Spatial-economic-ecological model for the assessment of sustainability policies of the Russian Federation

Project 213091

D9.2
Assessment of policy scenarios

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1. Introduction

This document contains a series of simulations, which were performed in the framework of WP9 of the EC-funded SUSTRUS project. The simulations were based on politically relevant themes and contain original model results and calculations. It is a draft report, containing results which may still be revised, modified or subjected to further scientific scrutiny before being published in peer-reviewed papers. Therefore, we urge readers not to refer to the results in this document without the consent of the writers and the European Commission. For those readers, who want to know more of the model and its characteristics, we advise to have a look at the deliverables D3.1, D4.1, D5.1 and D8 of the SUSTRUS project as these contains more information on the models structure and operation, the indicators and assumptions used and the linkages between the different modules.

This report contains the results from 3 simulations, performed in the course of WP 9 of the SUSTRUS project:

- In the first simulation, ***we increase the domestic price of natural gas***, which is currently underpriced as compared to the long-run marginal cost. This policy option is currently on the top of the political agenda: While the issue of raising gas prices has tangible implications for country's energy efficiency targets, the policy debate misses a comprehensive quantitative analysis of policy proposals. Our paper provides an impact assessment of gas price increases to illustrate potential pitfalls of alternative policy reforms. We compare several scenarios of differential gas pricing strategies, simulating increases in price for industrial and private consumers. The economic, social and environmental effects of this policy are evaluated in detail.
- The second simulation makes use of the opportunity offered by **the accession of the Russian Federation to the World Trade Organization (WTO)**. The policy modeled implies a limited change in import tariffs and a reduction in barriers for services (communication, financial sector, business, insurance and transport)
- The third simulation concerns ***the dependency of Russian on the export of energy products to the rest of the world***. During the financial crisis in the end of 2008, the collapse of the world price of natural gas, petrol, raw oil and coal did have a noticeable effect on the Russian economy. This simulation makes a 'back cast' of the impact of the collapse of the energy prices and evaluates to which degree the model replicates the empirical results.

The report for each simulation is structured in a similar way. The first paragraph of each section contains background and references. Then the set-up of the simulation is discussed, the choice of model closure and assumptions, often backed with formulas or preliminary results. The third paragraph discusses the model results in detail, using the SUSTRUS sustainability indicators. The final paragraph of each section is dedicated to conclusions and further steps towards valorization of the results.

2. Increase in gas price on domestic market

2.1 Introduction

2.1.1 Dual pricing of natural gas

Beyond the horizon of the current political upheaval, one of the grand challenges which are faced by Russia is to ultimately liberalize its energy markets, in particular the gas market. Today, Russia has the largest gas reserves in the world and currently produces around 550 billion cubic meters of gas each year. Sixty percent of the production is sold domestically at prices below long term marginal cost, for households and for industrial producers. The pricing of natural gas is currently a hot topic in Russia, as the Russian government proposes to liberalize the regulated domestic market price and decrease subsidies for natural gas products. This is claimed to fit in a policy promoting energy efficiency, increasing investments in natural gas production and bringing the natural gas price on the domestic market closer to long term cost recovery. The elimination of "dual-pricing" has also been discussed in the context of Russian accession to WTO. In this paper we study economic and social impacts of an upward correction of the natural gas price in Russian regions, raising the question of its political feasibility and environmental effectiveness. This issue that has not yet attracted much attention in the literature but it is of immense importance for Russia's development in the near- and mid-term perspective.

Underpricing of natural gas at the domestic markets was already an explicit feature of the Soviet era. Low gas prices were motivated from a political and economic perspective, stating that industrial growth could only be sufficiently maintained with cheap prices for natural resources and large state subsidies. In the post-Soviet period, domestic gas prices were kept at relatively low levels, though by 2006 this strategy had become increasingly untenable in the light of Gasprom's investment needs into new extraction fields and a desire to "green-up" the economy. The target of reaching parity with the European export netback price by 2011 for domestic gas prices was set by Putin in November 2006. As a result, prices for gas have been rising gradually over the last five years, but they are not yet recovering long term marginal cost and do not reflect the current international market prices. In fact, the domestic gas prices remained in 2011 as far from netback parity as they have ever been in 2006, an outcome which is largely determined by sharp increase of oil prices to which long-term contract gas prices in Europe are linked (Henderson, 2011). The current legislature calls for a change of strategy with respect of reaching parity and proposes to index the price of all energy sources to the level of inflation, but allow Gazprom to increase domestic gas prices at 10-15% each year (at double of the inflation rate), starting 2011.

Ongoing discussion on gas price liberalisation is closely related to the concern of the poor energy efficiency of the Russian economy. Over the last few years, the issue of energy efficiency improvement increasingly demanded attention. The Russian government started introducing a mix of structural policies to limit the energy consumption and to reduce GHG emissions while favouring longer-term growth of an economy and safeguarding competitiveness in the key industrial sectors. Despite some progress over the last two decades, the country is still among world's most intensive users of energy, while low energy intensity is endemic in every sector of economy. The heavy industry in particular has inherited an energy-inefficient and carbon-intensive production plants from the Soviet time, while the shortage of natural gas and electricity supplies to the industry become an factor determining "the limits of growth" in Russia in the 2000s (Worldbank 2011). The economic crisis 2007-2009 has even more disclosed the vulnerability of the "low-energy-efficiency" approach in the industrial landscape of both countries.

While the issue of raising gas prices has tangible implications for country's energy efficiency targets, the policy debate misses a comprehensive quantitative analysis of policy proposals. In the assessment of gas

market reforms, the bulk of the research is skewed towards an export-driven perspective. Tsygankova (2009) touches on the subject of dual pricing, claiming that equaling the price of gas on the European market and the domestic market, correcting for transportation costs and transfers would be necessary to avoid gas shortages in the future. Stern (2011) argues that Europe could find itself in competition for gas supplies with the Russian domestic and the CIS markets. There are a limited number of publications focusing on the domestic markets implications, most notably on social aspects. Estimating the long run marginal cost (LRMC) of gas production, Rutherford and Tarr (2003) concluded that the price on the Russian domestic market should be increased to full cost recovery, but not higher to avoid social inequality. Dudek et al. (2006) argue that dual pricing of natural gas remains the most efficient environmental policy for Russia as it prevents from an increase of coal combustion in existing facilities.
Neither of these studies investigated all relevant trade-offs pertaining gas price increases at the domestic market, including the social and environmental implications. Our analysis provides an impact assessment of gas price increases to illustrate potential pitfalls of alternative policy reforms. Based on quantitative simulations with a computable-general equilibrium model of Russia, we compare several scenarios of differential gas pricing strategies, simulating increases in price for industrial and private consumers at different annual growth rates, with a time horizon from 2012 until 2020. We find that deregulating natural gas pricing can lead to a significant improvement in energy efficiency, if prices are gradually increased for both consumers and industries alike. We show that increasing the consumer price of gas is indeed a regressive policy, but can be compensated for by the government. A policy of deregulation, by allowing Gazprom to act as a real monopoly on the domestic market is both negative for consumer welfare and social equality.

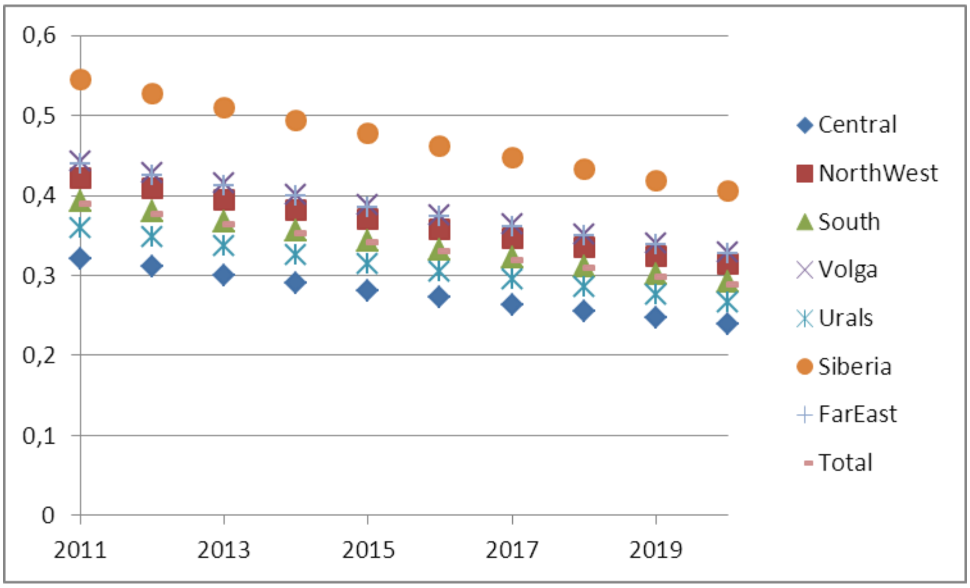
2.1.2 Energy efficiency in the Russian Federation and natural gas

Russia is the biggest consumer of natural gas in the world both in real and in relative terms. 56% of the domestic energy use can be directly attributed to natural gas. In the recent Worldbank and IEA report "Energy efficiency in Russia: untapped reserves"(2011), claims are made on the possibilities to reduce energy intensity in Russia. This document takes a clear standpoint on the current 'wasteful' practices and offers a number of good arguments why Russia should care about energy efficiency. Russia has (among a comparative study of 121 countries) the 12th highest energy use by GDP[1] (measured in kilograms of oil equivalent). Russian energy use by GDP is equal to 0.42 kgoe[2] / dollar, which is much higher than other 'cold' countries in Europe like Iceland (+- 0.32 kgoe/dollar), Canada (0.25 kgoe/dollar), Sweden (0.18 kgoe/dollar). It is also more than double the amount of the United States (around 0.2 kgoe/dollar) and almost triple the amount of average EU countries (0.1-0.15 kgoe/dollar). This led the authors to claim that there is a huge unused potential for energy savings. In fact, by realizing its energy efficiency potential, Russia could save over 240 billion cubic meters of natural gas (almost two thirds of the current domestic consumption), 340 billion kWh of electricity, 89 million tons of coal and 43 million tons of crude oils.

Increasing energy efficiency would be beneficial for economic development on the long term, taking into account the dwindeling resources of natural gas in Russia, as well as lead to an important decrease in pollution (mainly carbon dioxide) associated with combustion. In Figure 1 the baseline of the SUSTRUS model for the autonomous improvement of energy intensity is given (horizon 2020) for each of the 7 regions. Not surprisingly, Siberia has by far, the largest energy intensity. This can be explained by the cold climate, the remoteness of the region and the abundance of natural resources in Siberia. The central region has the smallest energy intensity by GDP, but consumes (by far) the largest amount of energy of Russia. A positive evolution is expected for all regions, but even by 2020, it is projected the energy intensity will remain far above the EU level.

