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The opinions expressed in this paper are those of the authors and do not necessarily reflect the views of the Bank of Finland.

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Macroeconomic Crisis and Price Distortions in Russia¹

Abstract

Several macroeconomic errors were made by the Russian Government during the reforms of 1992–1993. To rectify them, it will be necessary to concentrate on the problem of price distortions. Existing price distortions and movement of the domestic inter-industrial price structure towards international standards will greatly influence development of the Russian economy in the near future. Taking into consideration the existing structure of the economy and the necessity of a more rapid increase in energy prices in comparison with other commodity prices, one would expect to observe a situation in which total wholesale prices in the economy increase more than consumer prices. In general, this means that the value added will increase at a lower rate than material expenditures. Hence it follows that the state budget and the consolidated balance sheet of incomes and expenditures of the enterprise will suffer from the deficit and efforts to stop inflation in the near future will not be successful, although substantial reductions are possible. Changes in the taxation system offer the Government one means of controlling inflation.

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Introduction

Reforms in Russia have already lasted for almost two years. Was this enough time to change the situation significantly extent? Did the country's leaders fulfill their promises to society? If not, then why was this so? There are different views on this issue (see, for instance, [1],[2],[6]). In this paper, which supports the direction of the reforms, I would like to treat these issues and to analyse the drawbacks mainly from the macroeconomic viewpoint, without discussing the political problems or the institutional side of the governments' economic policy. I will also omit drawbacks in the organization of the reforms, which were caused by political instability to some extent. Thus it would seem to be helpful to determine a starting point for the analysis and conclusions.

The rather rapid transformation of the inter-industrial price structure seems to be one of the major factors affecting the recent economic situation in the Russian Federation. If the economy is really liberalized, then one should accept the elimination of price distortions as an absolute, unconditional tendency. In general, of course, this process can be controlled by state authorities, but only to some extent, and this applies mainly to the pace of transformation, and not to the tendency itself. One of the possible ways to slow down the process of price structure transformation is to increase import taxes. That is the way to restrict competition; it was the liberalization of imports that actually created a kind of competitive market in Russia. But now it seems that under pressure from Russian producers, the Government is trying to provide protection against competition from abroad. This, of course, will allow them to increase prices more and more, which will contradict the Government's declarations concerning the necessity of reducing inflation. Nevertheless, further transformation of the domestic price structure will also continue to affect the Russian economy significantly.

Naturally, transformation of the domestic price structure in Russia affects not only the volume of production in various industries and their profitability, wages funds employment, etc. It also influences (or should influence) Government economic policy. It is evident that movement of the domestic price structure towards international standards will enable some industries to become much more profitable than others. Hence many new questions will arise; for instance should the Government support declining industries? If yes, then for how long? Or should there be a special federal program for decreasing production and restructuring in these industries? Will the budget be strong enough for that? What are these industries?

Price changes in Russia can also cause social and regional problems; there are many mono-producing regions in the Russian Federation. If there were to be a shortage of production and mass dismissals, it is easy to imagine the acuteness of the social consequences in such regions.

And so, if society follows the course of economic liberalization², proclaimed by the Government in 1992 and confirmed in the new Government economic program of 1993 (see [7],[8]), then the transformation of the domestic price structure should be accepted as the key factor affecting the economy. It can be the starting point that may answer many current questions.

² This paper was written before the Russian parliamentary elections of December 12, 1993.

Without a clear understanding of the above-mentioned problem, it would also seem very difficult to start discussions about the level of economic decline in Russia and the structure of the Russian economy. It evidently depends on the sort of price scale that is considered. But which prices serve as "better" comparable prices – distorted values for 1990 or 1991 or 1992, or some others? The dynamics of production as well as the structure of the economy differ greatly, depending on the prices chosen. Of course, the best option seems to be to measure Russian industrial output at world prices. But an estimate of this kind can be very rough; it may be easy to calculate the output in the gas or oil or coal industries, but it is very difficult to estimate it in the machine-building or light industries. These questions are also examined in [3],[4].

The paper is organized as follows: section I is an attempt to analyse the errors made in economic policy and to explain some of them. In section II we shall examine the correlation between the transformation of the domestic price structure and inflation. Section III concentrates on the problems of the existing taxation system in Russia and on the prospects for reducing inflation. In each section we will, of course, focus on the problem of price structure transformation.

1 Government macroeconomic policy and the structure of domestic prices

At the beginning of the reforms, one of the main topics of discussion was the low level of domestic oil prices. However, it is necessary to emphasize that not only the well-known problem of energy price increases should be solved in Russia (as well as in the other republics of the former Soviet Union), but that the correlation between the main commodity prices should also be moved towards international standards. If this does not happen, it will be very difficult for Russia to become more fully involved in world economic relations. Until the problem of improving of the domestic price structure is solved, there will be no significant improvement in production efficiency in Russia, which is the key problem of the Russian economy.

