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

Project 213091

D1.2
Description of the modeling methodology

Contract No.	SUST-RUS 213091
Workpackage	WP1 - Development of methodology
Date of delivery	M9
Actual Date of Delivery	M9
Dissemination level	Public
Responsible	CEFIR
Author	Salavat Gabdrakhmanov, CEFIR
Status of the Document	Draft
Version	1.0

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement No. 213091.

Contacts of coordinator:
CEFIR, Nakhimovsky pr., 47, office 720, Moscow, Russia
Tel: +7 495 925 5002, Fax: +7 495 925 5003;
contact person – obuturlina@cefir.ru

Website: http://sust-rus.org

Contents

1 Introduction **4**

2 Modeling Methodology **5**

2.1 Consumers 5
2.2 Labor Markets 7
2.3 Producers 8
2.4 Industry Structure 9
2.5 Investment and Capital 10
2.6 Interregional and International Trade 11
2.7 Government 12

3 Data Restrictions and SUST-RUS Methodology **13**

3.1 Dataset Structure 13
3.1.1 Social Accounting Matrix 13
3.1.2 Behavioral Parameters 15
3.2 Effects of Data Limitations 16

4 Current and Possible Policy Measures **17**

Bibliography **20**

1 Introduction

This methodology review has been prepared for the SUST-RUS project (Spatio-economic-ecological model for the assessment of sustainability policies of Russian Federation). The goal of researchers behind this project is to develop and implement for Russia an integrated spatio-economic-ecological modeling approach that represents the state of the art and can be used to assist policy makers in their choice of sustainability policies.

This report is going to expand on methodology behind constructing Russian CGE model of economy, energy and environment, chosen by the SUST-RUS team. The methodology will be outlined on the basis of the best international and Russian practices in developing spatio-economic-environmental modeling tools for assessment of sustainable development policies. Thus, this report draws heavily on the work done in preparing literature review for the same project (see CEFIR, 2009) and the ongoing work on collecting and analyzing available data.

According to the current modeling philosophy, adopted by the SUST-RUS team, there will be two attempts at constructing a Russian CGE model. The first one will be called "basic" and will incorporate the most important features of both models. The second one ("advanced") will be the final version of the model and will build on top of the basic one. The basic model will be static whereas the advanced model will employ fully-rational (forward looking) dynamics, will introduce monopolistic competition in some of the markets, and will take account of labor migration. In the discussion of methodological questions below, we will describe the differences between the two models in more detail.

The rest of the report is organized as follows. We start with the description of our modeling methodology in chapter 2. Then we discuss data restrictions we face in chapter 3. Finally, we bring up current and possible policy measures that the Russian Federation adopted (is anticipated to adopt) with regard to sustainable development (chapter 4).

2 Modeling Methodology

This chapter lays out the modeling methodology of the SUST-RUS economy-energy-environment model, as it is currently conceived by the SUST-RUS team. We proceed in the following manner. First, we describe consumers' side of the economy in section 2.1. Then we discuss our view of labor markets (section 2.2). Production technology, along with emission accounting, and the industry structure are presented in sections 2.3 and 2.4. Investment and capital are discussed in section 2.5. Incorporation of international and interregional trade in the model is explained in section 2.6. Finally, the role of government is described in section 2.7.

2.1 Consumers

The basic model will incorporate the behavior of a representative household in each of the regions. The advanced model will distinguish between different types of individuals, according to their income (separated along income deciles).

The gross income (Y) of each household is calculated as the sum of its labor income and its capital income (interest accrued). The labor income of the regional household is the total endowment of labor (LS) minus the regional unemployment level (UNEMP) multiplied by the region-specific wage rate (PW).

$$Y = (\mathsf{LS} - \mathsf{UNEMP}) \cdot \mathsf{PW} + K \cdot \mathsf{RK}. \tag{2.1}$$

The variable more relevant for the household's decision, however, is its net income NY. It is derived from the gross income Y by subtracting the income tax (at the rate ty) and adding social transfers from the government TRF and unemployment benefits UNEMP.

