
Machinery n.e.c.	0.5	3 to 10	3.0	6.5	10.0	321, 322, 326
Manufacturing n.e.c.	0.5	3 to 5	3	4	5	HRT
Utilities	0	0	0	0	0	
Trade	0	0	0	0	0	
Transport	0.5	2	2	2	2	HRT
Financial services	0.5	5	5	5	5	HRT

Notes:
Column 1: Parameter α in the CDR calibration equation.
Column 2: Data corresponds to (β-1)*100 where β is from the CDR calibration equation.
Column 3-5: CDR estimated according to equation 58.
Column 6: Numbers indicated in this column correspond to NACE sectors from Table 5.1 in Pratten (1988). The assumptions on CDRs in services follow assumptions of HRT (1994).

Appendix 2.2. CGE Simulations

Appendix 2.2. Table 1. Output implications of the Deep FTA over 5-10 years

	Luxem-bourg	Nether-lands	Poland	Portu-gal	Slova-kia	Slo-venia	Spain	Sweden	UK
grains	0.7	0.3	0.1	0.7	0.5	0.4	0.3	0.7	0.3
vegetables fruit nuts	0.6	0.3	-0.3	0.4	0.2	0.9	0.4	0.3	0.5
sugar cane sugar beet plant-based fibers crops NEC	0.6	0.9	0.3	0.4	0.2	0.5	0.5	0.3	0.4
bovine cattle sheep and goats horses animal products NEC	0.6	0.3	0.1	0.4	0.4	0.4	0.4	0.2	0.4
forestry fishing	1.3	-1.6	0.8	0.5	0.6	0.6	0.4	0.4	0
coal	1.8	0.6	0.3	1.2	0.9	0.4	1.1	1.5	-0.1
Oil	0.5	0.0	0.1	1.6	1.6	4.8	1.7	0.9	0.3
Gas	2.1	0.7	-0.3	0.5	0.9	3.4	1.7	1.2	0.3
minerals NEC	0.9	1.1	-3.8	4.2	-0.1	-2.9	0.7	6.1	-0.3
bovine cattle sheep and goat meat products	0.6	0.4	0.1	0.3	0.8	0.4	0.5	0.2	0.3
vegetable oils and fats, processed rice, food prod-ucts NEC	0.4	0.4	-0.2	0.2	0.7	0.4	0.5	0.3	0.4
dairy products	0.5	0.3	-0.1	0.3	0.6	0.3	0.6	0.3	0.4
beverages and tobacco products	0.1	0.7	0.3	0.4	1	0.2	0.6	0.5	-0.5
textiles	0.8	1.5	1.3	0.6	1	0.2	0.6	1.0	0.6
wearing apparel	1	1.2	0.7	0.4	0	0.1	0.5	0.3	0.3
leather products	0.7	1	1.2	0.9	-0.2	-0.4	0.5	0.5	0.3
wood products	0.6	0.6	1.1	0.3	0.5	0.4	0.3	0.7	0.3
paper products publishing	0.6	0.7	1.1	0.3	1.2	0.1	0.6	0.3	0.3
petroleum coal products	2.9	0.1	0.0	-0.2	0.4	0.5	0.2	-0.3	0.1
chemical rubber plastic products	0.7	1.1	1.2	0.3	1.0	1.4	0.4	0	0.7

	Luxem-bourg	Nether-lands	Poland	Portu-gal	Slova-kia	Slo-venia	Spain	Sweden	UK
mineral products NEC	0.3	0.8	2.3	0.3	2.1	0.3	1.0	0.8	0.5
ferrous metals	0.1	0.0	0.1	-0.2	0.9	0.0	0.1	0.6	0.3
metals NEC	-0.3	0.2	-0.5	0.1	0.7	0.3	0.6	0.3	0.2
metal products	0.6	0.8	1.1	0.4	1.3	0.4	0.5	0.5	0.5
motor vehicles and parts	0.7	1.0	0.8	0.4	1	0.5	0.1	0.6	0.8
transport equip-ment NEC	0.5	0.4	0.0	0.6	0.3	-0.5	0.3	0.4	0.3
electronic equip-ment	0.3	1.0	1.1	0.3	1.8	1.2	0.4	1	0.8
machinery and equipment NEC	0.9	0.8	0.5	0.3	0.1	0.1	0.5	0.4	0.5
manufactures NEC	1.4	0.3	0.8	0.3	0.8	1.6	0.8	0.5	0.4
electricity	0.5	0.7	0.5	0.3	0.8	0.3	0.6	0.5	0.4
gas manufacture distribution	0.3	0.7	0.4	-0.1	0.8	0.3	-0.1	0.0	0.3
water	0.4	0.8	0.6	0.2	0.8	0.3	0.6	0.2	0.5
construction	0.3	0.5	0.6	0.3	0.9	0.4	0.6	0.4	0.4
trade	0.5	0.7	0.7	0.3	0.9	0.3	0.7	0.4	0.3
transport NEC	1.1	0.7	0.5	0.4	1	0.5	0.8	0.4	0.5
communication	-0.1	0.7	0.8	0.3	0.8	0.4	0.6	0.3	0.5
financial services NEC	0.9	0.6	0.5	0.4	1	0.3	0.6	0.4	0.6
insurance	1.2	0.8	0.7	0.4	1.2	0.4	0.6	0.7	0.5
business services NEC ownership of dwellings	0.7	0.4	0.6	0.3	0.9	0.4	0.9	-0.9	0.3
public admin and defense, educa-tion, health, rec-reational and other services	0.2	0.5	0.3	0.2	0.6	0.2	0.4	0.4	0.2

	Fin-land	France	Ger-many	Greece	Hun-gary	Ire-land	Italy	Latvia	Lithu-ania
grains	0.4	-0.1	0.4	-0.5	-0.1	0.5	0	-0.1	0.3
vegetables fruit nuts	0.4	0.5	0.5	0.4	0.6	0.3	0	0	0.2
sugar cane sugar beet plant-based fibers crops NEC	0.4	0.5	0.4	0.9	0.2	-1.3	0.3	0.8	0.4
bovine cattle	0.1	0.7	0.3	0.5	-0.1	0.1	0.6	0.2	0.3

	Fin-land	France	Ger-many	Greece	Hun-gary	Ire-land	Italy	Latvia	Lithu-ania
sheep and goats horses animal products NEC									
forestry fishing	-0.4	1.2	0.5	0.2	0.3	0.5	0.3	-1.2	-0.6
coal	2.6	1.9	0.4	0.5	0.5	0.3	1.4	3.7	1.3
Oil	2	0	1.2	1.6	0.9	0.4	1.2	7.2	2.8
Gas	4.6	1.7	2.8	2.7	2.4	1.5	1.5	6.1	6.1
minerals NEC	1.1	-0.2	0.5	1.9	0.6	0.6	0.7	2.3	2.5
bovine cattle sheep and goat meat products	0.6	0.6	0.2	0.4	-0.1	-0.1	0.8	0.4	0.5
vegetable oils and fats, proc-essed rice, food products NEC	0.3	0.8	0.7	0.5	0.5	0.3	0.5	-0.4	0.1
dairy products	-0.9	0.8	0.4	0.3	0.5	0.1	0.6	0.4	-1.6
beverages and tobacco prod-ucts	1.4	0.4	0.8	0.1	0.6	-6	0.5	-6.1	-0.5
textiles	3.4	1.2	1	0.9	1.1	-0.2	2.1	5.1	3.3
wearing apparel	2.8	1	1.2	2.3	0.5	-0.1	1.8	3.4	0.8
leather products	2.9	0.4	1.2	0.6	0	0.1	1.9	1	0.7
wood products	1	0.6	0.5	0.1	0.2	0.2	1.5	1.3	0.9
paper products publishing	0.9	0.8	0.3	0.3	0.6	-0.7	0.8	-0.2	0.4
petroleum coal products	-0.6	-0.1	0.1	0	0	-0.2	0.4	2.4	-0.1
chemical rubber plastic products	1.2	0.7	0.2	0.2	1.4	1.2	0.8	2.1	1.7
mineral products NEC	2.8	0.9	1	0.3	0.9	0.2	1.1	2.1	3.5
ferrous metals	1.1	0.3	0.2	1.3	0.6	0.2	0.8	2	2.9
metals NEC	0	0.3	-0.1	0	0.2	-0.3	0.9	1.7	1.8
metal products	1.6	0.7	0.5	0.4	0.9	0.4	1.1	3.5	3.6
motor vehicles and parts	2.1	0.9	0.5	0.1	1.2	0.3	0.7	1.6	3
transport equipment NEC	-0.8	1.1	0	0.8	0.4	0.3	0.8	0.1	0.2
electronic equipment	3.8	0.8	0	0.3	1	1	0.8	0.9	2.9
machinery and equipment NEC	-0.2	0.8	-0.3	0.1	0.8	0.9	0.8	0.7	0.6
manufactures NEC	2	0.7	0.6	0.5	1.1	0.4	1.2	2.9	2.4
electricity	1	0.8	0.5	0.4	0.5	0.4	0.7	0.5	0.5
gas manufacture	0.7	0.7	0.7	0.3	0.6	0.4	1.1	0.1	0.1

	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Latvia	Lithuania
distribution									
water	0.7	0.9	0.8	0.4	0.6	0.6	0.8	0.5	0.7
construction	0.7	0.8	0.6	0.3	0.7	0.7	0.9	0.4	0.6
trade	0.6	0.8	0.5	0.4	0.7	0.6	1.1	0.5	0.7
transport NEC	0.8	0.7	0.5	0.3	0.9	0	0.9	0.9	0.9
communication	0.4	0.8	0.7	0.3	0.7	0.3	0.7	0.5	0.7
financial services NEC	0.7	1	0.7	0.4	1	0.1	0.9	0.7	0.8
insurance	0.7	1.2	0.9	0.3	0.3	0.1	0.4	1.1	1
business services NEC ownership of dwellings	0.6	0.9	1.1	0.5	0.8	0.1	1.1	0.3	0.6
public admin and defense, education, health, recreational and other services	0.5	0.9	0.6	0.2	0.7	0.5	0.5	0.3	0.4

	Bulgaria	Romania	Rest of the World
grains	0.1	0.2	0.3
vegetables fruit nuts	0.1	0.2	0.4
sugar cane sugar beet plant-based fibers crops NEC	0.2	0.2	0.4
bovine cattle sheep and goats horses animal products NEC	0.1	0.2	0.4
forestry fishing	0.2	0.8	0.3
coal	1.2	0.4	0.4
oil	3.3	0.3	0.4
gas	3.6	1.4	0.5
minerals NEC	0.3	-0.1	0.4
bovine cattle sheep and goat meat products	0.2	0.5	0.4
vegetable oils and fats, processed rice, food products NEC	-0.3	0.5	0.4
dairy products	0.2	0.4	0.3
beverages and tobacco products	-1.8	0.4	0.5
textiles	0.8	0.7	0.3
wearing apparel	0.9	0.3	0.2
leather products	0.5	0.3	0.2
wood products	0.3	1	0.4

	Bulgaria	Romania	Rest of the World
paper products publishing	0	1	0.4
petroleum coal products	0.1	0	0.3
chemical rubber plastic products	0.2	0.5	0.4
mineral products NEC	0.2	0.4	0.4
ferrous metals	0.3	-0.2	0.4
metals NEC	0.3	-0.2	0.4
metal products	0.4	0.8	0.4
motor vehicles and parts	0.3	0.9	0.4
transport equipment NEC	0.2	0.2	0.4
electronic equipment	0.3	0.4	0.5
machinery and equipment NEC	0.5	0.7	0.5
manufactures NEC	0.2	0.6	0.3
electricity	0.1	0.4	0.4
gas manufacture distribution	-1.3	0.3	0.5
water	0.1	0.4	0.4
construction	0.2	0.4	0.5
trade	0.2	0.4	0.4
transport NEC	0.2	0.5	0.4
communication	0.1	0.5	0.5
financial services NEC	0.1	0.6	0.4
insurance	0.2	0.7	0.3
business services NEC ownership of dwellings	0.2	0.6	0.5
public admin and defense, education, health, recreational and other services	0.2	0.4	0.3

Appendix 2.2. Table 2. Output implications of the Deep FTA+ over 10-15 years.

	Russia	Ukraine	CIS	Austria	Belgium	Cyprus and Malta	Czech Republic	Denmark	Estonia
grains	2.0	-0.4	1.4	-0.2	0.9	2.7	0.3	0.3	-2.5
vegetables fruit nuts	2.4	0.8	3.4	1.4	-1.4	1.0	0.8	-1	0.4
sugar cane sugar beet plant-based fibers crops NEC	2.7	-1.2	-1.4	0.9	0.4	4.1	1.0	-0.9	0.8
bovine cattle sheep and goats horses animal products NEC	4.0	0.3	0.2	0.4	-0.7	0.6	0.5	-0.5	0.1

	Russia	**Ukraine**	**CIS**	**Austria**	**Belgium**	**Cyprus and Malta**	**Czech Republic**	**Denmark**	**Estonia**
forestry fishing	3.3	-0.3	0.5	-1.1	-0.6	0.2	0.3	1.4	-1
coal	-6.2	0.8	17.9	2.0	4.8	4.4	0.9	1.3	2
oil	0.7	2.4	-1.7	-0.8	2.4	-3.5	1.4	-0.4	0.5
gas	1.3	3.0	-0.6	-0.9	6.2	1.0	0.2	0.1	-0.7
minerals NEC	-1.3	-1.1	1.8	2.2	0.1	-0.3	1.1	0.1	2.9
bovine cattle sheep and goat meat products	9.4	5.6	0.2	0.3	-0.8	0.7	0.3	-0.2	0.1
vegetable oils and fats, processed rice, food products NEC	5.6	2.3	3.3	-0.2	0.5	16.2	0.2	0.8	-0.5
dairy products	4.3	1.9	0.4	0.6	0.3	0.8	0.3	-0.7	0.8
beverages and tobacco products	18.4	4.6	2.6	0.8	1.6	0.6	-0.4	1.3	-23.6
textiles	-3.9	-2.9	-2.2	1.3	3.3	0.9	1.2	0.2	3.5
wearing apparel	16.1	-0.8	-0.2	0.9	0.2	1.2	0.8	-0.1	2.3
leather products	2.1	-0.4	-0.5	1.3	0.4	0.7	0.7	1.1	1
wood products	9.6	0.6	0.2	0.5	-0.5	-0.8	0.3	0.3	1.9
paper products publishing	5	0.6	3.9	-0.9	4.6	-0.8	-2.8	0.9	-1.4
petroleum coal products	2.5	-1	1.2	0.2	-0.4	0.1	-0.3	0.2	-2.8
chemical rubber plastic products	3.7	-1.1	-1.1	1.4	0.5	1.1	0.3	-0.1	0.6
mineral products NEC	-0.8	-0.1	-0.1	0.8	1	0.3	0.8	0.4	0.9
ferrous metals	4.4	-1	-1.5	1.0	0.5	0.7	0.2	-0.9	1.5
metals NEC	-2.0	9.2	-1.1	-0.1	2.1	3.4	-0.3	0.4	2.4
metal products	-0.4	-1.3	-0.5	1.0	0.4	1.4	0.8	0.2	2.1
motor vehicles and parts	4.5	1.8	5.3	0.2	0.3	0.2	0	0.3	2.5
transport equipment NEC	7.1	8.1	0.9	-1.8	4.9	-2.4	0.5	3.1	1.7
electronic equipment	-1.7	-0.7	-0.6	1.3	0.7	2.1	1.3	0.5	1.6
machinery and equipment NEC	5.4	4.9	1.6	0.8	0.5	-2.1	-0.7	0.6	1.4
manufactures NEC	2.5	-4.6	-1.8	0.3	1.7	2.9	2.8	-0.3	3.3
electricity	2.2	0.1	0.2	0.5	0.5	0.2	0.5	0.4	0.2
gas manufacture distribution	2.1	-0.3	0	1.8	2.4	2.6	0.2	0	0.2
water	2.2	-0.1	0.2	0.5	0.2	0.9	0.5	0.5	0.3

