# Russian "Macro-regions": economic integration and interaction with the world economy

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## 1. Objectives of the study.

The project is dedicated to an analysis of interregional and foreign trade ties of large economic regions in Russia. In the project:

- Effects of economic interactions among the regions of Russia are estimated;

- Non-equivalence level of the actual interregional exchange is determined;

- Equilibrium of the system of regions, i.e., the state of an equivalent interregional exchange, is found;

- System core, i.e., a set of mutually beneficial exchanges, is estimated;

- Consequences of foreign trade liberalization are studied;

- Reasonable rate of export-import tariffs, providing an acceptable unemployment level and sufficient competition from the world market, is assessed;

- Volume of interregional financial transfers, maintaining a sufficient level of internal economic space homogeneity, is estimated.

## 2. Review of literature.

The Western regional science tackles similar problems within the framework of interregional trade and customs unions; conceptual basis of them are the classical studies of J.Thunen , A. Weber, A. Losch, W. Isard. Fundamental studies of these scholars were translated in Russia and, therefore, they are quite well known. In the theories of international trade, basic concepts are introduced, and trade opportunities under various conditions are explored. In particular, free trade zones, common markets, customs, monetary, and economic unions are

defined. In this field, the works of R. Caves, J. Frankel, R. Jones[11], P. Krugman [14], M.Obstfeld.[13], could be noted. The most strict principles, statements and results were obtained in the framework of the customs unions theory where small-dimensional models (1-2 products and 2-3 regions) were applied, and consequences of customs union formation had been studied. In this area of research, the works of B. Balassa [7], M. Kreinin [12], P. Robson [15], E.Truman [17], R. Vickerman [18], could be mentioned. Studies on international trade and customs unions generalize rich empirical data; they widely use econometric methods and models. Among authors who applied such methods, are J. Tinbergen [16], J. Brada, J. Mendez [10] J.Bergstrand [8,9]. Theories of international trade and customs unions had been included in the macroeconomics text-books long ago; advanced text-books in this field do exist, too. Among the latter is the work of B. Soderstren, G. Reed [19].

Our approach to the problems formulated is based on classical parts of mathematical economics: theory of economic equilibrium, multi-objective optimization, and theory of cooperative games.

The theory of economic equilibrium goes back to the works of Walras who gave the first strict definition of economic equilibrium and put the mathematical problem of the equilibrium search. In the thirties of this century, a number of authors (H. Neisser, H. Stakelberg, F. Zeuthen, Schlesinger) had shown that the problem of equilibrium existence is deeper than Walras thought. It is not reduced only to the calculation of the number of equations and variables. The first evidence of the equilibrium existence for simple models was found by A. Wald in mid-thirties. However, a break in this field is connected with name of J .Von Neuman and further Cacutani, who proved the fixed-point theorem. Based on their results, in the early fifties L. W. Mckenzie, K. Arrow and G. Debreu proved the existence of equilibrium for the economies of very general types. The further development of the theory of economic equilibrium is connected with the names of D. Gale, H. Nikaido, H. Uzawa, G. Debreu.

Cooperative games theory fundamentals were laid by the works of F. Edgeworth's: he introduced the concepts of core, negotiations, contract curve. These works were forgotten for almost 80 years. In the early fifties J. Nash, L. Shapley and Gillies studied the solutions of a particular class of games and suggested the concept of the c-core, often called Nash's core afterwards. In late fifties, M.Shubik realized the connection of these results with the ideas of F. Edgeworth. In the next decade and in early seventies, the studies of H. Scarf, G. Debreu, R. Aumann, K. Vind, W. Hildenbrand, M. Khan, D. Brown and A. Robinson explored the accordance among various game theory models, the conformity of the core and the equilibrium of an economic system. K. Arrow and M. Khan introduced the concept of effective sharing. This concept and the explanation of the role of prices usually are connected with the name of V. Pareto and effective sharing is often called Pareto-optimum.

The book by W. Hildenbrand [1] can be regarded as a summarizing work on the theories in question.

### 3. Specific features of the approach used.

Theories of economic equilibrium and cooperative games form two different concepts of market relations. In accordance with the theory of economic equilibrium, a market of commodity-money relations is determined. Any player at the market is completely independent in the decision making. He selects his own supply and demand maximizing his utility function and taking into consideration only the prices and budget constraints. The prices, under which demand and supply are in balance, are called equilibrium prices and the corresponding state of the system is called equilibrium. In accordance with the game theory, the so-called contract market is determined. All participants of the market are independent, too. Anyone of them decides with whom and in which way to interact, in particular, to exchange products and resources. That is, in what coalition and under what conditions he enters the coalition. Any par-

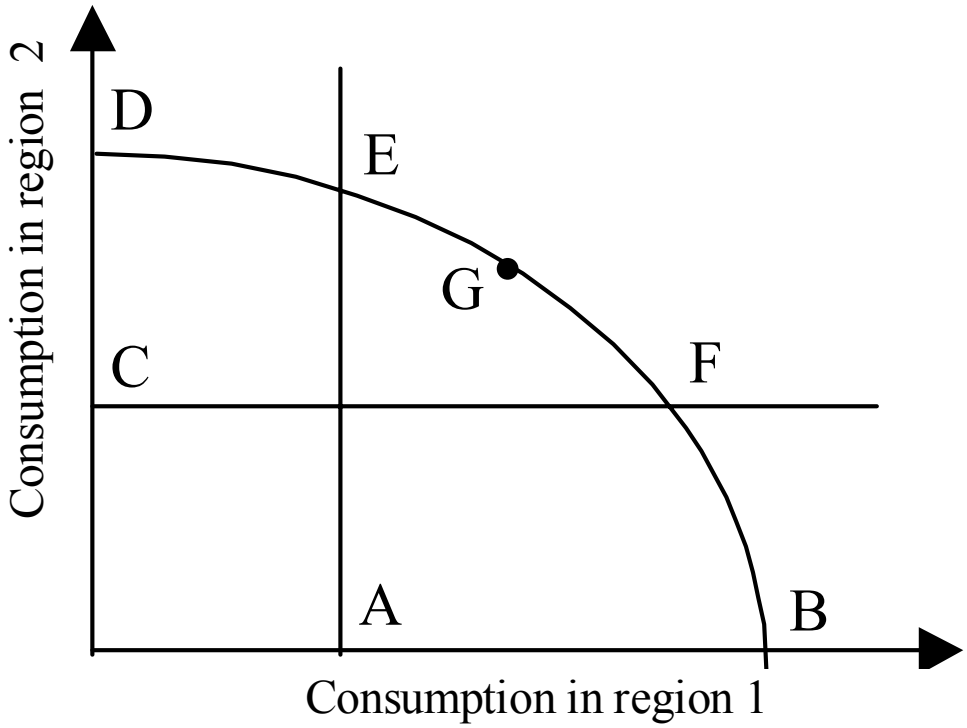
ticipant chooses the coalition that provides the maximum utility function. The existence of the set of exchange options (contracts) when the most beneficial coalition for all market participants is a complete system is proved for rather general conditions. This set is called the core of the system.

The natural field for the application of these mathematically advanced and quite abstract theories is a system of regions. Each region is regarded as the subject of the market relations; regions interact or enter into coalitions if there are no restrictions on the product exchange between them. When a region leaves the coalition (whole system), the exchange of goods with other regions in the coalition is terminated. In the framework of the above theories, the equivalent and mutually beneficial interregional exchange, the effects of interregional internal and external interactions are determined strictly; the ways of searching for the adequate state of exchange and the area of mutually beneficial exchange, are formulated; the methods of assessing the non-equivalency and levels of non-mutually beneficial exchange for the actual states of a regional system are constructed. All these problems were solved within the scope of our approach [3,6]. Illustrations of equilibrium and core for a two-region system are given in Fig1.