The above-mentioned problem of improvement of the domestic price structure has two basic aspects. One is the necessity to increase energy prices at a higher rate than prices of other commodities. The other aspect, which is very closely connected with the first, is the elimination of price distortions within the energy sector itself.

Table 1 gives some impression of price distortions in the Russian economy by comparing the domestic prices for several commodities with their world market prices. The price structure in Russia is, of course distorted against international standards.

The commodities presented in Table 1 could be conceived as basic commodities. This means that, to some extent, the dynamics of production for these products is closely related to production in the corresponding aggregated industries (rolled metals – ferrous metals industry, crude oil – oil extracting industry, fertilizers and ammonia – chemistry, wheat – agriculture, etc.). These aggregated industries are traditionally used as a basis for the aggregated input/output tables and for macroeconomic analysis in general. It is also apparent from historical data that changes in the prices for these commodities are also highly correlated with price indices in corresponding industries.

The world market commodity prices given in Table 1 are closer to those on the European market. The Russian domestic prices presented in this table are wholesale producer prices. Rather different principles of taxation are currently used in various industries in Russia. As a result, consumer oil prices for instance (which include payments to several extra-budgetary funds, excise tax, value-added and profit taxes and certain other payments) can be approximately two times higher than producer prices. In contrast, consumer wheat prices are not as high in comparison with producer prices, as the agricultural sector in practice still enjoys many privileges.

It should also be emphasized that the data for the first half of 1993 are preliminary and should be checked and updated. Moreover, as the prices shown in Table 1 are the average prices for the corresponding period (year or six months) and as the prices for some energy resources are still controlled by the Government (thus the increase in these prices could not be considered uniform over a given period), then it is not very informative or correct to compare the average half-year prices with the same annual average data. Preliminary 1993 prices are given in Table 1 more for information than analysis. Several columns "Oil=100" are

shown, especially in order to enable comparison of domestic and world price structures, but not the level of domestic prices. Neither are we going to discuss the problem of the market ruble to dollar exchange rate and its correlation with inflation and the purchasing power of the ruble (this is a separate theme).

One of the macroeconomic mistakes of the Russian Government was to announce at the beginning of 1992 that only energy prices need to be shifted towards the world level, and that this should be done in a few months or a year. Nothing was said about other prices. It became obvious soon after the reforms began in 1992 that it would not be possible to achieve this target.

Moving domestic energy prices towards the world level usually entails altering the entire inter-industrial price structure. Of course this does not mean that prices in Russia should be exactly the same as in Europe or the USA. They need only be closer to international standards; it makes better sense to speak (mainly) about eliminating the worst price distortions in Russia. It is obvious that world prices are not frozen; they also change, but not as significantly as those in Russia. That is why we do not view these fluctuations as so problematic.

Changes in the domestic price structure are very much associated with changes in the efficiency of production and technological development in any country. Thus price structure transformation in Russia should not be considered a short-term task. It is not possible to replace all equipment and machinery in a few months and to reduce energy consumption significantly (excluding some prospects for more economic utilization). Thus price distortions in Russia, even after two years of reform, are still significant. As seen from Table 1, domestic metal prices in 1991 (both ferrous and non-ferrous) if to measure them in terms of oil were two to three times higher than world prices. The same situation is apparent with chemical product prices in general and with prices of fertilizers in particular, which were much more higher than world prices (also measured in terms of oil).

This level of domestic metal and chemicals prices affects Russian machine-building prices and these in turn influence agricultural prices. For instance, the Russian wheat price was four times higher than the world price (both measured in terms of oil). The same situation was apparent for many other products intended for final consumption: machines, cotton and synthetic fabrics, etc. Gas and electric power were also much cheaper in Russia compared with oil than the same products on the world market. They are still too cheap, even at the end of 1993.

A similar situation was evident on not only the wholesale market, but on the consumer market as well. In August 1993, for instance, the price of a railway ticket from Moscow to St. Petersburg was the same as the price of one kilogram of bananas or two kilograms of fruit produced in the European part of the Russian Federation. The government also maintains rather low rents for housing. In many countries, some consumer prices are subsidized and perhaps many of them should be further subsidized in Russia, but not to such a great extent.

It is evident that all these price distortions affected the consumption of fuel and energy. They also affected the technological level of Russian machinery and equipment. Low prices for energy and for some other natural resources caused low productivity, as enterprises were not interested in developing the new technologies necessary to reduce consumption of these resources.

It was the liberalization of the economy in general, and the liberalization of prices in particular, that led to some changes in the price structure in 1992. Some of the changes were positive and others negative. For instance, the ratio between oil and metal prices was improved to some extent. Similar improvement is

apparent for chemicals, wheat and foodstuffs, cotton fabrics and certain other commodities. These prices (except the price of wheat) were completely deregulated.