[1] Corrected by Purchasing Power Parity (PPP)
[2] Kilograms of oil equivalent

Figure 1: Projections on energy use (in kgoe/USD), source: IEO (2011)



2.1.3 The regional dimension of gas production and consumption

SUSTRUS is a regional model on the level of the Russian Federations. Therefore we have a look at some basic facts of natural gas production on the regional level. In Figure 2 below, we show how the production of natural gas is divided between the 7 federal districts of the Russian Federation. We see that the main producing regions are the Central, Volga and Ural regions of the Russian Federation, each producing about a quarter of the total production. South, North and Siberia produce much less natural gas and the Far East has almost no production.

Comparing this with

Figure 3, which gives the prices of natural gas in each region, according to Goskomstat (2006), we see that natural gas prices are relatively higher in regions with less gas production, the highest price being in the South region.

Figure 2: share of natural gas production by region (source: Goskomstat 2006)

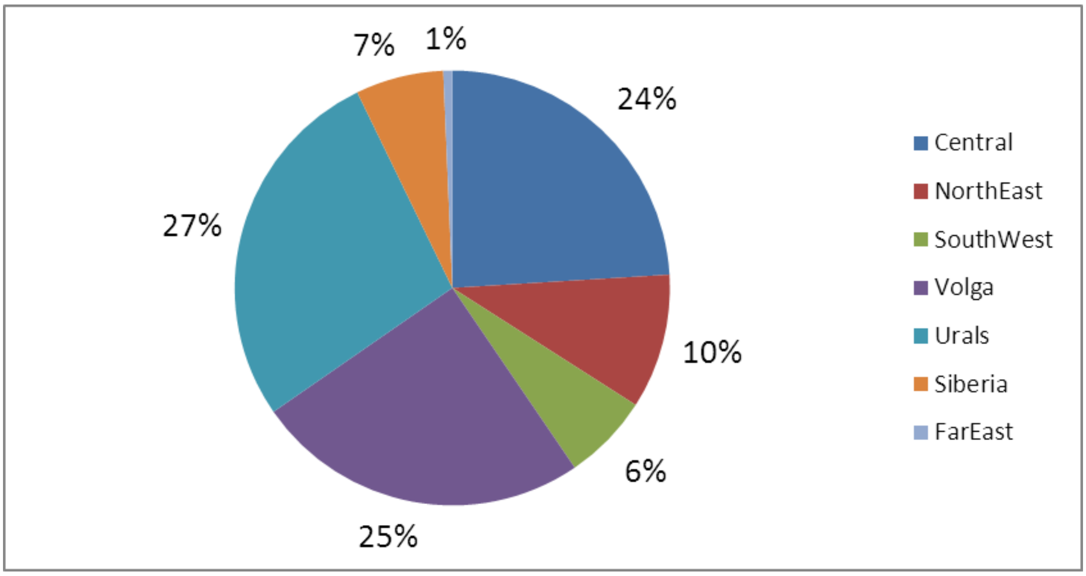
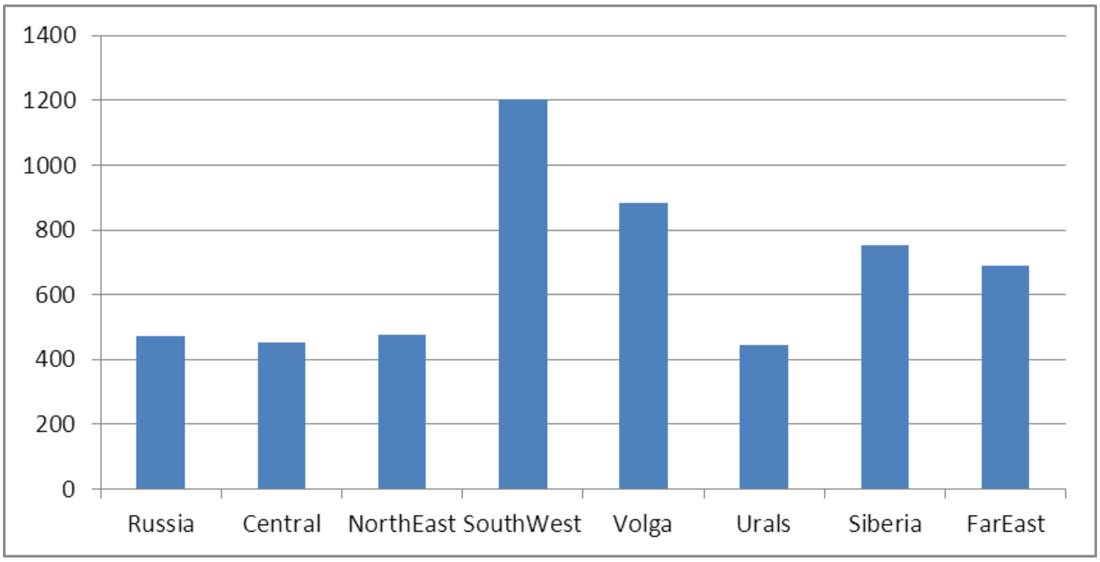


Figure 3: Natural gas price by region (production price), rubles/m3 (source: Goskomstat 2006)



2.2 Set-up of the simulation

In this simulation we will mimic the current proposal of the Russian government, to increase prices of natural gas on the domestic market annually with 10% from 2012 onwards. To simulate the impact of such a change in prices, we assume that the government systematically increases taxes on final and intermediate consumption of natural gas. This is not a self-evident assumption. The domestic market of natural gas is tightly government controlled and only little information is available on taxation, production cost of natural gas and competition with independent producers. In fact, the Russian government mainly applies price regulation and production subsidies to retain low domestic gas prices.

In the rest of this chapter we will work with the case of direct taxation of the natural gas product. The reason for this is that it leads to the least amount of distortion with other markets. In fact, this distortion is something we wish to avoid, as we want to focus on the effects of price changes on the domestic market and the resulting changes in energy use and energy efficiency. Also, we have only limited information on the real production cost of natural gas.

We will perform a dynamic simulation with the SUSTRUS model, where the domestic price of gas increases with 10% each year, by increase of the tax rate on consumption.

We will compare 3 situations:

1. **Scen H**: only the consumers experience a rise in the domestic price of gas
2. **Scen F**: only the firms face the increase in taxes
3. **Scen HF**: both consumers and firms face an increase in the price level of gas.

Our simulation will run from 2012 to 2020. In each year the price of gas goes up with 10%, compared to the last year. This means that by 2020 the price of gas will have doubled, compared to the base year. The chosen closure of the model is via the adjustment of foreign savings. The government balances its budget by increasing or decreasing public savings.

2.3 Results

Macroeconomic implications

We start the interpretation of our results with macroeconomic implications of gas price increases (Table 1). A policy option aiming at the households' taxation (*Scen_H*) has an overall positive impact at the macroeconomic level according to the key indicators such as real GDP per capita, tax revenues and investments. The main argument behind these effects is that large-scale distortions are removed. Albeit these mechanisms drive the results under the alternative scenarios as well (*Scen_F and Scen_HF*), there are substantial adverse sectoral adjustments which let export and GDP level decrease in comparison to the BaU.

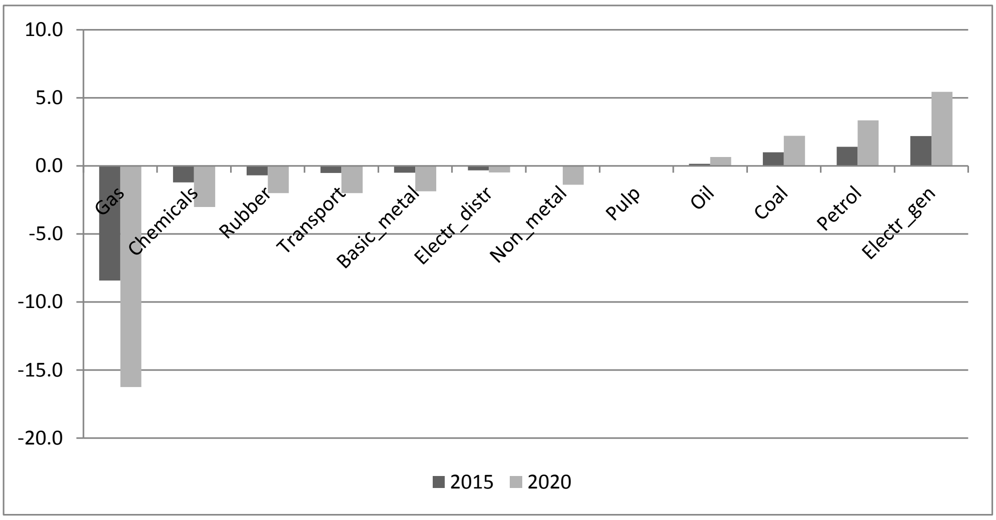
Table 1: Main macroeconomic impacts (% change from BaU in 2020)

Dimension	Indicators	Scen_H	Scen_H	Scen_HF
ECONOMY	GDP capita	1.74	-1.70	0.27
	Herfindahl	-0.01	-0.15	-0.19
	Invest	4.64	2.15	5.80
	Price Index	-0.18	-0.75	-0.84
	Tax Revenues	0.98	1.87	2.13

Sectoral effects

To economize space, Figure 4 depicts sectoral implications for energy producing and selected energy-intensive industries in the year 2020, focusing on the scenario in which we simulate firm's higher gas prices. As expected, switching from gas to other energy goods induces rather substantial production losses in the gas sector – up to roughly 15% in 2020 in comparison to the BaU. Coal and petroleum producing industries together with the power generating sector gain, with the latter expanding its production level by impressive 5% in comparison to the "doing nothing case". Energy-intensive industries suffer from a loss in competitiveness if we track the adjustments in output levels but production losses are not likely to be high even for significant gas price increases. If policy discriminates gas pricing in favour of industrial sectors and taxes households instead, these losses can be ameliorated and even overcompensated.

Figure 4: Sectoral implications for selected industries (% change from BaU)



Trade implications

Trade implications (Table 2) can be summarized as follows:

- Foreign direct investment increase substantially in relative terms, however this shift is not so large in absolute terms (the baseline for foreign investments is only 1.5% of GDP)
- The trade surplus slightly increases, especially when only firms are taken up in the tax scheme.
- Interregional trade is negatively affected, as a relatively large part of the interregional trade flows is natural gas.

