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Analysis of Structural Development of Petroleum and Sugar Markets in the Russian Economy

Svetlana Avdasheva

Nadezhda Rozanova

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CONTENTS

NON-TECHNICAL SUMMARY

Specific contracts between Russian enterprises, in particular, tolling contracts, play an important role in determining the economic performance of Russian firms under transition.

The research made by the authors deals with the market evolution in petrol and sugar industries. The research aims to show the main characteristics of Russian markets based on econometric investigation of the behavior of producers, traders and industrial consumers.

The Introduction presents the alternative approaches to the market determinants in the economy under transition. The paper shows that high level of transaction costs inducing the firms to be vertically integrated has significant influence on the market power in transitional Russia.

Part 1 of the paper is devoted to the general characteristics of the production-distribution chain. The degrees of producers concentration and competition in the markets are considered. The origin and growth of new types of market contracts - tolling contracts, and behavior of entities using these contracts, their stable economic interactions are shown.

Part 2 analyses the influence of tolling contracts on the economic performance and social welfare. Tolling contracts are treated as a type of vertical restrictions. Cournot type model of Russian firms conduct shows that the use of tolling contracts helps to improve economic performance by means of settling the double mark-up problem. But tolling contracts are not efficient enough as compared with formal vertical integration. The authors analyze the reasons why tolling contracts are widely used in Russia in contrast to vertical integration and more optimal types of vertical restrictions.

Part 3 presents econometric results that have to verify two main hypotheses concerning the Russian firms behavior that exist in Russian economic theory. The first hypothesis claims that it is the share of tolling contracts and not the market share that determines the market power of firms. The second hypothesis aims to find out whether tolling contracts are used because the firms have financial problems or due to high transaction costs in the economy.

The analysis proves the first hypothesis: the share of tolling contracts has significant influence on the economic performance of Russian enterprises. The research shows that the main cause of tolling contracts is more likely to

be connected with the processes of vertical integration due to high transaction costs than with the general insolvency of Russian firms. Being originally a tool of insolvency, the use of tolling contracts have become a kind of strategy that can mitigate opportunistic behavior of the partners and thus improve economic performance and market power of the enterprises.

The paper implies that competition in Russian markets is limited not only through high concentration of producers but rather by the institutional and macroeconomic determinants in general. The domination of special vertical contracts in Russia now reflects why the property rights enforcement system is underdeveloped. This phenomenon is the main factor of market developments in the economy under transition.

INTRODUCTION

The factors in the Russian economy that determine market structure, entity conduct and economic performance can be divided into two parts: those of market character (concentration of sellers, scale effects, vertical integration and vertical restraints, product differentiation, etc.), and those that are from the nature of the transition of the Russian economy (special contracts that help to mitigate Russian economic problems). There are several approaches which explain these characteristics of markets in Russia.

The first approach considers the special features of Russian markets as an effect of the monopolisation processes that have been inherited from the Soviet past in the production and distribution systems. Competitive advantages are seen as a result of previous development, having no links with the strategic behaviour of the entity. [16, 31, 35]

According to the second approach, market structure within a transition economy could be explained on the basis of a high level of transaction costs caused by higher levels of uncertainty in the transition economy than in the market economy. Competitive advantage belongs to the entities that are able to minimise transaction costs. [2, 21]

The third approach sees adaptation processes to market conditions as the main source of sellers monopoly power. The more an entity adapts to the market, the higher the advantages it has. [17, 19]

Our hypothesis is that it is the special contracts of the entities (and firstly of tolling contracts) that have the decisive influence on market structure and economic performance in Russia. As a determinant of performance, the market share of a seller plays a minor role. The analysis of the petrol and the sugar markets aims to confirm, develop or reject this hypothesis. The main problem lies in the analysis of the factors which induce enterprises to use tolling contracts, and the effects of tolling on the economic performance of suppliers and refineries both in the petrol and the sugar markets.

The main form of fall-back supply in the petrol market in Russia is tolling contracts. Tolling contracts have almost crowded out traditional relationships in the buying and selling of goods. According to a tolling contract, the oil refinery obtains a certain share of its final product in payment for its processing operations, of 30-35% on average. Tolling contracts are, as a rule, of long-term character and can exist either in the framework of the general contract on joint activity or in some other special contracts. But tolling contracts are not exclusive: a refinery could have several oil or other companies as agents for tolling contracts. In our sample, the maximum number is 6.

When concluded, tolling contracts sharply increase the share of the supplier the oil companies in the sales of the final product, as can be seen in Chart 1 in the Appendix. It is interesting that tolling contracts are run alongside the implementation of a joint production and sales policy in vertically-integrated oil companies. Moreover, oil companies with better-developed levels of internal integration (in LUKoil, for example) have begun to use tolling contracts earlier and more often than companies with less-developed central planning (for example, Sidanko).[1]

In the research, both descriptive and analytical tools have been used in order to investigate the problem and the institutional framework in particular. The Lerner index of monopoly power and its determinants have been placed at the centre of the analysis. Well-defined models of oligopoly have been applied to the competitive analysis of Russian enterprises along with factor analysis. The theory of vertical integration has played an important role in the theoretical framework.

Two markets petrol and sugar have been analysed. This choice is explained as follows. In the markets there are new economic agents whose activity is special for the transition economy. Special contracts of the transition tolling contracts have been developed primarily in these industries. There is a well-defined information database, including data on each intermediate and production-level enterprise in the industries.

State statistics and survey data have been used in researching the petrol and sugar markets. These two sources of information have helped investigate different features of the markets. State statistics give the possibility of obtaining objective characteristics for the concentration of sellers, the geographic borders of the markets, the price level, and the economic performance of enterprises. Executive surveys permit the drawing of conclusions on methods of competition, estimates of competitiveness, and trends in competition. As a result, the whole picture of interdependence between the non-strategic determinants of market structure, the conduct of firms and economic performance can be drawn.

[1] Ezov S (1997): *Reforming the tax system in the oil industry*. A report of the joint conference of MTI (USA) and the Institute Economics School (Russia), St. Petersburg, June 15-16.

1. GENERAL OVERVIEW OF THE PETROL AND SUGAR MARKETS

This section deals with the general characteristics of the relevant markets, including distribution channels and their recent development, the special features of contracts in resource delivery, and the economic agents that have control over the final resource flows in the markets.

The production chain of intermediate product delivery, its processing and final realisation has been considered as a relevant market. The data obtained through executive surveys of producers, wholesale traders and consumers conducted by Goskomstat have been used to determine the product share of each distribution channel. The characteristics of the sample are in Appendix 1. The sample of Goskomstat included only a share although a rather considerable one of the relevant firms. That is why State statistics of the markets have been used as well.

The share distribution of production in the petrol and sugar market between Russian enterprises has been stable in recent years. The changes in the petrol and other oil product markets are due to the combination of enterprises into vertical oil companies, and because of the divisions in the enterprises. That is true also in the sugar market. At the same time, great changes can be seen at the level of the realisation of the final product. In the petrol market, the proper delivery net created by the oil companies is playing a greater role, while the share of specialised wholesale traders is diminishing in the sale of petrol to the final consumer.