The situation for prices within the energy sector is totally different. In 1992 and the first half of 1993, electric power, coal and gas became cheaper in comparison with oil. These prices were controlled by the Government. This deterioration of the price structure within the energy sector forced the Russian Government to deregulate oil and coal prices and to allow freer price formation in the electric power industry. Hence it follows that the more liberalized the economy, the closer it moves towards international price structure. That is why further liberalization may allow producers to increase energy prices more rapidly.

The other drawback of the Government's economic policy, which is closely linked with the first, was that in January 1992 they effected an approximately five-fold increase in energy prices, while excessively restricting the money supply at the same time. The contradiction between a steep rise in energy prices and the monetary policy pursued, which caused a lack of money in the economy, provoked enterprises to issue their own money substitutes. These are arrears which still compensate for the lack of non-cash money in turnover. The arrears crisis has been studied thoroughly: low penalties for overdue payments, the absence of a bankruptcy law, monopolises in many sectors of the economy – that was the background of the arrears crisis.

The author and his colleagues tried to point out in the report delivered to the Government at the beginning of 1992 that there cannot be a significant gap between the energy price increase and the increase in prices for other commodities in the real Russian economy. This report was based on calculations made with an economic and mathematic model. It was suggested in the report that, if energy prices increase, let us suppose K times, then the overall price index for the economy will probably be somewhere between $0.6 \cdot K$ to $0.8 \cdot K$ per annum. In the alternative situation (when this index is lower than $0.6 \cdot K$), the solution was unstable (if the coefficient is close to one then there are no changes in price structure). The conclusion was as follows: if the Government's monetary policy is accepted, then the increase in energy prices should not exceed three times the average for 1992. If energy prices are further increased, then it will also be necessary to increase the money supply at a higher rate.

Actually, the first months of 1992 showed that, as the prices for most of the commodities were liberalized while energy prices were still regulated, the price structure changed for the worse. Enterprises increased prices and at the same time compensated for the lack of money in circulation by mutual non-payments. The situation was soon out of control. Moreover, after the first three months of 1992 energy prices increased by 634 percent while the overall wholesale price index for industry was 188 percent. To correct this situation the Government was forced to effect another increase in energy prices, which it did in May and then in September (mainly for oil and oil products). Only then did the annual price increase for oil exceed the total price increase in industry significantly (the above-mentioned coefficient was equal to 0.6).

(Appendix 1 also broaches this question. The above process of price structure transformation in a two-sectorial model of the Russian economy is described by hyperbolic curve. At the tail of the curve, where it approaches the linear, the economy does not feel any stress. However, when the gap between energy and other prices increases, one would expect to see a break in the curve, which

indicates qualitative changes. It was the arrears crisis that protected the economy from this break.

Moreover, the Russian government made its third macroeconomic mistake at the same time: much of its effort was aimed at curbing inflation on the consumer market, while inflation on the market for intermediate products was flourishing. There were artificial delays in compensation to employees, explained by the lack of cash. In mid-1992 these delays amounted to approximately 230 billion rubles. Inflation was really curbed (10 percent per month in the middle of the year), while at the same time wholesale prices were increasing by 20–25 percent per month. As final demand was limited (not enough cash on the consumer market) and intermediate demand was practically unlimited (arrears compensated for the lack of non-cash money), the negative structural changes in the economy were evident. Many enterprises continued to produce intermediate products and to distribute them among their partners without receiving payment in return. However, enterprises oriented to the consumer market were forced to reduce their production significantly, as their costs were increasing more rapidly than their incomes.

This situation forced the Government to implement some urgent measures. It introduced the mechanism of advanced payments. Together with the Central Bank, they were also forced to legalize the enterprises' money substitutes by mutual clearing of non-payments and increasing the money supply. They were forced to print paper money. As a result, inflation at the end of the year was very high. This was quite natural. Nevertheless, even by the end of the year, wholesale prices had increased more than consumer prices.

This situation (the excessive increase in wholesale prices in comparison with consumer prices) also affected budget incomes and expenditures. This will be examined in the next section.

2 Transformation of price structure and inflation

It seems that we have to accept the view that inflation in the Russian economy is not strictly monetary (see also [5]). The monetary roots of inflation are obvious, although perhaps not the first cause of high inflation in 1992. The State was forced to subsidize the economy, as it was not possible in such a short period either to change the behavior of producers or to replace equipment and increase efficiency.

If we divide the Russian economy into two sectors (the energy sector and the rest of the economy), then it can be proved that in order to move the domestic price structure towards international standards, wholesale prices in Russia should increase more than consumer prices. This is to some extent apparent from Table 1 and can be confirmed with actual data not only for 1992 (and even for 1991) but also for 1993 (see Table 2). It is apparent from this table that the two columns containing inflation statistics provided, on the one hand, by the Central Committee on Statistics of the Russian Federation and, on the other, by the Center of Economic Analysis of the Federal Russian Government give practically the same picture. The source of primary or raw information is the same, but these organizations use different methodologies for calculating inflation. Nevertheless, both methods show that wholesale prices constatly increase faster than consumer prices.