	Russia	Ukraine	CIS	Austria	Belgium	Cyprus and Malta	Czech Republic	Denmark	Estonia
construction	2	-0.4	0.1	0.4	0.1	-0.2	0.5	0.6	0.5
trade	2.2	-0.4	0.1	0.3	0.2	-0.3	0.4	0.4	0.5
transport NEC	0.4	-1.8	0.1	-0.3	-0.6	0.1	0.2	0	0.3
communication	2.0	-0.9	0.2	0.3	1.3	0.5	0.7	0.7	0.8
financial services NEC	0.5	-0.3	-0.1	-0.3	-0.1	2.3	1.1	0.6	-0.2
insurance	10.5	-2.1	-1.5	-1.5	-0.2	-0.7	0.5	0.6	-0.7
business services NEC ownership of dwellings	2.3	-0.2	-0.1	0.5	-0.2	-0.8	0.7	0.6	1.2
public admin and defense, education, health, recreational and other services	1.8	-0.7	0.2	-0.3	0.2	-0.1	0.4	0.4	0.4

	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Latvia	Lithuania
grains	0.5	1.4	0.1	0.3	0.9	0	1.1	0.3	1.7
vegetables fruit nuts	1.4	0.1	0.2	0.0	0.1	0.4	1.3	-0.1	0.7
sugar cane sugar beet plant-based fibers crops NEC	1.2	0.5	0.6	0.1	1.0	-1.5	1	0.4	0.6
bovine cattle sheep and goats horses animal products NEC	0.5	0.0	-0.3	0.0	0.5	0	0.5	0.0	0.2
forestry fishing	-1.6	-0.7	0.3	0.1	0.5	0.1	0.9	-1	-0.7
coal	7.5	6.9	0.7	1.1	1.1	0.5	4.9	13.6	7.4
oil	-0.6	1.2	-1.3	-3.9	0.5	0.4	-0.9	-3.4	-0.5
gas	-0.6	1.5	-1.6	-1.9	0.7	-1.3	-0.7	-0.4	-0.2
minerals NEC	0.3	4.3	0.1	-1.7	2.3	1.2	0.7	-1.3	1.9
bovine cattle sheep and goat meat products	1.1	0.0	-0.1	0.2	0.7	0.2	0.4	0.0	0.2
vegetable oils and fats, processed rice, food products NEC	1.0	0.1	-0.2	0.0	0.7	0.5	0.7	-0.8	0.1
dairy products	-1.6	0.1	-0.6	0.1	0.4	0.9	0.4	0.0	-2.6
beverages and	1.0	0.8	-0.2	0.1	0.8	-7.4	0.5	-8.6	-0.7

	Finland	**France**	**Germany**	**Greece**	**Hungary**	**Ireland**	**Italy**	**Latvia**	**Lithuania**
tobacco products									
textiles	2.7	1.5	1.0	0.7	1.6	-0.1	2.0	5.1	3.9
wearing apparel	1.9	1.5	0.6	1.7	1.4	0.1	1.1	2.6	0.8
leather products	2.1	1.5	0.6	0.3	1.2	-0.4	1.5	1	1.2
wood products	0.2	0.6	0.4	0.3	1.1	1.2	-2.5	0.2	0.3
paper products publishing	-0.2	0.7	0.3	0.2	0.7	-0.1	0.4	-0.2	0.9
petroleum coal products	-0.6	0.5	-0.2	0.1	-0.9	1.4	0.0	-6.5	-1.9
chemical rubber plastic products	0.4	1.1	0.8	0.4	0.5	-1.3	0.8	1.2	1.1
mineral products NEC	2.3	0.7	0.3	0.3	0.6	0.9	0.6	0.7	2.9
ferrous metals	-0.3	0.8	0.3	0.9	0.8	-1.1	0.2	1.7	2.2
metals NEC	1.0	1.4	0.8	1.2	1.7	2.3	0.1	1.1	-0.3
metal products	1.2	0.7	0.6	0.3	0.8	-0.4	0.4	2.1	2.1
motor vehicles and parts	-0.9	0.5	0.2	0.4	-0.1	1.1	0.6	0.7	-1.2
transport equipment NEC	1.8	-2.5	0.0	-1.1	0.7	0.2	-1.2	2.6	-1.8
electronic equipment	3.0	1.2	0.7	0.4	1.0	-0.6	0.8	1.5	3.9
machinery and equipment NEC	0.1	0.1	1.9	0.5	-0.7	-1.1	-0.3	0.1	-0.1
manufactures NEC	1.5	0.6	0.4	0.3	1.0	0.3	0.6	2.1	1.7
electricity	0.8	0.5	0.4	0.4	0.6	0.8	0.5	0.2	-1.5
gas manufacture distribution	0.6	0.8	0.2	0.5	0.4	1	0.4	0.5	0.9
water	1.3	0.4	0	0.4	0.5	0.4	0.5	0.2	0.4
construction	1.4	0.3	0.2	0.2	0.3	1.3	0.4	0.1	0.1
trade	1.2	0.4	0.3	0.3	0.4	0.8	0.2	0.1	0.3
transport NEC	0.5	0.8	0.5	0.5	0.1	1.4	0.3	0.2	0.4
communication	1.3	0.4	0.2	0.4	0.3	1.2	0.8	0.2	0.4
financial services NEC	1.0	0.1	0.3	0.3	-0.1	1.4	0.4	-0.6	0.1
insurance	0.9	-0.6	-0.2	0.3	0.9	1.1	1.5	-0.9	0
business services NEC ownership of dwellings	1.4	0.3	-0.3	0.4	0.3	2.4	0.3	1.1	0.8
public admin and defense, education, health, recreational and other services	0.8	0.2	0.2	0.2	0.3	1.1	0.5	0.1	0.3

	Luxem-bourg	Nether-lands	Poland	Por-tugal	Slova-kia	Slove-nia	Spain	Swe-den	UK
grains	-0.3	0.8	0.4	-1.0	0.7	0.0	0.7	-0.4	-0.1
vegetables fruit nuts	-0.3	0.5	-0.1	-0.3	0.7	-0.9	0.5	-0.1	-0.4
sugar cane sugar beet plant-based fibers crops NEC	0.0	0.3	1.1	0.1	1.1	-0.1	0.3	0.7	0.4
bovine cattle sheep and goats horses animal products NEC	-0.3	-0.2	0.6	0.2	0.7	0.4	0.0	0.6	0
forestry fishing	-0.7	3.1	-1.0	-0.2	0.3	-0.4	0.3	-0.7	0.5
coal	10.9	-3.1	0.3	7.0	0.2	0.8	4.4	8.7	-2.2
oil	0.5	0.3	4.1	-3.4	-0.9	-3.1	-3.1	-0.7	0.2
Gas	2.3	-0.2	2.1	0.3	1.0	-1.4	-1.6	-1.4	0.1
minerals NEC	-1.3	-1.9	-2.2	2.9	2.4	-2.4	-0.8	3.3	1.9
bovine cattle sheep and goat meat products	0.0	-0.1	0.4	0.2	0.5	0.3	0.0	1.1	0.2
vegetable oils and fats, proc-essed rice, food products NEC	0.1	0.7	0.3	0.2	0.3	0.5	0.2	0.5	0.2
dairy products	0.2	0.3	0.2	0.3	0.5	0.4	0.2	0.5	0.2
beverages and tobacco prod-ucts	1.2	-1.5	0.5	0.3	0.8	0.7	0.4	0.3	-1.4
textiles	0.6	0.7	1.6	0.4	2.0	0.6	1.2	0.4	0.6
wearing apparel	0.6	0.5	0.9	0.1	0.7	0.4	0.9	-0.3	0.4
leather products	0.4	0.4	0.9	0.3	0.8	-0.1	0.8	-0.4	0.5
wood products	-0.5	0.3	-1.4	0.5	0.3	0.2	0.7	-0.1	0.7
paper products publishing	0.4	0.2	0.3	0.1	0.3	0.2	0.6	0.0	0.2
petroleum coal products	-5.4	-0.5	-0.3	0.0	-1.0	-2.3	-0.1	0.3	-0.2
chemical rubber plastic products	0.4	-0.1	0.2	0.4	0.0	0.4	0.9	0.0	0.2
mineral products NEC	0.8	0.2	1.4	0.3	1.3	0.7	0.3	0.6	0.3
ferrous metals	0.5	0.4	0.7	-0.1	0.3	0.1	0.8	-0.8	0.2
metals NEC	2.8	1.0	2.8	1.2	0.4	0.6	0.4	0.1	1.1
metal products	0.4	0.6	0.7	0.2	0.7	0.3	0.8	0.0	0.3
motor vehicles and parts	0.3	0.2	0.1	0.2	-0.3	0.0	1.5	-0.2	0.2

	Luxem-bourg	Nether-lands	Poland	Por-tugal	Slova-kia	Slove-nia	Spain	Swe-den	UK
transport equip-ment NEC	0.3	0.7	1.2	-0.2	0.9	1.8	0.9	-0.8	0.4
electronic equip-ment	0.9	0.9	1.0	0.5	1.3	1.3	1.1	0.4	0.8
machinery and equipment NEC	-0.2	-0.1	-0.4	0.3	1.5	0.0	0.4	-0.3	0.3
manufactures NEC	0.7	0.7	0.6	0.3	0.5	0.9	0.3	0.5	0.6
electricity	0.3	0.3	0.5	0.4	0.2	0.4	0.3	0.4	0.3
gas manufacture distribution	0.6	0.5	0.1	1.6	0.3	0.7	2.5	5.9	-2.0
water	0.0	0.5	0.3	0.4	0.6	0.4	0.4	1.3	0.3
construction	0.0	0.6	0.3	0.3	0.5	0.5	0.2	0.6	0.3
trade	0.2	0.5	0.2	0.3	0.3	0.5	0.0	0.7	0.3
transport NEC	-1.0	0.3	0.3	0.5	-0.2	0.2	0.1	0.4	0.1
communication	2.4	0.4	0.1	0.5	0.4	0.5	0.2	0.8	0.4
financial ser-vices NEC	0.4	0.8	0.5	0.4	0.1	0.3	0.3	0.3	0.1
insurance	-0.7	0.2	-0.1	0.4	-0.4	0.2	0.4	-0.2	0
business ser-vices NEC own-ership of dwell-ings	0.2	1.2	0.4	0.5	0.7	0.6	-0.1	3.8	0.6
public admin and defense, education, health, recrea-tional and other services	0.2	0.4	0.2	0.2	0.5	0.4	0.2	0.5	0.3

	Bulgaria	Romania	Rest of the World
grains	0.0	0.3	0.4
vegetables fruit nuts	0.2	0.2	0.3
sugar cane sugar beet plant-based fibers crops NEC	0.2	0.3	0.4
bovine cattle sheep and goats horses animal products NEC	0.1	0.2	0.4
forestry fishing	0.2	-0.8	0.4
coal	4.1	0.9	0.6
Oil	-3.0	1.1	0.5
Gas	-2.9	0.1	0.5
minerals NEC	0.5	1.8	0.4
bovine cattle sheep and goat meat products	0.1	0.1	0.2

vegetable oils and fats, processed rice, food products NEC	-0.4	0.1	0.4
dairy products	0.3	0.2	0.5
beverages and tobacco products	-2.3	0.1	0.5
textiles	0.5	1.5	0.3
wearing apparel	0.4	0.9	0.2
leather products	0.3	1.0	0.1
wood products	0.5	-1.0	0.6
paper products publishing	0.1	-0.2	0.4
petroleum coal products	-0.8	-0.3	0.4
chemical rubber plastic products	0.3	0.5	0.3
mineral products NEC	0.4	0.2	0.5
ferrous metals	0.4	0.5	0.3
metals NEC	0.7	1.7	0.5
metal products	0.4	0.4	0.4
motor vehicles and parts	0.3	0.0	0.4
transport equipment NEC	0.3	1.6	0.5
electronic equipment	0.4	0.9	0.3
machinery and equipment NEC	0.3	0.0	0.3
manufactures NEC	0.3	0.4	0.3
electricity	0.5	0.2	0.4
gas manufacture distribution	3.5	0.3	0.5
water	0.2	0.3	0.5
construction	0.2	0.2	0.5
trade	0.2	0.2	0.5
transport NEC	0.3	0.0	0.5
communication	0.3	0.1	0.6
financial services NEC	0.2	-0.3	0.5
insurance	0.3	-0.4	0.5
business services NEC ownership of dwellings	0.5	0.2	0.6
public admin and defense, education, health, recreational and other services	0.1	0.2	0.4

Appendix 2.2 Table 3. Employment changes following the Deep FTA.

	Russia	**Ukraine**	**CIS**	**Austria**	**Belgium**	**Cyprus and Malta**	**Czech Rep.**	**Denmark**	**Estonia**
grains	1.5	0.7	0.4	0.8	0.3	-0.4	0.5	0.5	-1.4
vegetables fruit nuts	-0.6	0.6	1.1	0.0	1.1	0.6	0.2	1.0	0.5
sugar cane sugar	0.6	0.8	-0.1	0.8	1.4	0.9	0.3	1.6	-0.7

	Russia	Ukraine	CIS	Austria	Belgium	Cyprus and Malta	Czech Rep.	Denmark	Estonia
beet plant-based fibers crops NEC									
bovine cattle sheep and goats horses animal products NEC	1.1	0.3	0.3	0.6	0.5	1.1	0.5	0.3	0.4
forestry fishing	1.6	0.3	0.4	1.5	1.1	0.7	0.6	-0.5	-1.5
coal	-1.2	0.0	5.4	0.6	0.4	3.5	0.7	0.8	1.5
Oil	0.5	0.5	-0.8	1.6	-0.1	3.3	1.1	0.9	5.2
Gas	0.0	1.4	0.0	4.4	0.6	1.4	2.6	1.1	6.0
minerals NEC	0.4	0.8	2.2	0.2	0.6	0.8	1.0	2.4	2.0
bovine cattle sheep and goat meat products	1.6	0.9	0.5	0.6	0.5	0.7	0.3	0.5	0.0
vegetable oils and fats, processed rice, food products NEC	2.0	0.6	1.6	0.1	0.2	0.7	-0.1	-0.1	0.0
dairy products	1.9	0.7	0.3	0.3	-0.1	1.1	0.5	0.7	0.6
beverages and tobacco products	9.9	1.9	1.3	0.2	-0.2	0.1	0.5	0.4	-18.3
textiles	-7.4	-2.4	-1.6	0.9	3.8	1.7	1.4	1.1	4.1
wearing apparel	5.9	1.1	0.1	1.0	0.5	0.9	0.5	0.7	2.4
leather products	-2.2	1.2	0.9	1.0	0.9	1.3	0.3	2.4	0.9
wood products	-1.4	1.4	0.3	0.7	0.8	1.3	0.7	0.4	2.3
paper products publishing	3.3	-3.2	-0.5	0.6	0.2	1.2	0.9	0.2	0.2
petroleum coal products	1.9	-0.1	0.6	-0.2	0.8	0.4	-0.2	2.0	0.0
chemical rubber plastic products	1.3	-1.8	-1.3	0.5	0.4	1.5	1.0	0.3	1.8
mineral products NEC	-6.0	-1.5	-0.3	0.8	0.4	1.3	2.1	0.5	1.9
ferrous metals	3.9	-0.5	-0.7	0.4	-0.5	0.2	0.5	0.3	0.9
metals NEC	2.7	0.3	1.2	0.6	-0.3	-0.2	0.7	0.2	0.7
metal products	-6.5	-2.7	0.2	1.1	0.5	1.0	0.7	0.4	1.7
motor vehicles and parts	-1.0	-0.6	-4.5	1.2	0.6	1.6	1.0	0.4	3.3
transport equipment NEC	2.6	0.9	0.1	1.4	-0.1	-0.8	0.7	0.6	0.3
electronic equipment	-4.9	-0.3	-0.1	0.2	0.1	1.7	0.9	0.2	1.6
machinery and equipment NEC	3.5	1.2	0.1	0.5	0.5	1.8	1.0	0.2	0.7
manufactures NEC	-0.8	-0.5	-0.7	2.2	2.3	1.6	1.1	0.4	1.4
electricity	0.3	-0.1	0.2	0.8	0.4	1.2	0.6	0.4	0.7

