Title
Prospects for Restructuring the Soviet Price and Finance System

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I. Introduction

The radical economic Perestroika (restructuring) plan was presented to the Central Committee Plenum in June of 1987 ("Osnovnye...", 1987). One of the crucial tasks to ensure full implementation of the plan is the fundamental changing of Soviet price and finance structures. Soviet authorities have therefore stated their intention to carry out a comprehensive reform of the price and finance systems. Price reform will include higher industrial wholesale prices for fuels, the incorporation of rents for natural resources into the price system, a reduction in agricultural subsidies and some decentralization of pricing.1 This paper describes the price reform proposals put forward by Soviet mathematical economists who have provided the theoretical foundation for the new policy.

II. Price Reform Proposal of the Central Economic Mathematical Institute (TsEMI)

One of the fundamental characteristics of the Soviet-type centralized management system is that state enterprises enjoy viability and growth, regardless of their degree of profitability [Kornai (1981)]. Price levels in some sectors fail to reflect the cost of extended reproduction, and in some cases even the cost of simple reproduction. These sectors, however, remain viable. This can be possible only when the pricing policy is completely subordinate to national fiscal policy. Soviet authorities have managed the economy by means of the so-called "dual-price system," namely the industry wholesale price and the enterprise wholesale price, the difference of which constitutes the turnover tax. On the one hand, they collect

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1 The Soviet authorities decided on July 17, 1987 to undertake an extensive revision of industrial wholesale prices and to introduce rents, or payments, for natural resources (O korennoi perestroike... , 1987). The new price lists will become effective on January 1, 1990. In the past 20 years Soviet authorities have carried out such a comprehensive revision of industrial wholesale prices only two times; in 1967 and 1982 (the last agricultural price revision became effective in 1983). The 1967 price revision was associated with a significant change in the fundamental scheme for price formation, including the introduction of payment for capital stock, while the 1982 price revision modifies the price structure to a slight extent. For the 1967 price reform and the 1982 price revision, see Schroeder (1969) and Bornstein (1987).
the turnover tax from numerous sources, including the power generation and consumption goods sectors. On the other hand, the Soviet Union executes a redistribution of considerable sums through the state budget. As a result, serious price distortions, as well as chronic shortages of goods, occur which in turn hinder the directing of the economy to a more intensive growth path.

A feature of the Soviet price system is the artificially low price levels of primary raw materials in comparison with the price of manufactured products. The input-output of all products in an economy are interrelated. Therefore, price distortions of primary intermediate goods lead to an over-all distortion of the price structure through the interindustrial input-output inducement effect. As a result, price distortion appear, which cause price levels of the machine building industry to be considerably high as compared with the products of the extraction industry. In turn, this distortion causes: (1) wasteful use of raw materials and slow implementation of resource-saving technology (2) stagnation in the rate of modernization of the machine building industry (3) centralized administrative intervention in the profit formation and investment activities in each industry through large-scale redistribution of the state budget.

The TsEMI proposal for reform of the system is as follows:

Soviet mathematical economists seek to apply the optimal price (marginal cost) formation principle throughout the Soviet economy. However, recognizing the enormity of this task, they have suggested that the optimal price formation principle be applied initially only to the extraction (primary raw materials) industries, including coal mining, metal ore mining, crude petroleum extraction and the natural gas industries.

The price levels of these raw materials should be raised considerably by switching the price formation principle for the extractive industries from one based on average costs to one based on marginal costs. By adopting this procedure Soviet planners hope to increase the role of profits as an efficiency indicator for all industries, to increase the incentives for general energy savings and to provide the means for the introduction of energy-saving technologies. They also seek to raise Soviet domestic energy prices to more closely reflect world energy market price levels (as is the case in the developed capitalist countries, Soviet prices of manufactured products can be expected to be low in relation to the Soviet prices of raw materials). They further seek to lay the groundwork for a redirecting of the Soviet export structure from one based on energy exports to one based on machinery exports, as is the case in advanced capitalist countries, including Japan and the United States.

In order to develop the price formation for extractive industries, based on marginal costs, it is necessary to precisely establish the rates for rents on natural resources ("natural

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2 Recently, Khovalova (1988) posed a completely retrogressive, conservative opinion that the pure type of "dual-price" system established in the Stalin era should be re-established in the Soviet Union. As is stated in Belkin (1988), she seems to have missed the point that under the "dual-price" system the price is deprived of its fundamental function of comparative calculation of costs and results (benefits).

3 The 1982 price revision raised the level of prices for the extractive industries. However, the coal industry still operates at a "planned loss." Some high-cost enterprises in the extractive industries also operate at a planned loss in selling their products at prices based on planned sector average cost (see Bornstein, ibid.).

4 The new chairman of the Soviet State Prices Committee, Pavlov, properly posed this relation in an article. See Pavlov (1987).

5 The following discussions are based on Petrakov (1987a; 1987b), Petrakov et al. (1987), Vavilov (1986), Vavilov et al. (1986), Volkonsky and Vavilov (1987), and Volkonsky et al. (1987).
production conditions") and incorporate these rents into the raw material prices of the extraction industries. The rents are then paid to the State, the sole owner of all natural resources. It is also necessary to abolish or decrease subsidies for the extractive industries, and to abolish or decrease the turnover tax and tax for profits which are used to finance subsidies for these industries and which are paid for by other industries. Namely, the marginal pricing of raw materials caused by incorporating the rents on natural resources into the prices of raw materials results in a change in the state budget revenue structure from one dependent on the turnover tax and profit deduction to one dependent on rents. It also requires a decrease in the share of subsidies and state-centralized investment in budget expenditures.

III. Theory of Rents and Marginal-Cost-Prices in an Input-Output System

Let us assume that a product of the extraction or agriculture industry can be produced in \( i = 1, 2, \ldots, N \) sites (plots or deposits). It is assumed that each site \( i \) can increase output within a certain limit by switching to more intensive methods, and the costs of an additional unit of output increases as the amount of output increases. We define an average cost \((AC)\) for site \( i \), including capital charges, per single unit of the product as \( \bar{P}(x_i) \), where \( x_i \) denotes the output in site \( i \). Then, the marginal cost \((MC)\); the cost of production of an additional unit in site \( i \), is derived from \( d\bar{P}(x_i)/dx_i = MC_i(x_i) \). Let us assume that the optimal plan is given by the solution of the following cost minimization problem: 6

\[
\min \sum_{i=1}^{N} \int_{0}^{x_i} MC_i(q)dq \tag{1}
\]

\[
\sum_{i=1}^{N} x_i \leq X \tag{2}
\]

\[
0 \leq x_i \leq \bar{x}_i \quad (i=1, 2, \ldots, N) \tag{3}
\]

where

\( \bar{x}_i \): the maximum output capacity in site \( i \);

\( X \): the planned demand for the product.

We assume that the \( MC \) curve is depicted as shown in Fig. 1. This assumption corresponds to the actual state of the Soviet extraction and agriculture sectors.

The Lagrangean corresponding to the above problem can be written as

\[
L = - \sum_{i=1}^{N} \int_{0}^{x_i} MC_i(q)dq + \phi \left( X - \sum_{i=1}^{N} x_i \right) + \sum_{i=1}^{N} \lambda_i (\bar{x}_i - x_i) ;
\]

\[
\phi \geq 0, \lambda_1, \lambda_2, \ldots, \lambda_N \geq 0 ,
\]

where

\( \phi \): the shadow prices associated with Eq. (2) (the price of the product);

\( \lambda_i \): the shadow prices associated with Eq. (3) (in Marxian terminology, differential rent I).