The concentration of sellers in the petrol and the sugar markets is small. The analysis has shown (see Part 3) that market concentration has no influence on monopoly power in the relevant markets. The goal of this investigation into delivery channels has been to clarify the special institutional conditions for the supply of both the intermediate and the final product.

An interesting result that has been obtained through survey analysis is that a large part of final delivery is under the control of the suppliers of intermediate goods, both in the petrol and the sugar markets. In the petrol market, these are the oil companies, including their daughter firms; in the sugar market, they are the suppliers of sugar beet (agricultural enterprises) and new commercial firms that deal with the wholesale trade of sugar beet and raw sugar. As has been supposed, an important effect on the channels of distribution of the final product is achieved with special types of contract: tolling contracts, barter and commercial credit in the petrol market; tolling contracts in the sugar market.

Important changes can be seen in the distribution channels for raw products. A preliminary analysis has shown that, in 1997, the share of tolling contracts was

nearly 100% in both industries. But the distribution channels of final goods remain the same. Surveys conducted in 1996 have shown that the sources open to the ultimate consumer for obtaining products are strictly limited.

On the question as to whether there is a free choice of supplier, 77% of the enterprises surveyed in industry and 70% in transport, but only 40% of agricultural enterprises, have given a positive answer. The most important limiting factor for transport and industrial enterprises is the traditions in relationships (rated as 2.75, with 3 as the highest possible score).

The stability of purchasing channels in the petrol market is seen in the answers of buyers to the question: What is the possibility of changing your supplier in the next year? , with a score given from 0 (no change) to 3 (will definitely change). The average rate of change for suppliers is 0.46 in industry (the lowest possible rate), while it is 1.1 for agricultural enterprises and 2.2 in transport. The higher the share of producers in petrol delivery for a group of consumers, the more stable are its relationships with suppliers.

Similar results have been achieved in the sugar market. Wholesale traders estimate the probability of changes in suppliers to be 1.22 on average: enterprises in the food processing industry acquiring raw sugar is 0.9; sugar refineries estimate the probability of buyer changes as 1.02. The highest possible score is 3.

Market entities estimate the degree of competition as weak. On average, using the 3-point scale, producers and wholesale traders in the sugar market estimate the influence of competition on their shares as 1.08; while producers and wholesale traders in the petrol market have put it at 1.3 and 1.14.

These estimates have turned out to be rather unexpected. In the relevant markets, there are determinants that should have induced competition. The goods produced are almost homogeneous, and the strict links between an enterprise and its supplier could not be explained as the effect of brand loyalty except, perhaps, given the geographical limitations in the petrol market where the share of transportation costs in the selling price is 8-10%. In the sugar market, there are very many sellers that have to face a rather severe competition against imported sugar. In both markets, excess capacities exceed the level that could be considered as a tool of the strategic policy of sellers: constituting 33% in the petrol market and 40% in the sugar market.

The question arises: what is the mechanism that maintains the stability of the distribution channels in the final product market and prevents market competition? Our hypothesis is that the answer to the question could be found through an analysis of the special type of contract existing in resource supply that of tolling.

It turned out in the research that, in the sugar market, sharply distinct from the petrol market in concentration, in the stability of economic links and in problems with producers, the main type of raw sugar supply comes under tolling arrangements as well. In 1995, on average 78% of sugar beet was supplied to sugar plants under tolling contracts. In 1996 the share increased to 83% and in 1997 to 92%.

Tolling contracts are most popular in regions where there is a complete technological chain in the market from sugar growing to the sale of the final product. Tolling contracts comprise the junior partner in agricultural enterprises because the latter have uneven realisation channels: the largest share of the supply of sugar beet (70-100%) and sugar produced according to tolling contracts (60-80%) falls on the sole client. It should be pointed out that sugar refineries are not the major part of vertical integration.

Tolling contracts are mostly involuntary for the producers. That fact has been confirmed in the surveys. On the question as to whether they freely chose their supplier, most of the sugar refineries answered negatively. At the same time, surveys have revealed the low level of satisfaction of sugar refineries with their suppliers. 83% of the refineries surveyed pointed to their non-satisfaction with suppliers. The main causes of non-satisfaction were (according to the 3-point scale): quantity supplied (2.69); breach of obligations (1.63); the special conditions demanded by the supplier (1.06); and the low quality of raw materials (1.0).

According to the surveys, almost all the sugar refineries have no choice of supplier, despite their lack of satisfaction with the existing relationships. Refineries could be dependent on the next level of the production and distribution chain the sugar buyers. Most refineries point out that changes in distribution channels are unlikely or are even impossible.

The research has revealed that a new type of economic entity is actively developing in the sugar market, one that is able to play a leading role in vertical integration in the industry. This type is the new commercial firms or, as official Russian statistics record, non-trading commercial institutions . These institutions have under their control about 1/5 of sales in the sample, and in some regions their share is much more. Among the new commercial firms that have been taken into consideration in the research are two inter-regional enterprises Alfa-Eko and Russian Sugar (both Moscow) and a regional one Agroinkombank (Stavropol). The scale of their activity confirms the possibility of a significant influence on sales structure and product price in both the local and the national markets.

For example, Alfa-Eko has under its control 1/3 of the supply of sugar to food processing enterprises and 1/4 of the supply to wholesale traders in the Kaluga region, about 20% of the supply to consumer enterprises in Mordovia, and important shares of sales in some other regions. In the Belgorod region, four out of the five largest (not only regional but national) sugar refineries have Alfa-Eko as their dominant or sole supplier on tolling contracts. And three of them have Alfa-Eko as their major buyer of sugar with the use of barter making up 50-100% in payment. Besides, this commercial firm controls nearly 17% of the import of sugar into Russia.

Agroinkombank in the Stavropol region has under its control 40% of the turnover of sugar beet, with 1/3 on tolling contracts, 2/3 of the sugar sales by the refineries and an important share of sugar sales in wholesale trade. Russian Sugar in the Tambov region controls 100% of the sale of sugar by agricultural enterprises and not less than 75% of the local sugar turnover produced on tolling contracts. The firm supplies about 20% of the wholesale trade in the Kaluga region. Russian Sugar has under its control about 2% of sugar imports into Russia.

These commercial institutions use the following strategy: they set up diversified companies with the tools that can help influence the entire chain of sugar production and distribution. The firms are intermediaries between the agricultural enterprises supplying sugar beet, the sugar refineries, the wholesale traders and the enterprises consuming the final goods, and can influence the market structure. With traditional monopoly instruments, such as pricing policy in both the intermediary and final product markets, the firms employ the whole range of contracts particular to the transition economy: tolling, barter, etc.

Possessing general tendencies in the development of vertical integration in the petrol and the sugar markets, tolling contracts demonstrate particular features. Intermediate product supply and the sale of final goods received on tolling contracts are found at the inter-regional level in the petrol market and at the local level in the sugar market. Different economic entities have initiated vertical integration. In the petrol market it is the oil companies and their daughter firms; in the sugar market it is the large intermediaries. One can suppose that tolling contracts would have different effects on the former and on the latter. If tolling contracts give a surplus to the agent (we think they do), the distribution of that surplus between the supplier of the tolling contract and the receiver would not be the same in the petrol and the sugar markets. If a refinery is an integral part of the oil company, that should create the tools for facilitating the acquisition of surplus share by the latter, and tolling contracts, although having less influence on distribution channels in the petrol market,

can, nevertheless, have a positive effect on refinery performance. On the contrary, entities in the sugar market the users of tolling contracts have no interest in increasing performance in the sugar plants. Non-voluntary tolling contracts here can have a significantly negative influence on enterprise performance.