$$\mathsf{NY} = Y(1 - \mathsf{ty}) + \mathsf{TRF} + \mathsf{UNEMPB}. \tag{2.2}$$

The net income received by the household is either spent on consumption or saved. The ultimate utility, driving the choices of consumers, is derived from consumption of goods and services (today and in the future), with higher levels of consumption leading to higher consumer's satisfaction. Future consumption might be partially financed out of savings today, leading to the tradeoff between today's and tomorrow's consumption. We will model properly this tradeoff only in the advanced model, with its built-in intertemporal utility function. In the basic model we assume a mechanical way of savings formation, where a fixed portion (captured by the marginal propensity to save mps) of the net household's income is set aside as savings SH each period:

$$\mathrm{SH} = \mathrm{NY} \cdot \mathrm{mps}. \tag{2.3}$$

Accordingly, the funds apportioned to current consumption are given by

$$\mathrm{CBUD} = \mathrm{NY}(1 - \mathrm{mps}). \tag{2.4}$$

Notice that the marginal propensity to save mps in the basic model is different for each region. In the advanced model, the savings of the household can be found from solving the intertemporal maximization problem (see below).

Instantaneous household preferences at the top level are given by a linear expenditure function (see CEFIR (2009)) over "consumption goods" C_i:

$$U = \sum_i \alpha_i \ln(C_i - \mu_i). \tag{2.5}$$

The utility from consumption is associated only with the amount of a good or service C_i that is higher than its subsistence consumption level μ_i. In the basic model "consumption goods" C_i stand for the Armington composite of the domestic and foreign goods produced in industry i. Furthermore, the domestic good is itself an Armington composite of domestic goods of the same industry produced in different regions. (See more detailed discussion in section 2.6.) Given the corresponding prices P_i of the top-level Armington composites, the consumer in the basic model solves the following problem:

$$\begin{aligned} &\max_{C_1,\ldots,C_I} \sum_i \alpha_i \ln(C_i - \mu_i) \\ &\qquad \text{subject to} \\ &\qquad P_1 C_1 + \cdots + P_I C_I \leq \mathrm{CBUD}. \end{aligned} \tag{2.6}$$

In the advanced model we will introduce another layer in the consumer preferences nested structure: some of the domestic goods produced at a regional level will be interpreted further as composites of a variety of goods where the industry in question is modeled under assumptions of monopolistic competition. (For further details, see section 2.4).

Consumer's problem at the top nest in the advanced model (ignoring consumer heterogeneity for simplicity) will be given by

$$\begin{aligned} &\max_{(C_{it})_{it}} \sum_{t=0}^{T} \beta^t \sum_i \alpha_i \ln(C_{it} - \mu_i) \\ &\quad \text{subject to} \\ &\quad \sum_{t=0}^{T} D_t \sum_{i=1}^{I} P_{it} C_{it} \leq \sum_{t=0}^{T} D_t \Big(Y_t (1 - \mathrm{ty_t}) + \mathrm{TRF_t} + \mathrm{UNEMPB_t} \Big), \end{aligned} \tag{2.7}$$

where discount factors D_t are given by the inverse of compound interest rates:

$$D_t = \prod_{\tau=1}^{t} \frac{1}{1+\mathsf{RK}_\tau}. \tag{2.8}$$

2.2 Labor Markets

A regional labor market in the basic model is set up in a simple manner: labor supply is fixed so that the amount of labor supplied by the population is the same irrespective of changes in the economy. Thus, the levels of unemployment are fixed to the baseline scenario.

In the advanced model we anticipate two improvements on this situation. First, we will introduce mechanical (not sensitive to incentives) interregional migration patterns. Migration from one region to another each year will be fixed according to fixed rates (collected in the migration matrix migr). Thus, the labor supply LS_{rt} in region r in time period t will be given by

$$\mathsf{LS}_{rt} = \mathsf{LS}_{rt-1} + \sum_{r'=1}^{R} \mathsf{migr}_{r'r} \cdot \mathsf{LS}_{r't-1}. \tag{2.9}$$

Second, we will introduce search and matching for labor market, resembling the Pissarides approach to define involuntary unemployment by frictions on the labor market. Each period employers post vacancies in line with their firms' needs. With some probability these vacancies tend to be filled by the regional labor force. The underlying matching function is given in the equation (2.10) below. The probability QR of a match between a vacancy and a worker depends on the number of vacancies NV and the unemployment level UNEMP in the region:

$$\mathsf{QR} = a^m \mathsf{NV}^{\alpha^m - 1} \mathsf{UNEMP}^{1-\alpha^m}. \tag{2.10}$$

Notice that the number of matches $\mathsf{NM} = \mathsf{QR} \cdot \mathsf{NV}$ in the region is then given by the Cobb-Douglass function of the number of vacancies posted NV and the unemployment level UNEMP.