However in the case of the more rapid increase in wholesale prices, the total value added in the economy will increase at a lower rate than material expenditures if they are calculated in nominal prices. Hence throughout the period of price structure transformations, if we take into consideration expecations of a gap between the growth in value added and that in material expenditures, we would also expect the state budget to be balanced with the deficit. Naturally, the income side of the budget is based on taxation of the value added, while the expenditure side of budget is largely correlated with total material expenditures in the economy (for example direct expenditures such as investment or budgetary subsidies to other sectors of the economy, which are also supposed to spend their money in accordance with existing prices).

SOME WORLD AND DOMESTIC COMMODITY PRICES
(in RuR or USD per unit)

Table 1.

	USSR 1991		World prices		Russia 1992		Russia 1993 average Jan - Jun	
	(RuR / t)	OIL = 100	(USD / t)	OIL = 100	(RuR / t)	OIL = 100	(th RuR / t)	OIL = 100
CRUDE OIL	75.0	100.0	120.0	100.0	3352.0	100.0	12.7	100.0
GASOLINE	150.0	200.0	220.0	183.3	6647.0	198.3	32.0	251.7
ELECTRIC POWER *)	30.0	40.0	110.0	91.7	574.0	17.1	2.8	21.8
NATURAL GAS **)	14.0	18.7	80.0	66.7	675.0	20.1	0.6	4.8
COAL	20.0	26.7	40.0	33.3	539.0	16.1	1.5	11.6
ROLLED METALS	480.0	640.0	350.0	291.7	16693.0	498.0	65.7	517.3
ALUMINIUM	2415.0	3220.0	1270.0	1058.3	79736.0	2378.8	329.4	2593.7
COPPER	4801.0	6401.3	2300.0	1916.7	142576.0	4253.5	570.6	4492.9
WHEAT	450.0	600.0	176.0	146.7	8838.0	263.7	NA	NA
CEMENT	60.0	80.0	68.3	57.0	835.0	24.9	3.6	28.3
AMMONIA	166.0	221.3	100.0	83.3	6341.0	189.2	NA	NA
NITRIC FERTILIZERS	300.0	400.0	80.0	66.7	11414.0	340.5	NA	NA
POTASSIUM FERTILIZERS	150.0	200.0	100.0	83.3	5644.0	168.4	NA	NA
PHOSPHORUS FERTILIZERS	600.0	800.0	40.0	33.3	10068.0	300.4	NA	NA
TIMBER (logs) ***)	65.0	86.7	98.2	81.8	1085.0	32.4	4.2	33.1
TIMBER (planks) ***)	130.0	173.3	267.9	223.2	3864.0	115.3	13.5	106.3
COTTON FABRICS ****)	4000.0	5333.3	640.0	533.3	39000.0	1163.5	180.0	1417.3

*) per 1000 kWh

**) per 1000 cubic meters

***) per 1 cubic meter

****) per 1000 meters

Table 2. **Wholesale price indices in industry and inflation in 1993**

	Wholesale price index		Inflation (consumer prices)			
	in % to the prev. month	in % to Dec. 1992	(Goskomstat)		(C.E.A.)	
			in % to the prev. month	in % to Dec. 1992	in % to the prev. month	in % to Dec. 1992
January	132	132	127	127	126	126
February	132	174	126	160	129	163
March	123	214	121	194	117	190
April	124	266	125	242	116	221
May	119	316	119	188	119	263
June	117	370	120	346	117	307
July	129	477	122	422	119	365
August	127	606	126	531	129	471
September	121	733	121	643	121	571
October	119	873	120	771	125	713

C.E.A. – Center of Economic Analysis of the Russian Government

In this scenario not only the state budget, but also the consolidated balance sheet of revenues and expenditures of the corporate sector (enterprises) will be balanced with the deficit. The main reason for this is the lack of income in some non-energy industries due to changes in the solvent demand for their production. Moreover, their costs will increase after the rise in energy prices. Of course, in both cases, it is possible in principle to make the deficit equal zero, but this would mean a substantial decline in production measured in fixed prices or physical terms. In real life, however, it seems that the deficit will exist and will be covered by money supply expansion; this means permanent inflation in the near future. It also means that money will concentrate in those sectors where the value added is increasing at a higher rate thanks to the higher pace of increases in prices for the production of these sectors (above all in the energy sector).

This scenario was also examined with a computer model of the Russian economy and as usual, even with different initial assumptions, the solution was characterized by rather high inflation mainly in the next one to two years (if we assume that more complete deregulation of energy prices will be carried out mainly in these years).