So, the general characteristics of the markets have revealed the main instrument of the economic influence of an agent on distribution channels the tolling contracts in raw supply that have been such a major peculiarity of Russian industry today. The conclusion is that these contracts are now an important determinant of market developments in Russia.

Tolling contracts have been taken into consideration in our research. A theoretical model of tolling contracts between supplier and producer, and their effects on the final goods market, is presented in Part 2. A statistical investigation of the hypotheses for the influence of tolling on the economic performance of an enterprise and for the main reasons for using tolling contracts in Russia is developed in Part 3.

2. TOLLING CONTRACTS IN THE RUSSIAN ECONOMY

Our analysis shows that tolling contracts are one of the most important features of Russian markets in transition. The share of output of Russian industries produced from raw materials under tolling contracts is very substantial. Data characterising the scope of tolling contracts are presented in table below.

Industry/ Product	Share of output produced from the raw material supplied under tolling contracts (%)	
	1995	1996
Automobile petrol	37.5	68.9
Diesel fuel	42	71
Granulated sugar	85	78
Cereals	55.4	n/a

Source: Goskomstat data, statistical reports.

This part of the article is organised as follows: 2.1. contains different explanations of tolling contracts in the Russian economic literature; 2.2. contains a description of the problem; 2.3. describes the model; and 2.4. provides the results of tolling on performance and welfare.

2.1. Brief Review of the Literature

There are several explanations for the use of tolling contracts in the Russian economy.

1. Tolling contracts are a transient form of vertical restriction. Industrial organisations in Russia are in the process of transformation from the independent action of an entity to the formation of vertically-integrated firms.

In fact, the processes of the development of vertical integration have recently been very intensive in the Russian economy. In the oil industry, there is a clear tendency towards it. Vertical integration has also increased in the sugar market, and the most active leading agents have been new wholesale traders, such as Alfa-Eko, Russian Sugar, etc.

Nevertheless, to have this reason as the sole explanation of tolling contracts is not sufficient. Firstly, as integration processes are accelerating, tolling contracts are not used less, but more often. Tolling contracts are not

substitutes but are complementary to vertical integration within property relations.

Secondly, there are factors that prevent the developed forms of vertical integration and vertical restraints from being introduced into Russian markets. They are, in general, the weak mechanisms of property rights and for the enforcement of contracts, and the under-development of the property rights and the contracts themselves. This feature of the Russian economy has been revealed by many researchers. [2, 3, 4, 21]

2. Tolling contracts are considered as a tool to settle the problem of non-payments.

Non-payment can actually explain some specifics of contracts in the Russian economy. This is true not only for tolling contracts, but also for barter, bills, commercial credit and other forms of quasi-money. But this approach to tolling contracts is also insufficient. Alternative forms of payment other than traditional buying-selling relationships have been in Russia for years and are used regularly. They can be considered as a part of the special strategic behaviour of enterprises. [2, 3, 6, 12] That is why they can be analysed independently from the actual solvency of the enterprises.

For example, the analysis of the sugar market has revealed the existence of special wholesale traders that use tolling contracts. Contracts between wholesale traders and sugar refineries were not specific to the central economy as opposed to the direct links between agricultural enterprises supplying sugar beet and the sugar refineries. The appearance of tolling contracts in the relationships between wholesale traders and sugar refineries is, in fact, a feature of the new Russian economy. For the period 1995-97, the share of tolling contracts in relationships has increased very significantly. And this fact tells us that the tolling contracts used by Russian entities a special type of relationship different to that existing in the supplier-producer production chain in the centrally planned economy can now testify to their special role in market development.

The results of our analysis (given in Part 4 below) confirm the hypothesis of an insignificant relationship between non-payment and tolling contracts.

3. The use of tolling contracts can help sharply decrease the tax burden and is a form of tax evasion.

The explanation of tolling contracts as a form of tax evasion is very popular among Russian researchers [for example, 4]. As a matter of fact, tolling contracts can help decrease one of the heaviest indirect taxes, VAT, because, within a tolling contract, VAT in the book-keeping procedure is set up almost

voluntarily. Recent estimates, however, do not confirm this point: the decrease of the tax base within tolling contracts is not as large as has been supposed.[2]

4. Tolling contracts are a form of vertical restriction that result in the most efficient performance in the Russian economy. This approach supposes the analysis of tolling contracts in themselves, the causes of their advantages for suppliers and their suitability for producers. This approach has been developed in the economic literature, but it is not a leading explanation.

In general, we share this approach and consider such a point in research into tolling contracts to be one of the most fruitful. According to the leading views in the Russian literature (see Part 3), the procedure of payments in the Russian economy makes it impossible to characterise Russian enterprises as profit maximisers. We think, however, that, despite the special features of these contracts, one can use the idea of profit maximisation as the main aim of the firm. In this case, tolling contracts and their effects on market developments can be investigated within the framework of vertical integration models which are well-developed in the world economic literature.

The problems of vertical integration in the world economic literature have in the recent decades been developed in several directions. The common conclusion is that vertical integration in production and sales can help solve the negative vertical and horizontal externalities that arise in the supplier-producer and producer-distributor chain. [22, 23, 25, 26, 27, 32] The total effect of vertical integration on welfare depends on the correlation of its positive (the solution of the problem of the principal agent) and negative (market power) features. An important problem here is the substitutability of contracts given vertical restraints. The analysis of different contracts between producers and distributors reveals that, although under complete certainty on costs and demand many contracts can be treated as full substitutes to help obtain Pareto-efficiency equilibrium, under uncertainty the effects of contracts are quite different. [22, 27] Our aim here is to analyse tolling contracts in this respect and to show their place in the line of other possible vertical restraints given their merits and drawbacks.

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[2] In the petrol market, tolling contracts yield profits of $8-10 per ton. See Denisove T. and Sergeeva V. (1998): A comparative efficiency of oil sales in inner and outer markets . Oil-gas institution. February, No. 2 (17), pp. 73-75. In the sugar market, the tax decrease is not obvious, as has been shown in the project Enterprise monitoring (See Report 1.31: Investigation of the role of vertical integration in relationships between producers and distributors and its effects on the economic performance of firms , Moscow, 1997).

2.2 The problem

Empirical analysis shows the importance of tolling contracts for the development of Russian markets and their significant influence on the performance of enterprises in refining industries. It seems that tolling contracts can be considered as a tool of vertical control characteristic of the Russian transitional economy. The under-developed character of property rights and the legal system of support leads to advantages to long-term contracts, including tolling contracts. The influence of tolling contracts on social welfare, measured as a sum of the producer and consumer surplus, is ambiguous.