**Fig.1**

Economic equilibrium takes place under such exchange prices (prices of equivalent exchange) when each region maximizing the objective function, supplies a volume of export (supply) and demands a volume of import (demand) that are in equilibrium on the interregional market.

A set of sharings and corresponding states of the system, when there are no coalitions of regions that benefit from leaving it, is called the core of an economic system.




DEFB - set of Pareto-optimal values of consumption in regions 1 and 2;
A - value of consumption in region 1 under autarky (in coalition);
C - same for region 2;
EF - core of the system;
G - system equilibrium.

There is no difference of principle between our approach and that of the Western theory of economic integration. In both cases, consequences of alteration of internal and external trade modes for a system of regions are studied. The differences lie in the tools and methodical schemes of the analysis. The approach of Western regional science is based on empirical evaluations of the consequences of changes in trade regimes and, therefore, is limited in its abilities. Our approach is based on the use of models of multi-region systems that allow to conduct various experiments, sometimes fantastic from a standpoint of reality. Lately, the approach in question has been supplemented by the provisions of Western theories. E.g., we can tell that the system of Russian macro-regions in the project is regarded at the minimum as a free trade zone, at the maximum as a customs union. It makes sense to note that even within a customs union the participating regions are not completely independent in their decision making. This requires certain alteration of classical theories.

## 4. Multi-regional models.

A. Granberg proposed the multi-regional models used in this approach, in late sixties. W. Isard, L. Moses and Stevens suggested the idea of the above models that consist in joining the input-output conditions and transportation tasks, in the seventies. These are optimization models, but they are used as a tool for searching for specific states of a system of regions (e.g., equilibrium and core), which, in accordance with the theory, are supported by market mechanisms.

The basic model includes the following endogenous variables:

$\mathbf{x}^{r}$ - column vector of production in region r;

$\mathbf{x}^{sr}$ - column vector of export from region s to region r;

$\mathbf{v}^{r}$ - column vector of export from region r to world market;

$\mathbf{w}^r$ - column vector of import of region r from world market;

$\mathbf{S}^r$ - trade balance of region r;

**S** - trade balance of Russia;

$\mathbf{z}^r$ - consumption of the population in region r (goal function of the region);

**z** - consumption of the population of Russia (goal function of the system);

The model uses following parameters and exogenous variables:

$\mathbf{A}^r$ - $\mathbf{n_x n}$ matrix of coefficients of material expenses (input-output coefficients) in region r;

$\alpha^r$ - column vector of industry structure of population's consumption in region r;

$\lambda^r$ - share of region r in the system consumption (these are parameters of the model vector criterion function scalarization; their change is the main tool for studying various Pareto-optimal states of the system; in particular,- search for the equilibrium and the core);

$\mathbf{c}^r$ - row vector of capital-intensity coefficients in region r;

$\mathbf{C}^r$ - fixed capital in region r;

$\mathbf{l}^r$ - row vector of production labor-intensity in region r;

$\mathbf{L}^r$ - active population in region r;

$\mathbf{N}^r$ - column vector of accumulated production capacities in region r;

$\mathbf{q}^r$ - column vector of fixed part of the final product in region r;

$\mathbf{p}^r$ - row vector of commodity exchange rate of domestic currency with respect to foreign currency, its cells show the ratio of world market dollar prices to the domestic actual ruble prices;

$\mathbf{V}^r$ - column vector of feasible export (domestic prices) from region r;

**V** - column vector of feasible export (world prices) from Russia;

$\mathbf{W^r}$ - column vector of feasible import (domestic prices) into region r;

**W** - feasible import (world prices) into Russia.

**Regional blocks of the model include:**

**a)** Balance of production and distribution of the output:

$$(\mathbf{I} - \mathbf{A^r})\mathbf{x^r} - \alpha^r\mathbf{z^r} - \sum_{r \neq s}(\mathbf{x^{rs}} - \mathbf{x^{sr}}) - \mathbf{v^r} + \mathbf{w^r} \geq \mathbf{q^r},$$

where **I** is a unit matrix

**b)** Balance of fixed production assets:

$$\mathbf{c^r x^r} \leq \mathbf{C^r}$$

**c)** Labor balance:

$$\mathbf{l^r x^r} \leq \mathbf{L^r}$$

**d)** Constraints on production capacities utilization:

$$\mathbf{x^r} \leq \mathbf{N^r}$$

**e)** Constraints on the regional trade balance.

$$\mathbf{p^r(v^r - w^r)} \geq \mathbf{S^r},$$

**f)** Constraints on the regional size of export and import:

$$\mathbf{v^r} \leq \mathbf{V^r}$$

$$\mathbf{w^r} \leq \mathbf{W^r}$$

**System constraints:**

**g)** Constraint on the regional pattern of consumption:

$$\mathbf{z^r - \lambda^r z \geq o}$$

**h)** Constraint on the trade balance of the country:

$$\sum_r \mathbf{P^r(v^r - w^r) \geq S}$$

**i)** Constraints on the size of export and import for the country:

$$\sum_r \mathbf{v^r \leq V}$$

$$\sum_r \mathbf{w^r \leq W}$$

(Constraints on trade balance and export-import are introduced in order to study the consequences of regional foreign trade liberalization and various protectionist policies).

**j) Goal function**

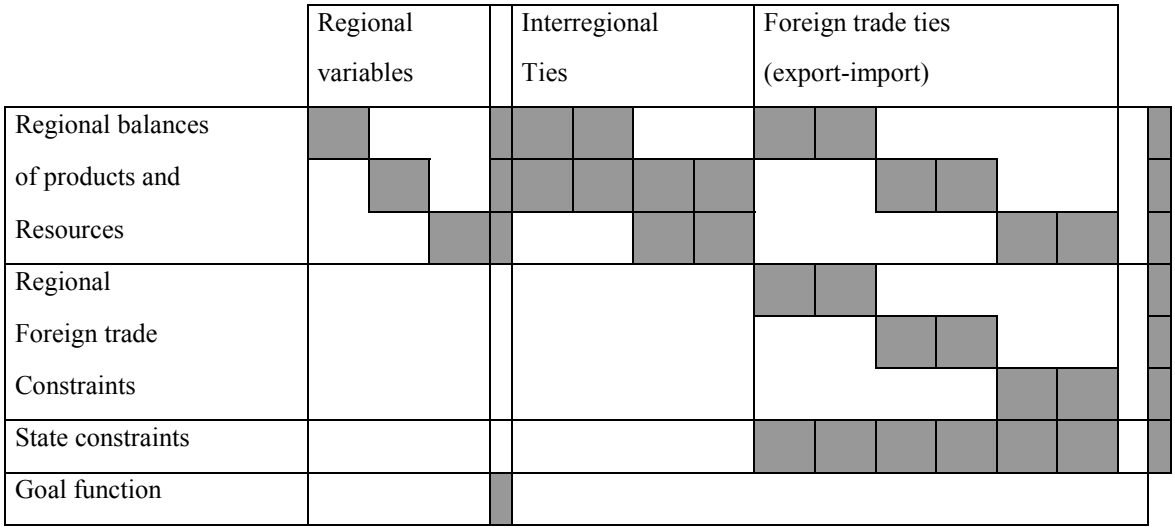
$$\mathbf{z \rightarrow max!}$$

The adduced model is simplified (in order not to cram the description). All goods are considered transportable. The applied calculations take into consideration the transportation costs.

Structure of the 3-region model is presented in Fig 2.

**Fig. 2**

**Multi-regional input-output model (example of three regions)**




Columns:

- Regional variables;
- Final consumption;
- Interregional ties;
- Foreign trade ties (export-import)
- Fixed value of constraints.