As was said above, the described scenario has been confirmed in real life. Naturally, both in 1991 and in 1992 (and, as predicted, in 1993 as well), a more rapid increase in wholesale prices compared with consumer prices was accompanied by a deficit in the state budget and by the necessity of expanding the money supply to cover the budget deficit and the deficit in the consolidated balance sheet for the enterprise sector. As was shown in Section I, an attempt to implement rather strict monetary policy at the beginning of 1992 led to a dramatic increase in inter-enterprise arrears. As these arrears should be seen as a kind of money substitutes "issued" by the enterprises, but not real money issued by the banking system, this was another macroeconomic cause of fiscal deficit; when real money does not pass through the banking system, taxes cannot be collected. This also encouraged the Government and the Central Bank of Russia to legalize the

existing non-payments by a more rapid increase in the money supply and by mutual clearing of inter-enterprise arrears at the end of 1992.

Inflation in Russia was also caused by credits issued by the Russian Central Bank to CIS republics. Some of these credits were transferred back to Russia, thereby increasing the money supply. However the primary cause of these credits was the same: the rise in prices for fuel exported from Russia to these republics. In 1992 enterprises not only within Russia, but even outside it, which cooperated with Russia, continued to supply each other without payments. Thus it was also rather natural to legalize arrears of this kind.

The above-mentioned problem of arrears is a separate topic. Many important aspects connected with this problem (such as bankruptcies, the necessity of increasing penalties for overdue non-payments, etc). are not discussed here, as they mainly concern the institutional side of economic policy, but not directly the formal macroeconomic field.

Nevertheless it seems that the rate of inflation can be controlled to some extent by the Government (fiscal and industrial policies) and by the Central Bank of Russia (monetary policy). In 1993 – despite all the contradictions in society and the economy, despite strong pressure on the Government from some sectors of economy aimed at securing various privileges and subsidized credits – some decrease in the ratio of inter-enterprise arrears to GDP is evident: non-payments increased only in nominal prices, but at a lower rate than the GDP. Production also decreases less dramatically (in terms of GDP it will be about 10–12 percent of the decline in 1993, in comparison with 18 percent in 1992; both figures are compared with the previous year). Chart 1 shows that the dynamics of arrears is highly correlated with price increases. Moreover, the amount of deflated arrears decreases and the proportion of overdue arrears decreases even more rapidly.

3 Elimination of price distortions and the taxation system

As was said in the previous section, it is possible to reduce inflation in Russia. Apart from monetary policy, there should also be some changes in the taxation system.

The main aim in setting up a new taxation system in Russia since the beginning of 1992 was uniformity. All enterprises were supposed to pay the same taxes and at the same rates. Unification was intended to eliminate all privileges granted earlier to various sectors of economy and to relieve future pressure on the Government. Unfortunately this policy was not very successful. Later the Russian parliament reduced the value-added tax in the food industry, and, in accordance with former Soviet practice, numerous privileges were granted to the agricultural sector.

At the same time during the second half of 1992, after a more rapid increase in energy prices, it became evident that the value added concentrated in the energy sector was too high. It was quite sufficient to cover all taxes due from this sector. Wages fund has also increased in it significantly. Despite the decline in production, increased employment was evident in the energy sector in 1992 (the increase between three and nine percent in the various branches). Profits were also rather high. Thus, by mid-1992 this sector had become virtually self-sufficient with respect to investment: internal financing accounted for more than 90 percent of total investment. Declining investment in the energy sector was not as significant as in the other sectors. A huge surplus appeared in this sector, while many other sectors were suffering from a lack of money. Hence it was possible to collect the surplus from the energy sector.

The same situation was apparent in metallurgy, where prices had increased much more than in the economy in general. For this reason, the Government introduced so-called "price regulation extra-budgetary funds" in these sectors in 1992. In general, this meant additional taxation. As a result, the principle of uniform taxation finally died.

There are also other large extra-budgetary funds in the Russian economy to which enterprises are supposed to pay taxes. The largest of these are the Pension Fund, the Social Insurance Fund, the Road Funds, the Price Regulation Funds mentioned above, and the Scientific Research Fund. In 1992 the total incomes of extra-budgetary funds were approximately 3.3 trillion rubles, which is comparable to the incomes of the federal budget. The extra-budgetary funds spent less than 70 percent of their incomes. Thus the surplus of more than 1 trillion rubles in extra-budgetary funds was sufficient in principle to cover the federal budget deficit. However, under existing decrees, the Government could not control the expenditures of these funds, nor use or borrow their surplus. The same situation was also typical in the first half of 1993.

Such a complicated taxation system stimulates inflation, as enterprises increase the prices of their products, increasingly taking into consideration the additional necessity of paying taxes to the extra-budgetary funds while a significant part of these funds is not used either for direct purposes or to cover the fiscal deficit. Thus one of the ways to restrain inflation is to allow the Government to use the surplus of the extra-budgetary funds to cover the fiscal deficit (this, perhaps, will be done in 1994) or to reduce rates of extra-budgetary taxation.

The other way to reduce inflation is to accept the idea of sectoral differentiation in taxation rates. Prices are still increasing irregularly in different industries (see Table 3). As expected, this will also be so in the near future. That is why the idea will remain current during the transition period. It would seem necessary to set up high taxation rates in the energy sector; this means that a rather high energy tax will be levied and that the levels of taxation rates (value-added tax, profit tax, etc.) in the rest of the economy will be reduced. It also means redistributing the shares of budget incomes which are collected from various sectors of economy.