Two questions are important here. First is the influence of tolling contracts on social welfare and economic efficiency. On the one hand, tolling contracts provide a reduction in the transaction costs associated with the purchase of raw materials and with the sale of output produced, and thus they lead to decreases in total costs. On the other hand, tolling contracts, like any form of vertical control, can lead to market power and entry barriers.

The second problem is the influence of market structure on the profitability of tolling contracts. Is the supplier of raw materials interested in the growth of concentration in the market or not? Can tolling operations be profitable for the supplier of raw materials in the market (of final goods) with a low level of concentration? Statistical data show that tolling contracts are widespread in the markets of, for example, granulated sugar where there is a very low level of concentration. Can we consider market power and monopoly profits due to tolling contracts in these kinds of markets?

2.3. Model of the Interaction of Firms under Tolling Contracts

We use the standard Cournot model to describe competition in the markets of final goods. There are *n* identical producers of the final product in the market. Let market demand, for simplicity, depend on the quantity sold as:

$$P = q - Q,$$

where $Q = nq_i$, (q_i - quantity produced by one firm).

Assume that the producers of final goods use two types of input: input A and input B. Suppose that firms use these inputs in a fixed proportion (a Leontieff production function with constant return to scale). Input B is supplied under the tolling contract with one firm producing intermediary goods B. Assume that there is zero cost to producing input B. The second type of resources includes all necessary components for the refining of intermediary goods. The unit cost of refining is *c*.

The conditions of the tolling contract are identical for each firm in the market. Under these conditions, a part of the output of the refineries a is sold by themselves. This part serves as payment for the refining of the raw materials. We suppose that a is determined by the supplier of input B (intermediary goods). The other part *(1 - a)* is retained as the property of the supplier the firm that uses the tolling contracts). For the sake of simplicity, let s assume *q=1.*

The profit of a refining firm *i* is:

$$p_i(q_i, a) = aP\,q_i - c\,q_i$$

The output of a refining firm depends upon a (from profit maximisation):

$$q_i = \frac{q - \frac{c}{a}}{n+1}$$

The price of the market is:

$$P = \frac{q + \frac{nc}{a}}{n+1}$$

The profit of the supplier of input B from the sale of the final product is:

$$p(a) = (1-a)P(a)n\,q_i(a)$$

The constraint on the choice of supplier is the positive level of output of the refinery that implies a to be sufficiently large *(a* **> c)**.

The computations allow the establishment of the profit maximising level of *a*(n, c)* :

$$a^* = (c^2 n + (c^4 n^2 + b)^{1/2})^{1/3} + (c^2 n - (c^4 n^2 + b)^{1/2})^{1/3}$$

where:

$$b = \frac{c^3 (n + nc - 1)^3}{27}$$

The optimal level of a^* decreases with the growth in the number of firms in the market and increases with the costs of refining **(** $\frac{\partial a}{\partial n} < 0$; $\frac{\partial a}{\partial c} > 0$ **).**

The profit of the supplier of input B positively depends on the number of firms in the market. Consider the results of the model. The constraint of the profit maximisation problem for the supplier of input B is a reaction of the function of industry output on a. Industry output ($Q=nq_i$) depends on a:

$$Q(a) = \frac{n\left(1-\frac{c}{a}\right)}{n+1}$$

The profit of the supplier of the raw materials is:

$$p = (1-a)\left(q-Q^2\right)$$

or:

$$Q = \frac{1}{2} + \sqrt{\left(\frac{1}{4} - \frac{\bar{p}}{1-a}\right)}$$

Figure 1 in the Appendix shows the choice of a^* and the effect of a rising number of producers on the optimal level of a and industry output.

The market power of the supplier of input B can be shown in the choice of a^*. The supplier of the raw material plays the role of Stackelberg leader in the market, taking profit due to the advantage of having first move.

We can see that a rising of the number of firms in the market leads to a decrease in a^*, an increase in the equilibrium level of Q and a growth in profits for the supplier of input B. An intuitive explanation of the profit increase could be the following: when the number of refining enterprises in the market is large enough, they lose their market power and their reaction on a decision about a^* becomes more sensible.

On the other hand, a decrease in a^* means that the share of industry output sold by the supplier of input B increases. At the same time, competition leads to an increase in industry output. The supplier of raw materials never chooses a level of a^* that would lead to equilibrium of quantity and price in the market associated with inelastic demand. And the decrease in price and the increase in quantity sold result in an increase in turnover (the total revenue of the sellers) in the market. The increase in total revenues, with a growth in the share of the supplier of the raw materials, means an increase in the profits of the supplier who uses tolling contracts.

Our conclusion is that, in a market in which tolling contracts are used, the amount of the profit and the level of monopoly power depend on the high share of the supplier of intermediate goods, in contrast to the high share of the refinery. The stability of tolling contracts is an important condition for monopoly power. But the organisation of the tolling contract itself means that refineries suffer from the lack of financial resources due to the low revenues. It is very difficult to refuse a tolling contract. In this way, tolling contracts can create additional barriers to entry in the intermediary goods market and heighten the strength of the supplier through market power.

2.4 Influence of Tolling Contracts on Social Welfare

Tolling contracts are used in the Russian economy as a possible tool of vertical restraint. As a form of vertical integration and vertical restraint, tolling contracts aim at solving in particular the hidden action problem and the double mark-up problem.

The efficiency of vertical integration can be estimated on the basis of two criteria:

- the neutralisation of negative vertical externality in the form of double mark-up, yielding maximum joint profit for the vertically-integrated firm;

- the optimal combination of stimuli and insurance for the agents.

The lower the uncertainty of future demand and production costs, the more significant is the first efficiency criterion for vertical control. In a fully determined environment, it is enough to have the decisions of a supplier in order to ensure the optimal activity of producers. Given an uncertainty in future production costs (in our case processing costs) and demand, the efficiency of vertical restrictions depends on the relationships between the stimuli and the insurance in vertical contracts.

Let us analyse how tolling contracts influence the performance of suppliers and producers by comparing the indicators of their activity.

- Given independent planning of sales and price, producers can form derivative demand in intermediate products, and suppliers can maximise profit, subject to the limitations of residual demand, and thus establish the price of the intermediate product;

- Under the utilisation of tolling contracts which have been analysed above;

- Given a vertically integrated firm in the market that combines suppliers and producers, the monopolist sets the price of the intermediate product $\bar{-}$ to

maximise profits subject to the constraints of the derivative demand of producers.

The sum of the profits for firms that are in the supplier-producer chain depends on the types of the contracts, as follows:

	Independent decision	Tolling contract	Vertical integration
Profit of a supplier	$\frac{n(1-c)^2}{4(n+1)}$	$(1-a^*)P(a^*)nq(a^*)$	$\frac{(1-c)^2}{4}$
Profit of a producer	$\frac{(1-c)^2}{4(n+1)^2}$	$q(a^*)(a^*P-c)$	
Total profit of sellers	$\frac{n(n+2)(1-c)^2}{4(n+1)^2}$	$nq(a^*)(P(a^*)-c)$	

As our analysis shows, tolling contracts can help solve the double mark-up problem, but this tool of vertical restraint is sub-optimal compared to the other instruments of vertical integration, because it does not allow entities to have vertically-integrated profits and is not efficient [in the sense indicated by 23]. Chart 2 in the Appendix presents the relationship between the profits of sellers under independent decisions on sales and price (with the double mark-up problem), under tolling contracts and within a vertically integrated firm. Let c=0,1; and the number of firms increases from 2 to 20.