At the same time, the number of matches in the region in equilibrium should equal the difference between the present labor demand L and past year's labor demand L_{-1}, adjusted for the mechanically modeled job destruction level $\mathsf{jd} \cdot L_{-1}$:

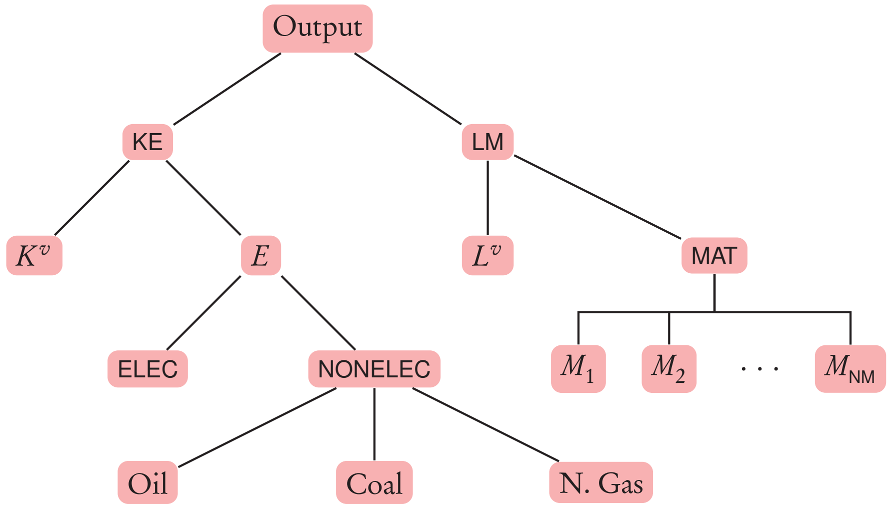
$$\mathsf{QR} \cdot \mathsf{NV} = L - L_{-1}(1 - \mathsf{jd}). \tag{2.11}$$

Here the job destruction rate jd in the economy is fixed exogenously.

Finally, the unemployment level UNEMP is determined as the difference between labor demand L and labor supply LS in the region:

$$\mathsf{UNEMP} = L - \mathsf{LS}. \tag{2.12}$$

Figure 2.1: SUST-RUS production structure



2.3 Producers

The production function (technology) of a generic regional industry will take the form of a nested CES function as is customary in most CGE models (see CEFIR, 2009). In particular, at the top nesting level the capital-energy bundle KE will be combined with the labor-intermediates bundle LM. The capital-energy bundle breaks down further into variable capital input K^v and the energy bundle E. The energy bundle is a combination of electricity ELEC and the fuels bundle NONELEC. The fuels bundle is a combination of fuel inputs: oil, coal, natural gas (see fig. 2.1).

The labor-intermediates bundle LM is a combination of variable labor input L^v and the intermediates bundle MAT. The intermediates bundle is a combination of the outputs (here as inputs) of all non-energy industrial sectors in the economy. Notice that the intermediates bundle is modeled with fixed coefficients (Leontief function), again in line with the CGE tradition[1] (see CEFIR, 2009).

Similarly to consumer's case, the intermediate inputs are assumed to be Armington composites of the corresponding imported foreign goods and Armington composites of domestically produced goods (across regions). For more detailed discussion, see section 2.6.

In the basic model there are no fixed capital or labor costs, so total capital and labor inputs are the same as their above-mentioned variable variants. In the advanced model, with introduction of fixed costs in the monopolistically competitive industries (see section 2.4), the total labor and capital (in a given industry and region) will be equal to the sum of their

[1] The main rationale being a significant reduction in the number of hard-to-estimate substitution elasticities in the model.

fixed and variable variants:

$$K = K^v + K^f, \tag{2.13}$$

$$L = L^v + L^f. \tag{2.14}$$

Finally, the levels of emissions will be captured as fixed proportions of separate fuel inputs in the fuels bundle.

2.4 Industry Structure

In the basic model we assume perfect competition in all markets. The same applies for most of the markets in the advanced model. Still, in some of the industries in the advanced model we will introduce monopolistic competition, along the lines of Dixit and Stiglitz (1977).