It can be proved as a theorem (using a two-sectorial model: the energy sector and the rest of the economy) that in this case budget incomes can be even higher as, taking into consideration expectations of a more rapid increase in energy prices in the near future, the value added, concentrating there will be increasing at a higher rate (see Appendix 1). The reduction of taxation rates in the non-energy sector will also allow an increase in non-energy sector incomes and reduce demand for subsidies, centralized investment and other privileges.

Table 3. **Wholesale price indices by sectors in 1993**

January–September 1993 in % to January–September 1992

Industry (in total)	975
including:	
Electric power industry	1368
Fuel industry	1856
Ferrous metals industries	851
Non-ferrous metals industries	845
Chemistry	1014
Oil-and-chemistry	795
Machine building industry	880
Timber, wood-processing, pulp and paper industries	725
Construction materials industry	982
Light industry	654
Food industry	1133

Source: Goskomstat RF

Examination of the statistics on arrears reveals a steady rise in the proportion of non-payments to the fuel industry. In November 1992 it was less than 20 percent, while in August–September 1993 it had increased to 27–31 percent. This means that a more rapid increase in energy prices will lead to a real but not artificial lack of money in some sectors of the economy and confirms that money will concentrate there.

Two-Sectorial Model of Russian Economy and Taxation

This is a brief examination of the above-mentioned principles of taxation which could be used for the economy in general and in the energy sector in particular. It is based on a two sectorial model of the Russian economy broken down into the energy sector and the rest of the economy. Here the energy sector refers to the oil industry as a whole (both processing and extracting), gas, coal, other fuel and electric power industries.

Let

$$a_{11} \times x_1 + a_{12} \times x_2 + y_1 = x_1$$

$$a_{21} \times x_1 + a_{22} \times x_2 + y_2 = x_2$$

be an input-output model for the base year T with the actual data, where a_{ij} – Leontiev matrix coefficients, y_j – final demand, x_j – gross output, $i, j=1, 2$. On the other hand,

$$a_{11} \times x_1 + a_{21} \times x_1 + v_1 = x_1$$

$$a_{12} \times x_2 + a_{22} \times x_2 + v_2 = x_2$$

is also an input-output model (v_j – value added). Let us denote all of the variables with index 1 as the energy sector, with index 2 – as the rest of the economy. Then let p^1 and p^2 be price indexes for the named sectors for the year T+1 in comparison with the year T. To simplify the analysis we will not examine wholesale and retail trade prices: p^i means average prices. For simplification, we also suppose that $x_j(T) = x_j(T+1) = x_j$. This means that there are no changes in the volume of production.

So it can be taken further for the year T+1 that

$$p^1 \times a_{11} \times x_1 + p^2 \times a_{21} \times x_1 + V_1 = p^1 \times x_1$$

$$p^1 \times a_{12} \times x_2 + p^2 \times a_{22} \times x_2 + V_2 = p^2 \times x_2$$

where V_1, V_2 – "new" value added, created in the year T+1. Hence we have:

$$V_1 = p^1 \times x_1 \times (1 - a_{11}) - p^2 \times a_{21} \times x_1$$

$$V_2 = p^2 \times x_2 \times (1 - a_{22}) - p^1 \times a_{12} \times x_2$$

We want to see how the value added depends on price changes in both sectors. Let

$$K(p^1, p^2) = \frac{V_1}{V_2} = \frac{p^1 \times x_1 \times (1 - a_{11}) - p^2 \times a_{21} \times x_1}{p^2 \times x_2 \times (1 - a_{22}) - p^1 \times a_{12} \times x_2}$$

be an indicator, showing how V_1 and V_2 depend on prices. For further simplification let us assume that $p^2 = 1$. (This means we keep non-energy prices fixed and increase only energy prices.)

The actual data for the Russian economy (using 1990 statistics from input-output table) are as follows:

$$I(p^1) = \frac{p^1 \times 66.5 - 21.8}{484.8 - p^1 \times 37.1}$$

Thus for 1990 $I=0.0998$. The type of curve shows that the wider the gap between energy prices and other prices, the more value added will concentrate in the energy sector. It also shows that, if this gap is too wide, then some qualitative changes may occur (a break in the curve).

It is also necessary to emphasize that the share of wages in the energy sector is significantly lower than in the economy as a whole. This allows us to suppose that as budget income is a function of value added minus wages, then more taxes could be collected from the energy sector if value added in this sector were to increase more rapidly. In 1990 gross wages in the energy sector (including payments to social security and pension funds accounted for 13.9 percent of the value added, as opposed to 40.5 percent in the non-energy sector).

Let us see how the value added (and value added minus wages) depends on prices (see Table A1). Indicator p in this table means the overall price index for the economy, V_p – value added for the entire economy in the event there are no changes in price structure (we take the index p for both sectors).

