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USSR Report

ECONOMIC AFFAIRS

(FOUO 2/80)

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CONTENTS PAGE

Use of Adaptive Econometric Models in Comparative Analysis (Ye. M. Levistkiy; EKONOMETRICHESKOYE MODELIROVANIYE, 1979) 1

Economic Factors in Placement of Industrial Production Reviewed (R.T. Semina, L.I. Tatevosova; IZVESTIYA AKADEMII NAUK SSSR, SERIYA GEOGRAFICHESKAYA, Sep-Oct 79) 24

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

USE OF ADAPTIVE ECONOMETRIC MODELS IN COMPARATIVE ANALYSIS

Novosibirsk EKONOMETRICHESKOYE MODELIROVANIYE in Russian 1979 pp 128-150

[Article by Ye. M. Levitskiy, candidate of economic sciences, published in the series "Problems of Building and Using National Economic Models," edited by Ye. M. Levitskiy and Yu. A. Chizhov, candidates of economic sciences]

[Text] The intensive development of trade relations of the USSR and other socialist countries with the capitalist countries and the increasingly elaborate international division of labor confront economic science with the problem of analyzing the processes of reproduction in capitalist countries, of forecasting the development of the capitalist economy and of studying problems related to economic competition with the capitalist countries.

Mathematical economic models based on Marxist-Leninist political economy are an effective means of analyzing the patterns and mechanism of social reproduction and long-range structural shifts and factors determining rates of economic growth. The use of mathematical models makes the economic analysis of the problems of economic competition between the two systems more concrete and sound.

An attempt is made in the present paper to compare levels of economic development of the USSR and United States with respect to various criteria on the basis of computations run on intersector econometric models of the two countries. The problem of making this comparison is very complex and necessitates solving many problems of methodology, methods and statistics. The problem of sector classification is one of the principal ones here if intersector models are to be used as the principal instrument.

The models we used each cover 19 sectors. The following were taken as the basis of sector classification: in the model of the USSR--the 104-sector classification of the retrospective intersector balance (MOB) for 1966[1] and in the model of the United States--the 87-sector classification of the retrospective intersector balance for 1967.[2]

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We will note certain peculiarities of our 19-sector classification. Since the ore-extractive industries are not given separately in the USSR MOB (the mining of the ores of ferrous and nonferrous metals has been added to the sector "Production of Ferrous and Nonferrous Metals"), the respective industries in the United States balance have also been consolidated and comprise the sector "Metallurgy."

Since the petroleum-refining industry is included in the fuel industry in the USSR sector classification,[3] the respective industry in the United States MOB has also been included in the sector "Fuel Industry." In comparing the gross outputs of the economic sectors of the USSR and the United States the sectors "Finance" and "Services" are omitted from the sector "Trade, Finance and Services" of the United States MOB. The remaining sector "Wholesale and Retail Trade" basically corresponds to the sector "Trade, Material and Technical Supply, and Procurements" of the USSR MOB.

The peculiarities enumerated above eliminate those discrepancies between the intersector balances of the USSR and United States models that have been present in previous versions.

But our classification of sectors contains a number of discrepancies which have still not been eliminated and which give rise to certain errors. For instance, the sector "Agriculture" in the United States model contains the subsector "Fish and Fish Products," which in the USSR model is included in "Food Industry." The gross output of the sector "Fish and Fish Products" (in the USSR) in 1966 was equal to 5.03 billion rubles, which constituted 5.8 percent of the gross output of agriculture and 2 percent of the total volume of industrial output. Thus the ratio between the USSR and the United States is in our calculations low in the comparison of agricultural output and a bit high in the comparison of the output of the food industry and the entire industrial sector of the two countries. This error has no effect on the ratio between the USSR and the United States in terms of gross social product.