Accordingly, in the advanced model consumer preferences are augmented in the following way. For regional industries in question, we add another layer of nesting in consumer preferences so that at the top level consumers cared about the CES composite C of the imperfectly substitutable goods c_k produced by firms k (instead of a simple aggregate of homogenous goods in ordinary industries):

$$C = \left(\sum_{k=1}^{\mathsf{NF}} (c_k)^{\frac{\sigma^{\mathsf{Reg}}-1}{\sigma^{\mathsf{Reg}}}} \right)^{\frac{\sigma^{\mathsf{Reg}}}{\sigma^{\mathsf{Reg}}-1}}, \tag{2.15}$$

where NF is the number of firms in the industry. Given the price P of the composite C, the price p_k of a single good c_k will be (in equilibrium, assuming all firms in the industry identical)

$$p_k = P \cdot \mathsf{NF}^{\frac{1}{\sigma^{\mathsf{Reg}}-1}}. \tag{2.16}$$

This price will not be equalized with the marginal cost COST_k as in a perfectly competitive case, but will be treated with a markup wedge:

$$p_k = \frac{\sigma^{\mathsf{Reg}}}{\sigma^{\mathsf{Reg}} - 1} \mathsf{COST}_k. \tag{2.17}$$

In other words, in all equations connecting input prices with the output price in the top level of nested CES production functions of monopolistically competitive industries, we will use COST_k as given by equation (2.17), instead of the naked output price p_k as in the standard perfectly competitive case.

Each firm in the monopolistically competitive industry incurs fixed labor fcL and capital fcK costs that are treated as constant amounts (in a given industry and region). Finally, free entry assumption ensures that operating profits are equal to fixed costs, which means that[2]

$$P \cdot C = \sigma^{\mathsf{Reg}}(\mathsf{PW} \cdot L^f + K^f). \tag{2.18}$$

Thus, we need only to estimate fcK, fcL and NF to be able to obtain the estimate of σ^{Reg} from equality (2.18).

Our treatment of monopolistically competitive industries is similar to ISEEM and GEM-E3 (see CEFIR, 2009).

2.5 Investment and Capital

Investment in the basic model is not changing the level of capital (as the model is static). Given the general equilibrium nature of the SUST-RUS model and the habitual lack of breakdown of new capital purchases in terms of separate investment goods in data, we introduce a special investment sector in each region with CES production function, turning intermediate goods into the gross investment good.

The total level of investment IT will be determined by the sum of household (SH) and government (SG) saving decisions plus the net amount of saving transfers from the rest of the world SROW adjusted with the exchange rate ER. Thus,

$$\mathsf{IT} = \mathsf{SH} + \mathsf{SG} + \mathsf{SROW} \cdot \mathsf{ER}. \tag{2.19}$$

The advanced model is supposed to be dynamic fully-rational with perfect foresight. Thus, the savings decisions by the individuals will be driven by the (exogenously given in the small open economy) interest rates. To reconcile this with different returns to capital in different regions, we will introduce adjustment costs for regional investment sectors. More specifically, the conditional cost of reaching gross investment level I at the factory floor, given the installed capital level K and the prices PM_i of intermediate inputs M_i ($i = 1, \ldots, \mathsf{NIM}$) is provided by[3]

$$A^{\mathsf{adj}} \left(\frac{I}{K} \right)^{\alpha^{\mathsf{adj}}} K \cdot \mathsf{ces}_{1/\sigma^{\mathsf{inv}}; a_1^{\sigma^{\mathsf{inv}}}, \ldots, a_{\mathsf{NIM}}^{\sigma^{\mathsf{inv}}}}(\mathsf{PM}_1, \ldots, \mathsf{PM}_{\mathsf{NIM}}). \tag{2.20}$$

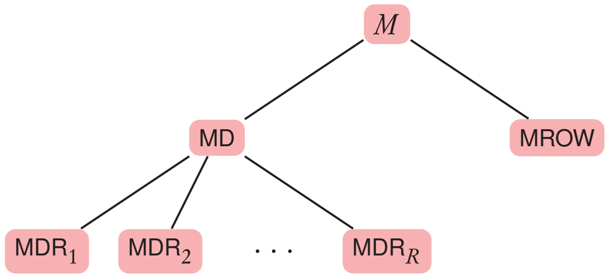
Finally, the usual equations for capital accumulation (in each region) will apply: the new level of capital is equal to the old level of capital net of depreciation and plus the gross investment:

$$K_t = K_{t-1} - \delta K_{t-1} + I. \tag{2.21}$$

[2]Notice that the revenue of a single firm $p_k c_k$ is equal to $P \cdot C/\mathsf{NF}$, and the profit of a single firm is equal to $p_k c_k / \sigma^{\mathsf{Reg}}$. Furthermore, the sum of fixed costs across all firms in the industry yields the industry level of fixed variables: $K^f = \mathsf{NF} \cdot \mathsf{fcK}$ and $\mathsf{PW} \cdot L^f = \mathsf{NF} \cdot \mathsf{fcL}$.