One can see tolling contracts as yielding an increased profit for monopolistic sellers compared to independent decision-making. The additional profit received, however, is lower than within a vertically integrated institution. Thus, tolling contracts do not limit vertical constraints.

The higher the additional profit yielded within tolling contracts, the lower the number of sellers in the market. This confirms the double mark-up problem as a major source of additional profit.

	Type of contract	
Indicator of partial derivative	Independent decision on sales and price	Tolling contract
Profit of monopolistic supplier to costs	0	$p'_{c} = \frac{(1-a)n(n-1)\left(\frac{c}{a}+q\right)}{a(n+1)^2} < 0$
Profit of monopolistic supplier to demand	0	$p'_{q} = \frac{(1-a)n\left(2q+\frac{c(n+1)}{a}\right)}{(n+1)^2} > 0$
Profit of producer to cost	$p'_{ic} = \frac{2(\bar{P}+c-q)}{(n+1)^2} < 0$	$p'_{c} = \frac{2\left(\frac{c}{a}-q\right)}{(n+1)^2} < 0$
Profit of producer to demand	$p'_{iq} = \frac{2\left(q-\bar{P}-c\right)}{(n+1)^2} > 0$	$p'_{q} = \frac{2(aq-c)}{(n+1)^2} > 0$

The increase in total profits is re-distributed towards the supplier. Tolling contracts yield additional profits for the supplier, but not for the producer.

Tolling contracts lead to the redistribution of losses where there are unexpected demand decreases and/or cost increases as well. Intuitively, it is obvious that, under independent decisions on sales and prices, the feasible changes in processing costs and demand capacity have no effect on supplier performance, given the non-existence of non-payments. With tolling contracts, the profits of the supplier change under the influence of costs and market demand: the earlier chosen level becomes sub-optimal. The possible losses of the producer change too: demand corrections influence its profits to a lower degree than under an independent realisation of the whole lot. At the same time, the fixed share of production going to the independent sales of the producer after the tolling contract has been reached limits the possibilities to low losses or production cost increases.

A rough comparison of possible losses for the supplier and for the producer under independent sales and under tolling contracts on the basis of partial derivatives is given below.

One notices the derivative of producer profit to costs to be higher in each value of the parameter (due to the constraint on the optimal value of a) under tolling

contracts. At the same time, with low values of a (in particular, where $a < 1/3$) the producer s profits become less elastic to demand.

Thus, we can conclude that tolling contracts offer a higher level of risk for the supplier compared with an independent decision on sales and prices; the profit level becomes more elastic to demand and cost. The effect of tolling contracts on the feasible losses of the producer is ambiguous. Given a low level of costs and changes in costs, a tolling contract can decrease the feasible losses of the producer.

The effect of tolling contracts for the sum of profits and the level of losses during the contract term is as follows.

	Profits	Feasible losses
Supplier	go up	go up
Producer	go down	?

So, the conclusion is that, under certain circumstances, tolling contracts are profitable for both parties, for the supplier and for the producer.

The question to be answered now is why tolling contracts are not being crowded out by the more traditional forms of relationship between suppliers and producers vertical integration, in particular that could increase total profits. As we know, the combination of supplier and producer in the integrated company (in the oil industry) does not exclude special tolling contracts at all. The solutions within vertically integrated institutions seem to be inefficient because of the principal agent problem. Co-ordinating their interests within an integrated company (in the petrol market) and outside it (in the sugar market) needs special contracts to determine the conditions for resource supply and final product sales. Tolling contracts have their advantage in the simplicity of enforcement and, thus, their low monitoring costs for the supplier.

In analysing the effects of tolling contracts for resource supply, we have not taken into consideration the long-run results of such relationships. It should be noted, however, that tolling contracts could create new entry barriers in the long-run. This effect could be examined using the model of Aghion and Bolton [10]: despite the increase in profits and consumer surplus, long-term contracts could be inefficient and deter industry entrance. The buyer (the producer, in our case) could have vertically-integrated effects within long-term contracts where penalties for opportunistic behaviour have been defined. This contract results in the low probability of entry (low competition) in the market and low performance in social welfare.

One can say that the current situation in Russian industry offers sufficiently large possibilities to extract penalties due to the excess capacities of

producers. The higher the excess capacities, the easier it is for the supplier to find alternative producers and to punish the enterprise for its opportunistic behaviour under tolling contracts. The level of excess capacity in industry can serve as a power which prevents opportunistic conduct under tolling contracts.

3. DETERMINANTS OF ECONOMIC PERFORMANCE AND THE CAUSES OF TOLLING CONTRACTS: ECONOMETRIC RESULTS

This Part contains the description and interpretation of the econometric analysis in determining the major factors of the Lerner index (a monopoly power indicator) in the relevant markets and the causes of tolling contracts.

The aims of factor analysis are to show the determinants of economic performance for producers in the markets and to define the causes of tolling contracts.

Two hypotheses have been tested. The first hypothesis is that it is tolling contracts and not concentration and the market share of sellers that determine the economic performance of Russian enterprises. It is impossible to distinguish between two determinants of performance market power and production efficiency so the margins of the enterprises have been used as Lerner indices of the indicators of performance.

Three variables have been chosen as determinants of the economic performance of an enterprise: the market share of sellers; the share of tolling resources in supply to producers; and capacity utilisation rates. Data for 1996 have been analysed.

3.1.Petrol Market: Refineries

In the petrol market, the analysis has been carried out on the basis of a panel of 31 refineries that produce 91% of the total output of the industry. Six indicators have been used: the Lerner index; the market share of oil companies; the tolling share in supply to the producer; the capacity utilisation rate; the share of the oil supply by the oil company to which system the refinery belongs; and the share of insolvency in total enterprise arrears.

The descriptive statistics for the database is in Table 1 in the Appendix.

The correlation between enterprise size and tolling share is zero.

The sample has large suppliers (LUKoil with a weighted share of the petrol market of 0.22; Bashneftkhimzavod 0.15; Sidanko 0.145; Onako 0.14), as well as small independent oil refineries. The average simple share of tolling contracts in oil supply is lower, at an average weight of 0.689, because of the

fact that, in this period, small enterprises used tolling contracts less often than did large firms. The average weighted rate of capacity utilisation is higher than the simple one for the sample, and is 0.59. There is a negative, although weak, correlation between it and enterprise size: the five largest enterprises of the sample had a rate of capacity utilisation of 0.52, compared to 0.7 for the smallest firms. The own-company share in oil supply has no correlation with the size of enterprises. The share of insolvency has been proved to have a weakly negative correlation with enterprise size.

There are two hypotheses to be tested concerning the petrol market. The first is that the economic performance of sellers depends on their market share, tolling contracts and excess capacity. The market share of sellers is the share in the petrol sales of the oil companies (not the refineries) in the national market. As has been shown in Part 1, oil companies control a significant share of refinery sales due to tolling contracts and to combining them in vertically-integrated institutions. Factor analysis has confirmed this hypothesis, revealing no correlation between the Lerner index of refinery enterprises and their market share, opposite to the share of the oil companies in petrol market.