	Russia	Ukraine	CIS	Austria	Belgium	Cyprus and Malta	Czech Rep.	Denmark	Estonia
gas manufacture distribution	0.5	0.2	0.2	0.2	-0.5	0.7	0.6	0.6	0.5
water	0.4	0.2	0.3	0.8	0.5	1.0	0.8	0.3	0.3
construction	0.9	0.2	0.5	0.7	0.5	1.3	0.7	0.3	0.6
trade	0.9	0.5	0.4	0.8	0.5	1.5	0.7	0.4	0.8
transport NEC	-0.5	0.6	0.3	1.1	1.0	1.4	0.9	0.6	1.6
communication	0.1	0.7	0.3	0.9	0.1	1.2	0.6	0.3	0.4
financial services NEC	-3.3	0.4	0.6	1.1	0.7	0.6	0.5	0.3	0.9
insurance	-14.7	1.2	0.7	1.6	0.7	1.8	0.7	0.2	1.1
business services NEC ownership of dwellings	0.8	0.5	0.8	0.8	0.9	1.6	0.7	0.5	0.4
public admin and defense, education, health, recreational and other services	0.5	0.4	0.5	1.3	0.3	1.3	0.6	0.2	0.4

	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Latvia	Lithuania
grains	0.4	-0.1	0.5	-0.4	-0.1	0.6	-0.1	0.0	0.4
vegetables fruit nuts	0.4	0.6	0.5	0.4	0.7	0.3	0.0	0.0	0.3
sugar cane sugar beet plant-based fibers crops NEC	0.5	0.6	0.5	1.0	0.2	-1.3	0.4	0.9	0.5
bovine cattle sheep and goats horses animal products NEC	0.2	0.8	0.3	0.5	-0.1	0.1	0.7	0.2	0.3
forestry fishing	-0.3	1.3	0.6	0.2	0.3	0.6	0.3	-1.2	-0.7
coal	2.8	2.2	0.5	0.5	0.5	0.3	1.6	3.9	1.4
Oil	2.2	0.1	1.3	1.7	1.0	0.4	1.4	7.7	3.0
gas	5.1	1.9	3.1	2.8	2.7	1.7	1.7	6.5	6.6
minerals NEC	1.2	-0.3	0.6	2.0	0.6	0.6	0.9	2.5	2.7
bovine cattle sheep and goat meat products	0.6	0.7	0.3	0.4	-0.1	-0.1	0.9	0.4	0.5
vegetable oils and fats, processed rice, food products NEC	0.4	0.9	0.8	0.6	0.6	0.3	0.6	-0.4	0.1
dairy products	-0.9	0.9	0.5	0.3	0.6	0.1	0.7	0.4	-1.7
beverages and tobacco products	1.6	0.5	0.9	0.2	0.6	-6.3	0.6	-6.4	-0.5
textiles	3.6	1.3	1.1	0.9	1.2	-0.2	2.4	5.4	3.5

wearing apparel	3.0	1.1	1.3	2.4	0.6	-0.1	2.0	3.6	0.9
leather products	3.1	0.4	1.3	0.6	0.0	0.1	2.1	1.0	0.7
wood products	1.0	0.7	0.5	0.2	0.2	0.3	1.8	1.4	1.1
paper products publishing	1.1	0.8	0.4	0.3	0.7	-0.7	0.9	-0.2	0.5
petroleum coal products	-0.6	0.0	0.2	0.1	0.0	-0.2	0.5	2.7	0.0
chemical rubber plastic products	1.3	0.8	0.2	0.2	1.5	1.3	0.9	2.2	1.8
mineral products NEC	3.1	1.0	1.1	0.3	1.0	0.3	1.3	2.3	3.8
ferrous metals	1.2	0.3	0.2	1.3	0.7	0.3	0.9	2.1	3.1
metals NEC	-0.1	0.4	-0.1	0.0	0.2	-0.4	1.0	1.8	1.9
metal products	1.7	0.8	0.6	0.4	1.0	0.4	1.3	3.8	3.9
motor vehicles and parts	2.4	1.0	0.6	0.1	1.3	0.4	0.9	1.7	3.3
transport equipment NEC	-0.8	1.3	0.0	0.8	0.5	0.4	1.0	0.1	0.3
electronic equipment	4.2	0.9	0.0	0.4	1.1	1.1	0.9	0.9	3.1
machinery and equipment NEC	-0.2	0.9	-0.3	0.2	1.0	1.1	0.9	0.8	0.7
manufactures NEC	2.2	0.8	0.6	0.6	1.2	0.5	1.3	3.1	2.7
electricity	1.0	1.0	0.6	0.4	0.6	0.5	0.9	0.6	0.7
gas manufacture distribution	0.8	0.8	0.8	0.3	0.7	0.5	1.3	0.1	0.1
water	0.7	1.0	0.9	0.4	0.6	0.6	0.9	0.5	0.8
construction	0.7	0.9	0.7	0.3	0.8	0.7	1.1	0.5	0.7
trade	0.7	0.9	0.6	0.4	0.8	0.7	1.3	0.5	0.8
transport NEC	0.9	0.8	0.5	0.4	0.9	0.0	1.0	1.0	1.1
communication	0.5	1.0	0.8	0.3	0.9	0.4	0.8	0.6	0.8
financial services NEC	0.8	1.1	0.7	0.4	1.1	0.1	1.0	0.8	0.9
insurance	0.7	1.4	1.0	0.4	0.4	0.2	0.5	1.2	1.1
business services NEC ownership of dwellings	0.7	1.1	1.2	0.5	0.9	0.0	1.3	0.3	0.6
public admin and defense, education, health, recreational and other services	0.6	1.0	0.7	0.2	0.7	0.5	0.5	0.3	0.4

	Luxembourg	**Netherlands**	**Poland**	**Portugal**	**Slovakia**	**Slovenia**	**Spain**	**Sweden**	**UK**
grains	0.7	0.3	0.1	0.8	0.6	0.4	0.3	0.8	0.4
vegetables fruit nuts	0.6	0.3	-0.3	0.5	0.3	0.9	0.5	0.4	0.6
sugar cane sugar	0.6	1.1	0.2	0.4	0.3	0.6	0.6	0.3	0.4

	Luxem-bourg	Nether-lands	Po-land	Por-tugal	Slova-kia	Slo-venia	Spain	Swe-den	UK
beet plant-based fibers crops NEC									
bovine cattle sheep and goats horses animal products NEC	0.7	0.4	0.1	0.4	0.5	0.4	0.5	0.3	0.5
forestry fishing	1.5	-1.7	0.9	0.6	0.7	0.6	0.5	0.4	-0.1
coal	1.9	0.6	0.3	1.3	1.1	0.4	1.3	1.6	-0.1
oil	0.5	0.0	0.1	1.8	1.9	5.2	1.9	1.0	0.3
gas	2.2	0.8	-0.2	0.5	0.9	3.7	1.9	1.4	0.3
minerals NEC	1.0	1.3	0.1	0.9	0.6	0.3	1.2	1.4	-0.1
bovine cattle sheep and goat meat products	0.6	0.4	0.1	0.3	0.9	0.4	0.5	0.2	0.4
vegetable oils and fats, processed rice, food products NEC	0.5	0.4	-0.2	0.2	0.9	0.4	0.6	0.4	0.4
dairy products	0.5	0.3	0.0	0.4	0.7	0.3	0.6	0.4	0.4
beverages and tobacco products	0.1	0.8	0.4	0.4	1.2	0.2	0.7	0.6	-0.5
textiles	0.9	1.6	1.4	0.6	1.2	0.2	0.7	1.1	0.6
wearing apparel	1.0	1.3	0.8	0.5	0.0	0.1	0.5	0.4	0.3
leather products	0.8	1.2	1.3	1.0	-0.3	-0.4	0.6	0.5	0.3
wood products	0.7	0.7	1.2	0.3	0.6	0.3	0.4	0.8	0.3
paper products publishing	0.7	0.8	1.3	0.4	1.3	0.1	0.6	0.4	0.4
petroleum coal products	3.1	0.1	0.0	-0.2	0.5	0.5	0.2	-0.3	0.2
chemical rubber plastic products	0.8	1.2	1.3	0.3	1.2	1.5	0.5	0.0	0.7
mineral products NEC	0.4	0.9	2.5	0.3	2.3	0.3	1.1	0.8	0.5
ferrous metals	0.2	0.0	0.1	-0.2	1.0	0.0	0.1	0.7	0.4
metals NEC	-0.3	0.2	-0.6	0.1	0.8	0.4	0.6	0.4	0.2
metal products	0.7	0.9	1.3	0.4	1.4	0.5	0.5	0.6	0.6
motor vehicles and parts	0.7	1.1	0.9	0.5	1.2	0.5	0.1	0.6	0.8
transport equip-ment NEC	0.5	0.5	0.0	0.7	0.4	-0.5	0.4	0.5	0.4
electronic equip-ment	0.3	1.1	1.1	0.4	2.0	1.2	0.5	1.0	0.9
machinery and equipment NEC	0.9	0.8	0.6	0.3	0.1	0.1	0.6	0.5	0.5
manufactures NEC	1.5	0.4	0.9	0.4	0.9	1.7	0.9	0.5	0.5

	Luxem-bourg	Nether-lands	Po-land	Por-tugal	Slova-kia	Slo-venia	Spain	Swe-den	UK
electricity	0.6	0.8	0.5	0.3	0.9	0.3	0.7	0.6	0.4
gas manufacture distribution	0.4	0.7	0.4	-0.1	1.0	0.3	-0.1	0.4	0.0
water	0.5	0.9	0.7	0.3	0.9	0.4	0.7	0.1	0.5
construction	0.4	0.6	0.6	0.3	1.0	0.4	0.6	0.5	0.4
trade	0.5	0.7	0.8	0.3	1.1	0.4	0.9	0.4	0.4
transport NEC	1.2	0.7	0.6	0.5	1.1	0.5	0.9	0.4	0.5
communication	-0.1	0.8	0.8	0.3	1.0	0.4	0.7	0.3	0.5
financial services NEC	0.9	0.6	0.6	0.3	1.1	0.4	0.7	0.5	0.6
insurance	1.3	0.9	0.8	0.4	1.4	0.5	0.7	0.7	0.6
business services NEC owner-ship of dwellings	0.7	0.5	0.7	0.4	1.0	0.4	1.0	-0.9	0.4
public admin and defense, educa-tion, health, rec-reational and other services	0.3	0.6	0.4	0.2	0.7	0.3	0.5	0.5	0.2

	Bulgaria	Romania	Rest of the World
grains	0.1	0.2	0.4
vegetables fruit nuts	0.1	0.2	0.4
sugar cane sugar beet plant-based fibers crops NEC	0.2	0.2	0.4
bovine cattle sheep and goats horses animal products NEC	0.1	0.2	0.4
forestry fishing	0.2	0.9	0.3
coal	1.2	0.4	0.5
oil	3.5	0.3	0.4
gas	3.9	1.4	0.6
minerals NEC	0.3	-0.1	0.5
bovine cattle sheep and goat meat products	0.2	0.6	0.5
vegetable oils and fats, proc-essed rice, food products NEC	-0.3	0.5	0.4
dairy products	0.2	0.4	0.4
beverages and tobacco products	-1.9	0.4	0.6
textiles	0.8	0.8	0.3
wearing apparel	1.0	0.3	0.2
leather products	0.6	0.4	0.3
wood products	0.3	1.1	0.4
paper products publishing	0.1	1.1	0.4
petroleum coal products	0.1	0.1	0.4
chemical rubber plastic prod-	0.2	0.5	0.4

	Bulgaria	Romania	Rest of the World
ucts			
mineral products NEC	0.3	0.4	0.4
ferrous metals	0.2	-0.2	0.4
metals NEC	0.3	-0.2	0.5
metal products	0.4	0.8	0.4
motor vehicles and parts	0.3	0.9	0.5
transport equipment NEC	0.3	0.2	0.4
electronic equipment	0.3	0.5	0.5
machinery and equipment NEC	0.4	0.8	0.5
manufactures NEC	0.3	0.6	0.4
electricity	0.2	0.4	0.5
gas manufacture distribution	-1.4	0.4	0.5
water	0.1	0.4	0.5
construction	0.1	0.5	0.4
trade	0.2	0.5	0.4
transport NEC	0.3	0.6	0.5
communication	0.2	0.6	0.5
financial services NEC	0.2	0.7	0.5
insurance	0.2	0.8	0.4
business services NEC ownership of dwellings	0.2	0.7	0.5
public admin and defense, education, health, recreational and other services	0.2	0.4	0.4

Appendix 2.2. Table 4. Employment implications following the Deep FTA+

	Russia	Ukraine	CIS	Austria	Belgium	Cyprus and Malta	Czech Rep.	Denmark	Estonia
grains	2.0	-0.4	1.4	-0.2	1.0	2.9	0.3	0.4	-2.6
vegetables fruit nuts	2.5	0.8	3.5	1.5	-1.4	1.1	0.8	-1.0	0.4
sugar cane sugar beet plant-based fibers crops NEC	2.8	-1.2	-1.5	1.0	0.5	4.4	1.1	-0.9	0.8
bovine cattle sheep and goats horses animal products NEC	4.0	0.3	0.1	0.4	-0.7	0.7	0.6	-0.4	0.2
forestry fishing	3.4	-0.3	0.5	-1.2	-0.6	0.2	0.4	1.4	-1.1
coal	-6.3	0.8	18.4	2.2	5.1	4.7	1.0	1.3	2.1
oil	0.7	2.5	-1.7	-0.8	2.5	-3.6	1.5	-0.3	0.6
gas	1.4	3.1	-0.6	-0.9	6.5	1.1	0.3	0.2	-0.7
minerals NEC	-1.2	-1.1	1.9	2.3	0.2	-0.3	1.2	2.4	0.6