6 Vavilov (1986, Ch. 2) and Vavilov et al. (1986, pp. 784–785) considered this problem.
For simplicity, we assume that $x_i^* < x_i$ for all $i$. By virtue of the complementary slackness, we have $\lambda_i^* = 0$ for all $i$. Then the marginal costs are equal for all sites:

$$\phi = MC_t(x_i^*)$$

Namely, we have the marginal cost price ($MC$ price) $\phi$ of the product at the moment of extraction. It should be noted that average costs $\bar{P}_t$ are usually different even under the optimal regime since each site differs in terms of quality. The difference between the $MC$ price and the individual average costs defines the rents (in Marxian terminology, differential rent II). The shaded area in Fig. 1 shows the sums of the rent for site $i$.

We denote by $S_t = \phi_t / \bar{P}_t(x_i)$ the "static" rent coefficient of site $i$. A greater [smaller] value of $S_t$ shows that site $i$ is a better [worse] one in terms of quality.

In the Soviet intra-sectoral practice\(^7\) the static, or direct, marginal cost of a product is calculated by

$$\phi = C_0 + EK$$

where

$C_0$: the marginal current cost (including amortization);
$K$: the marginal capital intensity;
$E$: the time discount rate.

On the other hand, the average cost of a product in a site is computed by

$$\bar{P} = \bar{C} + E\bar{F}$$

where

$\bar{C}$: the average current cost (including amortization);
$\bar{F}$: the average capital intensity.

At the present time, Soviet mathematical economists focus on the fact that for the last 10 to 15 years both average and marginal costs in the extraction industries, particularly in the petroleum extraction industry, have increased as the amount of more easily recoverable deposits have decreased and as new deposits are discovered which are further from industrial centers. In this case the (dynamic) marginal cost of extracting an exhaustible resource, $P(t)$ at the moment $t$ includes not only the direct (static) marginal cost $\phi(t)$ but also the present-value total of additional costs in the future, $\delta(t)$, associated with the need to increase the rate of extraction and to extract resources from less productive deposits. The present-value

\(^7\) A detailed description is given by Vavilov (1986, Ch. 2).
total of these additional costs in the future is also a type of differential rent which must be applied to “cheaper” deposits. Some noted Soviet economists have labeled this rent “dynamic rent (dinamicheskaia renta).” It should be noted that in agriculture there is no such impact on future costs.

We now describe mathematical formulas for the dynamic marginal cost and the dynamic rent. The increment of static marginal cost of an extraction output for the period \([\tau, \tau + d\tau](\tau > t)\), which is caused by extracting an additional unit of the exhaustible resource, can be denoted by \(d\phi(\tau)(=\phi'(\tau)d\tau)\).

Let \(E\) denote the discount rate. Then, the present-value total of incremental marginal costs for the time horizon \([t, \infty]\) is expressed as follows:

\[
\Delta(t) = \int_t^{\infty} \phi'(\tau) \exp\{-E(\tau - t)\} d\tau.
\]

Therefore, the marginal cost concept for an extraction output is redefined as a “dynamic” concept:

\[
P(t) = \phi(t) + \Delta(t)
\]

\[
= E \int_t^{\infty} \phi(\tau) \exp\{-E(\tau - t)\} d\tau. \quad (7)
\]

With regard to the (static) marginal cost path, two cases are considered:

Case 1: Assume that the (static) marginal cost increases over periods with a constant growth rate \(\rho_1\), i.e., \(\phi(t) = \phi(0) \exp(\rho_1 t)\). Then by Eq. (7) we have

\[
P(t) = \frac{E}{E - \rho_1} \phi(t). \quad (8)
\]

Case 2: Assume that the (static) marginal cost increases, up to period \(T\), with a constant rate \(\rho_1\) and after that with a different rate \(\rho_2\), i.e.,

\[
\phi(t) = \begin{cases} 
\phi(0) \exp(\rho_1 t)(t \leq T) \\
\phi(T) \exp(\rho_2(t - T))(t > T)
\end{cases}
\]

In this case Eq. (7) can be written as

\[
P(t) = \frac{E}{E - \rho_1} \phi(t) - \exp\{-E(T - t)\} \left( \frac{E}{E - \rho_1} - \frac{E}{E - \rho_2} \right) \phi(T). \quad (9)
\]

Let the dynamic rent coefficient be denoted by \(D(t)\):

\[
D(t) = P(t) / \phi(t).
\]

Then the hybrid rent coefficient \(Z(t)\), the ratio of the (dynamic) marginal cost to average cost, is defined by

\[
Z(t) = \frac{D(t)}{A(t)}.
\]

\[9\] Vavilov et al. (1986, p. 785). The author also uses the terminology “dynamic” and “static” marginal costs for convenience of description.

\[10\] Vavilov (1986, p. 52) and Vavilov et al. (1986, p. 785).

As is mentioned by Vavilov (1986) and Vavilov et al. (1986), Shchevel (1984, p. 1110) first posed the dynamic rent concept. He presented the following formula for the dynamic marginal cost.

\[
p = \phi + \frac{1}{E} \dot{\phi}
\]

Assuming \(\rho = \rho_1\), we can easily obtain Eq. (8) in the text.
Table I. Dynamic Rent Coefficients \((D)\) for Petroleum and Gas Extraction, 1982

<table>
<thead>
<tr>
<th>Discount rate (E)</th>
<th>Gas ((\rho=0.019))</th>
<th>Crude petroleum</th>
</tr>
</thead>
<tbody>
<tr>
<td>(E=0.08)</td>
<td>1.31</td>
<td>2.79 (p_1=0.068) (p_2=0.047)</td>
</tr>
<tr>
<td>(E=0.1)</td>
<td>1.23</td>
<td>2.15 (p_1=0.068) (p_2=0.025)</td>
</tr>
</tbody>
</table>


Note: In the author's calculation the dynamic rent coefficients are slightly higher than those shown above by approximately 0.02.

\[
Z(t) = \frac{P(t)}{\bar{P}(t)} ,
\]

or

\[
Z(t) = D(t) S(t) ,
\]

where \(S(t) = \phi(t)/\bar{P}(t)\) (static rent coefficient).

Table I shows the Soviet estimation of the dynamic rent coefficients \(D\) (1982) for petroleum and gas extraction, based on Eq. (8) or Eq. (9), for \(E=0.1\) and \(E=0.08\). From this table we can first see that the dynamic rent coefficient, hence the value of dynamic rent, is affected to a large extent by the selected discount rate \(E\), particularly in case I for petroleum, and the dynamic rent coefficient for petroleum extraction is estimated to be much higher than for coal extraction. Selected values on the growth rates \(\rho\) of (static) marginal costs are based on Soviet energy production forecasts [Melent’ev and Makarov (1983)].

For crude petroleum Eq. (9) is applied \((t=1982\) and \(T=1990\)). Cases 1 and 2 in Table I both assume that high growth rates of average costs and incremental capital-intensities in petroleum extraction, which have prevailed for the last 15 years, will be maintained until 1990. The changes in extraction costs in subsequent periods are estimated differently: (case 1 assumes that the high growth rates observed today will be maintained even after 1990; case 2 assumes that the growth rates will decrease after 1990 as other forms of energy, such as coal, are used as substitutes for petroleum. Economists of TsEMI support the case 2 theory. However, if the proposed price revisions are not maintained, the growth rate of marginal and average costs for petroleum extraction would remain rather high. Conversely, the overall annual growth rate of static marginal cost for extraction and transportation is assumed unchanged over time and set equal to 1.9%.