Table 2: Trade implications (% change vs. BaU in 2020)

Dimension	Indicators	Scen_H	Scen_F	Scen_HF
TRADE	Foreign Invest	55.44	58.98	57.60
	Trade Balance	0.20	0.82	0.00
	Interregional trade	-1.36	-0.59	-1.99

At the sectoral level, it can be claimed that higher domestic prices for natural gas, would stimulate exports of gas and lead to increased earnings for industry and government. In Table 3, we give an overview of the adjustments to exports and imports by 2020, in absolute values of 2006. In all cases export of natural gas is stimulated in real terms, however the adjustment mechanism is much more complex than would be expected. Together with natural gas, exports of other energy carriers increase. This is caused by an overall decrease in energy consumption due to the increase in the gas price. The reduction in domestic demand for energy leads to higher exports to the rest of the world. Imports of machinery counteract the effect of increased export of energy on the international market.

Increasing the price of natural gas for domestic firms leads to a reduction in total exports. While the export of energy carriers (oil, petrol, natural gas) and the trade and transport sector increases[3], the export of the manufacturing sectors decreases due to higher production cost[4].

Table 3: Exports and imports by industry/product compared to baseline in 2020, difference in absolute value (billions of rubles of 2006).

	Exports			Imports		
Sectors	**Scen_H**	**Scen_F**	**Scen_HF**	**Scen_H**	**Scen_F**	**Scen_HF**
Gas	***9.82***	***55.76***	***68.62***	***-1.16***	***-8.54***	***-10.12***
Oil	21.17	-23.68	-7.91	0.56	1.68	2.29
Petrol	15.28	26.47	42.38	0.91	4.21	5.37
Trade	38.06	41.97	75.6	0	0	0
Machinery	4.86	-8.21	-6.5	69.17	-2.23	63.76
Basic metals	17.24	-63.11	-48.79	11.8	1.85	16.97
Other	22.54	-37.59	-25.42	64.24	-49.18	15.28
Total	128.97	-8.39	97.98	145.52	-52.21	93.55

Environmental implications:

Table 4 illustrates changes in energy efficiency (EE) across Russian regions for 2015 and 2020, respectively. The energy efficiency improves as the indicator decreases; the energy efficiency deteriorates as the indicator increases. The magnitude of changes in EE depends on (i) the stringency of gas price

[3] The trade and transport sector captures a part of the surplus in trade margin and transport costs, caused by increased export of energy carriers.

[4] Increased price of electricity and natural gas

increases advancing towards the end of the decade, (ii) the energy intensity of a region in the reference case and (iii) the coverage of economic agents subjecting to the gas price increases.

Table 4: Economy-wide and regional energy efficiency improvements (% change from BaU) [5]

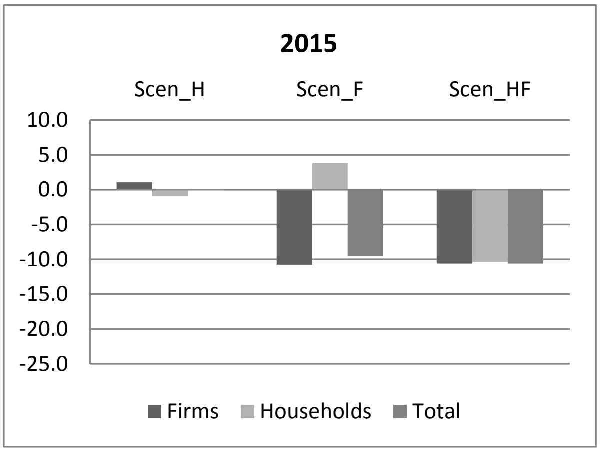
	2015			2020		
	Scen_H	Scen_F	Scen_HF	Scen_H	Scen_F	Scen_HF
RF	0.0	-3.4	-3.8	-0.2	-5.4	-6.3
Central	0.2	-3.0	-3.2	0.1	-4.8	-5.4
North West	0.2	-4.6	-4.8	0.3	-7.9	-8.4
South	0.1	-1.9	-1.9	0.0	-3.0	-3.2
Volga	0.0	-2.5	-2.8	-0.3	-3.8	-4.6
Urals	-0.3	-4.7	-5.7	-0.9	-7.1	-8.9
Siberia	0.1	-3.6	-4.1	-0.2	-5.8	-6.8
Far East	0.0	-4.9	-5.3	-0.3	-8.5	-9.5

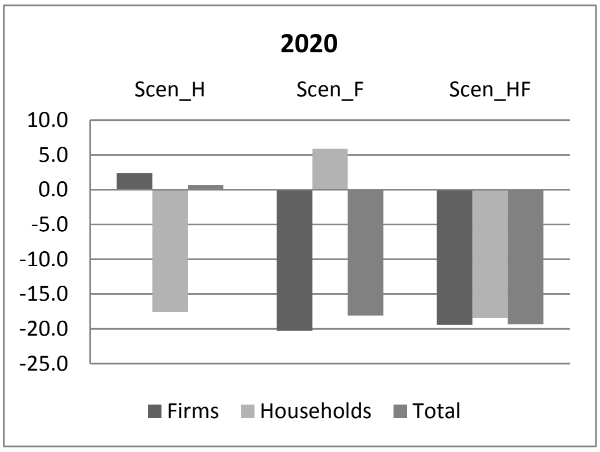
Probably one of the most important results of our simulations is that rising household's gas prices will leave economy-wide energy efficiency virtually unchanged in 2015 in comparison to "doing-nothing case". This is due to a rather small fraction of households' gas consumption in total gas consumption in Russia.

Table 4 further shows that at the regional scale there are even some adverse implications in terms of decreasing energy efficiency, though they are not likely to be substantial. This result can be mainly explained by indirect effects working through changes in prices on the Russian gas market. The cutback in gas demand by households implies a tiny drop in prices which is, however, of a magnitude sufficient enough to provide incentives to the industrial producers to use a bit more of cheaper energy in the production process. As a result, the regional energy efficiency deteriorates, with only one exception: in Urals region direct effects from households' energy reduction are likely to outweigh the indirect effects from the increasing demand by industrial producers.

Our simulations further highlight that substantial improvements in EE are feasible only if government charges industrial producers with higher gas prices. The regional rate of EE improvement varies then between 1.9% and 4.9% in 2015 and between 3.0% and 8.5% in 2020. The improvement of energy efficiency is highest vis-à-vis the BaU levels when both households and firms face increasing gas prices.

Figure 5: Economy-wide carbon emissions (% change from BaU)





[5] RF = Russian Federation

Figure 5 visualizes how the level of CO_2 emissions – from households, firms and totals (economy-wide emissions) – reacts to changes in energy efficiency. Under the most extensive scheme in *Scen_HF*, the large-scale emissions reductions of about 10% (20%) compared to the BaU in 2015 (2020) can be achieved. Thus, the gas price liberalisation will bring Russia on a substantially more sustainable path in terms of CO_2 emissions but only under the prerequisite that industrial producers will advance in terms of the energetic modernisation. Limiting the policy to the household's side will barely cause any measurable improvements in emissions levels.

Table 5: NOX, PM and SOX emissions

Dimension	Indicators	Scen_H	Scen_F	Scen_HF
	NOX emissions	0.95	-31.25	-32.03
	PM emissions	-0.69	2.08	1.37
	SOX emissions	-0.43	4.84	4.48

Finally, while by 2020 the amount of CO2 emissions may fall by 20 % and the amount of NOx by 30%, the economy becomes more intensive in coal, which leads to higher SOx and PM emissions (Table 5)

Social impacts:

The main results from Table 6 can be summarized as follows:

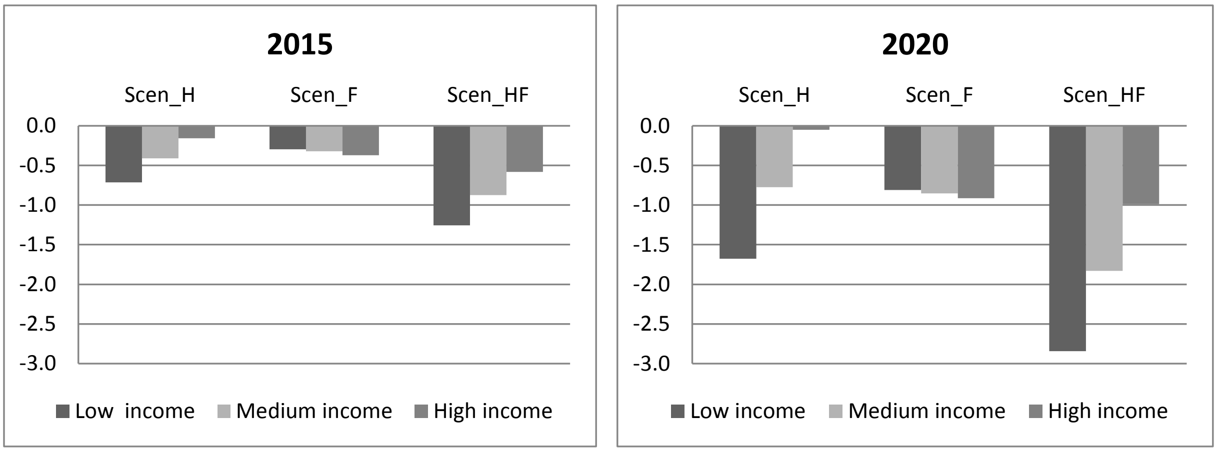
- The Atkinson and Gini indices report a slight rise in inequality when consumers are taken up in the scheme.
- The Kakwani index points towards a decrease in progressivity in the tax system with 5-10% according to the simulation.
- Unemployment is not expected to rise substantially and could even fall.

Table 6: Social implications (% change vs. BaU in 2020)

Dimension	Indicators	Scen_H	Scen_F	Scen_HF
SOCIAL	Atkinson	0.21	-0.25	0.09
	Consumption budget	-0.89	-0.30	-1.22
	Gini	0.03	-0.19	-0.06
	Kakwani	-6.22	-5.62	-10.19
	Poverty Intensity	-0.15	-0.15	-0.35
	Unemployment	-2.80	0.74	-1.96
	Unemployment Low skill	-1.48	0.58	-0.90
	Unemployment Med. skill	-3.74	0.35	-2.84
	Unemployment High skill	-2.38	2.77	-1.12
	Welfare	-0.44	-0.88	-1.45
	Welfare QL	-1.68	-0.81	-2.84
	Welfare QM	-0.78	-0.85	-1.83
	Welfare QH	-0.03	-0.91	-0.99

Figure 6 visualizes distributional impact assessment of gas price increases for low-, medium- and high income households. We find that deregulating natural gas pricing is indeed a regressive policy if prices are gradually increased for consumers only. From the distributional point of view, charging firms with higher gas prices might be a superior strategy as it will have a moderate and progressive impact on citizen's welfare in comparison to "doing nothing case".