	Russia	Ukraine	CIS	Austria	Belgium	Cyprus and Malta	Czech Rep.	Denmark	Estonia
bovine cattle sheep and goat meat products	9.6	5.7	0.2	0.4	-0.8	0.4	-0.2	0.1	0.0
vegetable oils and fats, processed rice, food products NEC	5.7	2.3	3.3	-0.2	0.5	0.3	0.8	-0.4	0.0
dairy products	4.3	2.0	0.4	0.6	0.4	0.8	0.4	-0.7	0.9
beverages and tobacco products	18.6	4.7	2.6	0.9	1.7	0.6	-0.3	1.3	-24.7
textiles	-3.9	-3.0	-2.2	1.5	3.4	1.0	1.2	0.2	3.7
wearing apparel	16.3	-0.8	-0.2	1.0	0.2	1.3	0.8	-0.1	2.4
leather products	2.1	-0.4	-0.4	1.3	0.4	0.8	0.8	1.2	1.1
wood products	9.7	0.7	0.2	0.5	-0.5	-0.9	0.3	0.3	2.0
paper products publishing	5.3	0.5	0.3	0.9	0.5	0.9	0.4	0.3	0.5
petroleum coal products	2.6	-1.1	0.3	-0.3	0.2	-0.3	0.2	-2.9	0.0
chemical rubber plastic products	3.9	-1.2	-1.2	1.5	0.5	1.1	0.4	-0.1	0.6
mineral products NEC	-0.9	-0.1	0.0	0.9	1.0	0.3	0.8	0.4	1.0
ferrous metals	4.8	-1.1	-1.6	1.1	0.6	0.8	0.2	-1.0	1.6
metals NEC	-1.9	9.4	-1.0	0.0	2.2	3.5	-0.3	0.5	2.6
metal products	-0.5	-1.3	-0.4	1.1	0.4	1.5	0.9	0.2	2.2
motor vehicles and parts	4.5	1.8	5.3	0.2	0.4	0.2	0.0	0.3	2.7
transport equipment NEC	7.3	8.3	0.9	-1.8	1.7	4.8	0.2	-0.5	2.1
electronic equipment	-1.6	-0.7	-0.6	1.4	0.7	2.3	1.4	-0.2	2.3
machinery and equipment NEC	5.5	5.0	1.7	0.9	0.5	-2.2	-0.7	0.6	1.4
manufactures NEC	3.6	-1.2	-2.5	1.4	2.1	1.5	0.8	0.2	1.4
electricity	2.3	0.1	0.1	0.6	0.5	0.2	0.6	0.4	0.2
gas manufacture distribution	2.3	-0.3	0.0	1.9	2.5	2.7	0.3	-0.1	0.3
water	2.3	-0.1	0.2	0.5	0.2	1.0	0.5	0.6	0.4
construction	2.1	-0.4	0.1	0.4	0.2	-0.2	0.5	0.6	0.6
trade	2.3	-0.4	0.1	0.3	0.3	-0.4	0.5	0.5	0.5
transport NEC	0.4	-1.8	0.1	-0.2	-0.5	0.2	0.2	0.0	0.4
communication	2.0	-0.9	0.2	0.3	1.4	0.6	0.8	0.7	0.8
financial services NEC	0.5	-0.3	-0.1	-0.2	-0.1	2.4	1.2	0.6	-0.3

	Russia	Ukraine	CIS	Austria	Belgium	Cyprus and Malta	Czech Rep.	Denmark	Estonia
insurance	10.7	-2.2	-1.5	-1.6	-0.2	-0.8	0.6	0.7	-0.8
business services NEC ownership of dwellings	2.4	-0.3	0.0	0.6	-0.2	-0.8	0.8	0.7	1.3
public admin and defense, education, health, recreational and other services	1.9	-0.7	0.3	-0.3	0.2	-0.1	0.5	0.4	0.4

	Finland	France	Germany	Greece	Hungary	Ireland	Italy	Latvia	Lithuania
grains	0.6	1.6	0.2	0.3	1.0	0.1	1.2	0.3	1.8
vegetables fruit nuts	1.5	0.2	0.1	0.0	0.1	0.4	1.4	0.0	0.8
sugar cane sugar beet plant-based fibers crops NEC	1.3	0.7	0.7	0.1	1.1	-1.5	1.1	0.5	0.7
bovine cattle sheep and goats horses animal products NEC	0.6	0.0	-0.3	0.0	0.5	0.0	0.5	0.0	0.3
forestry fishing	-1.7	-0.7	0.3	0.1	0.5	0.2	1.0	-1.0	-0.7
coal	8.2	7.4	0.8	1.2	1.2	0.6	5.4	14.3	7.9
Oil	-0.5	1.3	-1.3	-4.0	0.6	0.5	-0.9	-3.5	-0.5
Gas	-0.4	1.7	-1.6	-2.0	0.8	-1.2	-0.7	-0.4	-0.1
minerals NEC	0.4	4.6	0.1	-1.7	2.5	1.4	0.8	-1.3	2.1
bovine cattle sheep and goat meat products	1.2	0.1	-0.1	0.2	0.8	0.3	0.5	0.0	0.1
vegetable oils and fats, processed rice, food products NEC	1.2	0.2	-0.2	0.0	0.8	0.6	0.7	-0.8	0.1
dairy products	-1.6	0.2	-0.5	0.2	0.4	1.0	0.6	0.0	-2.7
beverages and tobacco products	1.2	0.9	-0.2	0.1	0.8	-7.7	0.5	-9.0	-0.7
textiles	2.9	1.6	1.1	0.7	1.7	-0.1	2.3	5.3	4.2
wearing apparel	2.0	1.5	0.7	1.7	1.6	0.0	1.3	2.7	0.9
leather products	2.2	1.6	0.7	0.3	1.3	-0.4	1.6	1.1	1.3
wood products	0.3	0.7	0.4	0.3	1.1	1.4	-2.5	0.2	0.4
paper products publishing	-0.1	0.7	0.4	0.3	0.7	-0.1	0.5	-0.2	1.0
petroleum coal products	-0.7	0.6	-0.2	0.2	-0.9	1.5	0.0	-6.8	-2.0
chemical rubber	0.5	1.2	0.8	0.5	0.5	-1.4	0.8	1.2	1.2

	Fin-land	Fran-ce	Ger-many	Greece	Hun-gary	Ire-land	Italy	Lat-via	Lithu-ania
plastic products									
mineral products NEC	2.6	0.8	0.3	0.3	0.7	1.0	0.7	0.8	3.1
ferrous metals	-0.3	0.9	0.3	1.0	0.8	-1.1	0.2	1.8	2.3
metals NEC	1.1	1.5	0.9	1.3	1.8	2.4	0.2	1.1	-0.3
metal products	1.3	0.8	0.7	0.3	0.9	-0.4	0.5	2.2	2.3
motor vehicles and parts	-0.8	0.6	0.2	0.4	-0.1	1.2	0.7	0.7	-1.2
transport equipment NEC	2.0	-2.6	0.0	-1.2	0.7	0.3	-1.3	2.7	-1.9
electronic equipment	3.3	1.3	0.7	0.4	1.1	-0.6	0.9	1.5	4.1
machinery and equipment NEC	0.1	0.2	2.1	0.5	-0.6	-1.1	-0.4	0.1	0.0
manufactures NEC	1.6	0.7	0.5	0.3	1.1	0.3	0.7	2.2	1.9
electricity	0.8	0.6	0.5	0.4	0.7	0.8	0.6	0.2	-1.5
gas manufacture distribution	0.7	0.8	0.3	0.5	0.5	1.2	0.5	0.5	1.0
water	1.4	0.5	0.0	0.5	0.5	0.5	0.6	0.2	0.5
construction	1.6	0.3	0.3	0.2	0.3	1.4	0.4	0.1	0.2
trade	1.3	0.5	0.4	0.3	0.5	0.9	0.3	0.1	0.3
transport NEC	0.6	0.8	0.5	0.6	0.1	1.5	0.4	0.2	0.5
communication	1.4	0.5	0.3	0.5	0.4	1.3	0.9	0.2	0.5
financial services NEC	1.1	0.1	0.3	0.3	-0.1	1.5	0.6	-0.6	0.1
insurance	1.0	-0.5	-0.2	0.3	1.1	1.2	1.5	-0.9	0.0
business services NEC ownership of dwellings	1.6	0.3	-0.3	0.4	0.4	2.5	0.4	1.1	0.8
public admin and defense, education, health, recreational and other services	0.9	0.3	0.3	0.2	0.4	1.2	0.5	0.1	0.3

	Luxem-bourg	Nether-lands	Po-land	Por-tugal	Slova-kia	Slove-nia	Spain	Swe-den	UK
grains	-0.3	0.9	0.4	-1.0	0.8	0.1	0.7	-0.4	0.0
vegetables fruit nuts	-0.3	0.5	-0.1	-0.3	0.8	-0.9	0.6	0.0	-0.4
sugar cane sugar beet plant-based fibers crops NEC	0.0	0.4	1.2	0.1	1.2	-0.1	0.4	0.7	0.4
bovine cattle sheep and goats horses animal	-0.2	-0.1	0.6	0.2	0.8	0.4	0.1	0.7	0.1

	Luxem-bourg	Nether-lands	Po-land	Por-tugal	Slova-kia	Slove-nia	Spain	Swe-den	UK
products NEC									
forestry fishing	-0.7	3.2	-1.0	-0.2	0.4	-0.4	0.3	-0.7	0.5
coal	11.5	-3.3	0.4	7.4	0.3	0.8	4.7	9.2	-2.3
Oil	0.5	0.4	4.4	-3.5	-0.8	-3.2	-3.2	-0.6	0.3
Gas	2.4	-0.2	2.3	0.4	1.1	-1.4	-1.6	-1.4	0.2
minerals NEC	-1.3	-2.0	1.8	-0.4	3.2	0.8	-0.5	-1.6	2.2
bovine cattle sheep and goat meat products	0.0	-0.2	0.4	0.3	0.5	0.3	0.1	1.2	0.2
vegetable oils and fats, processed rice, food products NEC	0.1	0.8	0.4	0.1	0.4	0.5	0.3	0.5	0.2
dairy products	0.2	0.3	0.3	0.3	0.6	0.5	0.2	0.6	0.2
beverages and tobacco products	1.3	-1.5	0.6	0.3	0.9	0.7	0.4	0.4	-1.4
textiles	0.7	0.8	1.8	0.4	2.2	0.7	1.2	0.4	0.6
wearing apparel	0.6	0.6	1.0	0.2	0.7	0.4	1.0	-0.3	0.5
leather products	0.4	0.5	1.0	0.4	0.8	-0.1	0.9	-0.4	0.5
wood products	-0.5	0.4	-1.5	0.5	0.4	0.2	0.8	0.0	0.7
paper products publishing	0.5	0.3	0.4	0.2	0.3	0.2	0.6	0.1	0.3
petroleum coal products	-5.6	-0.5	-0.3	0.0	-1.0	-2.4	-0.1	0.3	-0.2
chemical rubber plastic products	0.5	-0.1	0.3	0.4	0.0	0.4	1.0	0.0	0.2
mineral products NEC	0.8	0.3	1.4	0.4	1.5	0.7	0.3	0.6	0.3
ferrous metals	0.6	0.4	0.8	-0.1	0.3	0.2	0.9	-0.8	0.2
metals NEC	2.9	1.0	3.0	1.2	0.5	0.6	0.4	0.1	1.2
metal products	0.5	0.6	0.8	0.2	0.7	0.4	0.8	0.0	0.4
motor vehicles and parts	0.3	0.2	0.2	0.2	-0.2	0.0	1.6	-0.2	0.2
transport equipment NEC	0.3	0.8	1.3	-0.1	1.0	1.8	1.0	-0.8	0.5
electronic equipment	1.0	1.0	1.1	0.6	1.5	1.4	1.2	0.4	0.9
machinery and equipment NEC	-0.2	-0.1	-0.4	0.4	1.6	0.0	0.4	-0.3	0.3
manufactures NEC	0.8	0.8	0.7	0.3	0.6	1.0	0.4	0.5	0.7
electricity	0.3	0.3	0.5	0.4	0.3	0.5	0.4	0.5	0.3
gas manufacture distribution	0.7	0.5	0.1	1.6	0.4	0.8	2.6	0.5	0.0

	Luxem-bourg	Nether-lands	Po-land	Por-tugal	Slova-kia	Slove-nia	Spain	Swe-den	UK
water	0.1	0.6	0.4	0.4	0.7	0.5	0.4	1.3	0.4
construction	0.0	0.7	0.3	0.3	0.6	0.5	0.2	0.7	0.4
trade	0.2	0.5	0.3	0.3	0.4	0.5	0.1	0.7	0.4
transport NEC	-0.9	0.4	0.4	0.5	-0.1	0.1	0.1	0.4	0.2
communication	2.5	0.5	0.1	0.5	0.5	0.5	0.3	0.9	0.4
financial services NEC	0.4	0.9	0.5	0.3	0.1	0.4	0.4	0.3	0.1
insurance	-0.7	0.3	0.0	0.3	-0.4	0.3	0.4	-0.2	0.1
business services NEC ownership of dwellings	0.2	1.3	0.5	0.6	0.7	0.7	-0.2	4.0	0.7
public admin and defense, education, health, recreational and other services	0.2	0.5	0.3	0.2	0.6	0.4	0.3	0.6	0.3

	Bulgaria	Romania	Rest of the World
grains	0.0	0.3	0.4
vegetables fruit nuts	0.2	0.2	0.4
sugar cane sugar beet plant-based fibers crops NEC	0.2	0.3	0.4
bovine cattle sheep and goats horses animal products NEC	0.1	0.2	0.4
forestry fishing	0.2	-0.8	0.5
coal	4.3	0.9	0.7
Oil	-3.2	1.1	0.5
Gas	-3.0	0.1	0.5
minerals NEC	0.5	1.9	0.5
bovine cattle sheep and goat meat products	0.1	0.1	0.3
vegetable oils and fats, processed rice, food products NEC	-0.3	0.1	0.4
dairy products	0.3	0.2	0.5
beverages and tobacco products	-2.4	0.1	0.6
textiles	0.6	1.6	0.3
wearing apparel	0.5	1.0	0.2
leather products	0.4	1.1	0.2
wood products	0.5	-1.0	0.6
paper products publishing	0.2	-0.1	0.5
petroleum coal products	-0.8	-0.3	0.4
chemical rubber plastic products	0.3	0.5	0.4
mineral products NEC	0.4	0.3	0.5

	Bulgaria	Romania	Rest of the World
ferrous metals	0.4	0.6	0.4
metals NEC	0.7	1.8	0.5
metal products	0.4	0.4	0.4
motor vehicles and parts	0.4	0.0	0.5
transport equipment NEC	0.3	1.7	0.6
electronic equipment	0.4	1.0	0.4
machinery and equipment NEC	0.3	0.0	0.4
manufactures NEC	0.3	0.4	0.4
electricity	0.6	0.2	0.5
gas manufacture distribution	3.6	0.3	0.5
water	0.2	0.3	0.6
construction	0.2	0.2	0.5
trade	0.3	0.3	0.5
transport NEC	0.4	0.1	0.5
communication	0.4	0.2	0.6
financial services NEC	0.3	-0.2	0.6
insurance	0.3	-0.4	0.6
business services NEC owner-ship of dwellings	0.6	0.2	0.7
public admin and defense, edu-cation, health, recreational and other services	0.1	0.2	0.5

Appendix 3. The Quality of Environment in Russia and Government Policy

A3.1. Emission of greenhouse gases[25]

The 2006 overall emission of greenhouse gases in the Russian Federation[26], without account of land use, changes in land-use management and forestry, accounted for 190.4m t. of CO2 equivalent, or 107.5% of the 2000 level of emission, or 65.9% of its respective level of 1990.

The distribution of emissions between sectors has changed insignificantly over the period between 1990 and 2006. It is the energy sector that clearly dominates the scene, with its 2006 share in the overall volume of emissions accounting for 81.6%. Meanwhile, the share of agriculture declined slightly (from 9.3% to 6%). Notably, after the decline over 1991-98 this sector did not increase emissions. The major proportion of emissions (72%) falls on CO2, the major source of which is the energy sector with its firing of fossil fuels. Some drop in the proportion of N2O (from 6.6 to 4.6%) in the overall volume of emission can be attributed to the fall in the use of nitrogenous fertilizers in agriculture.

[25] The methodological basis for estimates of the emission of greenhouse gases is formed by the respective guideline documents of the International Panel on Climate Change (IPCC) and guiding documents on conduct of national greenhouses gases inventories approved by the UN Framework Convention on Climate Change. Underpinning the IPCC's approach is a designed monitoring of emissions and assimilation basing on the use of quantitative data on volumes of specific kinds of activities that entail emissions or assimilation of greenhouse gases. The bulk of original inputs is taken from materials of economic, forestry and other kinds of statistics.

[26] In soil one finds concentration of heavy metals, oil products, fluor, sulphates etc. Values of background mass fractions in soils are presented in yearbooks of contamination of soils with toxicants of industrial origin. Every summer, one selects between 1 and 10 integrated soil samples in background regions. To compare the level of contamination of soils with toxicants of industrial origin close to sources of industrial emissions with background values one annually carries out selection of soils samples in background areas bordering on the technogenic ones.