Table 2 shows the values of the marginal costs and rent coefficients for fuels, calculated by several institutes at Gosplan and the USSR Academy of Sciences, based on sectoral optimization models. In regard to coal and gas extraction, two regions are identified; the European and Asian regions of the Soviet Union. Table 2 provides us with important data for the Soviet economy which has not previously been available to scholars in the West (however, the sectoral models used and the database have not yet been published by the Soviet authorities as far as the author knows). Table 2 also constitutes part of the initial data for TsEMI's calculation. As can be seen in Table 2, the sectoral calculation shows the need to increase the current purchasers' prices of fuels to a considerable extent (approximately 200%).

From the sectoral estimates of marginal and average costs, Soviet mathematical econ-
### Table 2. Prices, Costs and Rent Coefficients for Fuels, 1982:
#### Sectoral Analysis

<table>
<thead>
<tr>
<th></th>
<th>Actual prices ($P_o$)</th>
<th>Average costs ($\bar{P}$)</th>
<th>Static $MC$ ($\varphi$)</th>
<th>Static rent coefficients ($S$)</th>
<th>Growth rates of static $MC$ ($\rho\cdot100$)</th>
<th>Dynamic rent coefficients ($D$)</th>
<th>Rent coefficients ($Z$)</th>
<th>$MC$ prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal (European region)</td>
<td>25.0</td>
<td>29.4</td>
<td>40.9</td>
<td>1.39</td>
<td>0</td>
<td>1</td>
<td>1.39</td>
<td>40.9</td>
</tr>
<tr>
<td></td>
<td>[28.7]</td>
<td>[36.7]</td>
<td>[1.28]</td>
<td></td>
<td></td>
<td></td>
<td>[1.28]</td>
<td>[36.7]</td>
</tr>
<tr>
<td>Coal (Asian region)</td>
<td>12.72</td>
<td>14.9</td>
<td>20.0</td>
<td>1.34</td>
<td>0</td>
<td>1</td>
<td>1.34</td>
<td>20.0</td>
</tr>
<tr>
<td></td>
<td>[14.6]</td>
<td>[18.1]</td>
<td>[1.24]</td>
<td></td>
<td></td>
<td></td>
<td>[1.24]</td>
<td>[18.1]</td>
</tr>
<tr>
<td>Gas (European region)</td>
<td>23.75</td>
<td>26.9</td>
<td>31.5</td>
<td>1.17</td>
<td>1.9</td>
<td>1.23</td>
<td>1.44</td>
<td>38.8</td>
</tr>
<tr>
<td></td>
<td>[24.7]</td>
<td>[28.7]</td>
<td>[1.16]</td>
<td></td>
<td></td>
<td></td>
<td>[1.31]</td>
<td>[37.6]</td>
</tr>
<tr>
<td>Gas (Asian region)</td>
<td>13.82</td>
<td>15.7</td>
<td>18.4</td>
<td>1.17</td>
<td>1.9</td>
<td>1.23</td>
<td>1.44</td>
<td>22.6</td>
</tr>
<tr>
<td></td>
<td>[14.4]</td>
<td>[16.7]</td>
<td>[1.16]</td>
<td></td>
<td></td>
<td></td>
<td>[1.31]</td>
<td>[21.9]</td>
</tr>
<tr>
<td>Crude petroleum</td>
<td>21.77</td>
<td>20.15</td>
<td>25.7</td>
<td>1.28</td>
<td>2.8-4.7</td>
<td>2.15</td>
<td>2.74</td>
<td>55.3</td>
</tr>
<tr>
<td></td>
<td>[19.4]</td>
<td>[24.0]</td>
<td>[1.25]</td>
<td></td>
<td></td>
<td></td>
<td>[2.79]</td>
<td>[67.0]</td>
</tr>
<tr>
<td>Heavy fuel oil</td>
<td>26.4</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
<td>44.6</td>
</tr>
</tbody>
</table>


Notes: 1. s.f.—the standard fuel unit used in the Soviet Union; n.a.—not available.

2. [-] shows the values for $E=0.08$.

Economists derive a hypothesis in which gas is considered as the marginal fuel for the European region of the Soviet Union, while coal is the marginal fuel for the Asian region. It should be noted that with regard to replacing oil with energy substitutes, they are of the opinion that only coal and gas should be considered, and further, that gas will replace oil only when their proposals for price revision are implemented.

Making use of the results of sectoral analysis (ignoring interindustry relations), Soviet mathematical economists further proceed to an input-output analysis of the price system. For the empirical analysis of sector average prices, they employ one of the following “two-channel” price systems, both of which satisfy the requirements for measurement of the price inducement effects and for the “self-financing” principle at the sector level:

**"Production prices":**  
\[ \bar{p} = \bar{p} \bar{A} + \bar{w} + \mu \bar{p} \bar{F}, \]  

(10)

**"Self-financing prices":**  
\[ \bar{p} = \bar{p} \bar{A} + \bar{w} + \nu \bar{p} \bar{K}, \]  

(11)

where

\[ \bar{p}=(p_j): \text{ an } n\text{-dimensional row vector of sector price indexes in relation to actual prices } (p_j=\bar{P}_j/P_{jo}); \]

\[ \bar{w}=(w_j): \text{ an } n\text{-dimensional row vector of wage coefficients, including social security funds (in the following calculations } \bar{w} \text{ is set as } 1.14 \times \text{ actual wage coefficient vector without social security funds); } \]

\[ \bar{A}=(a_{ij}): \text{ an } n \times n \text{ matrix of average input coefficients, including amortization; } \]

\[ \bar{F}=(f_{ij}): \text{ an } n \times n \text{ matrix of average capital coefficients; } \]

\[ \bar{K}=(k_{ij}): \text{ an } n \times n \text{ matrix of average net-investment coefficients; } \]
μ: a nation-wide average profit rate [given by the data in the Soviet Statistical Yearbook (Narkhoz)];

ν: a proportional factor showing the ratio of total net-investment to total profit, not less than unity (given by the data in Narkhoz).

"Production prices" are well known. Belkin (1963; 1972) made use of Eq. (10) in calculating the 1959 and 1966 Soviet sector price indexes. "Self-financing prices" were first presented by Petrakov (1983). In "self-financing prices," the following identical equation is satisfied in each sector:

\[
\text{amortization + profits = investment + other expenditures}
\]

Namely, the "self-financing" principle is ensured directly at the sector level when "self-financing" sector average prices prevail. Also under this price system growth-priority sectors which receive greater amounts of investment funding can earn higher profits. These profits may not accrue as the result of efficient production and management, but may simply be due to the higher level of investment funding. When \( ν > 1 \), Eq. (11) shows that "other expenditures" in a sector are formed in proportion to net investment. When \( ν = 1 \), sector profit is identically equal to net investment.

In the author's opinion, the case where \( ν = 1 \) is more reasonable from a purely theoretical point of view because we can also introduce this type of proportional factor into "production prices," Eq. (10) to show the formation of "other expenditures." For example, we can redefine Eq. (10) as

\[
\bar{p} = \bar{p}_A + \bar{w} + \nu(\mu \bar{p} \bar{F})
\]

The author feels that a superficial consideration of Eqs. (10) and (11) will lead to an understanding of the similarity of the two types of prices, since both include a uniform proportional factor. However, further consideration will show the fundamental difference between "production prices" and "self-financing prices." In the former the proportional factor \( \mu \) directly reflects profitability as one of the main indicators of economic efficiency, and each sector obtains profits in a manner uniquely proportional to its capital stock. On the other hand, in the case of "self-financing prices" the proportional factor does not reflect the profitability or investment efficiency of the economy as a whole. Under this price system the profit rate of each sector usually differs. Namely, we can re-write Eq. (11) \((ν = 1)\) as

\[
\bar{p} = \bar{p}_K + \bar{w} + \bar{p} \hat{G} \bar{F}; \quad \hat{G} \bar{F} = \bar{K},
\]

where

\[
\hat{G} = \begin{pmatrix}
g_1 & 0 \\
g_2 & \ddots \\
0 & \ddots \\
& & g_n
\end{pmatrix}
\]

and \( g_i \) is the sector \( i \)'s growth rate.