Another error is engendered by the discrepancy between the sectors "Transportation" and "Communications" in the intersector balances of the two countries. In the USSR MOB these sectors include outlays for transportation and communications insofar as they serve production. Outlays for passenger transportation and communications insofar as they serve the public are included in "Social Consumption" (second quadrant of the MOB). There is no such division in the United States MOB. In 1966 outlays for passenger transportation and communications insofar as they served the public amounted to 2.7 billion rubles, and those for transportation and communications insofar as they served production amounted to 19.1 billion rubles. Total outlays amounted to 21.8 billion rubles (4.4 percent of the gross social product of the USSR). Outlays for passenger transportation and communications insofar as they serve the public represent 12.4 percent of this total (0.5 percent of the gross social product).

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The third error is related to the discrepancy between the sectors "Electric Power" and "Fuel Industry" in the USSR and United States models. The problem here is that the subsector "Gas Supply" is included in the sector "Electric Power" in the United States MOB, while in the USSR MOB it is included in "Fuel Industry." That is why in our calculations the ratio of the gross output of the sector "Fuel Industry" (USSR and United States) is high, and that of the sector "Electric Power" low. We accordingly consider it more correct to compare the gross outputs of the group of sectors (fuel industry and electric power industry) of the two countries. At the same time this last error does not affect the relation with respect to the total volume of industrial output.

The second stage of preparation for comparison of the two countries in terms of economic development is conversion of the statistical information used as the basis for constructing the models (retrospective intersector balances of production and distribution of outputs and dynamic series of indicators of national accounts) to comparable prices. Selected as the comparable prices were 1972 prices.

In computing indices of comparable prices (1972 = 1) we used data on wholesale price indices of USSR industry including the turnover tax (1949 = 1) for the following industries:[4] electric power, petroleum refining, coal, ferrous metallurgy, chemical and petrochemical, machinebuilding and metal manufacturing, timbering and woodworking, fuel and paper, the building materials industry, light industry, the food industry.

Wholesale price indices of the coal industry were taken for the fuel industry, wholesale price indices of ferrous metallurgy were taken for metallurgy, and wholesale price indices of the sector "Machinebuilding and Metal Manufacturing" were taken for the sectors "Machinebuilding" (not including transport machinebuilding) and "Transport Machinebuilding." For "Other Manufacturing Industry" we used the general wholesale price index of the entire industrial sector. This same index was used to convert the gross output of the sectors "Transportation," "Communications," and "Other Sectors" to 1972 prices.

The gross output of construction consists mainly of the "fixed assets put into service" which in our statistics is represented in 1969 comparable prices. The price index for the sector "Construction" was therefore taken as equal to unity.

The price index for the sector "Agriculture" was obtained as follows. By comparing the gross output of agriculture in the 1951-1975 period in current prices and in 1965 prices, we first obtained a price index with respect to 1965, and then we converted the series of indices obtained so that they related to 1972.

Price indices were available for converting the intersector balances of the United States to 1972 prices except for "Agriculture," "Transportation,"

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

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"Communications," "Trade," and "Other Sectors," for which average price indices for the output of the entire national economy were used.

The sum total of the gross outputs of the sectors in the USSR model which were converted to 1972 prices on the basis of the "average" indices was equal to 26.8 billion rubles (1959) and 37.5 billion rubles (1966), which is 9.4 percent and 8.1 percent, respectively, of the gross social product. In the United States balances the total of the gross outputs of these sectors is considerably greater (36.7 percent for the MOB in 1958 and 37.5 percent for the MOB in 1967).

The result of comparing volumes of adjusted net output from the analytical balance and from the statistics of national accounts for the respective year in new prices might, for example, serve as an objective criterion of the correctness of converting intersector balances to comparable prices. Thus for the USSR model the difference between the calculated and actual magnitude of adjusted net output in 1972 prices was 12.7 billion rubles (7.7 percent) in 1959 and 2.9 billion rubles (1.2 percent) in 1966. For the United States model this difference was $19.0 billion (3.2 percent) in 1958 and $5.9 billion (0.7 percent) in 1967. These data indicate sufficient accuracy of the calculations we made in converting the retrospective intersector balances of the USSR and United States from current to comparable (1972) prices.