[3]It can be shown that the underlying production function is given in this case by $I = (A^{\mathsf{adj}})^{-1/\alpha^{\mathsf{adj}}} K^{\frac{\alpha^{\mathsf{adj}}-1}{\alpha^{\mathsf{adj}}}} (\mathsf{ces}_{\sigma^{\mathsf{inv}}; a_1, \ldots, a_{\mathsf{NIM}}}(M_1, \ldots, M_{\mathsf{NIM}}))^{1/\alpha^{\mathsf{adj}}}$. For the exact specification of a generic CES function ces see CEFIR (2009).

Figure 2.2: Armington structure of consumption and intermediate input goods



2.6 Interregional and International Trade

Our basic assumption in the trade part of the model is that of a small open economy. Besides, we adopt the standard in CGE literature (see CEFIR, 2009) Armington assumption, which takes care of the common presence in the same market of both domestic and foreign goods. Somewhat imperfect substitutability between them is required if we need both of them demanded domestically. Accordingly, each good M used in consumption or as an intermediate input in production is treated as a composite bundle of the good MD produced domestically and the foreign import MROW (see fig. 2.2). A CES function is responsible for this bundling, with the corresponding substitution elasticity called "Armington elasticity." Clearly, it stands for the degree of substitutability between foreign and domestic goods in the same sector.

In its own turn, the domestically produced good MD is also treated as a composite good, and is broken down further into goods MDR_r produced in each of Russian regions ($r = 1, \ldots, R$). Again, the combination is calculated according to a CES function with a specific substitution elasticity reflecting the degree of substitutability between the goods produced in different Russian regions.

Thus, our treatment of interregional and international trade leads to a 2-stage nested structure in the consumed (and used as intermediate inputs) commodities. At the top nest we have bundling of the domestically produced composite with the imported good. At the lower level the domestically produced good is distributed across domestic regions.

The "small open economy" assumption implies that the prices of imported goods are exogenously fixed in foreign currency. Thus, their prices in the domestic currency are calculated by multiplying their fixed foreign prices with the exchange rate ER:

$$\mathsf{PMROW} = \mathsf{PMROW}^0 \cdot \mathsf{ER}. \tag{2.22}$$

2.7 Government

In both our models we will set up two levels of government: federal and regional. Government consumption will be fixed as the proportion of GDP prevailing in the baseline scenario. Various taxes (income, VAT, social, etc) will be modeled in the traditional way: as wedges on prices.

The consumption budget of a government CBUDGOV will consist of the tax revenue TAXRG, income from the intergovernmental transfers TRFGY, transfers from abroad TRFROW; net of total subsidies SUBSG, unemployment benefits UNEMPB, transfers to households TRFF, expenditures on the intergovernmental transfers TRFGE and governmental savings SG:

$$\begin{aligned} \mathrm{CBUDGOV} = {} & \mathrm{TAXRG} + \mathrm{TRFGY} + \mathrm{TRFROW} \cdot \mathrm{ER} \\ & - \mathrm{SUBSG} - \mathrm{UNEMPB} - \mathrm{TRFF} - \mathrm{TRFGE} - \mathrm{SG}. \end{aligned} \quad (2.23)$$

Transfers between levels of government (mostly, from federal to regional) will be modeled mechanically, using the fixed transfer coefficients, again prevailing in the baseline scenario.

3 Data Restrictions and SUST-RUS Methodology

In this chapter we discuss the choice of modeling methodology in light of data available for the Russian Federation. We will proceed in the following way: firstly, a general structure of a dataset for a CGE model will be described. Special features of the available Russian data, especially input-output tables, used in the SUST-RUS project will be highlighted. Secondly, we will briefly mention data uncertainty in the use of behavioral parameters and discuss techniques helping to handle this uncertainty.