The "self-financing prices" system directly incorporates net investments, which are provided by the output equations. This price system may be associated with unbalanced growth, while the "production prices" system is associated with balanced growth. We have commented on the "self-financing prices" system from a theoretical viewpoint. However, it
should be noted that this price system can ensure realization of the self-financing principle in each sector, independent of the issues related to the determination of growth and accumulation.

Soviet mathematical economists further develop an input-output price system for determining sector price indexes by partially introducing the marginal pricing principle into the system. They apply either Eq. (10) or Eq. (11) to the sectors that do not supply primary, intermediate goods. On the other hand, they apply the marginal pricing principle to sectors producing primary, intermediate goods, including the iron ore, coal, gas, crude petroleum, lumber and agriculture sectors. Let us reformulate the original Soviet price equations [Vavilov et al. (1986, p. 788)] more precisely as follows:

Redefine sector indexes:

\[ i, j \in J: \text{ sector indexes other than those for primary sectors ("tr" indicates the transportation sector index) and their set; } \]

\[ r, s \in R: \text{ extraction sector indexes and their set. } \]

Using sectoral data on static and dynamic rent coefficients, marginal input (cost) coefficients for the primary sectors are given as follows:

\[ a_{h,r} = D_r S_r^* \tilde{\alpha}_{h,r} (h \neq tr), \quad a_{tr,r} = D_r S_r^{tr} \tilde{\alpha}_{tr,r}, \]

\[ w_r = D_r S_r^* \tilde{\omega}_r, \quad k_{tr} = D_r S_r^{tr} \tilde{f}_{tr}, \quad h \in J \cup R, \]

where

\[ S_r^* : \text{ the ratio of marginal to average "intermediate prime costs (sebestoimosti)'"; } \]

\[ S_r^{tr} : \text{ the ratio of marginal to average transportion costs; } \]

\[ S_r^k : \text{ the ratio of marginal to average capital intensity. } \]

Sector marginal cost price indexes for primary sectors, \( p_r \), are determined by

\[ p_r = \sum_i \tilde{p}_i a_{tr} + \sum_s p_s a_{tr} + w_r + E \sum_i \tilde{p}_i \tilde{k}_{tr}, \quad r \in R, \quad (12) \]

where \( E \) is the time discount rate, or the investment efficiency normative. Corresponding to the above equation, sector average price indexes, in the case of the application of "self-financing prices," are determined by the following equations:

\[ p_j = \sum_i \tilde{p}_i \tilde{a}_{ij} + \sum_r p_r \tilde{a}_{tr} + \tilde{w}_j + \nu \sum_i \tilde{p}_i \tilde{k}_{ij}, \quad j \in J. \quad (13) \]

In the case of "production prices" the fourth term of the right-hand side of the above equations is replaced with \( \mu \sum_i \tilde{p}_j \tilde{f}_{ij} \).

The system of price indexes consists of Eqs. (12) and (13).\(^{11}\) We can refer to the system as a "hybrid" price system. This "hybrid" system yields a unique price index vector \((p, \tilde{p})\) if the average input coefficients, the static and rent coefficients and \((\mu, \nu, E)\) are given, and satisfy the appropriate conditions.

Table 3 shows the initial data for sector-by-sector static rent coefficients which determine the relationship between the average and (static) marginal cost structures. In Table 3 the data for coal in the European region and gas in the Asian region are not given. This

\(^{11}\) The author's description of the Soviet input-output price system may be more convenient than the original rough description from the computational point of view. The terminology "hybrid price system" is the author's.
TABLE 3. INITIAL DATA FOR RENT COEFFICIENTS, 1982

<table>
<thead>
<tr>
<th></th>
<th>$S_{rc}$</th>
<th>$S_{rA}$</th>
<th>$S_{rfr}$</th>
<th>$D_r$</th>
<th>$Z_r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron ore</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
<td>1</td>
<td>1.3</td>
</tr>
<tr>
<td>Coal (Asian region)</td>
<td>0.78</td>
<td>5.62</td>
<td>0.78</td>
<td>1</td>
<td>1.34</td>
</tr>
<tr>
<td>Coal (European region)</td>
<td>1</td>
<td>1.38</td>
<td>1</td>
<td>1.23</td>
<td>1.44</td>
</tr>
<tr>
<td>Crude petroleum</td>
<td>1</td>
<td>1.27</td>
<td>1</td>
<td>2.15</td>
<td>2.74</td>
</tr>
<tr>
<td>Lumber</td>
<td>1</td>
<td>5.64</td>
<td>2.4</td>
<td>1</td>
<td>1.82</td>
</tr>
<tr>
<td>Grain</td>
<td>1.8</td>
<td>1.8</td>
<td>1.8</td>
<td>1</td>
<td>1.8</td>
</tr>
<tr>
<td>Livestock</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
<td>1</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Source: Vavilov (1986, p. 75).

Notes: 1. [.] shows the initial data for $E=0.08$.
2. For one computation in the following section (case 2 in Table 4), the value of $S$ and $Z$ in the "Lumber" sector is 1.22 and in the "Grain" sector 1.3 [see Vavilov et al. (1986, p. 789)].

is due to the Soviet assumption with regard to the substitute use of gas and coal. As has been mentioned, coal is considered to be the marginal energy source in the Asian region and gas is the marginal energy source in the European region. In each region the marginal cost of gas is assumed to be equal to that of coal. Namely,

$$ P_{coal} = P_{gas}; \quad p_{coal}P_{coal} = p_{gas}P_{gas}. $$

$P^0$ is already given by Table 2. Therefore, if the price index for either coal or gas is given the other is determined by the above equation. In the Asian region we subtract the price equation for the gas sector from Eq. (12) and insert $p_{gas} = \alpha p_{coal}(\alpha = P^0_{coal}/P^0_{gas})$ into the price equations for the sectors using gas produced in the Asian region. Thus $p_{coal}$ can be determined. For the European region the position of gas and coal are reversed in the above computations. Accordingly, two price equations are redundant and are eliminated from the system of price indexes.

It is worth making some additional comments regarding the data compilation method employed by Soviet mathematical economists. As is known, the Soviet official input-output tables are compiled in terms of purchasers' prices, including the turnover tax with different rates. In calculating the system of price indexes, differentiated rates for the turnover tax for each commodity should be adjusted to a unique rate or set to zero.

First, regarding the petroleum refinery (heavy fuel oil) sector, the turnover tax rate for intermediate use is also applied to final use. This causes a decrease in the intermediate uses of the product supplied by the petroleum refinery sector and thus a decrease in gross output of the sector. The turnover tax rate for electricity is regarded as being almost zero, which

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12 Eq. (8) in Vavilov et al. (1986, p. 789) should be read as the above equation in the text. Also, the explanation in Vavilov (1986, p. 74) should be read as in the text.