The share of tolling contracts in oil supply has been treated as an indicator of special contracts in the market. The effect of tolling contracts on refinery performance is ambiguous. On the one hand, tolling contracts should, in essence, decrease the market power of refineries. On the other hand, tolling contracts, and not independent decisions on sales and prices, can provide additional surpluses in the supplier-producer chain. In turn the combination of the supplier and the producer in an integrated institution should create certain tools for yielding the re-distribution of surplus towards the minor agents of vertical integration less connected with the tolling contracts as such.

The third important determinant of market structure has been assumed in the form of the capacity utilisation rate. The effect of this on the economic performance of Russian enterprises is still not clear. Most researchers think that a low capacity utilisation rate is involuntary for Russian enterprises and can not be treated within the framework of strategic entrance barriers. The correlation between the capacity utilisation rate and the economic performance of enterprises is often considered as a remnant of the centrally planned economy. But, in fact, the capacity utilisation rate was not a strategic parameter of enterprise choice in Russia.

The regression model to test the first hypothesis is the following:

$$L = 0.083 + 0.5SHARE + 0.26\ TOL \quad 0.11CAP,$$

where:

L is the refinery margin;

SHARE is the share of the oil company in the petrol market;

TOL is the share of tolling in oil supply;

CAP is the rate of capacity utilisation in the refinery.

Some descriptive statistics of the regression are given in the table below.

	Parameter	Standard error	t- statistic	p-level
L (intercept)	0.083	0.043	1.44	0.160
SHARE	0.35	0.176	1.99	0.056
TOL	0.26	0.033	7.86	1.8E-08
CAP	-0.11	0.05	-2.19	0.037

The number of observations is 31;

$R^2 = 0.73$;

R^2 adj. = 0.71;

$F(3,27) = 24.91$;

The standard error of estimation is 0.066.

The model can confirm the hypothesis of the effects of tolling on the economic performance of refineries. The correlation is positive. It is confirmed that tolling contracts increase the profits of a vertically integrated chain and that a part of the additional surplus is redistributed towards the refineries. At the same time, the positive influence of the market share of the oil company on the economic performance of the refineries can also be considered as confirmed. The negative correlation of margins and the capacity utilisation rate can testify to the weak link between the economic performance of enterprises and resource allocation in the former planned economy.

The second hypothesis is that the major reason for tolling contracts is vertical integration in industry, not the insolvency problem.

In this case, the dependent variable is the tolling share of the total supply of oil to the refinery. The independent variables are: the oil company share as an indicator of the degree of vertical integration within the refinery; and the share of bad debt in the total arrears of an enterprise as the indicator of its financial problems. As far as the former indicator is concerned, the shares of oil companies have been summed, if there are several oil companies in a vertically-integrated firm; while the share of small independent enterprises has been valued at zero.

Our aim has been to estimate the correlation between the share of tolling and the two feasible causes: vertical integration and/or insolvency.

The regression model is as follows:

$$TOL = -0.156 + 0.989SELF + 0.08DEBT$$

where:

TOL is the share of tolling in oil supply;

SELF is own-company oil supply;

DEBT is the share of bad debt in total enterprise arrears.

The descriptive statistics are given in the table:

	Parameter	Standard error	t-statistic	p-level
TOL (intercept)	-0.156	0.152	-1.02	0.314
SELF	0.998	0.166	5.96	2.03E-06
DEBT	0.08	0.17	0.45	0.66

The number of observations is 31;

$R^2 = 0.73$;

R^2 adj. = 0.71;

$F(2,28) = 20.56$;

The standard error of estimation is 0.066.

The results of the model have not confirmed the influence of insolvency on tolling contracts, but they have confirmed the important effect on them of vertical integration through the indicator of own-company oil supply. The latter result can be used as an argument for tolling contracts being tools of vertical integration in Russia.

3.2. Sugar Market: Sugar Refineries

The analysis of the Russian sugar market has been conducted on the basis of the sample survey made by Goskomstat in the second half of 1996. The sample included 15 regional markets among which there were 5 sugar producing and importing regions; 5 sugar producing and exporting regions and 5 sugar importing regions. The economic agents that were selected included 35 sugar producers and 65 wholesale traders with sugar sales amounting to more than 1/3 of their turnover.

There were two hypotheses to be tested in the sugar market. The first concerns market performance in general, and the second has a link to the special determinants of enterprise behaviour in Russia. Two regression models have been developed accordingly.

The first hypothesis is the following. Market performance under transition depends not on factors to do with traditional market structure (primarily the market share of sellers), but on special contracts during the transition (predominantly tolling contracts).

To test the hypothesis, the dependent variable is the enterprise margin; the independent variables are the market share of sellers; the share of tolling in the supply of sugar beet; and the capacity utilisation rate. The first variable shows the effect of the traditional market development; the second one the character of the transition; and the last the remnants of the centrally planned economy.

The regression model looks like this:

$$L = 2.7 \quad 2.74\ TOL + 0.07SHARE + 0.186\ CAP,$$

where:

L is the sugar plant margin (Lerner index);

TOL is the share of tolling in sugar beet supply;

CAP is the capacity utilisation rate;

SHARE is the sellers market share.

The results of factor analysis are included in the table:

	L (intercept)	TOL	SHARE	CAP
Coefficient of linear regression	2.7	-2.74	0.07	0.186
Standard error	0.31	-0.319	0.023	0.032
t-statistic	8.8	-8.587	3.093	5.8
Average value	0.43	0.87	0.029	0.62
Standard deviation	0.169	0.049	0.018	0.153
Maximum value	0.7	0.98	0.07	0.8
Minimum value	0.1	0.8	0.01	0.3

The number of observations is 35;

$R^2 = 0.759$;

R^2 adjusted = 0.736;

F (2, 32) = 32.596;

Standard error of estimate = 0.087.

The results show an insignificant influence of the market share of the sellers on the economic performance of enterprises (the correlation is 0.07). The rather

large negative correlation between the share of tolling and the margins of enterprises (-2.74) confirms the effects of special contracts on market development in Russia: the more the share of tolling in the supply of resources of a firm, the more dependent on the supplier it has proved to be and the less is its power in the product market because this power has been transformed towards the leading element of vertical integration the supplier. The significant coefficient of CAP (0.186) indicates the links of enterprises with the remnants of the planned economy: the higher the capacity utilisation rate (that is inherited from the past), the higher the possibility of having an influence on the market.

Thus, factor analysis of the sugar market has confirmed the first hypothesis the result is similar to that of the petrol market.

The second hypothesis deals with the causes of tolling contracts. As we noted in part 2, there are several competing views on this problem. The two most important are that tolling is a factor of vertical integration and/or it is solely a financial phenomenon. Our hypothesis has been that tolling is caused by the processes of vertical integration in industry. To test the hypothesis we have developed the second regression model.

The tolling share has been taken as the dependent variable with two independent variables that could help in distinguishing the two points of view that of the share of insolvency in total enterprise arrears and a dummy variable of transaction cost.