The third stage of preparation for comparing levels of economic development of the USSR and the United States should be a computation of sector relationships of the purchasing power of the dollar and ruble. Solving this complicated problem requires the conduct of special research dealing with a large amount of the necessary information. We did not set ourselves such a task and used ready data which we had at our disposition.[5] For a number of important indicators the results obtained were close to the data of the USSR Central Statistical Administration on the ratio between the USSR and the United States with respect to the production of the most important types of industrial products and the principal indicators of economic development.[6] For the others there are discrepancies related to differences in the methodology of the estimates.

1. Materials Intensiveness and Capital Intensiveness of Output and Labor Productivity in the USSR Model (1951-1975)

Price changes have a sizable impact on the dynamic behavior of the materials intensiveness of output in the national economy of the USSR. For instance, in comparing output for 1959, 1966 and 1972 in actual and comparable prices, we observe different tendencies in the variation of that indicator (Table 1). Materials intensiveness of gross output in actual prices is rising, while in comparable 1972 prices it is dropping. Yet the change of the materials intensiveness of production in a sector-by-sector breakdown represents a more complex picture. When we examine the sequence of balances in comparable prices, we can single out four groups of sectors differing from one another in the character of this indicator's variation.

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Table 1. Materials Intensiveness of Production in the Sectors of the USSR Economy

Sector	In Current Prices			In 1972 Prices		
	1959	1966	1972	1959	1966	1972
Agriculture	0.357	0.298	0.376	0.321	0.292	0.376
Fuel industry	0.338	0.353	0.382	0.263	0.315	0.382
Construction	0.500	0.513	0.506	0.611	0.560	0.506
Food and tobacco industry	0.598	0.667	0.729	0.820	0.799	0.729
Textile and garment industry	0.528	0.610	0.603	0.664	0.685	0.603
Timbering, woodworking and furniture industry	0.482	0.499	0.505	0.457	0.523	0.505
Pulp and paper industry	0.606	0.593	0.592	0.632	0.506	0.592
Chemical industry	0.586	0.549	0.543	0.695	0.635	0.543
Leather footwear industry	0.528	0.509	0.484	0.664	0.584	0.484
Building materials industry	0.539	0.467	0.501	0.549	0.476	0.501
Metallurgy	0.617	0.609	0.637	0.626	0.609	0.637
Machinebuilding, not including transport machinebuilding	0.429	0.499	0.505	0.641	0.590	0.505
Transport machinebuilding	0.490	0.541	0.545	0.764	0.657	0.545
Other manufacturing industry	0.336	0.417	0.521	0.423	0.455	0.521
Transportation	0.305	0.209	0.210	0.390	0.231	0.210
Communications	0.307	0.171	0.121	0.387	0.176	0.121
Electric power	0.413	0.369	0.436	0.594	0.437	0.436
Trade	0.161	0.146	0.125	0.183	0.159	0.125
Other sectors	0.422	0.238	0.360	0.403	0.239	0.360
Total	0.467	0.479	0.510	0.523	0.518	0.510

The group of sectors for which materials intensiveness is rising consists of the "Fuel Industry" and "Other Manufacturing Industry." The second group consists of sectors in which materials intensiveness was first dropping (up until 1966) and then increased. This group includes the following sectors: "Agriculture," "Pulp and Paper Industry," "Building Materials Industry," "Metallurgy," and "Other Sectors." In two sectors ("Textile and Garment" and "Timbering, Woodworking and Furniture") materials intensiveness first increased (up to 1966) and then dropped. And finally, the fourth group of sectors, which consists of "Construction," "Food and Tobacco," "Chemical," "Leather Footwear," "Machinebuilding," "Transportation," "Communications," "Electric Power" and "Trade," is distinguished by the fact that materials intensiveness shows a constant decrease.