13 See Vavilov (1986, pp. 83–84) and Vavilov et al. (1986, pp. 792–793).
### Table 4. Soviet Price Index System, Computed by TsEMI

<table>
<thead>
<tr>
<th>Sector</th>
<th>Case (1)</th>
<th>Case (2)</th>
<th>Case (3)</th>
<th>Case (4)</th>
<th>Case (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\nu=1.25$</td>
<td>$\nu=1.25$</td>
<td>$\mu=0.072$</td>
<td>$\nu=1.25$</td>
<td>$\nu=1.25$</td>
</tr>
<tr>
<td></td>
<td>$E=0.1$</td>
<td>$E=0.1$</td>
<td>$E=0.1$</td>
<td>$E=0.1$</td>
<td>$E=0.1$</td>
</tr>
<tr>
<td>Iron ore</td>
<td>1.35 [1.39]</td>
<td>1.38 [1.4]</td>
<td>1.53</td>
<td>1.53</td>
<td>0.95</td>
</tr>
<tr>
<td>Other ferrous metallurgy</td>
<td>1.2 [1.22]</td>
<td>1.16 [1.18]</td>
<td>1.31</td>
<td>1.36</td>
<td>0.9</td>
</tr>
<tr>
<td>Nonferrous metallurgy</td>
<td>1.02 [1.06]</td>
<td>n.a.</td>
<td>n.a.</td>
<td>1.09</td>
<td>0.83</td>
</tr>
<tr>
<td>Coal (European region)</td>
<td>1.96 [2.0]</td>
<td>1.88 [1.93]</td>
<td>1.9</td>
<td>2.14</td>
<td>1.22</td>
</tr>
<tr>
<td>Coal (Asian region)</td>
<td>2.08 [1.98]</td>
<td>1.97 [1.8]</td>
<td>2.33</td>
<td>2.13</td>
<td>1.22</td>
</tr>
<tr>
<td>Crude petroleum</td>
<td>3.08 [3.9]</td>
<td>2.96 [3.74]</td>
<td>4.34</td>
<td>3.35</td>
<td>1.98</td>
</tr>
<tr>
<td>Petroleum refinery</td>
<td>1.8 [2.21]</td>
<td>1.72 [2.11]</td>
<td>1.85</td>
<td>1.98</td>
<td>1.22</td>
</tr>
<tr>
<td>Gas (European region)</td>
<td>2.07 [2.11]</td>
<td>1.99 [2.04]</td>
<td>2.5</td>
<td>2.26</td>
<td>1.22</td>
</tr>
<tr>
<td>Gas (Asia region)</td>
<td>1.92 [1.82]</td>
<td>1.81 [1.66]</td>
<td>1.95</td>
<td>1.96</td>
<td>1.22</td>
</tr>
<tr>
<td>Oil fuel</td>
<td>1.36 [1.4]</td>
<td>1.3 [1.35]</td>
<td>1.66</td>
<td>1.69</td>
<td>1.16</td>
</tr>
<tr>
<td>Electricity (European region)</td>
<td>1.41 [1.52]</td>
<td>1.34 [1.44]</td>
<td>1.43</td>
<td>1.65</td>
<td>1.01</td>
</tr>
<tr>
<td>Electricity (Asian region)</td>
<td>1.41 [1.48]</td>
<td>1.33 [1.38]</td>
<td>1.42</td>
<td>1.62</td>
<td>1.01</td>
</tr>
<tr>
<td>MBMW</td>
<td>1.06 [1.08]</td>
<td>1.02 [1.05]</td>
<td>1.04</td>
<td>1.16</td>
<td>0.9</td>
</tr>
<tr>
<td>Chemicals</td>
<td>1.19 [1.23]</td>
<td>1.18 [1.16]</td>
<td>1.15</td>
<td>1.35</td>
<td>0.93</td>
</tr>
<tr>
<td>Lumber</td>
<td>2.06 [2.3]</td>
<td>1.4 [1.45]</td>
<td>1.51</td>
<td>2.35</td>
<td>1.03</td>
</tr>
<tr>
<td>Wood &amp; Paper</td>
<td>1.26 [1.33]</td>
<td>1.07 [1.1]</td>
<td>1.1</td>
<td>1.4</td>
<td>0.89</td>
</tr>
<tr>
<td>Construction materials</td>
<td>1.8 [1.23]</td>
<td>1.13 [1.18]</td>
<td>1.2</td>
<td>1.34</td>
<td>0.96</td>
</tr>
<tr>
<td>Light industry (Textiles)</td>
<td>0.92 [0.94]</td>
<td>0.8 [0.82]</td>
<td>1.08</td>
<td>0.95</td>
<td>0.67</td>
</tr>
<tr>
<td>Food industry</td>
<td>1.62 [1.63]</td>
<td>1.33 [1.35]</td>
<td>1.0</td>
<td>1.64</td>
<td>1.05</td>
</tr>
<tr>
<td>Industry, total</td>
<td>n.a.</td>
<td>n.a.</td>
<td>1.22</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>Grain</td>
<td>2.04 [2.05]</td>
<td>1.43 [1.46]</td>
<td>1.15</td>
<td>2.13</td>
<td>1.08</td>
</tr>
<tr>
<td>Livestock</td>
<td>1.75 [1.8]</td>
<td>1.49 [1.52]</td>
<td>1.12</td>
<td>1.81</td>
<td>1.08</td>
</tr>
<tr>
<td>Forestry</td>
<td>1.34 [1.36]</td>
<td>1.3 [1.32]</td>
<td>1.12</td>
<td>1.25</td>
<td>1.19</td>
</tr>
<tr>
<td>Construction</td>
<td>1.18 [1.22]</td>
<td>1.14 [1.17]</td>
<td>1.04</td>
<td>1.25</td>
<td>1.0</td>
</tr>
<tr>
<td>Transport &amp; communication</td>
<td>1.28 [1.34]</td>
<td>1.24 [1.3]</td>
<td>1.23</td>
<td>1.43</td>
<td>1.07</td>
</tr>
<tr>
<td>Distribution</td>
<td>1.39 [1.41]</td>
<td>1.23 [1.25]</td>
<td>0.9</td>
<td>1.31</td>
<td>1.14</td>
</tr>
<tr>
<td>Other material production</td>
<td>1.05 [1.08]</td>
<td>0.98 [1.0]</td>
<td>1.03</td>
<td>1.11</td>
<td>0.88</td>
</tr>
<tr>
<td>Gross output</td>
<td>1.43 [1.5]</td>
<td>n.a.</td>
<td>1.172</td>
<td>1.53</td>
<td>1.02</td>
</tr>
</tbody>
</table>

**Source:** Case 1: Vavilov (1986, p. 98); Case 2: Vavilov et al. (1986, p. 791); Case 3: Volkonsky et al. (1987, p. 16); Case 4: Vavilov (1986, p. 102); Case 5: Vavilov (1986, p. 109) and Vavilov et al. (1986, p. 792).

**Notes:**
2. [ ] indicates the price indexes for $E=0.08$.
3. The price index system in case 3 is computed by using estimated 1990 input-output data.
induces a decrease in the intermediate uses of power supplied by the electricity sector and causes a decrease in the gross output of the sector. Regarding the turnover tax for the food sector, two cases are considered. In one the turnover tax is set to zero (case 2 shown in Table 4 in the following section) and in the other no adjustment is made to the turnover tax, since the share of the turnover tax in the gross output of the sector is rather small, 0.5% (cases 1 and 4 shown in Table 4 in the following section). The turnover tax rate for the food industry is regarded as a unique rate, although, in effect it differs from user to user.

From the above observation it can be seen that the sector price index for heavy fuel oil is related to the current industrial wholesale price. The sector price index for electricity shows the ratio of the computed sector price to current tariffs, without turnover tax, in the material production sectors.