A3.2. The background concentration of pollutant substances in surface water

The background concentration of mercury, lead and cadmium in surface water in most background areas in Russia matched intervals of values observed over recent years and accounted: for mercury – 0.1-2 μg /kg, lead – 1-7μg /kg, cadmium – not more than 1μg /kg. In the Asian territory of Russia, the background concentration rates of heavy metals, as a rule, appeared lower than those in the European part. In the Astrakhan reserve, reaching in some tests 80-120 μg /kg, the concentration rates of cadmium in most cases were greater than those of lead.

A3.3. The radiation situation

Pollution of open air with technogenic radionuclids in Russia, as a rule, is determined by the lifting and moving by the wind of radioactive dust from the surface of the soil contaminated over the prior years in the process of global export of products of nuclear weapon tests from the stratospheric reservoir.

Between 1998 and 2007 the average weighted nationwide volumetric activity of the sum of long-life beta-active radionuclids in the ground atmosphere displayed a minor trend to decrease. The average weighted countrywide daily fallout deposition of the sum of beta-active radionuclids has remained practically unchanged since 1998.

Over the past decade the volumetric activity of 137Cs in Russia's territory decreased 1.4 times, which can be chiefly attributed to the fall in the specific activity of 137Cs in the upper dusting stratum, due to radioactive decay.

The average weighted nationwide volumetric activity of 90Sr in the ground atmospheric layer in 2007 accounted for 0.90· 10-7 Bq/м3, thus 1.3 times down vs. the respective indicator of 1998.

It was technogenic 90Sr washed away by rainfall from the polluted surfaces that made a major contribution to the radioactive contamination of surface water.

Accumulation on the soil of radionuclids that fell out of the atmosphere over 2007 was insignificant throughout the country's territory compared with their aggregate storage in soil and had practically no effect on the earlier formed levels of pollution.

Geographically, the scatter of the technogenic radioactive contamination of soil in Russia's territory did not undergo any changes in 2007. During the year, the

EDR rate of local γ- radiation throughout the country's territory was within the range of fluctuations of the natural radiation background, except for contaminated areas.

A3.4. Flora and fauna

Forests and other kinds of vegetation are objects of environmental protection. Main challenges are over cutting, littering, wildfires, reforestation and re-vegetation. Fauna, wildlife, microorganisms (microflora), their genetic fund also are objects of the legal environmental protection. Degradation of the environment may result in an irreversible mutation of vegetation and wildlife.

Rare or endangered animals and other species and their habitat are subject to a special protection (Art. 4 of the Federal Act "On Protection of environment"). The act also provides for conduct of the national and regional Red Books. The latter contains 414 rare or endangered wildlife species, including 65 mammal species, 123 bird species, 21 reptile species, 8 amphibian species, 39 fish species, 42 shell-fish species, and 92 arthropod species.

The federal law of RF has set requirements in the area of wildlife protection in the course of conduct of economic activity, particularly in the course of the operating of agricultural objects, carrying out melioration works and operating of melioration systems and hydrotechnic facilities, and developing, constructing and reconstructing of urban and rural settlements.

A3.5. The background concentration of polluting agents in soil and vegetation[27]

To exemplify this particular problem, the polluting substances found in soils in the Moscow region (Mozhaysky district) in 2007, exhibited the following compo-

[27] In the course of monitoring, the ground atmosphere tests of radioactive aerosols and their fallouts on the underlying terrain are selected non-stop with the daily exposition. Then one finds the concentration of the sum of beta-active and individual gamma-active and beta-radiating radionuclids of technogenic and natural origin. In the vicinity of some radioactive-perilous objects, one identifies the concentration rate of alpha-radiating radionuclids, that is, plutonium isotopes.

sition and indicators (mg/kg): Pb 19, Mn 750, Cr 40, Ni 18, Cu 12, Zn 30, Co 10, Cd 0,2, Fe 10000.

Concentration of heavy metals in soils in the remote areas in 2007 was within the ranges of average values of results of multiyear observations. Concentration of lead in the surface layer of soils in European territories of the North Caucasus accounted for 3-5 mg/kg and that of cadmium up to 04. mg/kg. In the central areas of the European territory, the benchmark concentration of lead in grassland vegetation and leaves was 0.9 mg/kg, while in the Caucasus up to 1.4 mg/kg. Overall, these results match those of multiyear observations, except for Astrakhan oblast, where the concentration of cadmium in vegetation reached 3-7 (vs. the national average of 4.5) mg/kg and not only appeared 5 to 10 times greater than the concentration rates of cadmium in other reserves, but exceeded the concentration rates of lead, too.

In 2007, concentration of pesticides in soils remained practically unchanged vis-à-vis results of the 1996-2006 observations and was on the levels close to the threshold of detectability: γ-HCCH a. 1 μg /kg, DDT 1.5-25 μg/kg (total of DDT 3-40 μg/kg).

A3.6. Challenges facing implementation of the environmental policy in the territory of the Russian Federation

The federal environmental law of the Russian Federation faces a whole array of challenges that affect the efficacy of the environmental policy. Some of them are cited below.

A3.6.1. Inconsistency between some federal acts

Systematization and codification might prevent the rise of divergence in the environmental law and improve its effectiveness. Experts argue in favor of codification of the environmental law in the form of an Ecological Code- Presently the Federal Ministry for Natural Resources and Ecology has designed a concept for, and the draft of such a code.

The main objective of development of the draft Ecological Code lies in codifying legislative and other legal acts that regulate relations in the environmental protection area, the transition from *ad hoc* legal regulation of environmental relations to a complex one, closing gaps, coordinated development and enforcement of

the national legislation on environmental protection and natural resources with the civil, administrative and other legislation, their harmonization with standards of the international law in the environmental protection area, and establishment of new legal institutions that meet modern requirements of the economic development of society and, finally, introduction, to a maximum possible extent, of direct-action rules.

The Ecological Code is to substitute for 550 effective legal acts which currently regulate the sphere of environmental protection, environmental safety and rational nature-using and contain some controversial or mutually conflicting provisions. The Code is to form a backbone of the legislation in the area of protection of environment, while federal acts in this particular area and those concerning environmental safety to be developed and promulgated in the future are be incorporated into the Ecological Code. Meanwhile, federal acts that fall under other branches of law and contain environmental provisions developed currently and to be promulgated in the future likewise should rest upon legal provisions of the Ecological Code.

The Code should ensure efficacy of exercise of the environmental function of the state on the basis of the concept of preservation of survival functions of environment.

A3.6.2. Ambiguity of the law enforcement practices

Analyses of the judicial practice reveal that a significant fraction of court disputes are related to an ex delicto bringing legal entities and individual entrepreneurs to administrative account, an incorrect interpretation of some provisions of the law, and the absence of a strict and consistent division of power between federal and regional government. The main reasons behind such disputes are legislative imperfections, collisions between legal provisions, and gaps in legal regulations. These drawbacks pose serious challenges, as far as law enforcement is concerned and require elimination.

A3.6.3. Inefficient employment of economic mechanisms in the environmental policy

In Russian Federation, the economic mechanism of environmental protection is insufficient. One of the causes is insufficient and imprecise legislation. To close this gap, experts in the environmental law area recommend adoption of a number

of legislative acts aimed at regulation of the ecological audit and a mandatory ecological insurance.

A3.6.4. The need for improvement of the environmental law with respect to an individual environmental object

The currently stipulated administrative responsibility for breaching the law on protection of open air is ineffective, due to its insignificance and failure to match additional costs of environmental measures incurred by enterprises. Meanwhile, the criminal responsibility is practically utterly ineffective, due to specificity of law abuses in this particular sphere. The tax law does not stipulate any additional burden for corporations whose economic activity engenders emissions in open air.

A3.6.5. Problems of comparability of indicators of quality of environment in Russia and the EU countries

Today, comparing actual environmental pollution indicators in Russia with those in the EU countries appears quite a problematic exercise as far as most environmental objects are concerned. But a substantial work on coordination and development of uniform principles of assessment of quality of environment is under way. It allows one to hope for development of comparable data on Russia and EU in a not-so-distant future.

In the EU countries, the USA, Canada and some Asian countries, critical levels of pollution content appear dozen- and hundred-fold greater than the respective indicators in Russia. To exemplify, in Canada, the upper marginal permissible content of lead in the soil in living areas and parks is 500 mg/kg, while in the soil within industrial zones or for commercial use – up to 1,000 mg/kg, and in the farming soil – 37.5 mg/kg. In UK, the permissible content of lead in the soil varies between 300 and 2,000 mg/kg depending on the category of its use.

Notwithstanding different approaches to setting open air quality standards, numerical values for many substances in Russia and EU appear fairly close to each other. This is in particular a result of recent efforts to specify a number of both Russia's MAC values and set by the WHO's recommendations on quality of open air in Europe. Meanwhile, there exist significant discrepancies with regard to setting requirements to the content of certain particles in open air.

Appendix 3. Table 1. Comparative data on standards of polluting agents content in soils of Russia and some foreign countries, as mg/kg

Substances	Germany	The Nether-lands	USA	Finland	Russia
Arsenium	25-140	29-50	30-300	50-100	2-10
Lead	200-2000	85-600	300-6000	200-750	32-130
Cadmium	10-60	0.8-20	30-800	10-20	0.5-2
Chrome	200-1000	100-800	1000-10000	200-300	-
Nickel	70-900	35-500	300-7000	100-150	20-80
Mercury	10-80	0.3-10	20-600	2-5	2.1
Zinc	-	140-3000	2500-10000	250-400	55-220
Copper	-	36-500	-	150-200	33-132
Cobalt	-	20-300	-	100-250	-
Molybdenum	-	10-200	-	-	-
Stannic	-	20-300	-	-	-
Petroleum deriva-tives	-	-	200-10000	-	180-1000
Cyanides	50-100	-	100-4000	10-50	-
Benzapyrene	2-12	-	0.7-100	2-15	0.02

A3.7. The Russian government's agenda in the environmental policy area

The strategic mission of government policy in the environmental area is formulated in the Ecological Doctrine of RF, which the RF Government endorsed with its Resolution of August 31, 2002, # 1225-p. The mission pursues such objectives as preservation of natural systems, supporting their integrity and life-supporting functions for the sake of sustained development of the society, improvement of living standards, the population's health and demographic situation, and securing the nation's environmental safety.

Prior to adoption of the Ecological Doctrine the national environmental policy was carried out according to Action Plans in the environmental area, subject to approval by Resolutions of the Russian Government. The first action plan was approved for the period of 1996-97, aiming at development of a sustained development policy, legal provisions of protection of environment and improvement of administration and control in the area of environment protection and nature-using. The second action plan for 1999-2001 was adopted in 1998. But shortly afterwards the Government abandoned the practice of preparation of these action plans.

With his Decree # 899 of June 4, 2008, "On some measures on increasing the energy and environmental efficiency of the Russian economy", the Russian President identified priority measures in the area of rational and environmentally efficient consumption of energy and energy resources for the period through 2020 and gave respective assignments to the RF Government. Pursuant to this Decree, the Government approved "Main avenues of activities of the RF Government for the period through 2012 in the area of ecology" (approved by Resolution of the RF Government of November 17, 2008, # 1663-p). This Resolution sets the following priority tasks until 2012:

- design of a new system of regulation of acceptable influence on environment that allows one to lower the level of the anthropogenic stress;
- a stage-by-stage refusal of the practice of setting temporary environmental emission and discharge standards (limits);
- elimination of administrative barriers in the determination of such standards (limits);
- improvement of economic mechanisms in the environmental protection area, particularly by improving the mechanism of payments for an adverse effect on environment and creating instruments of environmental insurance for economic agents;
- development of mechanisms of governmental support to work on minimizing and liquidating natural damage caused by economic activities;
- development of a system of the especially protected natural areas of federal value;
- implementation of a set of measures on preservation of the biological and landscape diversity of the public natural reserves, national parks of federal significance, and federal reserve;
- taking steps to ensure environmental safety and comfort of the population through bringing, stage-by-stage, the environmental situation in polluted localities in conformity with environmental standards. This requires developing criteria of attribution the status of a territory being in the critical or near-critical state in terms of environmental indicators and conducting the respective environmental audit of the territories in question;
- development and introduction of the modern system of environmental audit.

A mandate has been assigned to the Federal Ministry for Natural Resources and Ecology to secure by 2012:

- the decrease of the volume of emission of polluting substances in open air from stationary sources from 20,636 thousand t. to 20,560 thousand t.;
- the decrease in the number of cities with a high and very high pollution levels from 170 to 135 ones;
- the decrease of the share of cities, wherein the average annual concentration rate(s) of an individual or several polluting agents in open air are in excess of the MAC rates, in the total number of the cities subject to the regular monitoring, from 85% to 80%;
- increasing the share of the country's area occupied by reserves and national parks from 2.6% up to 3%;
- the drop of the volumes of pollution of open air and water bodies, and the volume of waste by 20%;
- the decrease in enterprises' energy consumption by 40% until 2020.

Overall, by its magnitude and main avenues, the governmental program of the environmental policy appears consistent with the recently announced EU plans to improve the environmental situation by 2020 through a 20% increase in the proportion of renewable energy sources, a 20% decrease of the volume of the greenhouse gases emission and a 20% rise in the energy efficiency rate in the industrial sector. Hence, there appears to be some convergence of Russia's environmental standards with those of the EU under way, which would mean first tangible results from their cooperation.

Appendix 3. Table 2. Placement in Operation of Capacities on Protection from Contamination of Water Resources and Open Air

	1992	1995	2000	2001	2002	2003	2004	2005	2006	2007
Household refuse processing plants, thos.m^3 a day	751	1439	231	263	362	522	544	1292	489	1502
Circulation water supply systems, thos.m^3 a day	1388	2246	135	3517	1052	1130	786	1090	2045	1697
Devices for screening and deactivation of repugnant substances from outgoing gases thos.m^3 per hour	5644	7531	3070	3618	4504	4378	2090	4209	5062	4127

Source: The Federal Service for Statistics of the Russian Federation.

Appendix 3. Table 3. Investment in Capital Assets Aimed at Environmental Protection and Rational Utilization of Natural

	1992	**1995**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total	53	6404	22339	27710	25270	35407	41168	58738	68188	76884
Of which on protection:										
Open air	9.2	1644	7946	9682	6750	10889	15521	19839	21316	21642
Water resources	33	3397	8251	10163	10928	14915	15748	26143	30241	32823
Land	7.1	946	3520	4337	4660	6415	5563	9206	11027	15749

Note. Data is provided in actual effective prices; as Rb m.; prior to 2000 – as Rb. bn. Since 2001 г. – less VAT.
Source: The Federal Service for Statistics of the Russian Federation.

Appendix 4.1. Quantification of Damage due to Airbone Pollution by EXternE Method

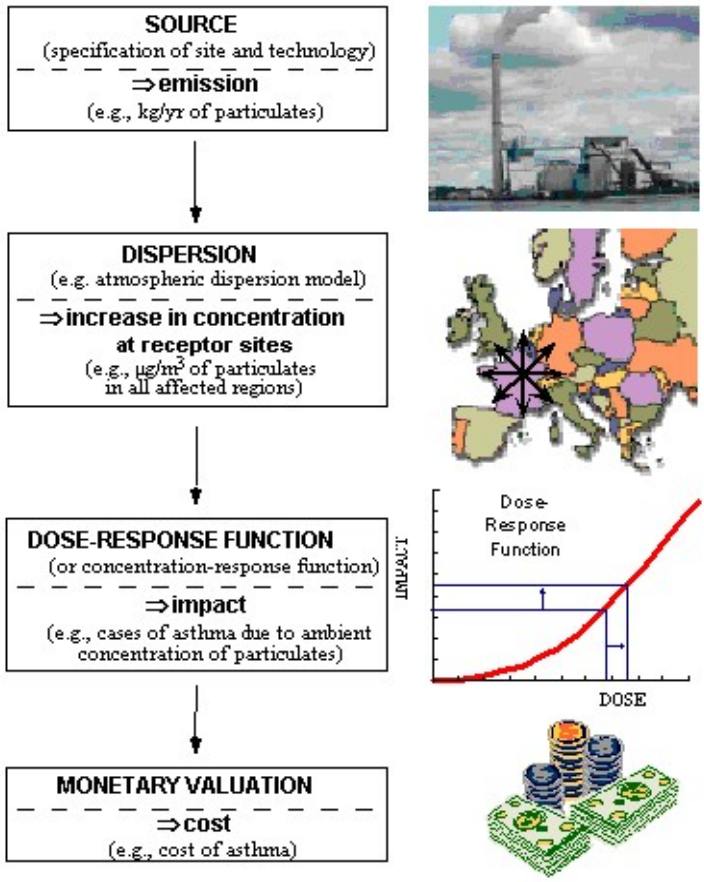
ExternE project series – launched at the beginning of 90's – have been aiming at developing, and further improving and extending appropriate methods to quantify the external costs mostly due to airborne pollution and climate change. So called Impact Pathway Approach (IPA) is followed in the ExternE. Basically, IPA consists of four steps: it starts with the emission of a pollutant at the location of the source into the environment. It models the dispersion and chemical transformation in the different environmental media in its second step. Introducing receptor and population date it then identifies the exposure of the receptors and calculates the physical effects that are, in the last step, monetized.