Rows:

- Regional balances of products and resources;
- Regional foreign trade constraints (trade balance, customs restrictions)
- National foreign trade constraints;
- Goal function of the model (final consumption of the system)

## 5. Input data.

Input data of the model for every region envelops input-output matrix, volumes of production, employment and fixed capital by industries, investment and consumption of the population, internal and external export and import, dollar exchange rates for exported and imported goods. Based on official statistics and with minimum of expert estimations, input data for 1990 were obtained. The actualization of the data with the use of various indirect methods of the indices evaluation has become a serious result of the pre-project work and the first stage of the project implementation. As of today, the basic solutions of the Russian model correspond to 1993. This model is presented in the context of five macro-regions (European part, the Urals, West Siberia, East Siberia and Russian Far East) and thirty industries of material production.

Data preparation was carried out as follows.

The basis for the primary data was the reported input-output balance of Russia for 1990 and input-output balances of all eastern economic regions - from the Urals to the Russian Far East for 1987. Generation of all regional input-output balances for 1993 consisted of several stages. At the first stage, a list of line items in the initial 18-branch balance for 1990 was extended, and input-output balance of 30 branches was created. The next stage was the formation of input-output balances of 5 regions for 1990: European part, the Urals, West Siberia, East Siberia and the Russian Far East. For this purpose, the list of initial 18-branch balances of the economic regions for 1987 was expanded; then, in accordance with the dynamics of the production in 1988-1990 represented in the appropriate reported statistics, a transition to 1990 was made. Due to the price change in 1988-1990, a multiplication of 1987 balance columns by the branch growth rates did not result in exact correspondence with the reported input-output balance for 1990. For several branches, volume of production measured in the 1987 prices, was less than actual data of the balance of 1990. The structure of net product was

deformed. It resulted from the higher rate of wage increase as compared with the gross social product. Therefore, the last stage of building the 5- region input-output balances was the additional adjustment of obtained 1990 balances with account for the change in prices and net product structure in 1988-1990.

Generation of regional 1993 input-output balances was based on the 5-region information for 1990.

The indices used for the transition to 1993, were those of actual volume of production and consumption. With respect to production technology, the hypothesis of the lack of essential changes was accepted. Regional structure of consumption of the population was determined from the reports on territorial structure of consumption spending in 1993. Capital inputs were calculated on the basis of investment dynamics and their structural changes with regard to the ratio between capital-producing branches. Assessment of export and import was done based on the developments of TACIS program “Analysis of development tendencies for Russian regions in 1992-1995”and on the published materials.

The result of coordinating the aforementioned issues with test calculations was the construction of input-output balances of 5 macro-regions for 1993; it allowed to obtain the indicators employed in the model: coefficients of material expenses, labor-intensity, production capital-intensity coefficients, labor resources, fixed capital, branch and territorial structure of non-production consumption, volume of production, indices of interregional ties, export and import for 30 industries and 5 Russian regions.

An important role in the model is played by the commodity exchange rate of the currency which transform domestic prices into the world prices. Their values were obtained based on a Goskomstat report carried out in 1989, where export and import data from foreign trade statistics were compared; namely, the world market prices measured in foreign currency

rubles and domestic prices from the input-output balances. Actually, these indices are the ratios of commodity exchange rates of domestic ruble to the foreign currency one. In order to obtain the commodity exchange rate as related to the dollar, these indices were divided by the dollar exchange rate.

David Tarr has made an assessment of commodity exchange rates for countries of the former Soviet Union including Russia. His results are presented in Working Papers of the World Bank ([23]). Since David Tarr used Goskomstat information in his work, the differences are rather negligible (Table 1). Margins for the values of exchange rates are shown because D.Tarr used more detailed classification of products and made (as the USSR Goskomstat) the estimates for export and import separately. In fact, he adjusted the Goskomstat estimates by the price dynamics in the early 90s. However, since price changes in that period were very chaotic, it would be incorrect to draw an unambiguous conclusion in favor of D.Tarr's data.

The problem of actualization of the input data has not been solved completely. In the process of work errors in the input data were found; they will be corrected in the nearest future. Therefore, results presented below are of somewhat preliminary character.

## 6. Analysis of the actual state.

Calculations were performed with the model including constraints **a, b, c, d, g** (see section 4), export and import variables were fixed on the actual values, right-hand portions of constraints on fixed capital, labor and production capacities ($\mathbf{C^r}$, $\mathbf{L^r}$,$\mathbf{N^r}$) were set (as in all main cases) at the actual level, as well.

Basic solutions of the model imitate the state of Russian economy in 1993, i.e., reproduce and, to some extent, remodel this situation. They remodel it, since actual information on the real situation is practically absent in the amount needed. To the most extent, this pertains to interregional exchange indicators.

**Table 1**

## Various estimates of foreign-to-domestic price ratio

| Industries | David Tarr's estimates (World Bank) | Goskomstat estimates |
|---|---|---|
| 1.Power industry | 1,500 | 1,490 |
| 2. Oil industry | 3,540 | 3,310 |
| 3. Oil-processing industry | 2,000 | 1,070 |
| 4. Gas industry | 2,460 | 2,140 |
| 5. Ferrous ores | 0,902 | 1,000 |
| 6. Ferrous metals | 0,70-1,50 | 1,180 |
| 7. Non-ferrous ores | 1,20-1,50 | 0,700 |
| 8. Non-ferrous metals | 1,50-1,60 | 1,570 |
| 9. Basic chemistry | 0,70-1,20 | 0,740 |
| 10. Petrochemistry | 0,60-0,90 | 0,603 |
| 11. Machine building | 0,90-1,40 | 1,200 |
| 12. Timber industry | 0,700 | 0,790 |
| 13. Woodworking industry | 0,75-0,80 | 0,720 |
| 14. Pulp and paper industry | 0,78-0,81 | 0,760 |
| 15. Textile industry | 0,25-0,33 | 0,390 |
| 16. Clothing industry | 0,327 | 0,330 |
| 17. Meat and dairy industry | 0,30-0,50 | 0,380 |
| 18. Fish industry | 0,451 | 0,480 |
| 19. Other food processing industry | 0,431 | 0,390 |
| 20. Flour-grinding and cereals industry | 0,434 | 0,640 |
| 21. Plant-growing | 0,500 | 0,440 |
| 22.Stock-raising | 0,2-0,3 | 0,180 |

This exchange has plausible character for the basic solutions (Table 2): European part of Russia supplies products of engineering, consumer goods, food processing industries, agriculture; the Urals supplies products of oil-refining, metallurgy and engineering industries; West Siberia is the main supplier of oil and gas, East Siberia - electric power and timber; Russian Far East – sea food. The balance of interregional exchange at 1990 prices is positive for the European part only (Table 2, the last row – in absolute terms; Table 9, row 1 – in relative terms); East Siberia and the Far East have particularly adverse balance.