Figure 6: Welfare impacts for different types of households (% change from BaU)



2.4 Conclusions

In this section we have taken the low price of natural gas on the Russian domestic market as a starting point for our analysis. We have implemented an ad-valorem tax, starting in 2012, increasing the price of natural gas for consumers, industry and both with 10% until 2020. This type of scheme was chosen, as it led to the least amount of distortion with other sectors in the economy. Our simulations show that increasing the price of natural gas for consumers alone, would not be effective in reducing emissions in the Russian Federation. The reason is that emissions would shift from the residential sector to the industries. A tax on industry only would be more effective to decrease pollution from natural gas, but would also lead to some 'leakage' to the residential sector on longer term. The government would best consider a mixed scheme, where both consumers and industry share in the burden of increased price of natural gas.

The environmental benefits of higher gas prices are substantial and could lead to a decrease in emissions by 20% in 2020 compared to BaU. Also the emission of NOx would decrease substantially. Oppositely however, a tax on natural gas would lead to higher consumption of coal, which (at longer term) would lead to substantially higher SOx and PM emissions under ceteris-paribus conditions. Therefore, while increasing the price of natural gas would be beneficial for the environment, it would also be important to consider the negative environmental impact of a shift to coal or petrol.

On the social side, the model indicates that taxation of natural gas for consumers is regressive and lead to an increase in inequality. This could best be considered, as the impact on welfare of the lowest income classes is 2 to 3 times higher than on the highest income classes. A fair tax scheme would take this into account and could involve cuts or exemptions for the lowest income classes. This would not really decrease the effectiveness of the tax scheme, as the industry remains the biggest consumer of natural gas in the Russian economy.

3. Accession of Russia to WTO

3.1 Background

In June 1993, a request was made for the accession of the Russian Federation to the World Trade Organization (WTO). After more than 17 years of negotiations, Russia is finally close to become full member of the WTO.

Info from the WTO website (http://www.wto.org/english/news_e/news11_e/acc_rus_10nov11_e.htm): "On 10 November 2011, the Working Party on Russia's accession, chaired by Ambassador Stefán Jóhannesson (Iceland), agreed, ad referendum, on the terms of the country's membership to the WTO by adopting the package containing reforms to Russia's trade regime, and the commitments that Russia undertook to implement as part of its WTO accession. From the date of accession, the Russian Federation has committed to fully apply all WTO provisions, with recourse to very few transitional periods."

The package of reforms Russia will undertake implies a set of reduction in import tariffs, reducing the overall tariff rate to 7.8 %, compared to an average rate of 10% in 2011. Table 7 and Table 8 contain own calculations of the import tariffs, as based on the info provided by the WTO on their website.

Table 7: Overview of pre- and post-accession tariff rates (source: own calculations and WTO 2011 [6])

	Before	After
Agriculture, hunting and forestry	13.2	10.8
Fishing	9	9
Coal	5	5
Gas	5	5
Oil	5	5
Mining and quarrying, except of energy producing materials	5	5
Manufacture of food products, beverages and tobacco	14.7	12
Manufacture of textiles and textile products	9.5	7.3
Manufacture of leather and leather products	9.5	7.3
Manufacture of wood and wood products	13.4	8
Manufacture of pulp, paper and paper products; publishing and printing	13.4	8
Manufacture of coke, refined petroleum products and nuclear fuel	5	5
Manufacture of chemicals, chemical products and man-made fibers	6.5	5.2
Manufacture of rubber and plastic products	15	15
Manufacture of other non-metallic mineral products	9.5	7.3
Manufacture of basic metals and fabricated metal products	9.5	7.3
Manufacture of machinery and equipment n.e.c.	8.4	6.2
Manufacture of electrical and optical equipment	8.4	6.2
Manufacture of transport equipment	15.5	12
Manufacturing n.e.c.	9.5	7.3

[6] http://www.wto.org/english/news_e/news11_e/acc_rus_10nov11_e.htm

Table 8: Own calculation of import tariff rates of food, based on WTO 2011 tariff data

	%Import	Before	After
Animal	2.9	20.7	17
Dairy	0.6	19.8	15.1
Fruits vegetables	3.5	11.3	10
Coffee,	1	8.6	8
Cereals	0.8	15.1	10
Oilseeds, fat oil	0.8	9	7.1
Sugar	0.7	17.7	12
Total food		**14.73**	**11.98**

Additionally, besides the change in tariff lines, Russia has made an agreement to improve the access of foreign investors to the market. Special agreements were made to improve the access of financial service providers, insurance and telecommunication. On transport services, the Russian Federation made commitments in maritime and road transport services, including the actual transportation of freight and passengers. On distribution services, Russia would allow 100% foreign-owned companies to engage in wholesale, retail and franchise sectors upon accession to the WTO. The transparency of duties, taxes and regulations will be increased or adapted to international standards.

3.2 Set-up of the simulation

The SUSTRUS model was used in its standard set-up, the international market closes through adjustment in foreign savings and government budget balance is attained by increasing or reducing public savings. Other closures were tested, but in this case, the standard closure provided the most realistic outcome.

We run our simulation from 2012 to 2015. The full shock in import tariffs takes place in 2012, after which we follow the adjustments of the Russian economy until 2015. The effects of the service reform imply a change in investments and capital flows, which are only taking effect after a few years. We take 2012 as the 'direct' impact, taking place after 1-2 years. The longer term is represented by 2015, taking place after 4-5 years after the reform.

To distinguish the impact of the reform in services, we did 2 simulations: one with and one without the reform in services. The 'no service reform' simulation is introduced for means of comparison only, as Russia has already agreed to implement the full WTO policy package in November 2011.

3.3 Results from simulation

In Table 9 we show the main changes in the sustainability indicator of the SUSTRUS model. We distinguish the short (2012) and mid-term (2015) impact of the WTO accession for the whole of the Russian Federation.

Table 9: Relative change in sustainability indicators (% from BaU)

		2012		2015	
Dimension	**Indicator**	**No reform**	**Service reform**	**No reform**	**Service reform**
Economy	GDP capita	-0.113	-0.121	0.753	0.830
	Herfindahl	-0.029	-0.028	-0.022	-0.049
	Investment	4.620	5.554	3.198	4.058
	Price Index	-0.381	-0.329	-0.436	-0.377
	Tax revenues	-0.762	-0.087	-0.730	-0.045
Environment	Carbon intensity	0.245	0.435	0.336	0.507
	Electricity	0.127	0.284	0.156	0.302
	Fossile fuels	0.305	0.608	0.323	0.605
	NOX emissions	0.252	0.217	0.486	0.420
	PM emissions	0.379	0.614	0.349	0.544
	SOX emissions	0.392	0.647	0.513	0.753
Social	Atkinson	0.440	0.774	1.346	1.728
	Consumptionbudget	0.305	0.906	0.134	0.730
	Gini	0.032	0.035	0.133	0.143
	Unemployment	-2.141	-5.061	-10.870	-14.429
	Unemployment LS	-1.043	-2.516	-5.367	-7.237
	Unemployment MS	-2.554	-5.656	-12.696	-16.548
	Unemploymen HS	-3.337	-9.337	-17.880	-24.689
	Welfare	0.416	0.809	0.960	1.409
	Welfare QL	0.480	0.793	0.823	1.171
	Welfare QM	0.447	0.808	0.941	1.355
	Welfare QH	0.389	0.814	0.998	1.484
Trade	Foreign Invest	18.903	18.912	30.696	30.596
	Trade Balance	-13.103	-15.295	-10.581	-12.687
	Trade Integr	0.154	0.734	-0.080	0.501
	Trade Open	2.271	2.493	2.193	2.395

The main observations from Table 9 are:

Economy:

- GDP decreases in the short run (-0.11%), with and without the reform in services. In the mid-term , GDP increases due to the increased foreign investments. At this point, the reform in services shows a modest impact (0.830% versus 0.753%)
- Tax revenues decrease in all cases, but the decrease is stronger when no service reform is implemented.
- Prices on the domestic market fall when the WTO scenario is introduced.
- Investments increase with or without the reform in services, but are larger when the reform of the services sector is taken into account.

Trade:

- Foreign investment increases substantially in the mid-term
- The trade surplus of the Russian federation decreases, due to a large increase in imports.
- Interregional trade and trade openness both increase in all simulations on short and on mid-term.

Environment

- Emissions of all pollutants increase, as well as the energy intensity of the economy measured in GDP.

Social

- Social indicators point to higher inequality in income, especially in the mid-termUnemployment is expected to decrease, especially for the higher income classes.
- Relative changes in welfare are progressive in the short term (larger relative change for low income classes), but are regressive in the mid-term (larger relative change for the highest income groups).

Figure 7 and Figure 8 give an overview of the impact of the WTO reforms on the level of the sectors. A strong increase in the imports of machinery, food, transport equipment, agriculture, basic metals and textiles is expected. Most sectors lose in terms of production, however the machinery, basic metals and non-metallic industry may benefit from cheaper intermediate products.

Figure 7: Direct impact (2012) of WTO (with service reform) on sectoral level, imports, exports and production in absolute value (bill. Rubles of 2006)