Monetary valuation of effects is based on valuation approaches consistent with welfare economics. It means that changes in marketed goods are quantified by using market prices and/or by estimating the variations; there is however no price for non-market goods such as human health or loss of biodiversity. Therefore the ExternE uses non-market methods, which use techniques based on revealed or stated preferences. The external costs expressed in monetary terms per unit of production are usual result of this approach.

For many questions in research and policy we need not be interested in the damages caused by one single process at a certain location but we might be interested in the damages per economic sector, per country or per unit of pollutant. EU-funded project NEEDS aimed at generalisation of the improved model in order to deliver generic values of the external costs per pollutant and a country. To calculate the generic country-specific values, parameterised results from an Eulerian dispersion and chemical transformation model for classical pollutants was used. Thanks to source receptor matrices to each unit of emission in one region a concentration or deposition increment in each of the 50 x 50 km^2 EMEP grid cells all over Europe were attributed. According to the IPA, total increment in concentration was multiplied by concentration (dose) response functions and the number of exposed population to get a cumulative exposure for each grid cell. Finally, the physical effects such as number of cases of respiratory diseases or premature mor-

tality was multiplied by monetary values of each impact category. As the result, the external cost per ton of pollutant is derived for each European country.

Appendix 4.1. Figure 1. Impact Pathway Approach for quantifying the external costs



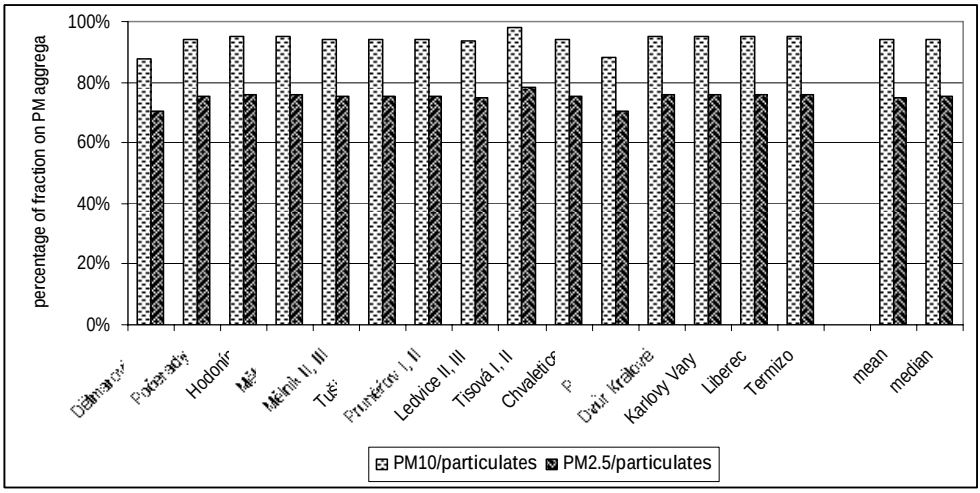
Results for damages due to classical pollutants are available for emissions discharged in 39 European and non-European countries and 5 sea regions. The receptor domain covers the whole of Europe. Impacts included are impacts to human health, crops, damage to materials and loss of biodiversity caused by acidification and eutrophication. Except the effect from regional model, thanks to Northern Hemispheric model (Tarrasón, 2006; 2008 in RS3a WP1) the external costs due to impacts to human health outside Europe caused by emissions of classical pollutants in Europe have been estimated and included as well.

Impact Pathway Approach is incorporated into a software tool so called *EcoSenseWeb* being developed within ExternE project series and operated by Uni-

versity of Stuttgart. This tool presents an integrated computer system developed for the assessment of environmental impacts and resulting external costs from electricity generation systems and other industrial activities. The online tool can be found at http://EcoSenseWeb.ier.uni-stuttgart.de/.

In the past of ExternE, emission of primary particulate was expressed as TSP (total suspended solid). In fact, the external costs of particulate matter strongly depend on the share of $PPM_{2.5}$ within PPM_{10}. In order to distinguish between primary and secondary particulate matter the abbreviation for primary particulate matter is PPM_{10}. However, in the impact assessment by ExternE, PPM_{10} is further distinguished into PPM_{co}, which is a particulate matter coarse with an aerodynamic diameter of smaller than 10 µm but larger 2.5 µm and $PPM_{2.5}$ that is particulate matter with an aerodynamic diameter of smaller than 2.5 µm. Environmental statistics usually report particulate emission as for the aggregate, i.e. without distinguishing their specific fractions. Because generic external costs are in ExternE provided for $PPM_{2.5}$ and $PPM_{2.5\text{-}10}$ fractions, we need to estimate these fractions on PPM aggregate. For some flue gases like in traffic the share of $PPM_{2.5}$ can be up to nearly 100% whereas the share for emissions of an embarkation of coal the share of $PPM_{2.5}$ can be as low as cca 5%. A general recommendation is therefore not possible. Example for shares of $PPM_{2.5}$ on PPM_{10} is reported for instance by Klimont et al. (2002); AEAT (2002); IIASA (2004), or (Pregger 2006). Based on our analysis of PPM emission released by main power plants being operated in the Czech Republic (see Appendix 4.1. Figure 2), we recommend using 75% share of $PPM_{2.5}$ and 20% of PPM_{coarse} respectively on TSP aggregate, if no disaggregation of TSP into its fraction is not available.

Appendix 4.1. Figure 2. Share of PM10 and PM2.5 on TSP in the Czech power plants



Appendix 4.2. Externalities due to Climate Change

Valuation of greenhouses gases is a very contentious issue because the assessment of the impacts is highly uncertain. Moreover, since the impacts are spread all over the whole world and into the future, the monetary evaluation is dependent on value choices, like discounting and equity weighting. Impacts due to climate change may be monetized by considering two different conceptual approaches. First, the costs of carbon might be based on abatement costs of reaching certain (arbitrary set) goal. This approach would be correct if one was sure the agreed policy target was also socially optimal. Estimate of abatement costs to reach Kyoto target by the EU15 countries were just used to value damage of carbon emissions last years in the ExternE project series. Methodologically more correct – at least following welfare economics ground – approach is, however, to estimate marginal damage costs of carbon, commonly referred to as the Social Costs of Carbon. Although, as noted by Anthoff (2007), the marginal damage figures are not the only measure used to quantify impacts from climate change[28], their estimates have been appearing more often in the literature.

Magnitude of social costs of carbon estimates do, however, significantly vary. Scope and structure of the assessment model present the first reason of variations; value of the estimate would then depend on number of impacts being covered, time horizon of impacts considered, or climate sensitivity assumed in given model (see Watkiss, 2007). Next, there are also two key parameters of modeling that certainly will influence magnitude of the estimates: it is discounting and equity weighting. As a meta-analysis of IAM studies by Richard Tol (2005) shows weighting impacts due to equity and giving higher weight to future outcomes, i.e. by applying lower discount rates might indeed result in more than one order larger value of the MSC.

To provide comprehensive picture on MSC, several runs by FUND model were performed within the NEEDS project. Anthoff (2007) reports a range of MSC estimated based on using several pure rates of time preference (such as 0%, 1%,

[28] Some studies also presented total damage costs (e.g. Nordhaus and Boyer 2000; Tol 2002), or balanced growth equivalent (Stern 2006), or a Pareto optimal marginal damage costs, i.e. that are equal to marginal abatement costs (Nordhaus 2005).

and 3%) plus declining rates over time, without equity weighting *(No_EqW)*or equity weighted by world average *(Aver_EqW)* or EU income average *(EU_EqW)*, including reporting a statistical inference for probabilistic MSC estimates. Values of MSC for given various assumptions of two key model parameters are displayed in Appendix 3Table 1 below *(all in 2000 Euro prices)*.

Appendix 4.2. Table 1. MSC of CO2 estimates based on FUND model v. 3.0

'deterministic'	0%	1%	3%	1% trimmean	0%	1%	3%
No_EqW	16.4 €	2.1 €	-1.4 €	No_EqW	31.5 €	7.0 €	-0.5 €
Aver_EqW	41.4 €	7.7 €	-1.4 €	Aver_EqW	75.8 €	20.3 €	1.7 €
EU_EqW	197.3 €	36.7 €	-6.8 €	EU_EqW	360.9 €	96.8 €	8.1 €
average	**0%**	**1%**	**3%**	**median**	**0%**	**1%**	**3%**
No_EqW	39.8 €	8.9 €	-0.1 €	No_EqW	8.6 €	0.3 €	-1.8 €
Aver_EqW	91.5 €	24.3 €	2.4 €	Aver_EqW	27.2 €	5.4 €	-1.5 €
EU_EqW	435.6 €	115.9 €	11.6 €	EU_EqW	129.5 €	25.9 €	-6.9 €

Note. Based on NEEDS project cit. in Anthoff 2005; all values are in 2000 Euros.

MSC estimates if world-wide outcomes are weighted by the EU average are about one order higher than without weighting, for instance, almost 97 € for 1% PRTP and 1% trim mean. Median MSC values are smaller than 1%, 5% and 10% trimmed mean values, while mean values of MSC are the lowest ones. The highest discount rate, the smaller MSC of carbon is. Applying declining discount rate in deterministic model runs, MSC per ton of CO_2 would be 3.8 €. Best guess MSC of CO_2 estimate based on deterministic runs, 1% PRTP and without equity weighting yields a value of 2.1 € per ton CO_2.

It is just a nature of damage estimation of climate change that the one (say true) value of MSC of carbon can't exist. Any decision about the parameters will have to be just arbitrary based on normative notion followed by the decision maker. Due to the fact, modeling exercise requires having one unique number or distribution of the variable, NEEDS coordination research team has widely discussed what a central value of parameters for discounting and weighting the MSC of carbon estimate shall be based on. As a result, a probabilistic estimate based on 1% PRTP, without equity weighting and taking 1% trimmed mean has been considered as the central MSC of carbon value; this yields 6.96 € per ton of CO_2 released in decade 2000-2010. In our impact assessment we use **6 USD_{2000}** as the lower bound of damage due to climate change. Discussion in NEEDS led to suggestion that higher value of damage will better reflect actual policy targets as well as value of abatement costs estimates. Therefore, 21 € per ton of CO_2 was suggested as the central estimate of damage due to climate change; we use 20 USD_{2000} in our assessment. Then, to cover wider range covered in discussion of potential damage

due to climate change, we assume 40 USD_{2000} per ton of CO_2 to be our upper bound.

In total, five impact categories (health, loss of biodiversity, crops, building materials, and climate change) involved by five classical pollutants (SO_2, NOx, NH_3, NMVOC and two fractions of PM) plus impacts due to climate change caused by GHGs are considered in our impact assessment. Table 2 documents a relevance of each impact category for each pollutant. For instance, each of substance causes effect on human health (GHGs cause health effect indirectly), while the effects on materials might be incurred by emission of SO_2 and NOx only.

Appendix4.2. Table 2. Impact categories relevant for each ExternE-relevant pollutant

	Human health	**Biodiversity**	**Crops**	**Materials**	**Climate change**	**Total**
SO_2	€	€	€-	€		Σ €
NOx	€	€	€	€		Σ €
$PM_{2.5}$	€					Σ €
PM_{coarse}	€					Σ €
NH_3	€	€	€-			Σ €
NMVOC	€	€-	€			Σ €
HMs, VOC	€					Σ €
GHGs					€	Σ €
Total	Σ €	Σ €	Σ €	Σ €	Σ €	**Σ €**

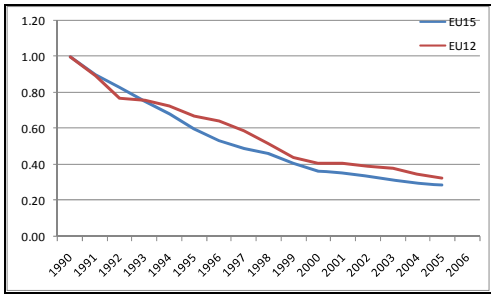
Appendix 4.3. Data and Other Simulation Results

Appendix 4.3. Table 1. Generic values of the external costs per pollutant and country

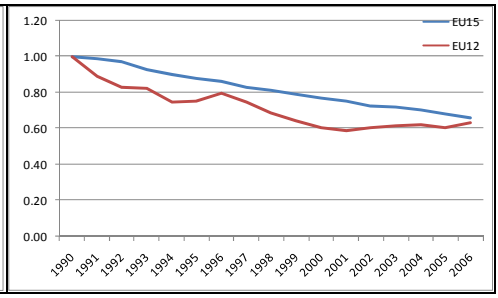
	RUS	BE	CZE	FIN	DE	EU27
Human Health	**36 409**	**86 167**	**57 370**	**12 882**	**72 056**	**46 850**
NH_3	6 944	21 588	16 566	3 119	12 901	9 360
NMVOC	287	1 549	576	173	820	576
NO_X	1 630	6 291	7 208	1 107	8 831	5 519
PPMco	1 557	2 634	996	196	2 039	1 308
PPM_{25}	22 526	45 674	24 883	6 019	39 254	24 097
SO_2	3 466	8 432	7 141	2 268	8 210	5 991
Loss of Biodiversity	**259**	**4 918**	**6 942**	**3 119**	**8 119**	**4 408**
NH_3	138	3 495	5 234	1 818	6 182	3 365
NMVOC	-7	-63	-86	-32	-210	-70
NO_X	91	1 124	1 382	920	1 549	930
PPMco	0	0	0	0	0	0
PPM_{25}	0	0	0	0	0	0
SO_2	37	362	412	413	598	182
Crops	**10**	**104**	**347**	**54**	**554**	**290**
NH_3	-3	-140	-124	-2	-62	-181
NMVOC	11	452	134	30	276	187
NO_X	20	-115	394	46	456	323
PPMco	0	0	0	0	0	0
PPM_{25}	0	0	0	0	0	0
SO_2	-17	-94	-56	-19	-116	-39
Materials	**325**	**546**	**617**	**93**	**529**	**325**
NH_3	0	0	0	0	0	0
NMVOC	0	0	0	0	0	0
NO_X	70	82	125	20	94	70
PPMco	0	0	0	0	0	0
PPM_{25}	0	0	0	0	0	0
SO_2	255	465	492	73	435	255
North Hemispheric modelling	**917**	**917**	**917**	**917**	**917**	**917**
NH_3	3	3	3	3	3	3
NMVOC	353	353	353	353	353	353
NO_X	129	129	129	129	129	129