Lastly, we will contrast SUST-RUS with comparable European models, stressing differences in methodology due to the lack of Russian data and/or different scope of the SUST-RUS model.

3.1 Dataset Structure

In discussing a general structure of the SUST-RUS dataset we should provide a disclaimer. At the time of preparation of this report the creation of the SUST-RUS dataset was at an early stage. Thus, in terms of dataset construction this is just a progress report. A usual CGE dataset consists of three distinct parts:

- A balanced dataset representing an economy in question in a base year. In our case this should be a 7-region social accounting matrix for the Russian Federation (RF), featuring seven federal districts of the RF.
- A set of behavioral parameters, such as elasticities of substitution between imported goods, elasticities of transformation in the production functions, etc.
- A set of policy variables; in other words, a set of parameters of the model that will be used in formulation of modeling scenarios. In terms of the SUST-RUS model these parameters are environmental taxes, output taxes, production taxes, product or production subsidies, etc.

3.1.1 Social Accounting Matrix

A Social Accounting Matrix (SAM) is a balanced dataset which records all income flows between economic agents of an economy in question. The principle of double bookkeeping requires a separate row and column for each agent. Each agent's row is a record of his receipts, each agent's column lists his expenditures. By assumption of balanced budgets, for each agent a row's sum must be equal to this agent's column sum.

The core of any SAM is an input-output (IO) matrix, which contains information on intermediate consumption for each industry specified in the economy in question.

Given the regional structure of the SUST-RUS model, the database should consist of 7 regional SAMs. Thus, it should incorporate 7 regional IOs.

There is no official information on structure of the regional input-output matrices in the Russian Federation. Thus, regional input-output matrices should be estimated. Usually, for the estimation of regional IOs a country-level IO matrix is used as a reference. For the RF the most recent official IO table is available for 2003. The unfortunate feature of the Russian 2003 IO matrix is that it is composed in an old Soviet industrial classification OKONH, which is not compatible with any standard international industrial classification. Thus, as a starting point for estimation of Russian regional input-output matrices we would like to use Russian IO table from the GTAP 7.0 database.

The Core Input-output Table for the SUST-RUS Model[1]

The core input-output (IO) table for the SUST-RUS model is a country IO table for Russia from the GTAP 7 Database.

The input-output table for the RF in the GTAP 7 Datebase was constructed on the basis of Rosstat input-output tables published in *The system of input-output tables for 2003* (Rosstat, 2006). The data were disaggregated, reclassified and balanced to meet the GTAP requirements stated in Huff et al. (2000). The provision of data for Russia was a part of the ENEPO research project supported by the European Union's 6th Framework Program[2].

Due to differences in industrial classification between Russian IO and GTAP, a step-wise procedure constructing the Russian IO for GTAP 7 Database was implemented. At the first step a transition matrix with 59-sector aggregation was constructed, based on an old Russian classification that is compatible with the original Russian input-output tables. At the second step the transition matrix was aggregated to the GTAP sectoral classification, summing up to 40 GTAP sectors. At the third stage the resulting matrix was transformed in order to match GTAP requirements. At last, imports use and tax tables were calculated in GTAP format.

[1] Following Shkrebela and Tourdyeva (2008).

[2] EU Eastern Neighborhood: Economic Potential and Future Development (http://enepo.case.com.pl/).

Data Sources

The principal data source for all calculations is a symmetric input-output table (SIOT) grouped commodity by commodity. It represents 22 "single-product" producing sectors[3]; data is measured in thousands of Russian rubles for year 2003.

The symmetric input-output table is accompanied by non-symmetric supply and use tables, tables of domestic and imported products use, tables of transport and trade mark-ups, and a tax table. All these tables include 24 producing sectors[4] and commodity groups aggregated according to Russian national industrial classification (Obsherossiiskii klassifikator otraslei narodnogo hozaistva, OKONH[5]) on a commodity-by-industry basis.

By the time of creation of the Russian IO tables for GTAP, there were available only OKONH-based official IO tables. There is no one-to-one mapping on the aggregated level from OKONH to standard international classification like ISIC or NACE. The source table had to be disaggregated in order to match GTAP sectoral classification. A Russian symmetric input-output table for year 1995 with 110 industries was used as a reference table for disaggregation. Its level of detail permitted building a one-to-one mapping from OKONH-based classification of Russian IO tables to GTAP.