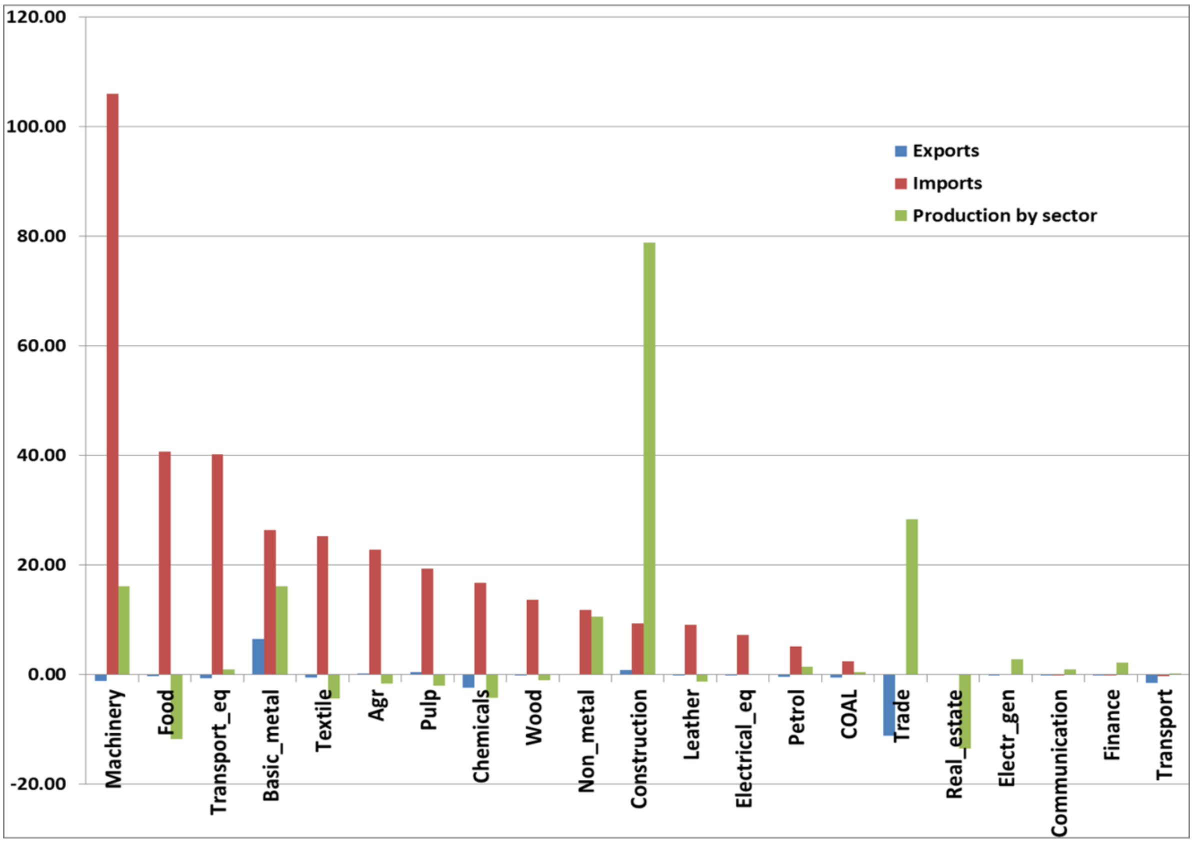
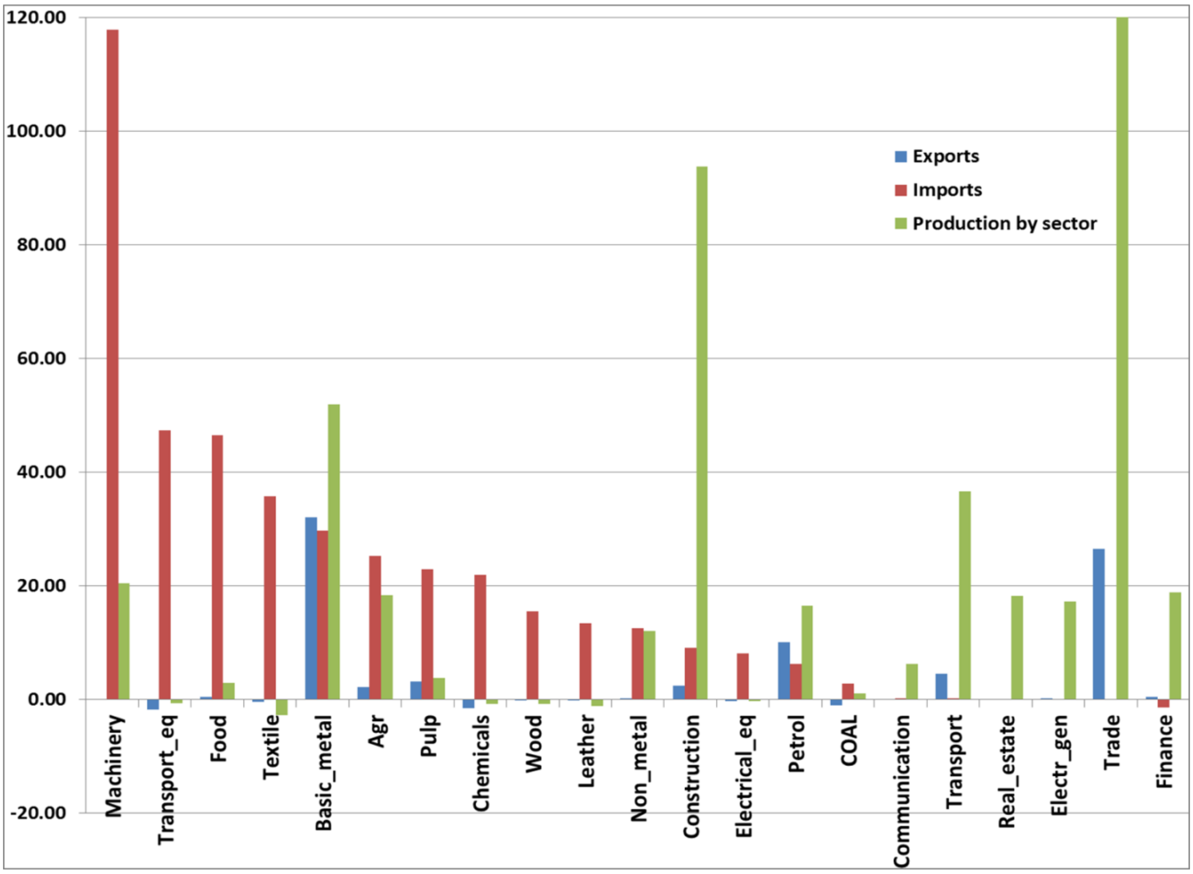


Figure 8: Mid-term impact (2015) of WTO (with service reform) on sectoral level, imports, exports and production in absolute value (bill. Rubles of 2006)



Comparing Figure 7 and Figure 8, we see that most effects of the WTO become more pronounced. The imports of machinery, transport equipment, food and textiles increase even more in the mid-term. However, the impact on domestic production becomes more pronounced. The machinery and basic-metals sector increase their production levels and the export of basic metals is increasing. The trade sector captures a part of the trade and transport margins of the increased trade openness. The construction sector is booming, due to increased (foreign) investments. Also, some of the service sectors (real estate, finance, communication) are growing at a faster rate.

Figure 9 displays the relative change in full market price after WTO accession in 2012. The import tariffs of wood, transport equipment, textiles and food are reduced to a considerable degree in the proposed simulation. As it can be seen, the price of these goods decreases much more for the Central, North West, South and Far East regions. The Volga, Urals and Siberian regions have a lower benefit in terms of price. The reason is, that these regions are more dependent on own production and less accessible to imported goods. However, the impact on the service sector (finance sector) is much more equally distributed.

Figure 10 shows how these results in a lower relative change in welfare for the Urals, Siberia and Volga regions. By 2015 however (Figure 11), the impact would be more equal among regions, especially when also considering the service reform. The reasons for this are additional investments and capital adjustment of the production sectors.

Figure 9: Impact of WTO accession on some products, by region (2012), including service reform