	RUS	BE	CZE	FIN	DE	EU27
PPMco	2	2	2	2	2	2
PPM_{25}	156	156	156	156	156	156
SO_2	275	275	275	275	275	275
All Impacts						
NH_3	7 081	24 946	21 679	4 937	19 024	12 547
NMVOC	643	2 291	977	523	1 240	1 046
NO_X	1 940	7 511	9 238	2 221	11 059	6 971
PPMco	1 560	2 636	998	198	2 041	1 310
PPM_{25}	22 681	45 829	25 038	6 175	39 409	24 252
SO_2	4 016	9 440	8 263	3 011	9 401	6 665

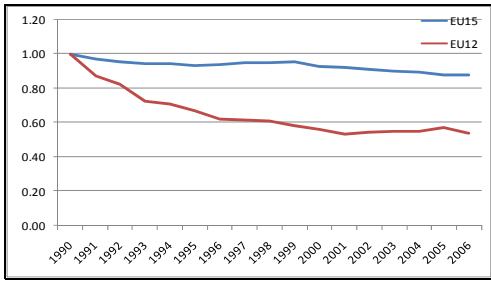
Appendix 4.3. Figure 1. Emission of SOx in the EU, 1990=1.0



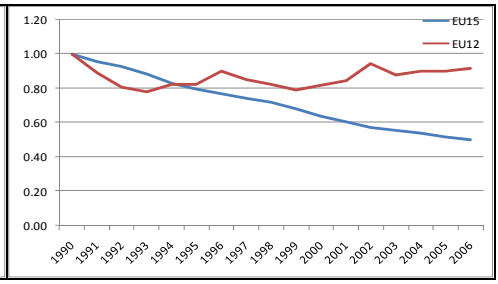
Appendix 4.3. Figure 2. Emission of NOx in the EU, 1990=1.0



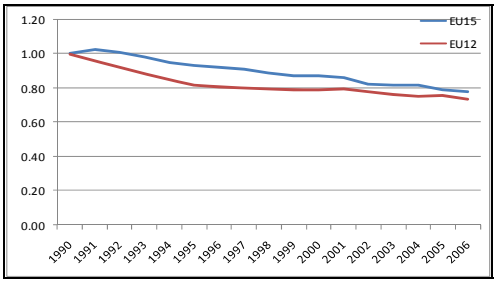
Appendix4.3. Figure 3. Emission of NH3 in the EU, 1990=1.0



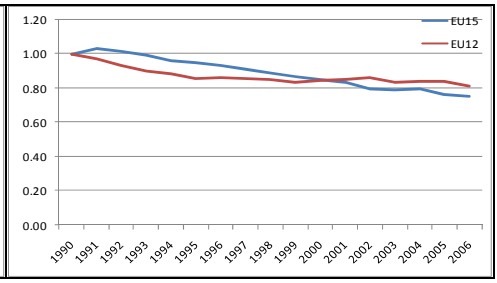
Appendix4.3. Figure 4. Emission of NMVOC, 1990=1.0



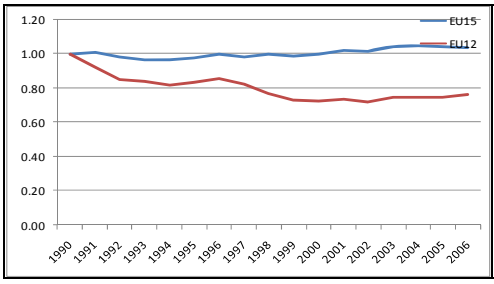
Appendix 4.3. Figure 5. Emission of PM10 in EU, 1990=1.0



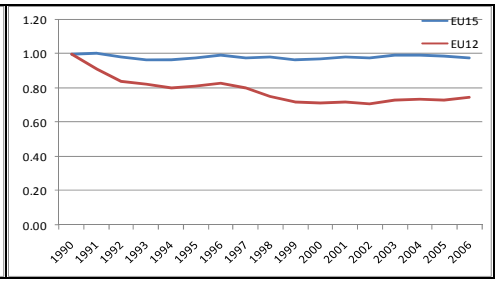
Appendix 4.3. Figure 6. Emission of PM2.5 in EU, 1990=1.0



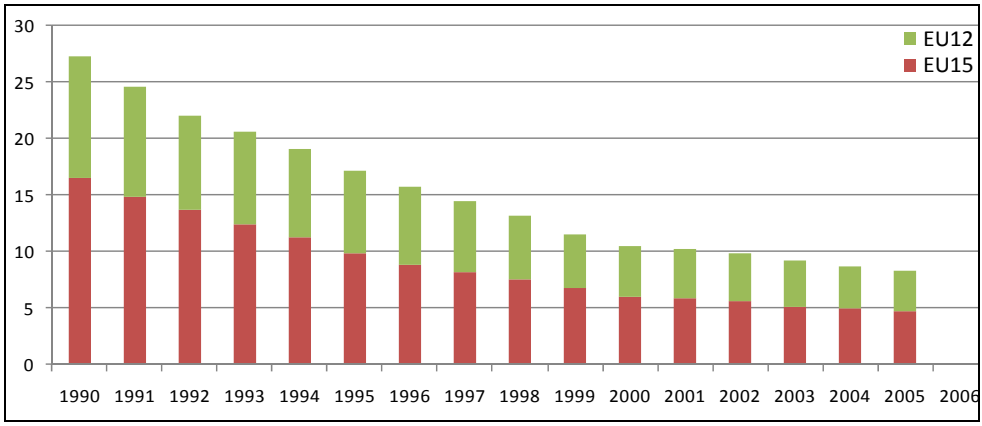
Appendix 4.3. Figure 7. Emission of CO2 in the EU, 1990=1.0



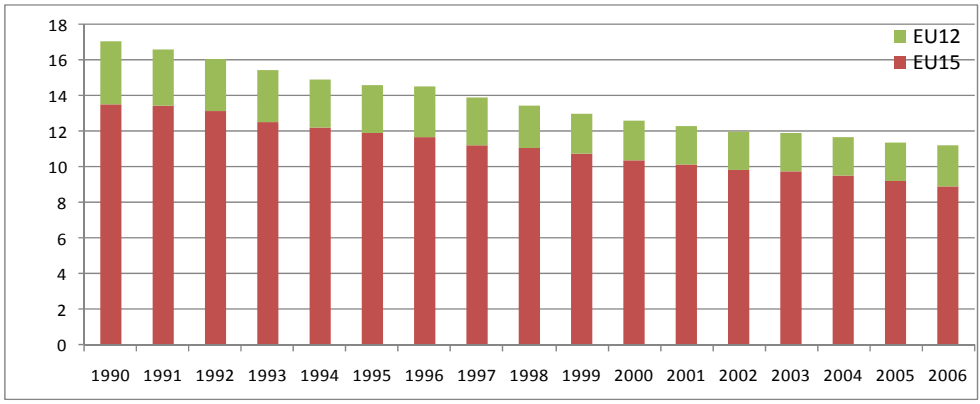
Appendix 4.3. Figure 8. Emission of GHG, 1990=1.0



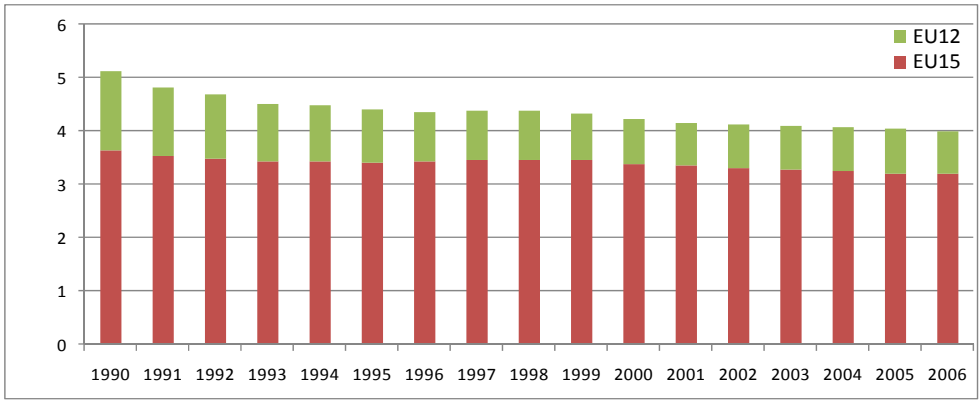
Appendix 4.3. Figure 9. Emission of SO2 in the EU, mil. t.



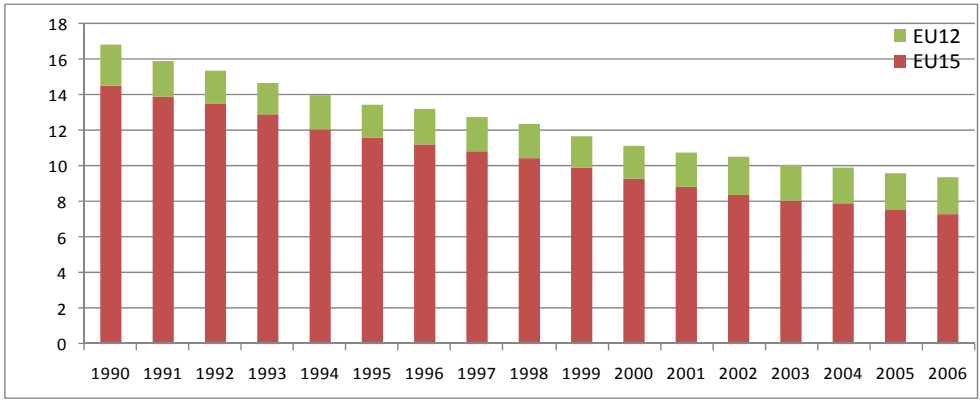
Appendix 4.3. Figure 10. Emission of NOx in the EU, mil. t.



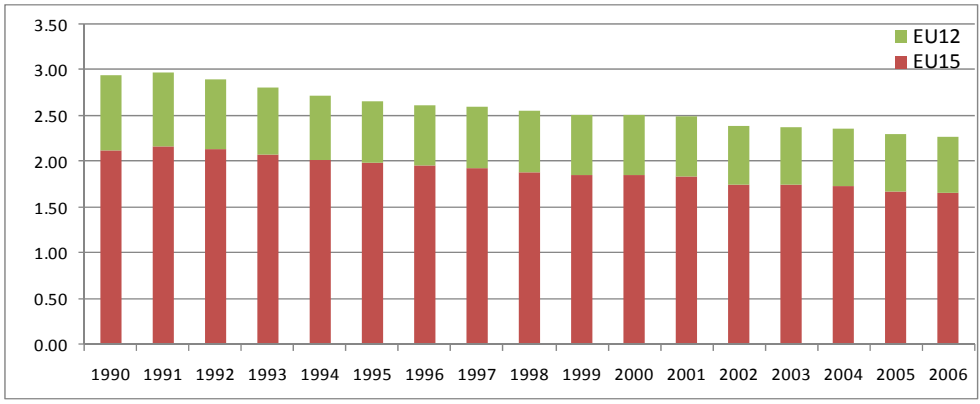
Appendix 4.3. Figure 11. Emission of NH3 in the EU, mil. t.



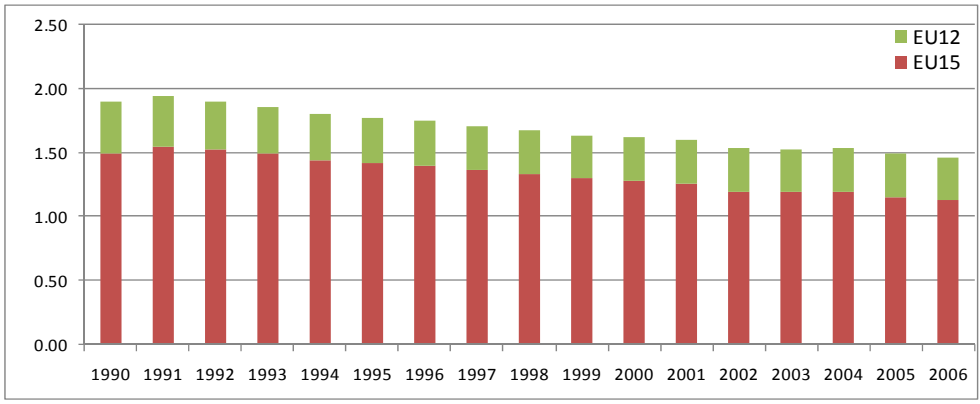
Appendix 4.3. Figure 12. Emission of NMVOC in the EU, mil. t.



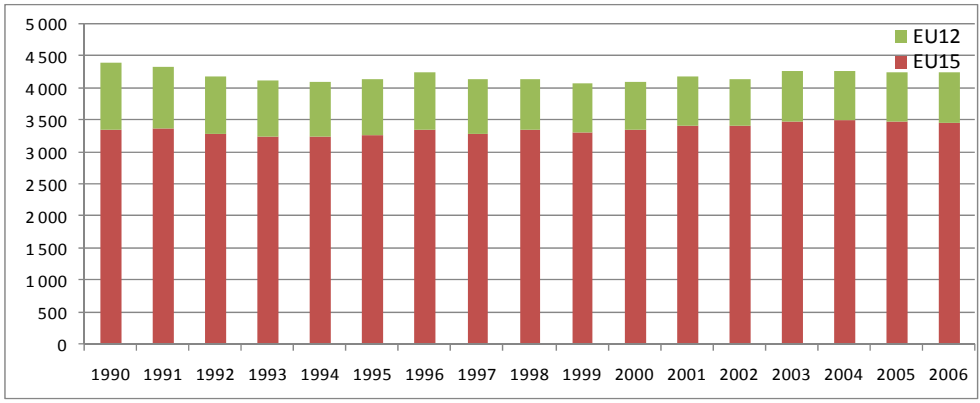
Appendix 4.3. Figure 13. Emission of PM10 in the EU, mil. t.



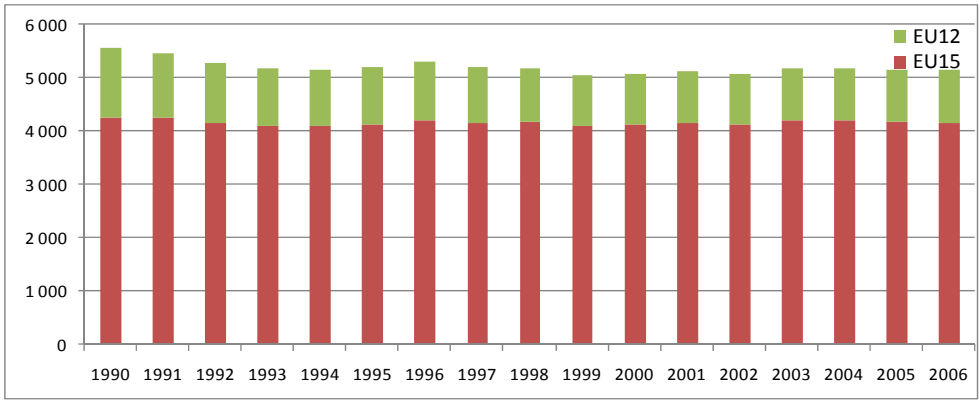
Appendix 4.4. Figure 14. Emission of PM2.5 in the EU, mil. t.



Appendix 4.3. Figure 15. Emission of CO2 in the EU, mil. t.



Appendix 4.3. Figure 16. Emission of GHG in the EU, mil. t.