**Table 2**

## Balance of actual interregional exchange in 1993 (billion rubles, 1990 prices) (estimate on the model solution) *)

| | European part | Urals | West Siberia | East Siberia | The Far East |
|---|---|---|---|---|---|
| 1.Power industry | 0,822 | -0,414 | -0,750 | 0,723 | -0,381 |
| 2. Oil industry | -0,755 | -0,228 | 2,323 | -0,759 | -0,581 |
| 3. Oil-processing industry | -2,052 | 2,712 | -1,143 | 0,316 | 0,168 |
| 4. Gas industry | -2,850 | -1,704 | 4,569 | -0,014 | -0,002 |
| 5. Other fuel producing industries | 0,097 | -0,504 | 0,144 | 0,187 | 0,076 |
| 6. Ferrous ores | 0,050 | -0,284 | -0,012 | 0,250 | -0,004 |
| 7. Ferrous metals | -1,413 | 2,149 | -0,260 | -0,238 | -0,238 |
| 8. Non-ferrous ores | -0,028 | -0,009 | 0,003 | 0,003 | 0,031 |
| 9. Non-ferrous metals | -0,554 | 0,471 | -0,019 | 0,013 | 0,089 |
| 10. Basic chemistry | 0,096 | 0,153 | 0,156 | 0,058 | -0,463 |
| 11. Petrochemistry | 0,047 | 0,124 | -0,040 | 0,035 | -0,166 |
| 12. Machine building | 5,513 | 0,874 | -2,877 | -1,674 | -1,836 |
| 13. Timber industry | -0,060 | 0,029 | -0,008 | 0,031 | 0,008 |
| 14. Woodworking industry | 0,016 | -0,027 | -0,118 | 0,101 | 0,028 |
| 15. Pulp and paper industry | 0,009 | -0,031 | -0,148 | 0,108 | 0,062 |
| 16. Textile industry | 2,281 | -1,129 | -0,631 | 0,061 | -0,582 |
| 17. Clothing industry | 0,989 | -0,104 | -0,296 | -0,262 | -0,327 |
| 18. Other light industry | 1,351 | -0,263 | -0,774 | -0,100 | -0,214 |
| 19. Meat and dairy industry | -0,325 | 0,177 | 0,377 | 0,089 | -0,318 |
| 20. Fishing industry | 0,169 | -0,450 | -0,236 | -0,209 | 0,726 |
| 21. Other food processing industry | 6,681 | -1,337 | -2,550 | -1,714 | -1,080 |
| 22. Flour-grinding and cereals industry | -0,218 | 0,524 | -0,145 | -0,164 | 0,003 |
| 23. Plant-growing | 3,964 | -0,998 | -0,472 | -0,820 | -1,674 |
| 24.Stock-raising | 3,118 | -0,171 | -0,534 | -0,931 | -1,482 |
| Total | 20,867 | -1,269 | -6,040 | -5,098 | -8,460 |

∗) In this table and all the following tables that contain industry information, the industries producing non-transportable goods, and a number of "other" industries were excluded.

Analysis of the results of calculations for all possible coalitions makes it possible to create a table of the effects of interregional interactions. In Table 3, the effects are presented in relative terms for the situation of fixed foreign trade. Hundred percent are the actual value of

the regional goal function - consumption of the population. Contribution of the European part constitutes 39.4%; i.e., under the conditions of complete autarky this region can provide 39.4% of the actual value of the goal function. Interaction with the Urals adds 15.4%, with West Siberia - 29.1%, and so on. The fixed foreign economic ties provide for mere 2.6% of consumption. It is clear from the table that eastern regions have no opportunities to develop under autarky. In Russia as a whole, the largest contribution is made by the European part (summarizing column of the table): it supports almost a half of total consumption. This, however, is significantly less than the consumption in this region itself. Second contribution value belongs to West Siberia: almost a quarter of the total consumption; this, on the contrary, is higher than its own consumption. Balance of interaction (Table 6, row 4), i.e., the difference between total regional contribution and regional consumption (more precisely, total internal effect), is +136.7% of the consumption for West Siberia and -26.3% for the European part.

**Table 3**

**Effects of interregional interactions under fixed foreign trade in % to consumption of the population**

| | European part | Urals | West Siberia | East Siberia | The Far East | Russia Total |
|---|---|---|---|---|---|---|
| European part | 39.4 | 56.1 | 68.4 | 60.4 | 56.3 | 46.7 |
| Urals | 15.4 | 8.1 | 14.7 | 14.4 | 20.7 | 14.7 |
| West Siberia | 29.1 | 16.2 | 0.0 | 17.5 | 16.1 | 23.1 |
| East Siberia | 8.8 | 3.8 | 5.8 | 0.0 | 4.6 | 7.1 |
| Russian Far East | 4.7 | 9.8 | 4.3 | 4.6 | 0.0 | 3.5 |
| Foreign trade | 2.6 | 6.0 | 6.8 | 3.1 | 2.3 | 3.5 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 |

These figures, however, should be treated with extreme caution. Their recording up to decimal point of a per cent is rather formal. We hope that the real balances of interaction are positive for West Siberia, negative for the European part, and the absolute values are about 1/6 - 1/3 of consumption for those regions.

The level of non-equivalency of interregional exchange for the actual state is rather high (Table 9, row 2). The values of balances of internal interactions in equilibrium prices (these are dual estimates of constraints - the balances of production and distribution) are significant and differ essentially from those in actual prices of 1990. These differences are particularly large for the European part and West Siberia. Because of the radical change in the price structure during 1990-1993 (the structure changed in the direction of equilibrium prices), the estimates of internal export - import balance in the actual 1993 prices apparently occupy an intermediate position (between the first and the second row of Table 9).

**Table 4**

**Effects of interregional interactions under free foreign trade in % to consumption of the population**

| | European part | Urals | West Siberia | East Siberia | The Far East | Russia Total |
|---|---|---|---|---|---|---|
| European part | 25,9 | 14,0 | 18,7 | 17,6 | 15,3 | 21,7 |
| Urals | 0,9 | 5,3 | 0,5 | 0,5 | 4,7 | 1,2 |
| West Siberia | 4,9 | 0,0 | 0,0 | 1,6 | 1,2 | 2,6 |
| East Siberia | 3,2 | -0,8 | 0,9 | 0.0 | 0,0 | 1,6 |
| The Far East | 0,2 | 3,5 | 1,5 | 1,0 | 0,0 | 1,7 |
| Foreign ties | 64,9 | 78,0 | 79,3 | 78,4 | 78,8 | 71,2 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 |

**Table 5**

**Effects of interregional interactions under regulated foreign trade in % to consumption of the population**

| | European part | Urals | West Siberia | East Siberia | The Far East | Russia Total |
|---|---|---|---|---|---|---|
| European part | 27.1 | 32,9 | 37,0 | 34,9 | 32,9 | 31,1 |
| Urals | 11,4 | 5,4 | 10,7 | 10,8 | 16,5 | 10,6 |
| West Siberia | 20,4 | 15,5 | 0.0 | 19,9 | 17,7 | 14,2 |
| East Siberia | 4,5 | 1,9 | 5,5 | 0.0 | 4,7 | 4,2 |
| The Far East | 3,1 | 6,5 | 4,2 | 3,6 | 0.0 | 3,7 |
| Foreign ties | 33,5 | 37,8 | 42,6 | 30,8 | 28,2 | 36,2 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 |

**Table 6**

## Final indicators of the effects of interactions under fixed foreign trade, in % to consumption of the population *)

| | European part | Urals | West Siberia | East Sibe-ria | the Far East | Russia Total |
|---|---|---|---|---|---|---|
| Own contribution | 39.4 | 8.1 | 0.0 | 0.0 | 0.0 | 26.8 |
| Pure internal effect | 58.0 | 85.9 | 93.2 | 96.9 | 97.7 | 69.7 |
| Total internal effect | 97.4 | 94.0 | 93.2 | 96.9 | 97.7 | 96.5 |
| Balance of interaction | -26.3 | 32.9 | 136.7 | 18.7 | -23.7 | 0.0 |

*) The first row of the table was formed with the diagonal elements of Table 3; the third row was obtained by subtracting the effects of foreign trade presented in row 6 in Table 3, from 100; indicators in the second row are differences between the corresponding indicators of the third and first rows; indicators in the fourth row were obtained by subtracting the total internal regional effects (they are presented in relative terms in the previous row) from the total regional contributions (they are presented in the relative terms in the total column of Table 3), and by dividing by the final regional consumption of the population.