For industry as a whole the fluctuations of this indicator are not great. In the 1951-1966 period the materials intensiveness of industrial output hardly dropped at all, and in the 1966-1975 period it rose 3.4 percent. The materials intensiveness of agricultural production has undergone greater changes. During the first half of the period under review it dropped 10.3 percent, and it increased 31.5 percent over the last 10 years.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

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In construction the materials intensiveness of output hardly changed at all in the first 9 years of the base period. A substantial drop began in 1960 and continued until 1971. In the last several years the materials intensiveness of the output of construction has stabilized at a level of 0.505, which is 21.2 percent lower than the 1959 level.

Variation of the materials intensiveness of output reflects one of the aspects of the interaction of intensive and extensive components of economic factors. A relative decrease of materials intensiveness signifies a rise in the efficiency of utilization of the factors of production. A rise in the efficiency of utilization of raw materials and supplies occurred over the last decade of the base period in a majority of the sectors of the economy. At the same time a drop in the efficiency of utilization of intermediate products is typical of agriculture, the fuel industry, pulp and paper, the building materials industry, metallurgy, "other" manufacturing industry and "other" sectors of material production.

The capital intensiveness of output in the USSR national economy varies more unambiguously than materials intensiveness. Except for 2 or 3 years when there were deviations from the general trends, capital intensiveness of output has been rising. For instance, in the industrial sector the ratio between the output-capital ratio and the capital-worker ratio has been as follows (relative to adjusted net output in 1972 prices):

Year	Output-Capital Ratio, billions of rubles/billions of rubles	Capital-Worker Ratio, billions of rubles/millions of workers	Labor Productivity, billions of rubles/millions of workers (Col 1 x Col 2)
1951	1.52	1.62	2.46
1955	1.21	2.77	3.35
1960	0.97	3.90	3.78
1965	0.81	5.29	4.28
1970	0.72	7.11	5.12
1975	0.65	10.16	6.60

The capital intensiveness of adjusted net output in the USSR industrial sector increased 2.3-fold between 1951 and 1975 thanks to the fact that in that period the volume of adjusted net output grew 5.6-fold, and the volume of fixed productive capital increased 13.1-fold. But over the last 10 years the rise in the capital intensiveness of industrial output has slowed down greatly. Whereas it increased twofold in the 1951-1966 period, in the 1966-1975 period it increased only 1.14-fold. We will give the ratio between the output-capital ratio and the capital-worker ratio in USSR agriculture (on the basis of adjusted net output in 1972 prices):

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

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Year	Output-Capital Ratio, billions of rubles/billions of rubles	Capital-Worker Ratio, billions of rubles/millions of workers	Labor Productivity, billions of rubles/millions of workers (Col 1 x Col 2)
1951	1.39	0.62	0.86
1955	1.55	0.90	1.39
1960	1.39	1.33	1.85
1965	1.09	2.11	2.30
1970	0.80	3.47	2.78
1973	0.65	4.64	3.02
1975	0.42	5.51	2.31

Fixed productive capital in agriculture increased 7.7-fold over the base period, and the volume of adjusted net output increased 2.3-fold. The capital intensiveness of adjusted net output of agriculture increased 3.3-fold. It has experienced a particularly sharp increase over the last 10 years. For instance, over the 1951-1966 period the capital intensiveness of agricultural output rose 1.3-fold, while over the 1966-1975 period it increased 2.5-fold. In the USSR construction industry we observe the following relation between the output-capital ratio and the capital-worker ratio (on the basis of adjusted net output in 1972 prices):

Year	Output-Capital Ratio, billions of rubles/billions of rubles	Capital-Worker Ratio, billions of rubles/millions of workers	Labor Productivity, billions of rubles/millions of workers (Col 1 x Col 2)
1951	2.76	0.47	1.29
1955	2.55	0.68	1.74
1960	2.29	1.01	2.30
1965	1.71	1.56	2.66
1970	1.65	2.15	3.55
1975	1.41	2.84	4.00

The capital intensiveness of the adjusted net output of construction nearly doubled over the period under review. The increase between 1951 and 1966 was 1.7-fold and between 1966-1975 it was 1.2-fold.