The dummy has been constructed in the following way. We have collected data on the behaviour of sugar refineries, including statistics on the number of suppliers that each enterprise has (in general, one or many) and survey statistics. Respondents were asked to estimate the stability of their relationships with suppliers on the basis of none, weak or strong possibility of change. If the enterprise has one supplier and does not want to change it, its transaction cost is the lowest and a value of 0 has been assigned to the dummy. If the enterprise has many suppliers and plans to change at least some of them, its transaction cost should be the highest, and a value of 2 has been assigned to the dummy. Intermediate cases have a dummy of 1 (see table).

	Number of suppliers	
Probability of changing suppliers	One	Many
High	1	2
Low	0	1

The second regression model is as follows:

$$TOL = 0.8199 \quad 0.0004ARR + 0.866TC$$

where:

TOL is the tolling share in the supply of sugar beet;

ARR is the share of bad debt in the total arrears of enterprises;

TC is the transaction cost dummy.

The results of factor analysis are presented in the table.

	TOL (INTERCEPT)	TC	ARR
Coefficient of linear regression	0.8199	0.866	-0.00040
Standard error	0.0182	0.09	0.000079
t-statistic	44.946	9.538	-5.05
Average value	0.87	1.14	0.22
Standard deviation	0.0494	0.912	0.058
Maximum value	0.98	2	0.306
Minimum value	0.80	0	0.10

The number of observations is 35;

$R^2 = 0.74$;

R^2 adjusted = 0.724;

F (2, 32) = 45.64;

Standard error of estimate = 0.0259.

The results of model 2 show that the role played by enterprise financial problems in the choice of tolling contracts is insignificant: the correlation is weak and, as expected, negative (-0.0004). Thus, the view on tolling as a financial problem has not been confirmed.

At the same time, transaction cost has proved to be a more important cause of tolling contracts, with a positive correlation of 0.866. The higher the level of transaction cost in the market, the higher is the incentive for enterprises to use tolling contracts as a tool of vertical integration. Our hypothesis concerning the essence of tolling contracts under transition have had further confirmation.

CONCLUSIONS

The results of market analysis allow us to draw some conclusions concerning the determinants of market developments in the economy under transition.

The special factors of the transition play the most important role in market developments in Russia. For developed countries, traditional factors of market power concentration and the size of sellers have only a minor influence under transition.

The effect of producers on prices and sales is declining. At the same time, due to tolling contracts, the influence of suppliers is going up. In the sugar market, tolling contracts are used by economic entities which are new to traditional production and distribution chains. The emergence of these entities in the markets increases the effects of tolling contracts on production flows and the economic performance of enterprises.

Tolling contracts are special relationships in the transition economy that have the most important influence on market developments in Russia. Their effects are ambiguous. On the one hand, tolling contracts can increase firms profits and consumers surplus, compared to independent decisions, thanks to the partial solution of the double mark-up problem. However, tolling contracts can not ensure the maximisation of total profits that is possible under vertical integration. On the other hand, tolling contracts are tolls of suppliers market power.

The more tolling contracts are used, the higher their concentration in the intermediate product markets. A major factor limiting tolling contracts with suppliers is the uncertainty of production cost and demand because tolling contracts place an additional risk on suppliers compared to independent decision-making. The more the incentives held by producers in tolling relationships, the higher the demand uncertainty and the lower the production cost.

Competition in Russian markets is limited not only by a high concentration of producers but also by institutional and macroeconomic determinants in general. The special vertical contracts now dominant in Russia reflect the under-development of the enforcement system for property rights that is the main factor of market developments in the transition economy.

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APPENDIX

Chart 1. Number of refineries and profit of supplier of raw materials

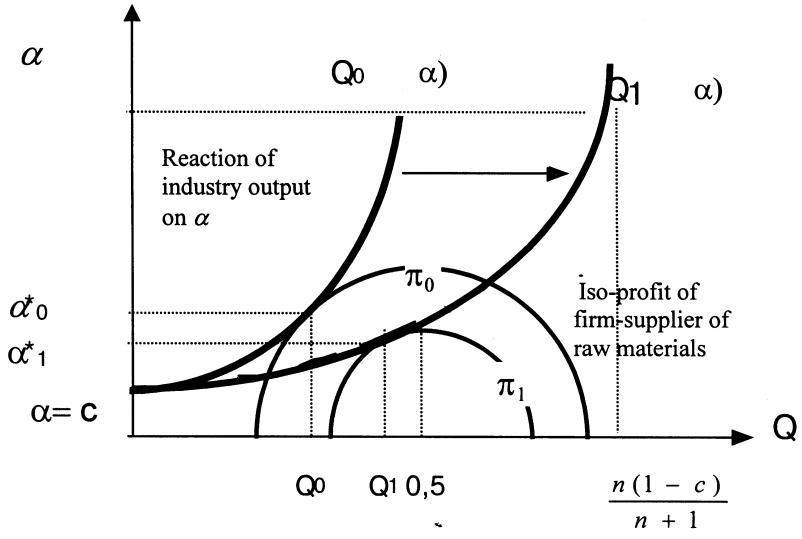


Chart 2. Profit of vertical chain under different types of contract arrangements

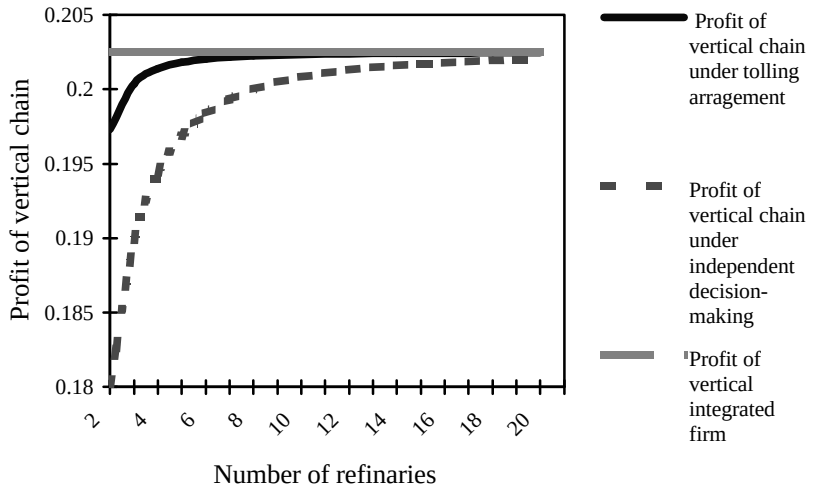


Figure 1. Petrol market: distribution channels (1996)