Appendix 4.3. Table 2. Emission discharged in the EU, Russia and Ukraine in 2004, per mil. USD of GDP

	CO_2*	GHG*	SOx	NOx	NH_3	NMVOC	PM_{10}	$PM_{2.5}$	PM_{coarse}
AT	0.378	0.447	0.133	1.138	0.324	0.859	0.213	0.114	0.099
BE	0.515	0.593	0.638	1.213	0.307	0.834	0.183	0.124	0.059
BG	3.457	4.578	60.306	13.999	3.496	8.424	6.410	4.139	2.271
CY	0.840	1.069	4.921	1.991	0.599	1.337	0.095	0.054	0.041
CZ	1.980	2.293	3.551	5.124	1.096	3.175	0.735	0.546	0.189
DE	0.461	0.526	0.303	0.785	0.320	0.718	0.103	0.060	0.043
DK	0.325	0.408	0.154	1.160	0.591	0.698	0.218	0.157	0.062
EST	2.259	2.647	11.762	4.856	1.281	5.310	3.945	2.942	1.003
ES	0.537	0.650	2.074	2.333	0.649	1.567	0.274	0.210	0.064
FI	0.518	0.611	0.632	1.549	0.252	1.062	0.429	0.291	0.139
FR	0.291	0.391	0.345	1.012	0.531	1.064	0.373	0.246	0.127
GR	0.804	0.975	3.861	2.311	0.532	2.420	0.458	0.332	0.127
HU	1.062	1.397	4.352	3.258	1.303	2.767	0.834	0.482	0.352
IE	0.389	0.581	0.611	1.038	0.935	0.533	0.095	0.077	0.017
IT	0.433	0.510	0.438	1.041	0.373	1.111	0.163	0.132	0.031
LT	0.882	1.409	2.747	3.550	2.168	4.366	0.698	0.565	0.133
LU	0.531	0.585	0.128	0.119	0.232	0.244	0.143	0.105	0.038
LV	0.728	1.032	0.367	3.774	1.303	5.727	1.406	1.230	0.175
MT	0.792	0.943	5.367	2.781	0.257	1.168	0.608	0.385	0.223
NL	0.454	0.546	0.159	0.848	0.336	0.422	0.097	0.054	0.043
PL	1.649	2.000	6.460	4.186	1.647	4.624	1.456	0.699	0.757
PT	0.573	0.734	1.750	2.487	0.565	2.491	1.226	0.984	0.241
RO	2.389	3.382	16.053	7.934	4.069	7.648	1.000	0.800	0.200
SE	0.210	0.265	0.157	0.713	0.202	0.771	0.187	0.140	0.047
SI	0.747	0.914	2.462	2.178	0.778	2.101	0.362	0.278	0.084
SK	1.708	2.080	4.029	4.081	1.130	3.679	1.493	1.151	0.342
UK	0.349	0.413	0.525	1.043	0.202	0.630	0.096	0.061	0.036

	CO_2*	GHG*	SOx	NOx	NH_3	NMVOC	PM_{10}	$PM_{2.5}$	PM_{coarse}
EU15	0.410	0.493	0.582	1.113	0.381	0.923	0.203	0.140	0.063
EU12	1.659	2.087	8.020	4.729	1.740	4.400	1.331	0.727	0.604
EU27	0.475	0.576	0.967	1.300	0.452	1.103	0.261	0.170	0.091
RUS	4.626	6.449	5.653	14.876	1.889	8.139	4.156	2.317	1.839
UA	7.266	9.473	31.335	19.028	12.485	12.148	10.401	6.311	4.090

Note. * Data is provided in kt/mil.USD. Otherwise it is t/mil.USD.

Appendix 4.3. Table 3. Emission discharged in the EU, Russia and Ukraine in 2004, in tons or kg per capita

	CO_2	GHG	SOx	NOx	NH_3	NMVOC	PM_{10}	$PM_{2.5}$	PM_{coarse}
	t p.c.	*t p.c.*	*kg p.c.*	*kg p.c.*	*kg p.c.*	*kg p.c.*	*kg p.c.*	*kg p.c.*	*kg p.c.*
AT	9.486	11.215	3.335	28.543	8.131	21.536	5.345	2.862	2.484
BE	12.165	14.025	15.066	28.675	7.248	19.712	4.319	2.934	1.385
BG	6.846	9.067	119.431	27.723	6.924	16.684	12.695	8.197	4.498
CY	10.466	13.325	61.330	24.818	7.462	16.667	1.190	0.676	0.514
CZ	12.393	14.351	22.224	32.068	6.861	19.870	4.600	3.414	1.185
DE	10.905	12.453	7.173	18.567	7.571	16.990	2.430	1.419	1.011
DK	9.983	12.556	4.739	35.663	18.172	21.443	6.717	4.824	1.893
EST	12.676	14.850	65.990	27.244	7.189	29.793	22.130	16.505	5.625
ES	8.244	9.979	31.846	35.826	9.961	24.062	4.205	3.218	0.987
FI	13.094	15.453	15.975	39.140	6.373	26.830	10.847	7.343	3.504
FR	6.597	8.844	7.807	22.916	12.026	24.094	8.446	5.560	2.886
GR	9.962	12.089	47.860	28.644	6.599	29.994	5.683	4.114	1.568
HU	5.976	7.860	24.491	18.338	7.330	15.571	4.691	2.711	1.980
IE	11.304	16.886	17.741	30.164	27.177	15.480	2.753	2.251	0.501
IT	8.441	9.936	8.533	20.286	7.266	21.638	3.178	2.566	0.612
LT	3.957	6.321	12.321	15.922	9.725	19.583	3.132	2.535	0.597
LU	26.561	29.257	6.396	5.959	11.591	12.225	7.160	5.239	1.921
LV	3.304	4.684	1.665	17.135	5.915	25.999	6.382	5.586	0.796
MT	6.454	7.692	43.761	22.678	2.093	9.520	4.959	3.140	1.819
NL	11.122	13.373	3.902	20.753	8.225	10.322	2.372	1.313	1.059
PL	8.299	10.062	32.507	21.063	8.289	23.268	7.326	3.516	3.810
PT	6.324	8.094	19.309	27.435	6.238	27.475	13.519	10.858	2.661
RO	5.171	7.321	34.750	17.174	8.808	16.554	2.166	1.732	0.433
SE	6.136	7.747	4.584	20.881	5.905	22.567	5.473	4.091	1.382
SI	8.226	10.061	27.100	23.976	8.568	23.130	3.981	3.060	0.921
SK	7.630	9.289	17.996	18.226	5.046	16.431	6.668	5.141	1.527
UK	9.274	10.981	13.956	27.711	5.378	16.727	2.563	1.612	0.951
EU15	9.081	10.914	12.882	24.638	8.441	20.429	4.491	3.094	1.397
EU12	7.486	9.414	36.179	21.333	7.848	19.847	6.004	3.279	2.724
EU27	8.743	10.597	17.809	23.939	8.315	20.306	4.811	3.133	1.677
RUS	10.574	14.739	12.921	34.002	4.318	18.602	9.498	5.296	4.203
UA	6.769	8.825	29.193	17.727	11.631	11.318	9.690	5.879	3.810

Appendix 4.3. Table 4. External costs due to pollutant discharged to air, year 2004, in billion USD 2004 per impact category

	Impacts due to emission of classical pollutants					All Impacts	CO2 20$/t CO2	Total Impacts		
	Human Health	Loss of Biodiversity	Crops	Materials	North Hemisph			6$/tCO2	20$/tCO2	40$/tCO2
aut	4.05	0.83	0.14	0.04	0.10	5.17	1.9	5.7	**7.1**	8.8
bel	6.59	0.64	0.03	0.10	0.16	7.52	3.1	8.4	**10.6**	13.4
cymt	0.45	0.01	0.00	0.02	0.03	0.51	0.3	0.6	**0.8**	1.0
cze	6.14	0.90	0.13	0.15	0.18	7.51	3.1	8.4	**10.6**	13.4
dnk	1.85	0.30	0.04	0.02	0.08	2.29	1.4	2.7	**3.7**	5.0
est	0.54	0.07	0.00	0.01	0.05	0.67	0.4	0.8	**1.1**	1.5
Fin	0.78	0.28	0.01	0.01	0.10	1.18	1.7	1.7	**2.9**	4.4
Fra	31.21	3.89	1.21	0.22	0.91	37.43	11.6	40.7	**49.0**	59.5
deu	32.37	6.30	0.98	0.40	0.88	40.92	21.6	47.1	**62.5**	82.0
grc	3.99	0.10	0.06	0.06	0.31	4.52	2.8	5.3	**7.3**	9.9
hun	5.16	0.49	0.10	0.15	0.15	6.05	1.7	6.5	**7.7**	9.2
irl	1.02	0.10	0.01	0.01	0.06	1.21	1.4	1.6	**2.6**	4.0
ita	20.20	3.80	0.69	0.13	0.76	25.58	12.1	29.0	**37.7**	48.7
lva	0.31	0.07	0.01	0.00	0.03	0.42	0.2	0.5	**0.6**	0.9
ltu	0.66	0.11	0.01	0.01	0.04	0.84	0.5	1.0	**1.3**	1.7
lux	0.23	0.04	0.00	0.00	0.00	0.28	0.3	0.4	**0.6**	0.8
nld	6.31	0.84	-0.04	0.06	0.12	7.29	4.6	8.6	**11.9**	16.0
pol	19.07	2.26	0.24	0.71	0.78	23.06	8.1	25.4	**31.1**	38.4
prt	3.09	0.13	0.02	0.01	0.21	3.47	1.8	4.0	**5.3**	6.9
svk	2.44	0.28	0.05	0.06	0.07	2.90	1.0	3.2	**4.0**	4.9
svn	1.12	0.24	0.03	0.02	0.04	1.45	0.4	1.6	**1.9**	2.3
esp	12.76	1.51	0.36	0.09	0.96	15.68	8.9	18.2	**24.6**	32.7
swe	1.29	0.29	0.04	0.01	0.11	1.74	1.5	2.2	**3.2**	4.5
gbr	18.55	1.35	0.12	0.22	0.81	21.07	13.8	25.0	**34.9**	47.4
bgr	6.67	0.17	0.07	0.21	0.34	7.46	1.5	7.9	**8.9**	10.3
rom	9.10	0.64	0.10	0.33	0.39	10.55	3.3	11.5	**13.9**	16.9
EU27	195.9	25.63	4.43	3.06	7.68	236.76	109.0	267.9	**345.8**	444.4
EU15	144.3	20.40	3.69	1.38	5.58	175.35	88.5	200.6	**263.9**	344.0
EU12	51.66	5.23	0.74	1.68	2.10	61.41	20.5	67.3	**81.9**	100.4
rus	37.60	0.58	0.09	0.82	2.21	41.29	44.5	54.0	**85.8**	126.1
ukr	19.22	0.37	0.03	0.41	0.72	20.75	8.8	23.3	**29.5**	37.4

Appendix 4.3. Table 5. External costs due to pollutant discharged to air, year 2004, in billion. USD2004 per pollutant

	SO2	NOX	NH3	NMVOC	PM2.5	PMco	CO2 20$/tCO2	Total
aut	0.24	2.77	1.21	0.25	0.69	0.02	1.9	7.1
bel	1.48	2.24	1.88	0.47	1.40	0.04	3.1	10.6
cymt	0.37	0.07	0.04	0.01	0.02	0.00	0.3	0.8
cze	1.88	3.03	1.52	0.20	0.87	0.01	3.1	10.6
dnk	0.13	0.88	0.82	0.12	0.34	0.01	1.4	3.7
est	0.34	0.09	0.08	0.02	0.14	0.00	0.4	1.1
fin	0.25	0.45	0.16	0.07	0.24	0.00	1.7	2.9
fra	4.18	13.17	8.45	1.82	9.59	0.22	11.6	49.0
deu	5.56	16.94	11.88	1.74	4.62	0.17	21.6	62.5
grc	2.65	0.76	0.34	0.17	0.59	0.01	2.8	7.3
hun	1.95	1.99	1.22	0.14	0.72	0.03	1.7	7.7
irl	0.34	0.47	0.22	0.06	0.11	0.00	1.4	2.6
ita	3.72	9.80	6.50	1.22	4.27	0.06	12.1	37.7
lva	0.02	0.14	0.11	0.04	0.11	0.00	0.2	0.6
ltu	0.21	0.27	0.22	0.05	0.10	0.00	0.5	1.3
lux	0.03	0.03	0.13	0.01	0.08	0.00	0.3	0.6
nld	0.70	2.56	2.67	0.31	0.99	0.05	4.6	11.9
pol	9.11	5.46	4.19	0.76	3.36	0.17	8.1	31.1
prt	0.66	0.38	0.24	0.20	1.95	0.02	1.8	5.3
svk	0.74	0.94	0.55	0.07	0.60	0.01	1.0	4.0
svn	0.42	0.48	0.35	0.06	0.14	0.00	0.4	1.9
esp	6.06	4.87	2.07	0.75	1.89	0.03	8.9	24.6
swe	0.15	0.66	0.39	0.13	0.40	0.00	1.5	3.2
gbr	5.30	7.51	4.21	1.27	2.67	0.11	13.8	34.9
bgr	4.94	1.33	0.37	0.04	0.76	0.02	1.5	8.9
rom	4.88	3.14	1.66	0.24	0.62	0.01	3.3	13.9
EU27	56.32	80.44	51.51	10.23	37.26	1.00	109.0	345.8
EU15	31.46	63.51	41.19	8.62	29.82	0.75	88.5	263.9
EU12	24.86	16.94	10.31	1.61	7.44	0.25	20.5	81.9
rus	7.46	9.49	4.40	1.72	17.28	0.94	44.5	85.8
ukr	7.76	3.52	3.84	0.42	5.02	0.18	8.8	29.5

Appendix 4.3. Table 6. External costs due to FTA per region – the scale based on changes in total income of the country

	Russia		EU27		EU15		EU12	
	SC1	SC2	SC1	SC2	SC1	SC2	SC1	SC2
FTA –WTO, in billion. USD	0.47	2.01	2.10	1.06	1.69	0.85	0.41	0.21
FTA/WTO, in % of WTO	0.543	2.306	0.589	0.298	0.620	0.314	0.486	0.246

Note. The central value of climate change damage assumed.

Appendix 4.4. Table 7. Bridge between CGE model sectors and NACE sectors

sector in envi IA		NACE		CGE sector		Model name
1	agri	1-5	A-B	1	grn	grains
		1-5		2	v_f	vegetables fruit nuts
		1-5		3	osb	sugar cane sugar beet plant-based fibers crops NEC
		1-5		4	ctl	bovine cattle sheep and goats horses animal products NEC
		1-5		5	frs	forestry fishing
2	coal	10	CA	6	coa	coal
3	oilgas	11	CA	7	oil	oil
		11	CA	8	gas	gas
4	omn	13-14	CB	9	omn	minerals NEC
5	food	15-16	DA	10	mea	bovine cattle sheep and goat meat products
		15-16		11	ofd	vegetable oils and fats processed rice food products NEC
		15-16		12	mil	dairy products
		15-16		13	b_t	beverages and tobacco products
6	tex	17	DB	14	tex	textiles
7	wap	18	DB	15	wap	wearing apparel
8	leath	19	DC	16	lea	leather products
9	wood	20	DD	17	lum	wood products
10	ppp	21-22	DE	18	ppp	paper products publishing
11	p_c	23	DF	19	p_c	petroleum coal products
12	crp	24-25	DG,DH	20	crp	chemical rubber plastic products
13	mnm	26	DI	21	nmm	mineral products NEC
14	i_snfm	27	DJ	22	i_s	ferrous metals
		27		23	nfm	metals NEC
15	fmp	28	DJ	24	fmp	metal products
16	vehic	34-35	DM	25	mvh	motor vehicles and parts
		34-35		26	otn	transport equipment NEC
17	ele	30,32	DL	27	ele	electronic equipment
18	ome	29,31,33	DK,DL	28	ome	machinery and equipment NEC
19	omf	36-37	DN	29	omf	manufactures NEC
20	power	40	E	30	ely	electricity
		40		31	gdt	gas manufacture distribution
		40		32	wtr	water
21	cns	45	F	33	cns	construction
22	trd	50-52	G	34	trd	trade
23	otp	60-63	I	35	otp	transport NEC
24	cmn	64	I	36	cmn	communication
25	ofi	65,67	J	37	ofi	financial services NEC

sector in envi IA		NACE		CGE sector		Model name
26	isr	66	J	38	isr	insurance
27	obs	70-74	K	39	obs	business services NEC ownership of dwellings
28	osg	55,75-93	H,L,M,N,O	40	osg	public admin and defence education health recreational and other services