Thus in the industrial sector and the construction sector of the USSR we note a recent change in the relationship between extensive and intensive factors of production to the advantage of the latter. In agriculture extensive factors of production continue to prevail.

Now let us examine the dynamic behavior of labor productivity in the USSR economy.

The number of employees in the industrial sector increased 2.1-fold between 1951 and 1975 and amounted to 33.9 million persons in 1975. Labor

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productivity (based on adjusted net output) rose 2.7-fold. Since labor productivity can be represented as the product of the output-capital ratio and the capital-worker ratio, we can clarify the contribution which each of these factors made to the labor productivity indicator and their dynamic relationship. As is evident from the data given above, the "contribution" of the output-capital ratio has been dropping sharply, and the rise of labor productivity has been occurring mostly thanks to the rise in the capital-worker ratio.

Labor productivity in agriculture increased 2.5-fold between 1951 and 1973, while the increase in the volume of adjusted net output was threefold and the number of employees decreased 15 percent.

Over the first several years of the base period, and also in the years of large harvests, the output-capital ratio increased in agriculture and considerably exceeded the "contribution" of the capital-worker ratio to the labor productivity indicator. For instance, in 1976 the growth rate of labor productivity owing to the output-capital ratio was 77.6 percent, while that owing to the capital-worker ratio was 22.4 percent; in 1973 (a year of a large harvest) the respective figures were 62 and 38 percent. But then about 1959 the output-capital ratio began to drop sharply, and the subsequent growth of labor productivity was mainly achieved thanks to the rise of the capital-worker ratio.

Labor productivity in the construction industry has been rising steadily, and in 1975 stood at a level 3.1-fold higher than in 1951. Over that period the number of employees increased 2.7-fold, while the volume of adjusted net output grew 8.5-fold. The value of fixed productive capital increased 16.7-fold.

As a consequence of the constant drop in the efficiency of utilization of capital and the considerable growth in its volume the "contribution" of the output-capital ratio is negative and the growth rate of labor productivity has been determined over this entire period by the rise in the capital-worker ratio.

2. Materials Intensiveness, Capital Intensiveness of Output and Labor Productivity in the United States Model (1955-1975)

The materials intensiveness of output in the sectors of the United States economy (Table 2) shows a different variation depending on the price system. In current prices materials intensiveness dropped from 0.514 in 1958 to 0.489 in 1972. In constant 1972 prices it increased from 0.483 in 1958 to 0.495 in 1967 and then dropped to 0.489 in 1972. For all the sectors in the United States model (except for "Other") this same pattern took place: materials intensiveness first increased (until 1967) and then dropped.

The materials intensiveness of industrial output increased 2.8 percent between 1955 and 1966, but decreased 1.2 percent by 1973. In agriculture it

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rose until approximately 1968 (6 percent), and in subsequent years stayed at a constant level. The materials intensiveness of output in construction hardly changed at all over the entire base period (0.570-0.573). Thus in the United States economy there has been a tendency toward a decline or stabilization of the materials intensiveness of output.

Table 2. Materials Intensiveness of Output in the Sectors of the United States Economy