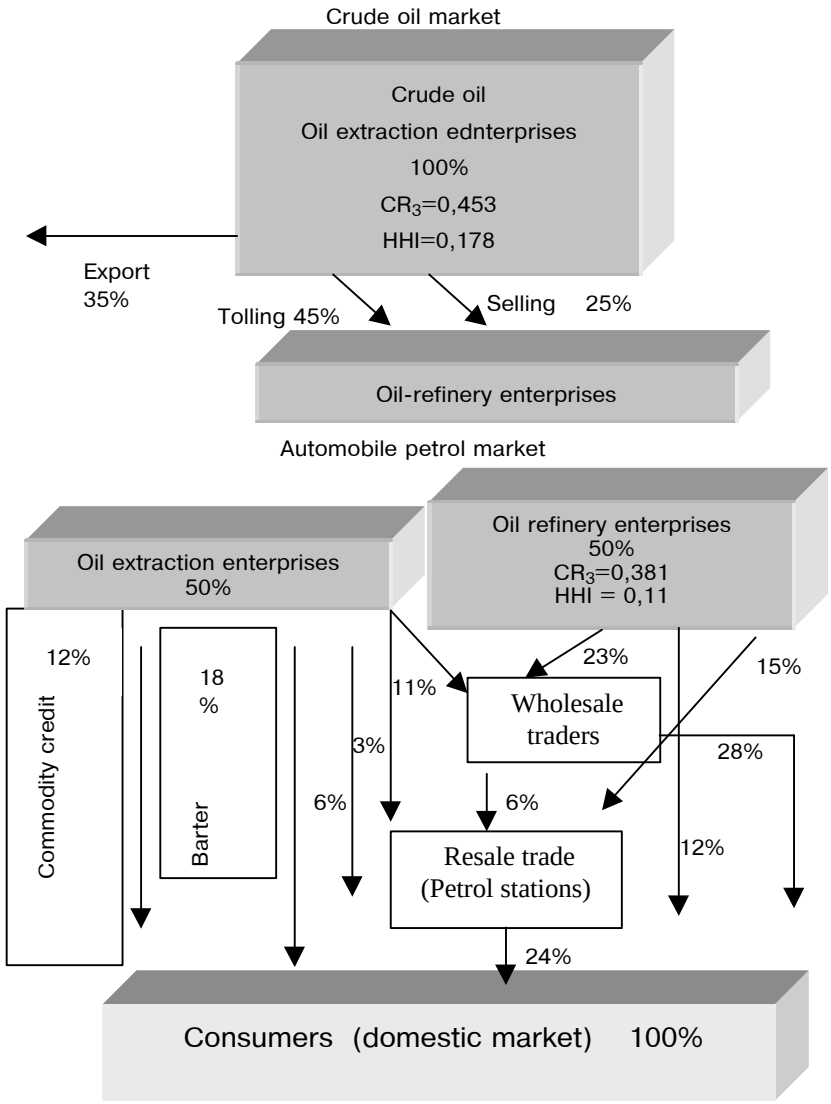
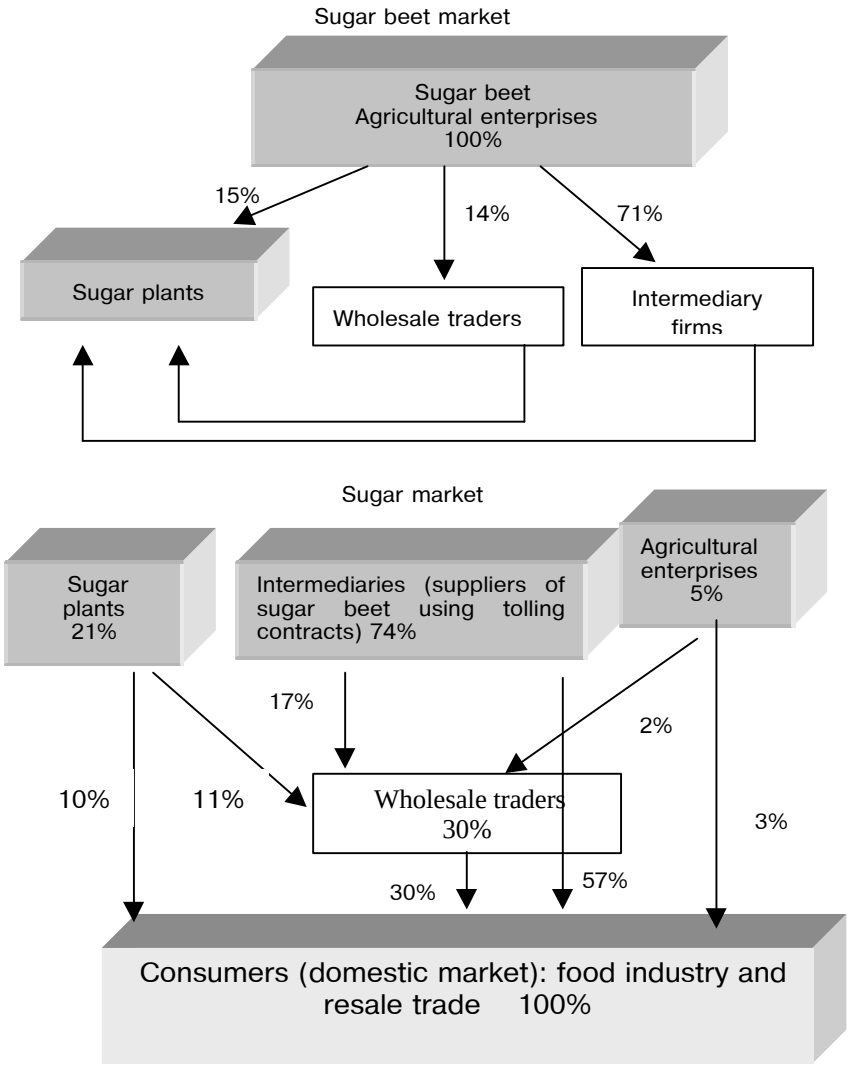


Figure 2. Sugar market: distribution channels (1996)



Characteristics of the Data of the State Committee of Statistics

Investigation of the Petrol and Sugar Markets

An investigation of the petrol and sugar markets was carried out by the State Committee on Statistics during the second half of 1996. The scope of survey conducted was the following:

	Petrol market	Sugar market
Producers	9	35
Agricultural enterprises (producers of sugar beet)		65
Wholesale traders	58	65
Consumers	190	121

Research was conducted for the following regions:

Petrol market

Type of region investigated	Name of region
Regions where oil is extracted and processed	Bashkorstan, Komy, Astrakhan, and Orenburg
Regions where oil is processed but not extracted	Krasnoyarck, Ryazan, Yaroslavl, and Omsk
Regions consuming petrol	Altay, Murmansk, Pskov, Penza, Smolensk, Chelyabinsk, and Kemerovo

Sugar market

Type of region investigated	Name of region
Regions where sugar is produced, fully provided	Krasnodar, Belgorod, Orel, Kursk, and Tambov
Regions where sugar is produced and imported	Mordoviya, Stavropol, Bryansk, Mula, and Nizny Novgorod
Regions which are net consumers of sugar	Primorsky, Kaliningrad, Tver, Kaluga, and Rostov-on-Don

Characteristics of Petrol Market Database (1996)

	Margin	Share of oil company in production	Share of tolling contracts	Rate of capacity utilisation	Share of oil supply by its own company	Share of insol-vency
Average	0.137	0.066	0.58	0.658	0.613	0.398
Standard error	0.021	0.012	0.066	0.042	0.053	0.05
Mean	0.145	0.040	0.450	0.688	0.6	0.3
Standard deviation	0.122	0.069	0.369	0.239	0.297	0.284
Minimum	-0.149	0.00496	0	0.139	0.08	0.04
Maximum	0.352	0.22	1	1	1	0.87