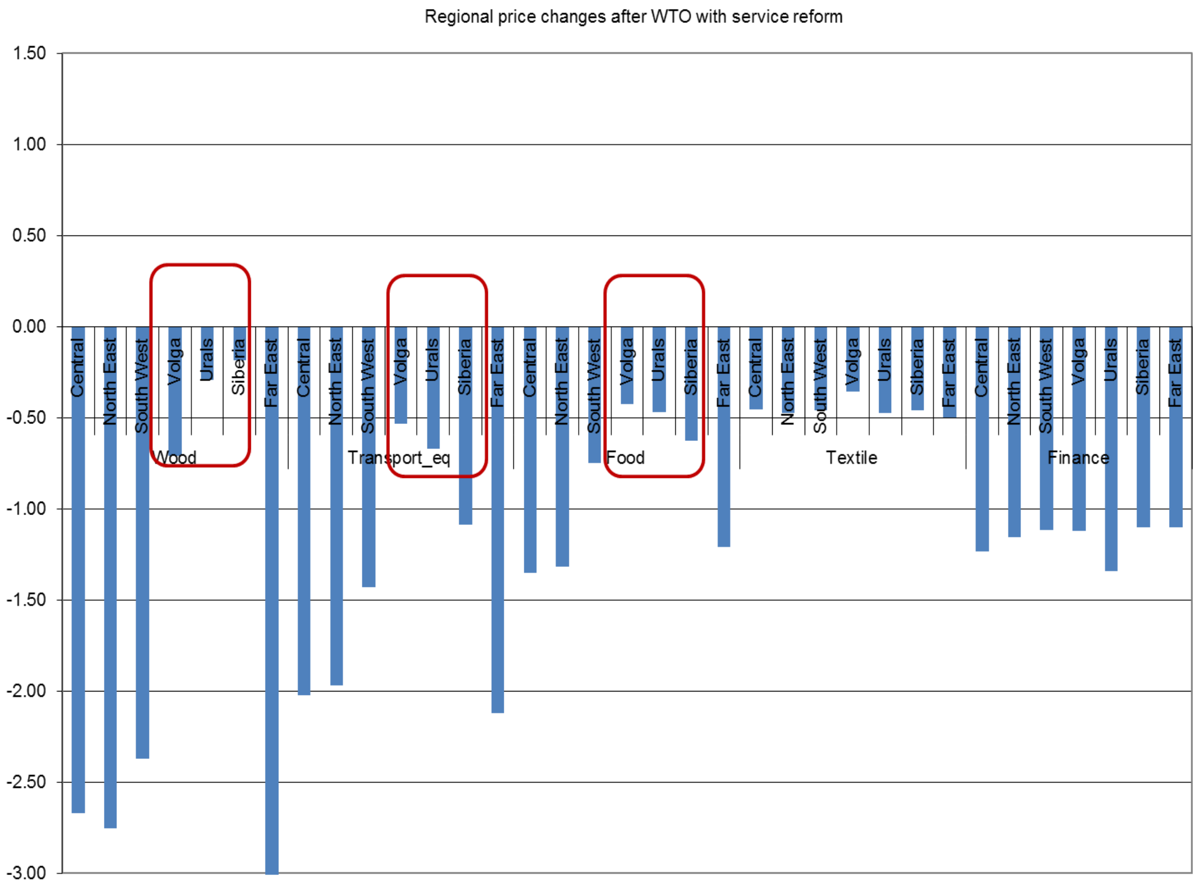


Figure 10: Relative change in welfare (2012), by % of regional income

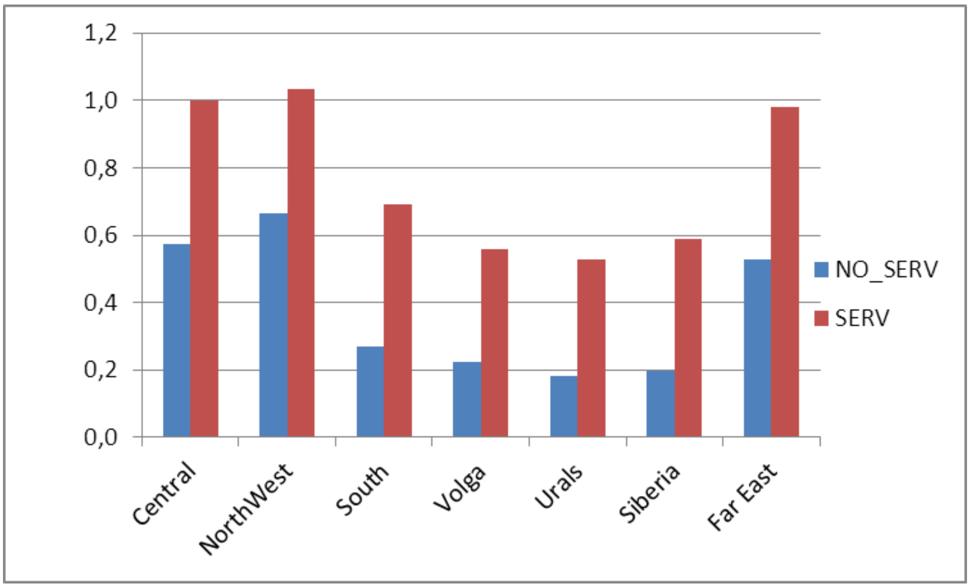
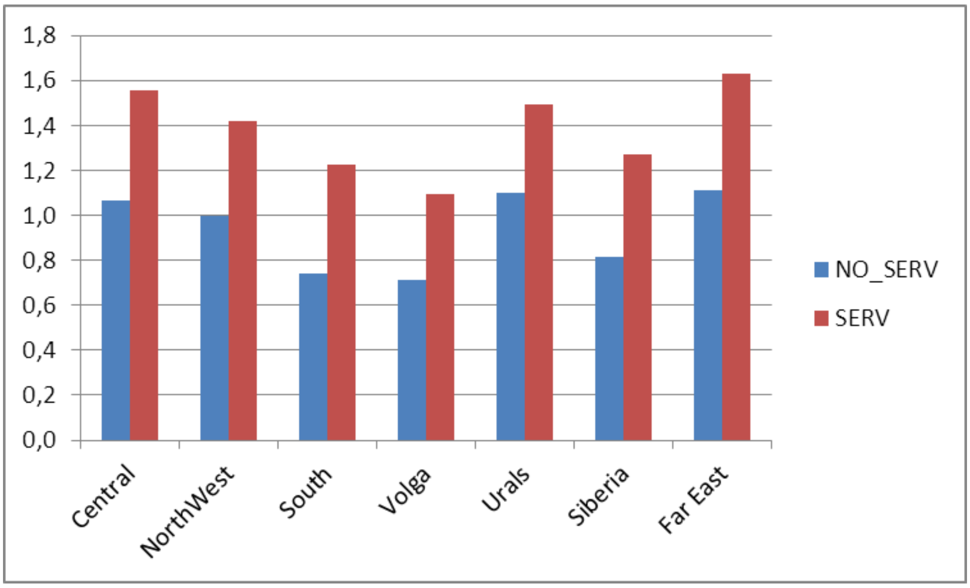


Figure 11: Relative change in welfare (2015), by % of regional income



3.4 Conclusion

We used the SUSTRUS model to calculate the effects of the current WTO reforms for Russia. A calculation was made for the economic and social effects on short term (2012) and within 4-5 years (2015) assuming the full reform in tariffs is taking place. The reforms are shown to decrease average prices for wood, food, transport equipment, clothing, chemicals and pharmaceutical products between 1.5 - 2.5 % on the short term and up to 3% on the longer term. This leads to an improvement in welfare between 0.4% and 0.8% in real consumer budget on the short term and up to 1.5% of real consumer budget on the long term. The reforms in the service sector are important and are realizing almost half of the real welfare effect on the long term, as financial and distribution centers are expected to grow and increase employment.

On the downside, real GDP and tax incomes are negatively influenced; GDP can decrease by 0.1 % on short term. Negative adjustments are expected mainly for the local foods, chemicals and pharmaceutical and textile sectors, which may lose (in output) between 0.5% and 2%. The basic metals and machinery sectors would not be affected or even grow, due to cheaper intermediate inputs. A strong adjustment is expected on the level of the trade balance. A decrease in trade surplus of 10-15% belongs to the predictions by the model.

In the mid-term, GDP is expected to grow, as the reform is shown to stimulate foreign investment in service sectors. Within 5 years after the adjustment GDP has fully recovered and is growing above the average growth rated, realizing 0.7-0.8% more production within 5 years than in the base scenario. The trade balance effect diminishes over time, as the Russian economy becomes more competitive. The food production and textiles sector is expected to adjust more slowly to the reform.

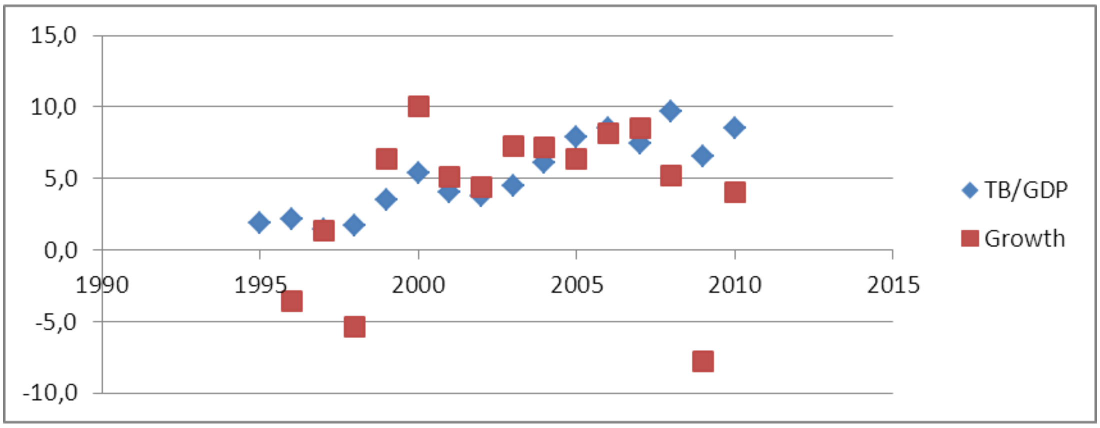
The result in terms of welfare is positive and progressive on the short term, as many primary products get less expensive. In the mid-term, especially when taking into account the reform of services, the effect is more positive for rich households. This is due to the increased employment of skilled people in service sectors (such as the financial sector) Manufacturing sectors, are expected to attract less or stable employment levels.

4. Impact of international energy prices on Russian economy

4.1 Background

After a period of transition and economic recession in the final decade of the last century, the Russian economy has recovered considerably. From 1998 to 2008, the Russian economy grew at steady rates between 4% and 8% yearly. At the same time, the trade balance (trade surplus) has risen each year, coming from 2% by GDP in 1998 to 9.5% of GDP in 2008. The increase in trade surplus was driven by increased export of energy carriers consisting mainly of crude oil, petroleum and natural gas.

Figure 12: Trade balance in % of GDP (TB/GDP) and yearly growth in GDP (Growth) (source: Russian Central Bank, 2011)

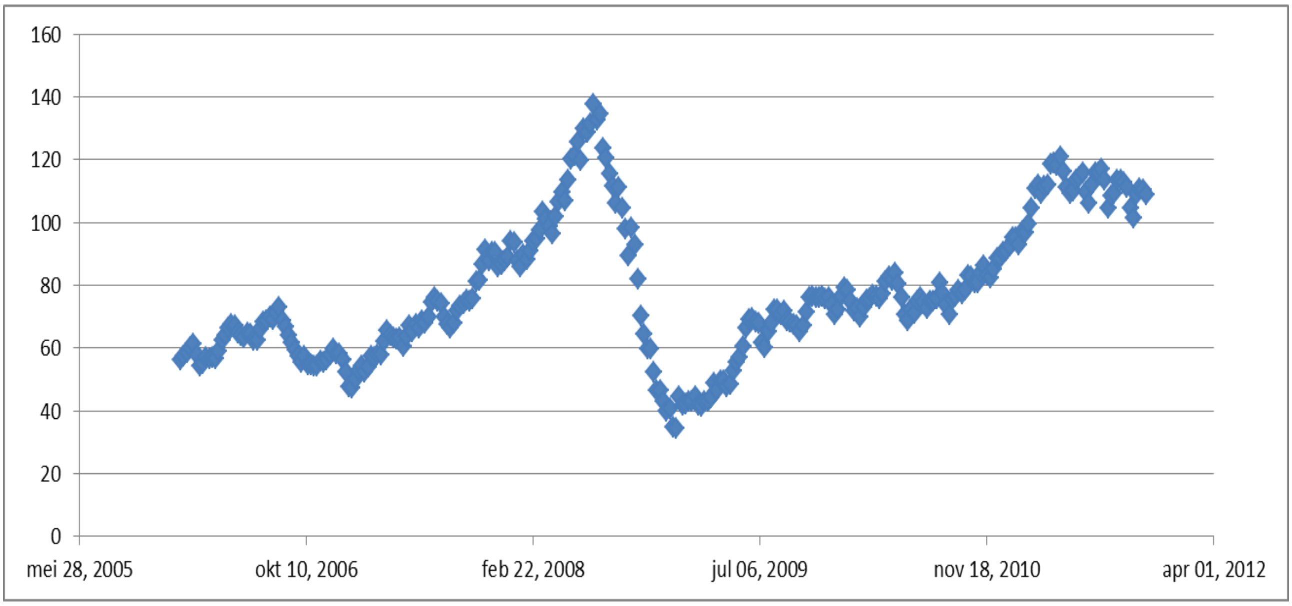


In the end of 2008 and the beginning of 2009, the global economy went through a serious recession, caused by the financial crisis. While the Russian economy initially remained untouched, difficulties started to arise when the demand for energy carriers plunged from the high peak of 2008 to bottom prices in 2009. Prices of crude oil and petroleum more than halved and went under the level of 2006. This sudden plunge in energy prices, reinforced by a decrease in foreign direct investments and return from foreign savings, is said to be the main culprit of the Russian economic downturn and the devaluation of the ruble. This has opened questions on the current export dependence of the Russian economy. While other European countries had a benefit from the lower energy prices during the financial crisis, the Russian economy went through a slow recovery. This economic recovery was not fully attained by 2011, even though the prices of energy are almost back at the level of 2008.