**Table 7**

## Final indicators of the effects of interactions under free foreign trade in % to consumption of the population

| | European part | Urals | West Siberia | East Sibe-ria | The Far East | Russia Total |
|---|---|---|---|---|---|---|
| Own contribution | 25,9 | 5,3 | 0.0 | 0.0 | 0.0 | 13,9 |
| Pure internal effect | 9,2 | 16,7 | 20,7 | 21,6 | 21,2 | 15,9 |
| Total internal effect | 35,1 | 22,0 | 20,7 | 21,6 | 21,2 | 29,8 |
| Balance of interaction | -1,0 | -10,7 | 10,4 | 9,0 | 3,4 | 0.0 |

**Table 8**

## Final indicators of the effects of interactions under regulated foreign trade in % to consumption of the population

| | European part | Urals | West Siberia | East Sibe-ria | The Far East | Russia Total |
|---|---|---|---|---|---|---|
| Own contribution | 27,1 | 5,4 | 0.0 | 0.0 | 0.0 | 14,7 |
| Pure internal effect | 39,4 | 56,8 | 57,4 | 69,2 | 71,8 | 49,1 |
| Total internal effect | 66,5 | 62,2 | 57,4 | 69,2 | 71,8 | 63,8 |
| Balance of interaction | -21,0 | 31,3 | 116,6 | -5,0 | -19,3 | 0.0 |

**Table 9**

## Balance of interregional exchange in % to consumption of the population (with actual territorial pattern of consumption of the population)

| Prices: | European part | Urals | West Siberia | East Siberia | The Far East |
|---|---|---|---|---|---|
| Fixed foreign trade | | | | | |
| 1990 | 15.9 | -5.6 | -29.9 | -40.7 | -64.1 |
| Equilibrium | -3.2 | -10.1 | 101.4 | -43.3 | -76.5 |
| Complete liberalization of foreign trade | | | | | |
| *1990* | *-8.9* | *2.3* | *78.4* | *-5.6* | *-30.9* |
| Equilibrium | -20.7 | 10.2 | 161.1 | 7.5 | -57.8 |
| Foreign trade liberalization under export-import constraints | | | | | |
| 1990 | -10.2 | 11.2 | 69.0 | 5.9 | -29.6 |
| Equilibrium | -18.0 | 22.8 | 112.1 | -2.1 | -37.0 |

However, the actual situation is formally mutually beneficial. I.e., any coalition of regions will lose if it isolates itself from the system. This happens due to weak adaptive abilities of large regions to breaking the ties under the fixed foreign trade conditions. The system core area is large and includes the actual point (Table 13, rows 1,3). The core area is most stretched in the direction of West Siberia: final consumption of this region may be increased more than by four times at the expense of other regions in the core area. For the Urals, East Siberia and the Russian Far East, the increase is possible by about two times; and for the European part – by less than one and a half times.

**Table 10**

## Balance of export-import (billion rubles, 1990 prices)

| | Actual | | Completely free foreign trade | | Regulated foreign trade | |
|---|---|---|---|---|---|---|
| | Domestic prices | World prices | Domestic prices | World prices | Domestic prices | World prices |
| 1.Power industry | 0,373 | 0,556 | -1,878 | -2,798 | -2,446 | -3,644 |
| 2. Oil industry | 5,583 | 18,480 | 12,445 | 41,193 | 8,688 | 28,757 |
| 3. Oil-processing industry | 4,282 | 4,582 | -14,612 | -15,635 | -3,480 | -3,724 |
| 4. Gas industry | 3,136 | 6,711 | 1,952 | 4,177 | 1,915 | 4,098 |
| 5. Other fuel producing industries | 0,589 | 0,477 | 0,023 | 0,019 | 0,000 | 0,000 |
| 6. Ferrous ores | 0,373 | 0,373 | 0,367 | 0,367 | 0,367 | 0,367 |
| 7. Ferrous metals | 4,755 | 5,611 | 4,494 | 5,303 | 4,465 | 5,269 |
| 8. Non-ferrous ores | -0,021 | -0,015 | -0,034 | -0,024 | -0,033 | -0,023 |
| 9. Non-ferrous metals | 5,962 | 9,360 | 5,649 | 8,869 | 5,669 | 8,900 |
| 10. Basic chemistry | 1,342 | 0,993 | -1,473 | -1,090 | -1,255 | -0,929 |
| 11. Petrochemistry | 2,572 | 1,620 | 1,791 | 1,128 | 1,803 | 1,136 |
| 12. Machine building | 2,797 | 3,356 | -5,387 | -6,464 | -5,609 | -6,731 |
| 13. Timber industry | 1,181 | 0,933 | 1,225 | 0,968 | 1,132 | 0,894 |
| 14. Woodworking industry | 1,763 | 1,269 | -0,259 | -0,186 | -0,235 | -0,169 |
| 15. Pulp and paper industry | 1,020 | 0,775 | 0,761 | 0,578 | 0,729 | 0,554 |
| 16. Textile industry | -3,218 | -1,255 | -11,084 | -4,323 | -10,345 | -4,034 |
| 17. Clothing industry | -2,953 | -0,974 | -9,730 | -3,211 | -9,053 | -2,987 |
| 18. Other light industry | -2,748 | -1,071 | -6,949 | -2,710 | -6,533 | -2,547 |
| 19. Meat and dairy industry | -4,870 | -1,851 | -30,590 | -11,624 | -17,984 | -6,834 |
| 20. Fish industry | 0,185 | 0,089 | -1,235 | -0,593 | -1,193 | -0,573 |
| 21. Other food processing industry | -7,031 | -2,742 | -31,636 | -12,338 | -30,474 | -11,885 |
| 22. Flour-grinding and cereals industry | 0,174 | 0,111 | 3,149 | 2,015 | -0,009 | -0,006 |
| 23. Plant-growing | -5,620 | -2,473 | 5,447 | 2,397 | -7,247 | -3,189 |
| 24.Stock-raising | -0,163 | -0,029 | -27,434 | -4,938 | -9,556 | -1,720 |
| Total | 11,893 | 46,899 | -107,840 | 0,001 | -83,286 | 0,008 |

**Table 11**

## Equilibrium prices under completely free foreign trade

| | European part | Urals | West Siberia | East Siberia | The Far East | Commodity exchange rate of the ruble |
|---|---|---|---|---|---|---|
| 1.Power industry | 2,571 | 2,556 | 2,545 | 2,519 | 2,492 | 1,490 |
| 2. Oil industry | 5,710 | 5,660 | 5,632 | 5,631 | 5,535 | 3,310 |
| 3. Oil-processing industry | 1,852 | 1,837 | 1,829 | 1,822 | 1,840 | 1,070 |
| 4. Gas industry | 3,708 | 3,679 | 3,633 | 3,655 | 3,566 | 2,140 |
| 5. Other fuel producing industries | 1,393 | 1,395 | 1,391 | 1,358 | 1,345 | 0,810 |
| 6. Ferrous ores | 1,724 | 1,717 | 1,700 | 1,688 | 1,684 | 1,000 |
| 7. Ferrous metals | 2,037 | 2,020 | 2,013 | 2,003 | 1,981 | 1,180 |
| 8. Non-ferrous ores | 1,211 | 1,201 | 1,196 | 1,191 | 1,171 | 0,700 |
| 9. Non-ferrous metals | 2,713 | 2,688 | 2,678 | 2,661 | 2,632 | 1,570 |
| 10. Basic chemistry | 1,280 | 1,269 | 1,264 | 1,251 | 1,245 | 0,740 |
| 11.Petrochemistry | 1,087 | 1,078 | 1,076 | 1,065 | 1,059 | 0,603 |
| 12. Machine building | 2,072 | 2,054 | 2,048 | 2,037 | 2,015 | 1,200 |
| 13. Timber industry | 1,358 | 1,346 | 1,338 | 1,324 | 1,312 | 0,790 |
| 14. Woodworking industry | 1,241 | 1,236 | 1,232 | 1,215 | 1,202 | 0,720 |
| 15. Pulp and paper industry | 1,310 | 1,306 | 1,301 | 1,281 | 2,268 | 0,760 |
| 16. Textile industry | 0,674 | 0,669 | 0,666 | 0,663 | 0,655 | 0,390 |
| 17. Clothing industry | 0,570 | 0,566 | 0,563 | 0,560 | 0,554 | 0,330 |
| 18. Other light industry | 0,674 | 0,668 | 0,665 | 0,662 | 0,655 | 0,390 |
| 19. Meat and dairy industry | 0,660 | 0,655 | 0,653 | 0,652 | 0,644 | 0,380 |
| 20. Fish industry | 0,832 | 0,826 | 0,823 | 0,821 | 0,798 | 0,480 |
| 21. Other food processing industry | 0,675 | 0,670 | 0,667 | 0,664 | 0,657 | 0,390 |
| 22. Flour-grinding and cereals industry | 1,104 | 1,094 | 1,094 | 1,090 | 1,069 | 0,640 |
| 23. Plant-growing | 0,752 | 0,744 | 0,763 | 0,765 | 0,755 | 0,440 |
| 24.Stock-raising | 0,316 | 0,314 | 0,314 | 0,317 | 0,312 | 0,180 |
| Exchange rate of dollar (dual prices of **e**) | 1,727 | 1,713 | 1,705 | 1,696 | 1,677 | |