Sector	In Current Prices			In 1972 Prices		
	1958	1967	1972	1958	1967	1972
Agriculture	0.572	0.615	0.586	0.554	0.591	0.586
Fuel industry	0.605	0.597	0.569	0.560	0.576	0.569
Construction	0.582	0.558	0.572	0.571	0.574	0.572
Food industry	0.715	0.706	0.697	0.644	0.708	0.697
Textile and garment industry	0.679	0.664	0.663	0.648	0.666	0.663
Timbering, woodworking and furniture industry	0.628	0.583	0.519	0.519	0.519	0.519
Pulp and paper industry	0.620	0.607	0.626	0.615	0.628	0.626
Chemical industry	0.581	0.603	0.658	0.637	0.662	0.658
Leather footwear industry	0.585	0.589	0.526	0.485	0.539	0.526
Building materials industry	0.479	0.497	0.464	0.433	0.472	0.464
Metallurgy	0.624	0.628	0.609	0.568	0.615	0.609
Machinebuilding, not including transport machinebuilding	0.558	0.556	0.554	0.518	0.559	0.554
Transport machinebuilding	0.638	0.645	0.645	0.633	0.648	0.645
Other manufacturing industry	0.563	0.547	0.560	0.544	0.562	0.560
Transportation	0.371	0.387	0.381	0.350	0.388	0.381
Communications	0.184	0.213	0.210	0.180	0.218	0.210
Electric power	0.510	0.524	0.513	0.498	0.516	0.513
Trade, finance and services	0.338	0.330	0.327	0.319	0.329	0.327
Other	0.644	0.560	0.554	0.613	0.561	0.554
Total	0.514	0.497	0.489	0.483	0.495	0.489

Capital intensiveness of the adjusted net output of the United States in 1973 was at the 1955 level.[7] In the interval between these two moments of time changes in capital intensiveness were cyclical in nature. In years of crisis capital intensiveness increased to 1.6, but in years of economic boom it dropped to 1.4.

Labor productivity in the United States based on adjusted net output increased 1.6-fold over this entire period in the industrial sector, 3.1-fold in agriculture and 1.2-fold in construction. Taken by 5-year periods, the increase of this indicator is characterized by the following data (billions of dollars/millions of persons in 1972 prices:

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

Year	Industrial Sector	Agriculture	Construction
1955	12.46	4.13	14.70
1960	14.07	5.61	14.73
1965	16.25	7.73	16.54
1970	17.62	10.90	16.12
1975	20.05	12.80	17.05

In industry the size of the work force increased 1.2-fold, while the volume of adjusted net output increased 1.8-fold. In agriculture adjusted net output rose 1.6-fold, and the size of the work force decreased by a factor of 10/19. In construction adjusted net output increased 1.7-fold, while the size of the work force increased 1.4-fold (1973). The relationship between the output-capital ratio and the capital-worker ratio has undergone sharp changes over the base period:

Year	Output-Capital Ratio, billions of dollars/billions of dollars	Capital-Worker Ratio, billions of dollars/millions of workers	Labor Productivity, billions of dollars/millions of workers (Col 1 x Col 2)
1955	1,341	15,013	20,132
1956	1,322	15,241	20,149
1957	1,297	15,779	20,465
1958	1,259	16,536	20,819
1959	1,308	16,556	21,656
1960	1,298	16,793	21,797
1961	1,296	17,319	22,445
1962	1,340	17,585	23,564
1963	1,359	17,928	24,364
1964	1,390	18,152	25,232
1965	1,419	18,610	26,407
1966	1,437	19,213	27,608
1967	1,407	19,790	27,845
1968	1,406	20,343	28,603
1969	1,376	20,760	28,566
1970	1,315	21,507	28,281
1971	1,313	22,231	29,189
1972	1,346	22,333	30,061
1973	1,367	22,582	30,870
1974	1,287	23,125	29,763
1975	1,210	24,349	29,463

In the 1955-1958 period the output-capital ratio dropped in the United States economy, and its "contribution" to the growth rate of labor productivity was negative. Labor productivity at the same time increased because of the higher capital-worker ratio. In 1959 the output-capital ratio increased, and its "contribution" to the growth rate of labor productivity stood at 97.2 percent. The share of the capital-worker ratio was 2.8

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percent of the growth. In 1960 and 1961 there was another drop of the output-capital ratio, and the rise of labor productivity was determined solely by the rise of the capital-worker ratio. Over the 5 years that followed up through 1966 the output-capital ratio again increased, but when the crisis came in 1966 it began a decline up until 1971. A rise of the output-capital ratio was noted in 1972 and 1973, when the output-capital ratio accounted for 84.5 percent and 58.4 percent, respectively, of the growth rate of labor productivity. In years of crisis (1974-1975) the output-capital ratio again experienced a sharp drop. Thus the dynamic behavior of the relationship between the output-capital ratio and the capital-worker ratio in the United States economy is cyclical in nature.