Russian IO for 2003 with 22 sectors was disaggregated to 59 sectors[6] with use of an entropy minimization technique, similar to Robinson et al. (2001). A resulting balanced IO with 59 sectors for 2003 was aggregated to GTAP format.

The same procedure was applied to imports and tax matrices.

3.1.2 Behavioral Parameters

Behavioral parameters of the model usually could not be calculated on the basis of data from a SAM. Those include, e.g., elasticities of substitution between imported and domestic goods, elasticities of substitution of inter-

[3]Description of IO table's methodology is published in Rosstat (1998), Chapter 5: "Input-Output Tables."

[4]Some differences in methodology should be noted; for instance, Rosstat does not calculate imputed rent for owner-occupied dwellings. "The value of housing services is treated as a sum of current expenditure of dwelling and consumption of fixed capital" (Masakova, 1998).

[5]OKONH classification (`http://www.standard.ru/classif/okonh/okonh.phtml`) was the official industrial classification in the Soviet Union and in Russia up until recently (1976–2004). In 2004 Russia adopted a new classification OKVED based on "Statistical Classification of Economic Activities in the European Community" (NACE Rev. 2).

[6]Russian IO tables report data in OKONH classification. In order to find a correspondence between IO data and GTAP sectors we build a mapping from IO sectors to OKONH, then from OKONH to ISIC. We base our classification on a mapping between OKONH and OKVED classifications, published by the Ministry of Economy of the RF and Rosstat in 2002. (`http://okpd.org/product/okonh_okved.zip`). The minimum common classification contains 59 sectors.

regional trade, etc. Unfortunately, there are no estimates of elasticities in question for the RF.

Estimation of these parameters is out of scope of the SUST-RUS project, mainly due to lack of data. Thus, in our scenario estimation we would employ values of elasticities cited as base values in comparable models built for other countries. Given uncertainty in behavioral parameters, all model results should be tested on sensitivity to elasticities values, or in other words, a systematic sensitivity analysis (SSA) should be conducted.

A good example of a SSA is provided by the Programming Tools for Systematic Sensitivity Analysis of GAMS Models by Thomas F. Rutherford[7].

3.2 Effects of Data Limitations

Due to the scope of the SUST-RUS model and availability of data, there are some features of state-of-the-art European models that we could not adopt in the SUST-RUS model. In particular, we leave outside the scope of the model

- commuting;
- household emissions;
- land use.

There is no available data on commuting time for big municipalities in Russian federal districts. Thus, we would not be able to introduce this feature in the SUST-RUS model.

Almost all major Russian cities have central heating; thus, household emissions in Russia are negligible. The major source of emissions associated with heating is attributed to companies in the housing services sector.

A consistent database for land use on all territory of the Russian Federation is unavailable; thus, we would not be able to introduce this feature into the SUST-RUS model either.

[7] Programming Tools for Systematic Sensitivity Analysis of GAMS Models were created by T.Rutherford as part of the project "Indicators and Quantitative Tools for Improving the Impact Assessment Process for Sustainability" (I.Q. Tools), 6th Framework Programme of the European Commission, Contract SSP1-CT-2003-502078, Thematic Priority 8: Policy Oriented Research. (http://www.mpsge.org/qtool/).

4 Current and Possible Policy Measures

Before turning to the nitty-gritty of actual CGE modeling, it is advisable to understand the kind of policy questions that the model might help answering. Accordingly, the purpose of this brief chapter is to review the current and putative sustainable development policy measures in Russia. In particular, we are interested in sustainable development policies that could be helped along by our model, as currently envisioned by the SUTS-RUS team.

Unfortunately, the current situation with policy measures in support of sustainable development in Russia is lacking any specifics. The legal environment at the federal level consists of the following documents:

- *The environmental protection law* (2002, amended as of 2004);
- *The air protection law* (1999, amended as of 2004);
- *The concept of transition of Russian Federation to sustainable development* (promulgated as part of the Presidential Decree No. 440, 1996);
- *The ecological doctrine of Russian Federation* (2002).

The concept of transition of Russian Federation to sustainable development has a declarative character, for the most part not specifying any policies but advancing general objectives and directions for policy development in future. Even though the concept was adopted a while back in 1996, to this day the situation has not changed appreciably. Among measures of potential interest mentioned in the concept, we can bring up the following:

- supporting foreign investment connected with environmental issues;
- development of regulatory mechanisms on the regional level addressing environmental concerns;
- taking measures in improving public health and social infrastructure.