Table 10: Export price of energy carriers (source: Russian Central Bank, 2011)

	Natural gas			Crude Oil			Oil products		
	Quantity (bil. m3)	Value (USD)	Price (USD)	Quantity (mil. tonnes)	Value (USD)	Price (USD)	Quantity (mil. tonnes)	Value (USD)	Price (USD)
2006	202.8	43806.2	216	248.4	102282.9	56.32	103.5	44671.7	431.63
2007	191.9	44837.4	233.66	258.6	121502.8	64.28	112.3	52227.6	465.15
2008	195.4	69107.1	353.69	243.1	161147	90.68	118.1	79885.6	676.54
2009	168.4	41971.4	249.27	247.5	100593.2	55.61	124.5	48144.9	386.76
2010	177.8	47739.3	268.48	250.7	135799.3	74.11	133.2	70471.1	529.16

Figure 13: Price of crude oil between 2006 and 2011 (y-axis: price in USD, source: Russian Central Bank, 2011)



In Figure 12, Figure 13 and Figure 14 we respectively show the prices of crude oil, the exchange rate and the degree of foreign savings held by the National Bank of Russia. Interestingly, we have a good overview of how the Russian economy adjusted to the crisis. In Figure 13 we see the sudden crash (price of crude oil on the international market). In Figure 14 we see depreciation of the exchange rate. In Figure 15 we have the adjustment of foreign savings.

During the crisis, the exchange rate of rubles to dollars increased with about 10% and during the peak of the crisis in 2009, it reached 35 dollars / rubles. The decrease in exports of oil and other energy carriers had repercussions on foreign currency held by the national bank and a part of the oil reserve fund was used to fuel domestic investments and demand. In Figure 16, we see that during the crisis (as in many EU countries) the domestic inflation slowed down, as both internal demand and the trade surplus from oil and energy export decreased.

Figure 14: Exchange rate between 2006 and 2011 (source: National Bank Russia, 2001) (y-axus: Rubles/USD), the spread of the exchange rates is shown within each year

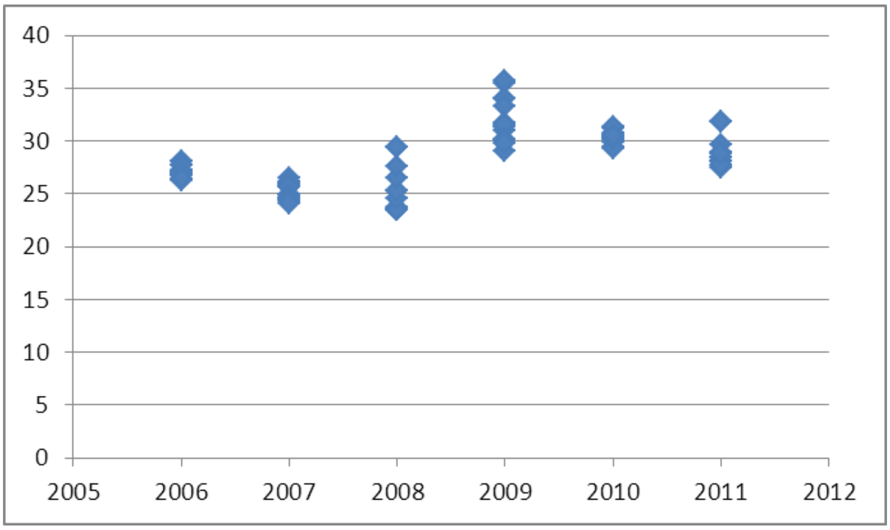


Figure 15: Foreign reserves between 2006 and 2011 (source: National Bank Russia, 2011) (y-axis: USD)

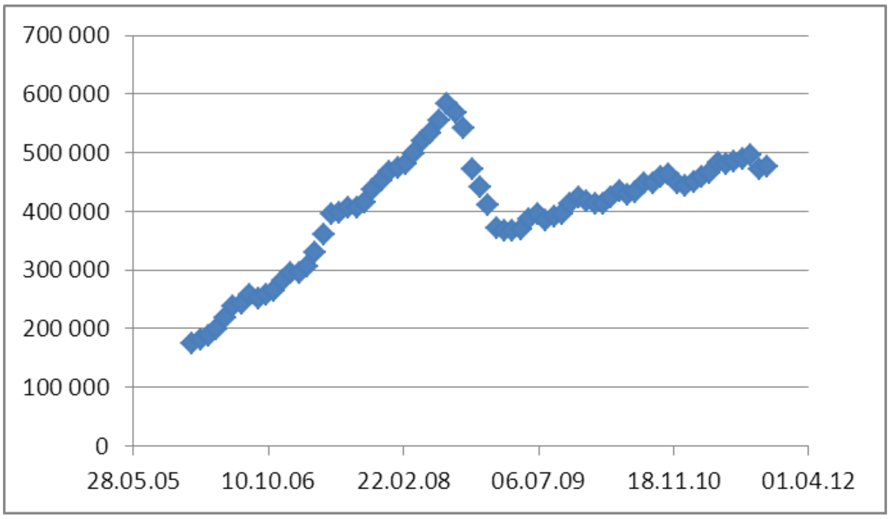
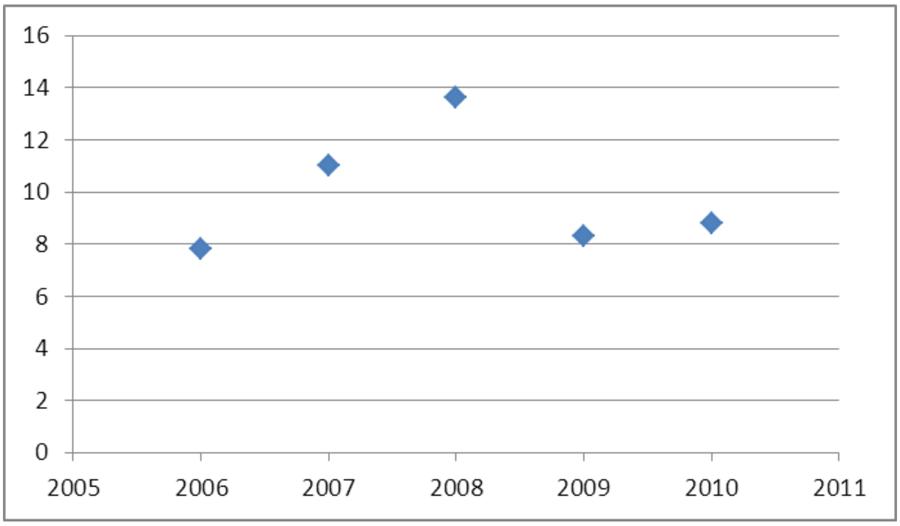


Figure 16: Core inflation rate (y-axis: %) in December (source: National Bank Russia, 2011)



4.2 Set-up of the simulation and choice of closure

This simulation is a part of a larger series of tests, with the goal of singling out the macro-economic effects of energy price fluctuations for Russia and its effect on environmental and economic sustainability.

The figures in paragraph above are obviously correlated with the onset of the financial crisis, but it would not be correct to conclude that they are single effects of the decrease in energy prices on the international market. In fact, they are a result of complex adjustment mechanisms, economic policy and the shock of the financial crisis to the world economy. Still it would be interesting to know more about the vulnerability of Russia to shocks in energy prices. Therefore we try to single out the effect of the price shock on the world energy market with a SUSTRUS simulation. We do a dynamic simulation starting in 2007 and ending in 2010, where we mimic the price shocks on the energy market during this period. We implement the changes in world prices as in Table 10, as stationary shocks each year.

Choosing the correct closure of the international market for SUSTRUS is a difficult task. As we have seen in the section above, the exchange rate did vary, as well as the inflation rate and foreign savings. This type of behavior is relatively hard to implement in a CGE model and requires additional assumptions. In fact, in current practice, it is common to fix all but one of the components of the international budget equation. For example, fixing the exchange rate and the core domestic inflation rate (via the GDP deflator) and allowing foreign savings to adjust to balance the international budget equation.

By a test of trial and error, we have chosen to let the main adjustment to the international budget, go through adjustments to foreign savings. Additionally we have implemented a simple mechanism to allow some changes to the exchange rate and price index. The exchange and inflation rates are set-up to move together with the relative change in foreign savings. The model was calibrated to match with the data of the National Bank of Russia from this period. The set-up used is that the relative change in foreign savings is 2 times higher than the change in the GDP deflator and the change in exchange rate. In fact, in this way the model produces a weighted average, with a larger weight for the adjustment of foreign savings.

To illustrate how strong the effect of the closure on the international market can actually be, we perform a simulation comparing all closures of the model on a simplified simulation. We check how a change in set-up of the model, affects the two core socio-economic indicators: Social welfare and GDP. To increase the performance of the model and to reduce running time, only 1% of the changes implied in the full simulation are introduced. This means that the results are only an indication and should be interpreted with caution.

The columns of table 2 represent each type of closure

1) **Fix ER**: Fixed exchange rate, GDP deflator fixed, flexible foreign savings
2) **Flex ER**: Flexible exchange rate, GDP deflator fixed, fixed foreign savings
3) **ER num**: Exchange rate and foreign savings are fixed, domestic prices adjust to international market
4) **Mixed**: Proposed 'mixed closure' retaining elements of other closures, with larger weight to the fix ER type.

The rows represent results in % change from the baseline situation. Each row represents one year in the simulation.

Table 11: Comparison of closures on international market (relative change from the base case of 2006 in %)

	GDP real				Welfare			
Year	**Fix ER**	**Flex ER**	**ER num**	***Mixed***	**Fix ER**	**Flex ER**	**ER num**	***Mixed***
2007	0.000	-0.006	0.102	0.014	0.003	0.005	0.105	0.023
2008	0.002	-0.041	0.655	0.077	0.020	0.028	0.669	0.169
2009	0.000	0.006	-0.103	-0.014	-0.003	-0.005	-0.107	-0.020
2010	0.001	-0.016	0.257	0.034	0.008	0.011	0.25	0.059

In Table 11, we can see how the set-up of the model influences the indicators. Changing the closure of the model has large effects on the result, especially when considering the real GDP. The differences are rather pronounced for the 2008 when Russia was benefiting out of high gas and oil prices, while the differences across different closure assumptions are much less present for the year 2009 when prices for energy goods dropped significantly. We suggest that these differences underlie fundamental assumptions on the adjustment mechanisms of the international market and the financial system. The third type of closure leads to an inflation of the results of the model. While not overly realistic, this third closure may mimic a system with an exceptionally stringent international market policy where no adjustment in exchange rate or foreign savings is allowed. As such, it is well known that adjustments will go through wages and domestic pricing. Interestingly, however, the closure with fixed exchange rate and foreign savings, does replicate the fall in domestic product during the crisis relatively well.

In terms of welfare both the fixed exchange rate and flexible exchange rate set-up of the model give similar results. Again the third type of closure behaves much more erratic. The mixed closure we have applied (fourth and eight columns), behaves much like a weighted average of the other simulations.