**Table 12**

## Equilibrium prices under regulated foreign trade and export-import tariffs

| | Euro-pean part | Urals | West Siberia | East Siberia | The Far East | Tariffs | Share of tariff in internal price | Com-modity ex-change rate of the ruble |
|---|---|---|---|---|---|---|---|---|
| 1.Power industry | 2,052 | 2,097 | 2,072 | 2,032 | 2,096 | 0,023 (i) | 1,1 | 1,490 |
| 2. Oil industry | 3,579 | 3,561 | 3,501 | 3,599 | 3,731 | 1,08 (e) | 28,9-30,8 | 3,310 |
| 3. Oil-processing indus-try | 1,639 | 1,586 | 1,616 | 1,576 | 1,511 | 0,127 (i) | 7,7-8,4 | 1,070 |
| 4. Gas industry | 3,027 | 3,018 | 2,954 | 3,022 | 3,057 | | | 2,140 |
| 5. Other fuel producing industries | 1,136 | 1,203 | 1,191 | 1,118 | 1,135 | | | 0,810 |
| 6. Ferrous ores | 1,407 | 1,408 | 1,383 | 1,392 | 1,424 | | | 1,000 |
| 7. Ferrous metals | 1,663 | 1,657 | 1,668 | 1,683 | 1,705 | | | 1,180 |
| 8. Non-ferrous ores | 0,988 | 0,985 | 0,973 | 0,983 | 0,989 | | | 0,700 |
| 9. Non-ferrous metals | 2,227 | 2,205 | 2,194 | 2,195 | 2,225 | | | 1,570 |
| 10. Basic chemistry | 1,045 | 1,041 | 1,029 | 1,032 | 1,052 | | | 0,740 |
| 11. Petrochemistry | 0,887 | 0,884 | 0,889 | 0,918 | 0,947 | 0,017 (e) | 1,8-1,9 | 0,603 |
| 12. Machine building | 1,691 | 1,707 | 1,718 | 1,733 | 1,755 | 0,051 (i) | 2,9-3,0 | 1,200 |
| 13. Timber industry | 1,120 | 1,103 | 1,088 | 1,090 | 1,107 | | | 0,790 |
| 14. Woodworking in-dustry | 1,013 | 1,053 | 1,082 | 1,049 | 1,016 | 0,079 (i) | 7,3-7,8 | 0,720 |
| 15. Pulp and paper in-dustry | 1,069 | 1,108 | 1,096 | 1,056 | 1,071 | 0.037 (e) | 3,3-3,5 | 0,760 |
| 16. Textile industry | 0,550 | 0,547 | 0,542 | 0,547 | 0,554 | | | 0,390 |
| 17. Clothing industry | 0,466 | 0,461 | 0,458 | 0,463 | 0,469 | | | 0,330 |
| 18. Other light industry | 0,550 | 0,554 | 0,541 | 0,546 | 0,554 | | | 0,390 |
| 19. Meat and dairy in-dustry | 1,162 | 1,161 | 1,156 | 1,163 | 1,169 | 0,626 (i) | 53,6-54,2 | 0,380 |
| 20. Fishing industry | 0,680 | 0,678 | 0,671 | 0,679 | 0,614 | | | 0,480 |
| 21. Other food process-ing industry | 0,551 | 0,549 | 0,543 | 0,549 | 0,556 | | | 0,390 |
| 22. Flour-grinding and cereals industry | 0,901 | 0,868 | 0,891 | 0,900 | 0,875 | 0,02 (i) | 2,2-2,3 | 0,640 |
| 23. Plant-growing | 0,628 | 0,543 | 0,622 | 0,635 | 0,640 | | | 0,440 |
| 24.Stock-raising | 0,352 | 0,370 | 0,359 | 0,375 | 0,377 | 0,127 (i) | 33,7-36,1 | 0,180 |
| Dollar exchange rate (Dual prices of e) | 1,409 | 1,395 | 1,399 | 1,386 | 1,417 | | | |

**Table 13**

## Regional pattern of consumption of the population (parameters $\lambda^r$)

| | European part | Urals | West Siberia | East Siberia | the Far East |
|---|---|---|---|---|---|
| under the exogenous foreign trade | | | | | |
| Actual | 65.4 | 11.6 | 10.1 | 6.3 | 6.6 |
| Equilibrium | 65.8 | 10.5 | 18.7 | 3.5 | 1.5 |
| Core boundaries | 32-90 | 1-28 | 0-44 | 0-16 | 0-16 |
| complete foreign trade liberalization | | | | | |
| Equilibrium | 52.1 | 12.7 | 26.5 | 5.8 | 2.9 |
| At world prices | 50.5 | 14.5 | 26.7 | 5.5 | 2.8 |
| Core boundaries | 2.1 | 2.7 | 6.5 | .8 | .9 |
| Foreign trade liberalization under the export-import restrictions | | | | | |
| Equilibrium | 52.0 | 12.6 | 26.8 | 5.7 | 2.9 |
| At world pricesв | 50.2 | 14.1 | 27.2 | 5.6 | 2.9 |
| Core boundaries | *21-78* | *3-15* | *6-30* | *0-8* | *0-7* |

**7. <u>Foreign trade liberalization.</u>**

Consequences of the foreign trade liberalization are estimated. The variables of export and import ($v^r$, $w^r$) become endogenous and c constraints (see Section 4) on the regional balance of foreign trade are imposed. In the calculations these balances were assumed to be equal to zero ($S^r = 0$). The decisive role in such model experiments belongs to the commodity exchange rates of the ruble (parameters $p^r$). Their values are presented in the last columns of Tables 11 and 12. As is seen, domestic prices differ essentially from the world ones: oil price is more than by 3 times lower than the world price; price of stock-raising products – by more than 5 times higher than world one. This predetermines very serious consequences of foreign trade liberalization.

If territorial structure would not change and would stay on the actual level (the system would not come to equilibrium), then the nature of interregional ties would change radically. European part of Russia is the only region which has a positive actual balance of interregional

exchange, would be the importing region (Table 9, row 3); positive balance of West Siberia would reach almost 80% of regional consumption, Urals region would get small positive balance of exchange. Measurement of these balances in equilibrium prices provides the estimates of non-equivalence level of interregional exchange (Table 9, row 4). The level of non-equivalence increases in comparison with the actual state under fixed foreign trade. Burden on West Siberia grows substantially; Urals and East Siberia become recipients. European part appears to be the biggest donor (20% of regional consumption is formed at the expense of other regions).

Further on, the system is brought to equilibrium (equivalent exchange). Foreign trade turnover increases significantly (as compared with the actual turnover), foreign trade pattern changes (Table 10, columns 3,4 в in comparison with columns 1,2). Oil export increases more than by 3 times, import of light, food and stock-raising industry products increases by 3, 4 and more times. Russia becomes an importer of oil-processing and engineering products; sign of export-import balance changes for several other products too.