IV. Computation Results of Sector Price Indexes and Reform of the Soviet Finance System

Table 4 describes five variants of the sector price index system computed by TsEMI, based on the “hybrid” input-output price system (Eqs. (12) and (13)), sectoral data (Table 3) and Soviet 1982 input-output table (not yet published). From this table we can first see that the prices of fuels and energy require a large increase due to the introduction of the marginal cost principle and rent. Considering cases 1 to 4 in Table 4, where \( E=0.1 \), we can state that the price of the crude petroleum sector product requires an approximately 300% to 434% increase, the price of the coal sector product requires a 188% to 233% increase and the price of the iron ore mining sector product requires a 35% to 53% increase. The price increase of crude petroleum induces a 72% to 98% increase in the price of petroleum refinery commodities, and the price increase of fuels, including coal, induces a 33% to 43% increase in the price of electricity.

Secondly, the remarkable increase in prices of fuel and energy requires only a slight increase in the prices of MBMW (machine building and metalworking) sector products. The relative price ratio of the crude petroleum price index to the MBMW price index is 2.88 [2.91] in case 1 [case 4], where the MBMW sector shows a 6% [16%] price increase. This computation result directly implies that the realization of “self-financing” is compatible with the radical reform of the relative price structures of fuels and machinery.

In a dynamic context, Soviet mathematical economists expect the Soviet economy to develop as follows:

An improvement in price proportions will induce a switch from inefficient energy usage to efficient energy usage, and this in turn will induce a decrease in the resource output growth rate. In addition, it will reduce the need for extracting energy resources from marginally productive sites and deposits. After these goals have been attained, the marginal cost prices of fuel and energy, which will initially be considerably higher than the average costs of these products, can be expected, over the long term, to decrease and approach the average costs.

The computation results in cases 1 to 5 in Table 4 can be classified from several points of view.
Classification I:

Based on the method of application of the price equation for sectors other than the extractive sectors, cases 1, 2, 3, and 5 employ “self-financing prices,” while case 4 makes use of “production prices.” However, we can see from Table 4 that the computed values of “self-financing prices” (case 1) are similar to those of “production prices” (case 4). This may be partly due to a similarity between the investment and capital stock structures in 1982. It may also be partly due to the method of application of the price equations, where the price equations for the extractive and agricultural sectors, in cases 1 and 2, are based on “production prices” principles, not on “self-financing prices.”

Classification II:

The most important classification concerns the coverage of price formation based on marginal cost ($MC$), i.e., the extent to which the sectors apply the marginal cost prices. Cases 1, 2, and 4 apply the $MC$ price to each basic extractive sector, including energy and agriculture. Case 3 applies the $MC$ price to each basic extractive sector except agriculture. Case 5 applies the $MC$ price only to the crude petroleum and gas sectors. Case 5 is the most passive policy proposal for the introduction of $MC$ prices. Therefore, Soviet economists refers to this case as “first-stage pricing.” Accordingly, we refer to case 3 as “second-stage pricing” and also to cases 1, 2, and 4 as “third-stage pricing.”

The theoretical ideal of The Central Economic Mathematical Institute (TsEMI) is based on the concept that the optimal price system or $MC$ prices should be applied to all commodities, including not only raw materials but also other products. In this ideal situation the “self-financing” system functions effectively in each intra-industry enterprise. In comparison with this ideal situation even “third-stage pricing” is an insufficient policy proposal. However, if “third-stage pricing” is applied we must deal with two problems; the general price level and the retail prices of agricultural products. If we regard the level of the retail price of agricultural products as constant, application of $MC$ prices to the agriculture sector induces a remarkable increase in the State procurement prices for agricultural products, and in turn, a general increase in subsidies for agricultural products. This is an undesirable situation. On the other hand, application of $MC$ prices to only the extraction and agriculture sectors requires an increase in the general price level in proportion to the extent of coverage of the price formation, based on marginal cost.

Case 1 [case 2] of “third-stage pricing” shows a 100% [43%] and a 75% [49%] increase in the prices of grain and meat, respectively. The high level of the $MC$ price for agriculture induces a high level in the price of food industry output; in case 1 [case 2], 62% [33%] higher than the current retail price. This results in imbalances in food demand and household incomes; demand exceeds income. This imbalance cannot be eliminated by a general increase in the overall wage level since such an increase implies a corresponding rise in all values of the computed price indexes ($hP=(I-A-hF)-1 h w$, where $h$ is a proportional factor).

Setting the procurement and retail prices at the proposed price level leads to an increase in agricultural subsidies and retail food prices. If “third-stage pricing” is implemented, a radical review of both the retail price system and the household income structure is required. However, this problem is beyond the scope of the price computation provided by the Central
If applied, "third-stage pricing" will result in a rather high increase in the general price index; 43% [20%] in case 1 [case 2] in terms of gross output [national income].

"First-stage pricing," case 5, seeks the attainment of two goals; elimination of income deficits in the coal industry through self-financing prices and acceleration of energy substitution from oil to coal. The procurement price for agriculture shows only a slight increase, 8%. The general price level also shows a very slight increase, 2% in terms of gross outputs. However, limiting the application of the marginal pricing principle only to the crude petroleum and gas extraction industries may distort the inter-industry relation of price formation among the extractive industries. In this situation "second-stage pricing" appears to be the more appropriate proposal.

"Second-stage pricing," case 3, shows a 12% increase in the procurement prices. The retail price of food does not show any increase. The general price level in terms of national income shows a rather low increase, 5.2%. With "second-stage pricing," the share of rent in the national income is 12%, of which the fuel and energy sectors provide 92.5%. Dynamic rents make up 56% of the total amounts of rents for the extraction industries, of which 45% and 11% are generated by the crude petroleum and coal industries, respectively. An estimation of the total amount of rents for 1990 is expected to be 80 to 85 billion rubles. Total dynamic rent is estimated at 47 to 49 billion rubles, of which the crude petroleum sector provides 38 to 39 billion rubles and the gas sector 9 to 10 billion rubles. [Volkonsky et al. (1987, p. 9)].

### Table 5. Soviet Marginal Cost Prices for Fuels, 1982

<table>
<thead>
<tr>
<th></th>
<th>Actual purchasers' prices</th>
<th>MC prices sectoral analysis</th>
<th>MC prices input-output analysis (case 1 in Table 4)</th>
<th>Affects of IO relations (column 3/ column 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal (European region)</td>
<td>25.0</td>
<td>40.9</td>
<td>48.7</td>
<td>1.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[36.7]</td>
<td>[50.0]</td>
<td>[1.36]</td>
</tr>
<tr>
<td>Coal (Asian region)</td>
<td>12.72</td>
<td>20.0</td>
<td>28.9</td>
<td>1.45</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[18.1]</td>
<td>[25.1]</td>
<td>[1.39]</td>
</tr>
<tr>
<td>Gas (European region)</td>
<td>23.75</td>
<td>38.8</td>
<td>48.7</td>
<td>1.26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[37.6]</td>
<td>[50.0]</td>
<td>[1.33]</td>
</tr>
<tr>
<td>Gas (Asian region)</td>
<td>13.82</td>
<td>22.6</td>
<td>28.9</td>
<td>1.28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[21.9]</td>
<td>[25.1]</td>
<td>[1.15]</td>
</tr>
<tr>
<td>Crude petroleum</td>
<td>21.77</td>
<td>55.3</td>
<td>66.7</td>
<td>1.21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[67.0]</td>
<td>[84.8]</td>
<td>[1.27]</td>
</tr>
<tr>
<td>Heavy fuel oil</td>
<td>26.4</td>
<td>44.6</td>
<td>52.8</td>
<td>1.18</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[56.0]</td>
<td>[70.0]</td>
<td>[1.25]</td>
</tr>
</tbody>
</table>

Source: Vavilov (1986, pp. 103–104); Volkonsky and Vavilov (1986, p. 52).
Note: [ ] shows the values for E = 0.08.