Table A1.

$p^2=$	1	1	1	1	1	1	1	1	1	1	...	1
$p^1=$	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	...	5
$p=$	1	1.017	1.03	1.05	1.067	1.083	1.1	1.117	1.133	1.15	...	1.333
$V_1=$	44.7	58.0	71.3	84.6	97.9	111.2	124.5	137.8	151.1	164.4	...	310.7
$V_2=$	447.8	440.4	433.0	425.5	418.1	410.7	403.3	395.9	388.5	381.1	...	299.6
$V_1/V_2=$	0.1	0.13	0.16	0.2	0.23	0.27	0.31	0.35	0.39	0.43	...	1.04
$V_1+V_2=$	492.5	498.4	504.3	510.1	516.0	521.9	527.8	533.7	539.6	545.5	...	610.3
$V_p=$	492.5	500.7	508.9	517.1	525.3	533.5	541.7	549.9	558.1	566.3	...	656.6
$V_1W=$	38.5	51.7	64.9	78.1	91.3	104.5	117.7	130.9	144.1	157.3	...	302.5
$V_2W=$	266.6	256.0	245.6	235.2	224.7	214.3	203.9	193.4	183.0	172.6	...	57.8
$BI_1=$	19.3	38.4	51.4	64.4	77.4	90.4	103.3	116.3	129.3	142.3	...	285.0
$BI_2=$	133.2	128.0	122.8	117.6	112.4	107.1	101.9	96.7	91.5	86.3	...	28.9
$BIN=$	152.5	166.4	174.2	182.0	189.8	197.5	205.2	213.0	220.8	228.6	...	313.9
$BIO=$	152.5	153.9	155.3	156.6	158.0	159.4	160.8	162.2	163.6	164.9	...	180.1

In principle then, if the rise in prices in the energy sector is the same as in the rest of the economy (with index p for instance), then the value added for the entire economy is somewhat higher than in the case of a more rapid increase in energy prices (compare lines V_p and V_1+V_2).

In the opposite case, if we consider a policy of price structure adjustment, then we should examine rows V_1W and V_2W , which show value added excluding wages in both sectors. For simplification, we suppose that wages increase in accordance with inflation p in the energy sector and also in the rest of the economy. Let us also suppose that 50 percent of the value added (less wages) is paid to the budget (see rows BI1 and BI2 and column 1) and the remaining 50 percent of the value added in the energy sector is investment. Therefore, to maintain this investment on the same level we obviously have to suppose that it should increase in accordance with inflation p , which would be much below the pace of increase in value added in the energy sector. This means that more of the value added for the energy sector could be collected in the budget. If we accept the above suppositions, the total budget incomes would be those in row BTN. But if we assume that taxation rates are made uniform (50 percent in both sectors) than budget incomes will be considerably lower (row BTO). Thus in the first case (BTN) it is possible to reduce taxation norms in the non-energy sector, i.e. the main part of the economy.

The same conclusion can be made from the 1991 data. Table A1 shows that in principle we can find policy in which an even more rapid increase in energy prices is of some advantage to the economy. This scenario was also studied with a 20-sectoral computer model of the Russian economy. The overall results were similar.

It is also interesting that when the gap between the growth in energy prices and non-energy prices is equal to 5 then V_1 becomes equal to V_2 .

A Brief Description of the Macroeconomic Model of the Russian Economy

The macroeconomic model of the Russian economy consists of several sub-models. The econometric sub-model, simulating production of the main commodities in physical terms (about 360 products), is used for modelling the supply side. The transient block is used to go from production in physical terms to production in aggregated industries, calculated at fixed prices. (Practice shows that the traditional type of production functions, such as Cobb-Douglas, do not work well in the Russian case – there is practically no correlation between output and labor, for instance.)

The demand side is simulated by sectors with simple standard demand functions of the following type:

$$D = D_{-1} + c * \left(\frac{I_{rev}}{I_{pr}} - 1 \right) \quad (A2.1)$$

where D , D_{-1} – demand for current and previous years, I_{rev} – index of revenue changes, I_{pr} – price index (both compared with the previous year), c – coefficient (demand functions of the same type but in logarithms are also used in some cases). Inventory changes are a balancing category.

The idea of simplification and unification of the demand functions proceeds from the idea that annual time series which describe the Russian economy (till 1991) do not describe any demand and do not reflect recent consumer behavior as before it was traditional distributional system. Monthly data, which have been available since November 1991 and mainly since 1992, do reflect consumer behavior depending on prices and incomes. We therefore make an assumption in this model that the elasticity estimated on a monthly base can be extended to annual data. This is a basis for estimation of the Input-Output (I-O) table for the current year at fixed prices using actual statistics for the previous year.

A macromodel of financial turnover and price formation is used for reunification of the supply and demand sides. Let

$$X = A * X + Y^{priv} + Y^{oth}$$

be the I-O model of the current year calculated at fixed prices of the previous year, where X – gross output, A – Leontiev matrix, Y^{priv} – private consumption, Y^{oth} – other elements of the final product.