Some of Russian regions and municipalities have adopted their own sustainable development frameworks. Yet taking a leaf out of the federal rulebook, their policy suggestions are nebulous and hard to quantify as well.

A little more light can be shed on the subject of possible Russian policy measures by looking at other countries' experience. Thus, the review of the EU Sustainable Development Strategy (see CEU, 2006) identifies seven key challenges facing EU and suggests a number of actions connected with each of them. We can summarize those actions that seem the most relevant to the future Russian sustainable development policy, and which can conceivably be addressed by our model in one way or another.

Climate change and clean energy

1) exploitation of cost-effective emission reduction options for cars and aviation;
2) review of the EU emission trading scheme and its extension to other greenhouse gases and sectors (aviation);
3) promotion and research connected with the use of renewable energy;
4) promotion of use of biomass;
5) more widespread use of combined heat and power.

Sustainable transport

1) improvement in the economic and environmental performance of transportation;
2) improvement in energy efficiency of transport through use of cost-effective instruments.

Sustainable consumption and production

1) extension of performance labeling schemes to new groups of environmentally harmful products;
2) promotion of sustainable products stemming from organic farming and fair trade.

Conservation and management of natural resources

1) promotion of organic farming and biomass.

Public health

1) measures targeting life-style related health determinants, such as drugs, tobacco use, harmful drinking, poor diet and physical inactivity.

Social inclusion, demography and migration

1) reduction in the number of people at risk of poverty;
2) social protection modernization in view of demographic changes.

Global poverty and sustainable development challenges

(no actions relevant to our project.)

We can conceivably address questions associated with these actions if they are reduced to changes in policy variables built in in our models: tax rates; subsidy levels; possibly, technical standards and limits modeled as constraints. Questions relating to the introduction of emission permit trading can be addressed by calculating shadow prices implied by our model in presence of relevant constraints. Furthermore, technical changes due to improvements in technology can be modeled directly with changes in technical coefficients responsible for (exogenous) growth. Improvements in pollution levels stemming from technology can be directly captured by reductions in the corresponding emission levels coefficients.

Bibliography

Overview of the relevant literature. Technical report, CEFIR, 2009. URL http://sust-rus.org/wp-content/uploads/2009/07/sus-rus_d11.pdf. (Cited on pages 4, 6, 8, 10, and 11.)

Renewed EU sustainable development strategy. Annex to a note, Council of the European Union, June 2006. (Cited on page 17.)

A. K. Dixit and J. E. Stiglitz. Monopolistic competition and optimum product diversity. *The American Economic Review*, pages 297–308, 1977. (Cited on page 9.)

Huff, K., McDougall, R. and Walmsley, T. (2000). "Contributing Input-Output Tables to the GTAP Data Base," GTAP Technical Paper No. 1, Release 4.2, January. (Cited on page 14.)

Masakova, Irina (1998). Practice of 1993 SNA: Implementation in Russia. Report on Joint OECD/ESCAP meeting on national accounts, 1998. (www.oecd.org/dataoecd/16/62/2665332.pdf) (Cited on page 15.)

Robinson, Sherman, Andrea Cattaneo, and Moataz El-Said (2001). "Updating and Estimating a Social Accounting Matrix Using Cross Entropy Methods." Economic Systems Research, Vol. 13, No. 1, pp. 47-64. (http://www.ifpri.org/divs/tmd/dp/tmdp33.htm) (Cited on page 15.)

Rosstat (1998). Statistical methodology. Part 2. Moscow. (in Russian) [Росстат. Методологические положения по статистике. Выпуск второй. Москва 1998 год. (http://www.gks.ru/documents/metod/met98_2.arj)] (Cited on page 15.)

Rosstat (2006). System of Input-Output tables of Russia for 2003. Moscow. (in Russian) [Росстат. Система таблиц "Затраты-Выпуск" России за 2003 год. Статистический сборник. Москва 2006 год. (http://www.gks.ru/doc_2006/Zatrat06.zip)] (Cited on page 14.)

Shkrebela, I., Tourdyeva, N. (2008) Estimating a Russian input-output table in GTAP format. In Badri Narayanan G. and Terrie L. Walmsley, Editors (2008). Global Trade, Assistance, and Production: The GTAP 7 Data Base, Center for Global Trade Analysis, Purdue University.
(Cited on page 14.)