Which closure to choose remains an open question. The 'mixed' closure we suggest could be an improvement, but should be checked in detail with a better theoretical and econometric basis. In fact, it may just as well be an option to insert changes in exchange rate, foreign savings or inflation rate in an exogenous way. We have chosen to retain the mixed closure, due its better match with the empirical data.

4.3 Results

In the table below, we show the results from the SUSTRUS model, corresponding with the description of the simulation under section 4.2 and applying the proposed closure.

Table 12: Main results in relative change from baseline (%) 2006

	2007	2008	2009	2010
Exchange rate[7]	0.97	0.79	1.03	0.93
GDP real	1.38	7.67	-1.40	3.36
National savings	1.51	11.21	-1.38	4.03
Savings from EU	5.56	41.75	-5.07	14.81
Tax revenues	4.92	34.51	-4.52	12.76
Total exports	1.36	9.69	-1.30	3.69
Total imports	1.49	11.55	-1.39	4.02
Total investments	1.82	16.56	-1.55	5.12
Welfare	2.10	12.20	-2.10	5.20

In the results of Table 12, we see that some of the effects of the crisis are reproduced. The years 2007 and 2008 are retained as years of economic growth; the crisis in 2009 is reproduced and followed by recovery in 2010. In accordance with section 4.1, the exchange rate drops in 2007 and 2008 and rises sharply in 2009, to drop again in 2010. In the interpretation of table 3, one should be careful about the reference year. The reference is equal to 2006, multiplied with a steady growth rate of 3.5%. This signifies that the changes presented are relative to a scenario with a baseline growth of 3.5% and not to the previous year.
In Figure 17, we compare the model results, concerning the GDP indicator to the data of Goskomstat. Given Figure 17 we can conclude that the model does seem to reproduce the direction of the change, but only to a certain degree. The model overestimates the recovery and has a different fluctuation.

[7] Reference 2006 = 1

Figure 17: Model versus reality, comparison of change in GDP (y-axis= change in % from baseline)

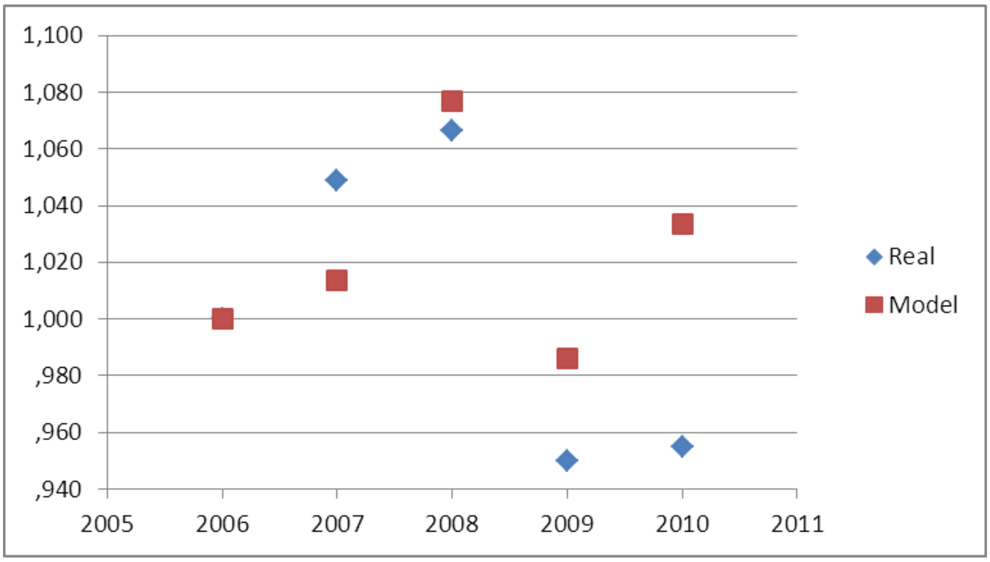


Table 13: Main sustainability indicators on national level, relative change compared to 2006 (%)

Dimension	Indicator	2007	2008	2009	2010
Economy	GDP	1.38	7.66	-1.39	3.36
	Invest	0.376	2.56	-0.365	1.061
	Price Index	0.43	8.25	-0.16	1.69
	Tax revenue	1.869	13.5	-1.7	4.9
Environment	Carbon intensity[8]	-1.7	-8.3	0.251	-4.1
	Electricity	-1.05	-5.3	0.903	-2.48
	NOX emissions	-1.67	-7.74	1.6	-4.1
	PM emissions	-1.54	-7.360	-0.745	-3.686
	SOX emissions	-1.55	-8.7	1.44	-3.94
Social	Atkinson	1.42	6.94	-1.5	3.28
	Gini	3.54	26.7	-3.1	9.4
	Poverty Intensity	0.33	2.56	-0.30	0.87
	Unemployment[9]	0.057	0.039	0.065	0.051
	Unemployment Low skilled workers	0.156	0.129	0.167	0.149
	Unemployment Middle skilled workers	0.049	0.033	0.056	0.044
	Unemployment High skilled workers	0.026	0.009	0.036	0.020
	Welfare	2.257	16.8	-2.04	5.94
	Welfare Low-income households	2.482	18.1	-2.27	6.52
	Welfare Middle-income households	2.374	17.8	-2.16	6.27
	Welfare High-income households	2.157	16.1	-1.94	5.67
Trade	Foreign Invest	-1.362	-6.53	-14.0	9.9
	Trade Balance	-0.346	-2.48	0.325	-0.48
	Trade Integration	1.673	13.87	-1.68	5.12
	Trade Openness	0.036	2.60	0.062	0.45

[8] Emissions of CO2 / GDP

[9] Unemployment is in actual rate not in relative change!

In Table 13, we give the full overview of our sustainability indicators on the level of the Russian Federation. Table 14 gives additional information, to serve as background for the simulation.

The main points of interest from the table are the economic effects. We see that the SUSTRUS model replicates the increase in domestic production, investment and inflation during the 2006-2010 periods quite well. We remind the reader that it is not necessary to get an exact match for the 'real effects' during the economic boom of 2008 and the subsequent crisis in 2009. We want to show the capabilities of SUSTRUS to model deviations in international energy prices and visualize the impacts on the domestic economy. In fact, no single model is able to replicate reality.

The social and environmental effects may seem contradictory at first, however one should take into account that we only modeled the effect on the international energy prices during the 2006 – 2010 period. The model predicts a reduction in emissions and energy use during 2007, 2008 and 2010. This is explained by the higher energy prices on the international market and therefore also (to a certain degree) on the domestic market. During the crisis period in 2009, price of energy carriers goes down, increasing the consumption of natural gas and oil compared to the baseline.
In the 'real world' most countries had higher absolute emissions of carbon dioxide and other combustion related pollutants in 2008, while in 2009 the crisis actually led to a reduction in emissions. One should be careful to interpret the results however, as our simulation only focused on the effects of the energy prices during the period and is no full simulation of the financial crisis. For example, we have not included demand effects on other products.

The social indicators of the model point towards higher inequalities and reductions in unemployment, in the periods of growth (2007, 2008) and lower inequality and higher unemployment during the crisis (2009). This type of prediction is common in CGE models, as the highest income classes tend to increase their wealth more rapidly during times of economic growth.

Somewhat surprising is that the model predicts that trade balance by GDP[10] goes down during 2007 and 2008, even though price of energy sources increase substantially at that time. This is caused by a strong increase in imports of machinery and other intermediary goods into Russia. Comparing our model results with the actual data in Table 14, shows that the model only partially replicates the actual results. In fact the trade balance by GDP went down during 2007, but increased in 2008. In 2009, the trade balance decreased compared to both the previous year and 2006.

Table 14: GDP, exports, imports and trade balance in millions of USD, 2006-2010, actual data (source: Russian national bank 2011)

Year	GDP[11]	Exports[12]	*Energy[13]*	Imports	Trade Balance	TB / GDP
2006	16286.5	303550	*190760.8*	164281	139269	8.55
2007	17676.5	354401	*218567.8*	223486	130915	7.41
2008	18604.2	471603	*310139.7*	291861	179742	9.66
2009	17150.4	303388	*190709.5*	191803	111585	6.51
2010	17842.3	400419	*254009.7*	248738	151681	8.50

[10] (Total exports – Total imports) / GDP
[11] In prices of 2003 (source, national bank)
[12] In value, including exports of energy
[13] In value, including oil, natural gas and petroleum products

4.4 Conclusion

In this simulation, we performed a back-cast of the effect of the financial crisis on the price of energy carriers such as oil, natural gas and coal. The export prices and volumes during the period 2006-2010 were at the basis the simulation. It was not our goal here to replicate the changes in macro-economic indicators from 2006-2010 to their full extent. The simulation shows how the SUSTRUS model may be used to simulate the export dependence of the Russian domestic economy and make predictions on energy use and changes in GDP.

In first instance, we have experimented with the assumptions used on the international market. It was found that the set of closures available to us from state-of-the-art modeling did not seem to reflect the reality of the international market to a sufficient degree. In general equilibrium modeling, relatively inflexible assumptions are made to balance the international trade account. For example, by fixing the exchange rate or fixing the amount of foreign savings and debts. Given that the shock in energy prices had a large influence on the international market equilibrium, it was found – in accordance with theoretical predictions – that modifying the so-called 'closure' of the international market had a large influence. By allowing more liberty in the adjustment of the trade balance, exchange rate and domestic price deflator, the model results did match better with the empirical results. In this way, we were able to reproduce the real changes in domestic product to a relatively good degree.

Our simulation could only replicate the economic recession of 2009 by modifying the standard assumption of international trade balance of SUST-RUS. This means that our results are somewhat ambivalent. By calibrating the model to match the empirical data to a larger degree, we lost a part the analytical power. Actually, our experiments in WP9 show that a stronger effect on domestic prices, caused by a more stringent exchange rate and foreign savings policy creates a larger fluctuation in domestic product within the model. Increasing the flexibility in the exchange rate and foreign savings decreased the impact of price shocks on the international market for energy considerably and could actually lead to beneficial results on welfare and GDP. The reason for this is that the lower prices for energy sources are benefitting the output of energy intensive sectors and consumers. A depression in the amount of energy exports leads to pressure on the ruble to devaluate, promoting the output of non-energy sectors and decreasing imports.

What we can conclude from this simulation is the following: The SUST-RUS model could replicate a recession of the Russian economy, based solely on the fall of international energy prices on the market (as they occurred in reality). Even though sufficient liberty was given to the modeler to calibrate the model to the empirical data, the fall in energy prices cannot capture the whole story. By 2011, the prices of energy are almost back on their levels of 2008, but the real growth in GDP of Russia is lagging seriously behind. The model overstates the economic recovery of Russia based on the market prices, which is an indication that more factors are influencing the Russian economy after 2010.

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