Three price index vectors are considered in the model: p^w – wholesale price index, p^c – consumer price index, p^a – average price index. Thus

$$p^a * X = p^w * A * X + p^c * Y^{priv} + p^a * Y^{oth}$$

is an input-output model for the current year expressed in nominal prices. On the other hand, it follows that

$$V + p^w * A * X = p^a * X$$

where V – value added (wages, profits, taxes, etc.).

Balance sheets of revenues (R_j) and expenditures (E_j) for each sector of the economy considered in the model are also included in the set of equations where j is the sector's number: enterprise sector (20 industries), government sector, households, banking sector. Thus in general we have:

$$R_j = R_j(p, V, Y, M)$$

$$E_j = E_j(p, Y)$$

$$R_j = E_j$$

$$M = M(p, v)$$

$$Y \in (Y^{\text{priv}}, Y^{\text{oth}})$$

$$p \in (p^w, p^c, p^a)$$

where M – money supply, v – velocity of money circulation.

The equations A2.1, if written in this general form, are as follows:

$$Y = Y(R, p)$$

$$Y \in Y(Y^{\text{priv}}, Y^{\text{oth}})$$

$$p \in (p^w, p^c, p^a)$$

For reasons of simplicity, we do not describe here the employment block, which is interrelated with the I–O model at nominal prices with the help of the wages fund and production, and certain other sub-models (the export-import and balance of payments sub-model, etc.).

The tool described above us allows to simulate changes in price structure and their impact on the economy. If wholesale price indices are exogenous, then consumer price indices are endogenous and vice versa: if consumer price indices are exogenous, then wholesale price indices are endogenous. It is also possible to take a mixture of wholesale and consumer price indices as endogenous and the rest will be the solution. Average price indices are calculated automatically in any case.

It is not necessary to set up all of the endogenous price indices simultaneously. It is possible to calibrate the model step, by step searching for a solution which could make the balance sheets of the sectors of the economy perfectly reasonable from a common-sense point of view and from an economic point of view in general.

The model usually has to be solved as a system of non-linear equations many times before finding a set of acceptable solutions taking different initial assumptions which define some scenario. If for instance, in the first iteration we change the price index for the oil-extracting industry (let it be more than one) while other

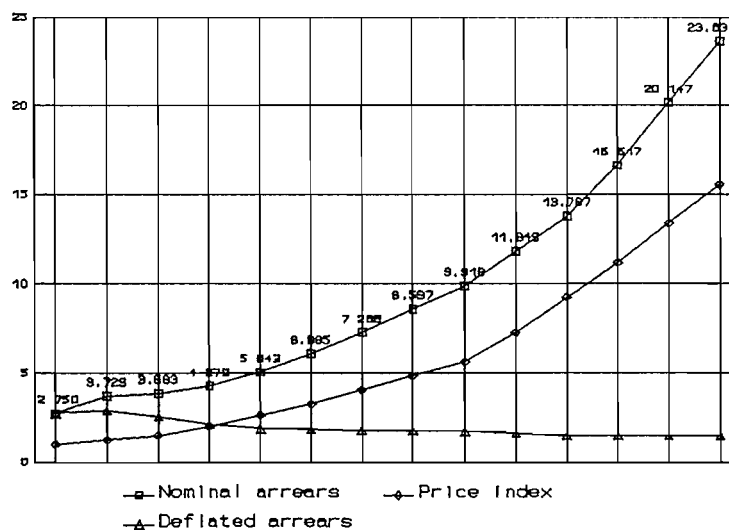
prices remain constant, then the solution will show that the balance sheet of revenues and expenditures in the oil-processing industry is balanced with the deficit. We must therefore subsidize it from the budget (it will increase the budget deficit and money supply) or increase its price index (which is closer to reality). However, the same problem will appear in the next iteration for electricity (then for transportation, etc.) if we increase the price index for the oil-processing industry. We must therefore calibrate the model further.

In calibrating the model, we have to adjust profits and wages on each iteration in order to obtain acceptable sectoral balance sheets. We also have to stop the iterations when we achieve targets (acceptable fiscal deficit, inflation, money supply increase, etc.) that describe the scenario. Thus we can see whether the chosen scenario makes sense or not. If not, then we have to change our initial assumptions and the scenario. It is clear that even if we eventually get one solution for a set, it will still provide some impression of the entire set and the scenario in general.

The process described here is in principle optimization. Initially there was an attempt to describe it as an optimization problem, but the first experiments showed that it was rather difficult to find a solution and then also difficult to understand it. Setting up frontiers for the variables was another problem which affected the solution. The rather complicated process of setting up frontiers led to rejection of optimization and to accept in the simpler idea of solving the system of non-linear equations with various exogenous variables.

Chart 1.

Arrears and the Wholesale Price Index in Industry
monthly, starting from November 1992



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