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14 See Vavilov et al. (1986, p. 793). Increasing retail prices have a direct effect on people’s lives and constitute a very delicate political problem.
TABLE 6. THE STATE BUDGET STRUCTURE OF THE USSR, 1985
(in terms of percent of total)

<table>
<thead>
<tr>
<th></th>
<th>Parcice in 1985</th>
<th>Proposal (a)</th>
<th>Proposal (b)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Revenues</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Turnover tax</td>
<td>25.0</td>
<td>13.1</td>
<td>12.9</td>
</tr>
<tr>
<td>2. Payments for productive capital</td>
<td>9.8</td>
<td>9.5</td>
<td>21.0</td>
</tr>
<tr>
<td>3. Fixed(rent) payments</td>
<td>1.3</td>
<td>7.0</td>
<td>2.6</td>
</tr>
<tr>
<td>4. Fees from the free residual of profits</td>
<td>12.1</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>5. Rents on natural resources</td>
<td>—</td>
<td>15.9</td>
<td>—</td>
</tr>
<tr>
<td>6. Progressive tax on profits</td>
<td>—</td>
<td>—</td>
<td>10.5</td>
</tr>
<tr>
<td>7. Other deductions from profits and miscellaneous payments</td>
<td>7.4</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>8. Income tax from cooperatives, collective farms, etc.</td>
<td>0.6</td>
<td>—</td>
<td>6.6</td>
</tr>
<tr>
<td>9. State social security funds</td>
<td>6.5</td>
<td>6.9</td>
<td>10.5</td>
</tr>
<tr>
<td>10. Other revenues</td>
<td>37.3</td>
<td>47.5</td>
<td>35.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Total payments for resources (2+3+5+9)</td>
<td>17.6</td>
<td>39.4</td>
<td>—</td>
</tr>
<tr>
<td><strong>Expenditures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Investment finance</td>
<td>20.2</td>
<td>12.0</td>
<td>n.a.</td>
</tr>
<tr>
<td>2. Subsidies for agricultural products</td>
<td>14.8</td>
<td>15.2</td>
<td>n.a.</td>
</tr>
<tr>
<td>3. Social, cultural and scientific expenditures</td>
<td>32.5</td>
<td>31.5</td>
<td>n.a.</td>
</tr>
<tr>
<td>4. Defence</td>
<td>4.9</td>
<td>3.5</td>
<td>n.a.</td>
</tr>
<tr>
<td>5. Administration</td>
<td>0.8</td>
<td>0.6</td>
<td>n.a.</td>
</tr>
<tr>
<td>6. Other expenditures</td>
<td>26.8</td>
<td>37.2</td>
<td>n.a.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: 1. This table is based on Volkonsky et al. (1987, p. 31) and Petrakov (1987a, p. 53).
2. "—": not applicable; n.a.— not available.

It is worth making two additional comments regarding Soviet price computation methods. First, regarding the effect of the time discount rate ("normative" of investment efficiency), E, on the price indexes, we can see from Table 4 that a lower value of the discount rate induces an increase in the dynamic rent coefficients (Table 1), and thus yields higher values of the MC price indexes for crude petroleum. It also induces a 1.9% increase in the coal price index in the European region of the Soviet Union and a 0.9% increase in the percentage that rents contribute to the national income.

Secondly, the absolute level of the MC price, $p_T P^0_r$, based on input-output calculation, shows a higher value in relation to the level which is based on sectoral optimal analysis (Table 5). In case 1 ($E=0.1$) this increase in the rates of the MC price level shows values in the range of 18% to 45%. The highest increase, 45%, is shown in the coal industry in the Asian region of the Soviet Union. Crude petroleum shows a 21% increase by the change of $E$; when $E=0.08$, this increase is 27%.

Let us next observe changes in the structure of budget revenues and expenditures associated with the aforementioned measures for reforming the Soviet price system.

Proposal (a) in Table 6 describes changes in the 1985 budget structure which will result from implementation of "second-stage pricing" (case 3 in Table 4). In regard to the revenue
side, we can first see from Table 6 that the share of payments for resources (rents plus quasi-rents) in total revenue shows a remarkable increase from 17.6% to 39.4%, while the share of turnover tax conversely shows a considerable decrease from 25% to 13%. It should be noted that “rent” and “quasi-rent” indicate payments for natural resources and fixed capital, respectively. The share of rents is 15.9% in Proposal (a). The share of fixed (rent) payments for natural resources, which have been introduced since the 1965 reform, is 7.1%. The share of rents and fixed (rent) payments in total revenue constitute approximately one fourth the total revenue in Proposal (a). The decrease in turnover tax share and the increase in rent share are complementary. For example, the turnover tax on oil (gasoline and others) is transferred in part to the rent assessment of the crude petroleum industry. Further, it should be noted that an increase in the domestic price of petroleum causes a decrease in the foreign trade organization’s procurement price for petroleum, and in turn, budget income from foreign trade decreases. However, this decrease is compensated for by revenues from rents. Incorporating rents in the petroleum price makes the evaluation of revenue, based solely on foreign trade activities, more accurate and increases the role of price incentives in the domestic extraction industries.

Turning to the expenditure side, we can first see from Table 6 that the share of state investment in terms of total expenditures decreases from 20.2% to 12% in Proposal (a). However, the share of subsidies for agricultural products increases from 14.8% to 15.2%. This increase is slight but shows the limitations of “second-stage pricing” since the enormous size of these subsidies casts a heavy burden on the Soviet budget.

According to Volkonsky et al. (1987, pp. 29–30), through a revision of prices the state investment share of the overall investment funds can be reduced from 48.3% to 33%. The remaining 67% investment can then be financed by profits reserved in the enterprises and through bank credits. In 1985, 56% of profits accrued by industry was collected and placed in the state budget under the category “deductions from profits.” This share can also be reduced to 40%.

Proposal (b) in Table 6 was presented by Petrakov (1987a; 1987b). In place of rents in Proposal (a) a progressive tax is levied on profits in Proposal (b). The share of the progressive tax in terms of total revenue is a rather high 10.5%. The share of payments for fixed capital shows the largest value, 21%, which is double the value of the payments required in Proposal (a). As in the case of Proposal (a) the turnover tax share remarkably decreases from 25% to 12.9%. While the rent payments can be replaced by a progressive tax on profits, details regarding Proposal (b) have still not yet been published. Therefore, further research is required. During the author’s interview, Professor Petrakov stated that the progressive tax on profits in his proposal includes the payments for capital, labor and natural resources. Also during another interview with Professor Volkonsky and Dr. Vavilov, both suggested that their proposal assumes the rate of payments for productive capital to be 3%, while Professor Petrakov’s proposal assumes it to be 6%. As a result, the ratio of payments for productive capital in Proposal (b) is double that of Proposal (a). It should be noted that Professors Petrakov and Volkonsky have worked diligently and cooperatively for a reform of the Soviet price and finance system.
V. Conclusions: Toward Further Price Reform

This chapter has described the theoretical foundations of a sector price index system and a "hybrid" price system with rents developed by Soviet mathematical economists. The author would like to make the following comments regarding the price revision computation.

1. The practical proposals for Soviet price reforms put forward by Soviet mathematical economists imply, in effect, that the application of the recommended price increases at a single stroke will subject the Soviet Union to an enormous "energy shock," similar to that experienced by the rest of the world in the 1970's.

2. The price calculations for the extraction industries are primarily based on sectoral calculations which do not take into consideration interindustry relationships. It should be noted that in the Soviet Union over the past 20 years substantial sectoral experience in calculating marginal extraction costs has been accumulated and this has made possible the development of the "hybrid" input-output price system.