Domestic equilibrium prices for the above situation are presented in Table 11. They coincide with the world market prices with an accuracy of transportation costs. Data from the Table gives proof to this: if domestic price is divided by exchange rate of the dollar (in rubles) given in the last row of the table (these are dual estimates of constraints on the regional balances of foreign trade), then the result will be similar (with an accuracy of transportation costs) to the commodity exchange rate of ruble.

Complete foreign trade liberalization results in:

a) consumption increased by 1.5; consumption in West Siberia increased more than by 4 times;

b) on the average, employment decreased almost by 10 percent points (it was particularly significant in the Russian Far East, East Siberia and in the Urals)

c) total destruction of stock-raising, oil-refining, meat and dairy industries, catastrophic decrease of production in consumer goods and food processing industries;

d) practically complete disintegration of the internal economic space: the regions do not exchange products, they operate in the world market only.

Export proceeds from oil, gas, metals, timber are used for the import of oil-refining products, consumer goods, food products and some other products. As for the regional consumption pattern, West Siberia's share had risen, share of the European part had decreased essentially (Table 13, rows 4,5). The system core is reduced to a single point - the state of equilibrium (in Table 13, row 6, the core is presented as a point that coincides with the equilibrium).

It is like the situation in the recent past, but in exaggerated and even caricatured form.

Interaction effects were estimated in order to compare with the previous version. They are presented in Tables 4 and 7. Effects of foreign trade are the most important: they amount to almost 80% of regional consumption. With the complete economic disintegration of internal space these effects should be equal to 100%. But, as the weak ties among regions, particularly in some coalitions, still do exist, the effects of interregional interactions have rather low values. They are not of any particular interest.

### 8. State control of the foreign trade.

Therefore, complete foreign trade liberalization is damaging the Russian economy. Protectionist measures are necessary. In the analysis in question, they were introduced in two ways. First, export tariffs were introduced on primary fuel, metals, lumber products. As a result, domestic prices of these products decreased and they became affordable for Russian consumers. Second, import tariffs were introduced on the products of some processing industries. As a consequence, domestic prices of such products grew and they became profitable. The

consequences of the unified customs policy for the country were tested, i.e., the system of macro-regions was regarded as the customs union (as compared with previous variant, **i** constraints were introduced in the model, their dual values are interpreted as export-import tariffs). The value of export and import duties was fixed in such a manner so as to allow to keep all industries at the level not lower than 90% of the production in 1993.

In the model solutions under actual territorial pattern of consumption of the population, interregional turnover at actual 1990 prices does not decrease as compared with the situation of totally free foreign trade (Table 9, rows 5,6). A new quality is that East Siberia becomes a region with positive balance of internal exchange. However, the level of non-equivalence of exchange (balance at equilibrium prices) decreases. On the contrary, East Siberia, instead of being a recipient, becomes a donor.

Then, as before, the system was transformed into equilibrium state (equivalent exchange). In comparison with the previous case, export-import volumes are reduced, mainly due to oil export and import of meat, dairy and stock-raising products (Table 10, columns 5,6). Signs of export-import balances change in two industries only. Exchange rate of dollar falls dramatically, i.e., the ruble gets stronger (compare the last rows of Tables 11, 12). Domestic equilibrium prices, as it was conceived, begin to differ from world prices (Table 12). For instance, if we add export tariff to domestic oil price (column 6) and divide the result by dollar exchange rate, the world price will be obtained (the corresponding commodity exchange value of the ruble). Foreign trade tariffs are essential for three industries only (Table 12, column 7): oil industry (export tariff is almost 30% of domestic price), meat and dairy industry (import tariff is more than half of domestic price), and stock-raising (import tariff is a little higher than 1/3 of domestic price).

As the result of foreign trade regulation, consumption in the country decreased on the average by 5%, employment increased (it reached the level of 1993 - 88% of active popula-

tion); internal commodity exchange has been restored, but not in full measure. Equilibrium regional structure of the final consumption almost did not change, as compared to the case of complete foreign trade liberalization (Table 13, rows 4,*7,8*). The system core expanded (Table 13, row 9), but remained remarkably narrower than in the case of fixed foreign trade.

In Tables 5, 8 (effects of interactions), the effect of foreign trade decreased by 2 times (in comparison with the case of completely free foreign trade), the effects of interregional exchange became more substantial.

**Table 14**

**Differentiation of per capita consumption (in % to the Russian mean)**

| | European part | Ural | West Siberia | East Siberia | The Far East |
|---|---|---|---|---|---|
| Fact of 1993: | | | | | |
| In model | 101 | 84 | 99 | 102 | 129 |
| RF Goskomstat Data | 103 | 88 | 87 | 90 | 129 |
| Equilibrium, Foreign trade: | | | | | |
| Fixed | 102 | 76 | 183 | 57 | 29 |
| Free | 81 | 92 | 260 | 94 | 57 |
| Regulated | 80 | 91 | 263 | 92 | 57 |

The shares of East Siberia and the Far East are understated in the equilibrium (i.e., equivalent exchange) regional structure of consumption, particularly under the conditions of exogenous foreign trade (Table 13, row 2), (to a certain extent it may be due to the fact that some factors were not taken into account). Per capita income in these regions decreases by 1.5-2 times under equivalent exchange. High regional disparities in per capita consumption (Table 14) can cause the disintegration of the country. Interregional exchange within a federal state does not have to be equivalent in order that internal economic space is sufficiently homogeneous; and interregional differences in living standards are not very large. Certain redistribution of financial and other resources is required. However, the level of exchange non-

equivalence and volumes of transfers (and other gratuitous transfers of financial resources – subsidies, budget financing) must be reasonable. The values of the interregional redistribution of financial resources supporting the non-equivalence of the interregional exchange, for the actual level of 1993, are the balances of interregional exchange in equilibrium prices presented in Table 9. For fixed foreign trade, they amount to about 10% of the total consumption of the population or about 7% of the GDP. Under completely free foreign trade, noticeably higher volume of financial redistribution – about 17% of total consumption or almost 12% of the GDP (row 4)- is required in order to support the actual level of non-equivalence of exchange. The need in financial redistribution goes to 13% of total consumption or 9% of GDP (row 6) due to regulation of foreign trade. Apparently, it is not that much, because currently (1996-1997) about 5% of GDP is redistributed via the budget channels. The point is whether the level of exchange non-equivalence is sufficient; it evidently requires further investigations.

**Table 15**

## Indices of volumes of production in % to 1990

| | European part | Urals | West Siberia | East Siberia | The Far East | Russia |
|---|---|---|---|---|---|---|
| 1996 (estimate) | 41 | 49 | 60 | 56 | 41 | 46 |
| Solution of the model | | | | | | |
| Complete foreign trade liberalization | 48 | 50 | 59 | 56 | 46 | 50 |
| Regulation of the foreign trade | 57 | 55 | 65 | 62 | 51 | 58 |
| Expert estimation of an influence of foreign trade regime changing | | | | | | |
| | 64 | 64 | 71 | 69 | 61 | 67 |
| Expert estimation of chare of other factors | | | | | | |
| | 39 | 31 | 28 | 30 | 34 | 37 |

In this study, the impact of changes in foreign trade regime on the Russian economy and its macro-regions, was explored. In particular, it was shown that foreign trade liberalization results in the decrease in internal production. It is possible to estimate significance of the

influence of this factor on the total decrease of production in Russia. Table 15 proves that the actual drop in production from 1990 to 1996 in Russia was 54% . The model solutions show that complete liberalization of foreign trade would result in decrease of production by 50% and under state control – by 42%. Such decline, only as the result of one factor impact, would take place if market mechanisms have turned the system into equilibrium.

If we assume that only ¾ of this task was actually completed, and the two hypothetical situations considered (complete liberalization and state regulation of foreign trade) are implemented in practice with equal weights (0.5 and 0.5), then the actual decrease related with the change in foreign trade regime amounts to merely 33% (row 4). I.e., other factors (reduction of investment, financial disproportion, etc.) determine 21 percentage points of production decline. Their share equals to 37% (additional row of the table). The most significant influence of other factors takes place in the European part (39%). On the contrary, the consequences of foreign trade liberalization reduced production in West and East Siberia, and in the Urals to the highest extent.

## 9. General context of the study.

The above results are assumed to be the most essential for the first stage of the project. They were obtained for the three situations; each of them includes free (optimized) internal (interregional) trade, i.e., the country is regarded as a free trade area:

**A)** exogenous (fixed on the actual level) foreign trade - section 6;

**B)** endogenous (optimized ) foreign trade (regional balances of the foreign trade are fixed at zero level) – section 7;

**C)** export-import constraints common for the entire country (the country as a common customs area), providing for the level of production not less than 90% of the actual values in 1993 – section 8.

The equilibrium and the core were determined for each of the situations, the effects of interregional (internal and foreign) interactions were estimated.

Pre-project studies and the work at the first stage of the project were carried out on a wider scale. 7 possible situations were considered:

**a)** exogenous (fixed on the actual level) internal and foreign trade, i.e., the economy is entirely centralized (usual regional input-output models are employed: **a, b, c, d, g** constraints and fixed variables of internal and external links $\mathbf{x^{rs}, x^{sr}, v^{r}, w^{r}}$);

**b)** internal trade becomes free (this condition stands in all further situations), i.e., the situation is equivalent to the **A)**;

**c)** production capacity expansion is allowed (above and beyond the actual values in 1993), i.e., the inter-industry redistribution of fixed capital within the limits of its actual value in the region is permitted（for all industries except mining in several regions the capacities are increased by 10% of $\mathbf{N^{r}}$);

**d)** technological substitution of some products is permitted; e.g., coal for natural gas in power industry (two-component modes of substitution are introduced in the model: in balance of output **a** which is substituted, the mode has component «+1»; in the balance of output which substitutes, the norm of substitution has a negative sign;

**e)** foreign trade becomes endogenous under the actual value of regional balances of foreign trade in 1993; in comparison with situation (B) $\mathbf{S^{r}}$ is fixed at the actual level, but not at the zero one;

**f)** in comparison with case (e), **f** constraints (see section 4) on the regional export under the actual level in 1993 are imposed;

**g)** in comparison with case (e), **f** constraints on the regional import $w^r$ at the actual level of 1993 are imposed.

The effects of interregional exchange were estimated for all these situations and core boundaries were found for all of them, except for situations **a)** and **e)**. For situation **a)** it is impossible to find the core, because the regional pattern of consumption (final demand of the population) can not change; in situation **e)** the calculations remained unfinished and equilibrium points were not found.

The results are presented in the Tables 16-19 (these tables were adduced with the small differences in the preceding report). The rows of the table are 7 situations. Five columns of the table are total columns in the table of effects of interregional interactions. The second row of this table coincides with the total column of Table 3 (as situations **A)** and **b)** are equivalent). The second rows of Tables 17, 18, 19 coincide with the total column of Table 6, with the fourth row of Table 6, and with the third row of Table 13, respectively.

## Table 16
## Contributions of the regions to the consumption of population (%)

| | European part | Urals | West Siberia | East Siberia | the Far East | Foreign ties |
|---|---|---|---|---|---|---|
| Actual state | 32.5 | 12.3 | 11.9 | 11.9 | 11.9 | 19.5 |
| Endogenous internal trade | 46.7 | 14.7 | 23.1 | 7.1 | 4.9 | 3.5 |
| Capacity expansion | 47.1 | 12.0 | 24.2 | 3.9 | 6.0 | 6.8 |
| Substitution of products | 50.6 | 22.0 | 9.8 | 6.1 | 6.1 | 5.4 |
| Endogenous foreign trade | 31.5 | 2.2 | 8.2 | 0.6 | -0.9 | 58.4 |
| Constraints on export | 41.5 | 6.0 | 6.3 | 1.9 | 0.5 | 43.8 |
| Constraints on import | 45.2 | 3.2 | 23.4 | 4.5 | 4.7 | 19.0 |

The information contained in these tables is too large to be analyzed in the framework of the project. That is why the results presented above relate only to a small portion of this information. Nevertheless, some general remarks may be made.

The role of West Siberia is decreased noticeably when substitution of some products is allowed; particularly, gas and coal in the power industry (Table 16), as Russian regions in this case become less sensitive to the break of ties with West Siberia.

**Table 17**

**Indices of the effects of interactions in % to population's consumption**

| | Own contribution | Pure internal effect | Total internal effect |
|---|---|---|---|
| Actual situation | 26.8 | 53.7 | 80.5 |
| Endogenous internal trade | 26.8 | 69.7 | 96.5 |
| Capacity expansion | 27.0 | 66.2 | 93.2 |
| Substitution of products | 28.3 | 66.3 | 94.6 |
| Endogenous foreign trade | 23.8 | 17.8 | 41.8 |
| Constraints on export | 25.8 | 30.4 | 69.6 |
| Constraints on import | 26.4 | 54.6 | 81.0 |

The liberalization of the foreign trade results in sharp increase of the foreign trade effect. The contribution of the foreign trade constitutes more than a half of the final consumption of the country (Table 16).

In the centralized economy the role of East Siberia and the Far East were significant, the contribution of these regions into the Russian consumption was higher than their own consumption. After liberalization of internal trade the, situation changes to the opposite: their balances of interaction become negative (Table 19).

**Table 18**

**Balance of interactions of the regions in % to population's consumption**

| | European part | Urals | West Siberia | East Siberia | the Far East |
|---|---|---|---|---|---|
| Actual state | -31.4 | 25.6 | 33.3 | 118.9 | 104.7 |
| Endogenous internal trade | -26.3 | 32.9 | 136.7 | 18.7 | -23.7 |
| Capacity expansion | -22.0 | 13.0 | 150.4 | -32.7 | -5.0 |
| Substitution of products | -16.5 | 91.3 | 3.7 | 2.2 | -4.2 |
| Endogenous foreign trade | 0.8 | -12.3 | 69.8 | -32.6 | -63.2 |
| Constraints on export | 0.5 | 57.2 | -3.4 | -39.2 | -64.1 |
| Constraints on import | -11.6 | -53.4 | 153.3 | -12.8 | -14.3 |

## 10. Political implications of the project

In our opinion, integral estimates of the Russian economic space quality under the conditions of the free market relations obtained in this study, (the level of interregional exchange non-equivalence, value of the payments actually received from the resource-extracting regions, the level of territorial differentiation by the living standards of the population), the roles of particular regions in supporting the Russian statehood, the trends of changes in the above indicators, are important "food for thought" for politicians. The obtained values of export-import tariffs, volumes of interregional redistribution of financial resources, can find practical implication. The ideology of the project, which considers Russian regions as a free market system that is regulated with the "civilized" tools by the state, may have certain political repercussions.

**Table 19**

**The possible change in the regional structure of population's consumption (parameters $\lambda^r$) within the limits of the system core**

| | European part | Urals | West Siberia | East Siberia | the Far East |
|---|---|---|---|---|---|
| Actual state | is not calculated | | | | |
| Endogenous internal trade | 32-90 | 1-28 | 0-44 | 0-16 | 0-16 |
| Capacity expansion | 30-89 | 2-27 | 0-45 | 0-11 | 0-15 |
| Substitution of products | 37-87 | 2-32 | 0-27 | 0-16 | 0-15 |
| Endogenous foreign trade | Calculations *were not done* | | | | |
| Constraints on export | 65-77 | 8-12 | 1-10 | 0-6 | 0-7 |
| Constraints on import | 36-82 | 2-13 | 0-43 | 0-8 | 0-9 |

## 11. Conclusion

This study can be regarded as an initial stage of analysis of interactions between macro-regions and world economy. Further, many fragments of the input data will have to be verified, the models will be modified and the results will be tested more carefully.

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