3. In a historical context it is ironic that the Soviet Government will henceforth rely on revenues from rents, since an original goal of the Soviet Union was land reform and the abolition of the landlord system. However, the logic employed by economists on the staff of TsEMI has been successful in rationalizing the need for this policy.

4. While the "hybrid" price system is at present useful for reforming the Soviet economy, it suffers from some drawbacks. Specifically, in making use of the "hybrid" price system Soviet mathematical economists do not explicitly treat the "quasi-rents" for commodities supplied by the MBMW sector. When considering the quasi-rents (the concept of which is similar to that of the rents on natural resources), we may be able to obtain alternative price calculation results that may weaken the assertion regarding relative prices between machinery and fuels put forward by the Soviet economists.

5. Soviet mathematical economists have not yet reached a satisfactory solution for the comprehensive price revisions which should include an increase in the retail prices of food and light industry outputs and a radical reduction of subsidies to compensate for the difference between the procurement price and the retail price. This corresponds to the presently held attitudes of Soviet authorities, but limits the effectiveness of price reform.

Next, let us refer briefly to the recent controversy in the Soviet Union regarding the adoption of marginal cost pricing.

Deriabin (1987) proposed price formation oriented toward minimum enterprise cost of production without presenting any explicit quantitative formulation of his proposal, and criticized the marginal cost pricing by claiming that under the condition of the acceleration of scientific and technical progress and the increased efficiency of social production, marginal costs cannot exceed the level of average costs. However, as Borozdin (1987) pointed out, theoretically, the marginal cost of a product can exceed the average cost, and practically, the actual marginal cost of an extraction product is greater than the average cost in the present Soviet economy. When we consider only the aspect of inputs and costs as in Deriabin's paper, we cannot deal with the comparative calculation of costs and benefits, namely efficiency of production. Further, the problem should be defined not in terms of "what prevails under the condition of the acceleration of technical progress?" but "what prevails..."
under the present Soviet economy (in a system lacking the conditions required for the acceleration of technical progress)?” or “what should be done in order to create the conditions necessary for technical renovation and innovation?”

Danilov-Danil’ian, who attempted to describe a most complicated, hierarchical optimal system of models based on the “composition” method in the 1970’s, criticized marginal cost pricing for extractive products [Danilov-Danil’ian (1987)] for these reasons; the impossibility of direct, precise, quantitative representation of the constraints on extraction, the possibility of price inflation and distorted extension of resources caused by a positive correlation between increasing scarcity and increasing marginal cost and the uncertainty of future extraction conditions. As Albegov, Volkonsky and Gofman (1987) clarified, Danilov-Danil’ian placed the optimization approach to economic problems in general and economic management, applying a specific concrete optimal model, together in a single class, and as the result he adopted a form of economic “nihilism” where any kind of step-by-step approach to possible rationalization of the existing economy is rejected.

The author would like to conclude this chapter by considering some serious problems which bar the way to further price reforms in the Soviet Union.

The most important remaining issue is related to the possibilities for centralized and decentralized pricing. Energy prices may be effectively controlled by the pricing authorities, since the quality of the energy produced is uniform throughout the economy and the product mix of the energy enterprises is rather simple. However, this is not the case with other products, particularly MBMW products, which do vary widely in terms of quality from enterprise to enterprise.

Pricing of the MBMW products should be decentralized by using contract or free prices as Soviet economists insist (Volkonsky, et al. (1987, p. 2)). However, in order to implement demand-oriented and anti-input pricing, which reflects the relative scarcity of resources, the Soviet Union must establish a nationwide range of markets. This will require the abolishment of the “state commercial order (goszakaz)” system which the Gorbachev regime introduced in 1987 to replace the traditional system of centrally mandated targets for each enterprise.

The “state commercial order” system was originally developed more than twenty years ago in a paper by the late Academician V.S. Nemchinov, a founder of Soviet mathematical economics. (During the June 1987 Soviet Plenum, Gorbachev quoted a passage from this paper). Nemchinov wrote the following [Nemchinov (1964, pp. 77–78)]:

“Profit-and-loss accounting relations should serve as the basis for ensuring that the economic potentialities of enterprises are in accordance with the requirements of the national economy as a whole. This can be attained only by radically changing the pattern of relationships between the planning bodies and the enterprises. This requires, in particular, that the planning bodies distribute, in an economically effective and rational way, sufficiently profitable orders—based on the national economic plan—among enterprises and construction sites through the network of economic agencies. Each enterprise should submit to the planning bodies preliminary proposals concerning the conditions under which it is prepared to fulfill one or another plan order (planovyi zakaz) for the delivery of goods, specifying the assortment, quality, time limits, and prices. The economic and planning bodies, for their part, should distribute their orders
only among those enterprises whose terms for carrying out plan orders are most advan-
tageous for the national economy as a whole.”

“... that is useful and advantageous for the national economy as a whole should also
be advantageous for the enterprise carrying out the corresponding portion of the plan as
an executive link. The operation of this principle can be guaranteed if the plan assign-
ment is transformed into a plan order and if the basic conditions for fulfilling the order
are established, in particular, if the price is acceptable both to the planning body and the
enterprise.”

15 In the documents of the June 1987 plenum of the CPSU Central Committee and the Law on the State
Enterprise, two types of economic levers are posed which the Soviet authorities intend to use to replace the
administrative-mandatory target figures of production: rules and economic parameters (normativy) and state
commercial orders. Soviet authorities expect these levers to operate as follows:
Economic parameters lay out the general rules of economic activities. They are first determined by
Gosplan and then adjusted by the ministries and territorial authorities. The parameters serve as the primary
lever in developing long-term plans and as a kind of regulator of these plans, since they prevent the emergence
of hare-brained schemes.

State commercial orders enable the central planning board (CPB) to attempt tasks which can be more
effectively solved from the CPB, or which are in general harder to solve without the assistance of the CPB.
A state commercial order will be profitable for the enterprise which fulfills the order. Further, the state
commercial order will ensure that the enterprise is provided with the required materials and other resources.

16 Popov, a noted radical Soviet economist, issued the following two warnings in August 1987 [Popov (1987)]
while he positively appreciated the role of the state commercial orders:

“... the price has a binding character, being fixed from above. And, given this price, both wholesale
trade and the market may become a sphere of influence, not of the law of value, but of those ideas by
which the authors of the prices were guided. The documents also mention contract prices, but their role
has not yet been clearly legitimized. Therefore, the second line is the struggle for reconstruction and the
development of such a price formation, in which the price would reflect the cost, instead of someone’s
opinion about the cost.”

The “danger” that Popov warned of, in fact, appeared soon after the state commercial order system
was implemented. On January 1988, Popov (1988) warned that the state commercial order system made a fiction
of the autonomy of enterprises and the self-financing system.

The close relationships between the state commercial orders and the possibilities of centralization and
decentralization of pricing are analyzed by Iashin (1987). We can confirm from this paper that the state
commercial order system is associated with centralized pricing.
Gorbachev has in effect adopted the suggestions put forward by Nemchinov, but has changed the name from "plan order" to "state commercial order." 15

Of course, Nemchinov put forward positive suggestions, such as the abolishment of the administration assignment of resources, the introduction of "wholesale trade" (market) to eliminate the chronic shortage of commodities, and rationalization of the price system with implementation of a self-financing system. Gorbachev also adopted these suggestions. However, these positive policy measures are not compatible with the state commercial order system. So long as the Soviet authorities retain wide-ranging decision-making powers over enterprises, the state commercial order system is easily bypassed by the traditional centralized allocation system. Also, since all the input-output activities within each enterprise and among enterprises are closely related, the vertical relationship implied in the state commercial system for public and non-public goods contradicts the horizontal relationship expected to be found in wholesale trade.16

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