3. Comparison of the Economic Development of the USSR and the United States in the 1955-1975 Period

Simulation computations performed on the intersector econometric models of the USSR and the United States in comparable 1972 prices serve as the basis for a comparative analysis of the economic development of the USSR and the United States in the 1955-1975 period. The results of the calculations for each model were converted to the monetary units of the other country by means of purchasing power relations between the ruble and dollar by sectors (Table 3). For a number of reasons the coefficients for convering one currency to another do not coincide.[8]

Table 3. Calculation of 1972 Sector Parities on the Basis of 1966 Equivalent Evaluations

Sector	Equivalent Evaluations (1966)		Value (1966)	
	From USSR Model, rubles	From United States Model, dollars	Rubles to Dollars	Dollars to Rubles
1	2	3	4	5
Agriculture	1.710	0.906	0.530	1.887
Fuel industry	1.186	1.273	1.073	0.932
Construction	0.960	1.609	1.676	0.597
Food and tobacco industry	0.563	0.581	1.032	0.969
Textile and garment industry	0.626	0.574	0.917	1.091
Timbering, woodworking and furniture industry	0.892	0.686	0.769	1.300
Pulp and paper industry	0.666	0.761	1.314	0.875
Chemical industry	0.748	0.665	0.889	1.125
Leather footwear industry	0.790	0.870	1.101	0.908
Building materials industry	0.974	0.964	0.908	1.010
Metallurgy	0.688	0.626	0.910	1.099

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

Table 3 (continued)

1	2	3	4	5
Machinebuilding, not including transport machinebuilding	0.899	0.929	1.033	0.968
Transport machinebuilding	0.763	0.645	0.845	1.183
Other manufacturing industry	1.059	0.981	0.927	1.079
Transportation	1.150	1.282	1.115	0.897
Communications	1.205	1.589	1.319	0.758
Electric power	1.159	1.487	1.284	0.779
Trade	1.565	1.337	0.854	1.171
Other sectors	1.395	1.381	0.990	1.010
Gross social product				

Sector	Price Index (1972 = 1)		Value (1972)	
	Rubles	Dollars	Rubles to Dollars	Dollars to Rubles
1	6	7	8	9
Agriculture	0.784	0.847	0.626	2.407
Fuel industry	0.743	0.825	1.301	1.254
Construction	1.000	0.835	2.007	0.597
Food and tobacco industry	1.000	0.838	1.231	0.969
Textile and garment industry	0.985	0.881	1.041	1.108
Timbering, woodworking and furniture industry	0.928	0.694	1.108	1.401
Pulp and paper industry	0.923	0.871	1.509	0.948
Chemical industry	1.049	0.954	0.932	1.072
Leather footwear industry	0.985	0.787	1.399	0.922
Building materials industry	0.912	0.780	1.164	1.107
Metallurgy	0.836	0.800	1.137	1.314
Machinebuilding, not including transport machinebuilding	1.149	0.821	1.258	0.842
Transport machinebuilding	1.149	0.836	1.011	1.029
Other manufacturing industry	0.984	0.853	1.087	1.096
Transportation	0.984	0.835	1.335	0.911
Communications	0.984	0.835	1.580	0.770
Electric power	0.937	0.820	1.566	0.831
Trade	1.030	0.835	1.023	1.137
Other sectors	0.984	0.835	1.186	1.026
Gross social product			1.043	0.958

In comparing the gross output in the sectors of the USSR and the United States and also labor productivity double counting of services in the United States gross national product was eliminated, and the work force in the service sphere was subtracted from the work force in material production of the United States. In view of the negligible share of "services" in the personal consumption of the USSR population, we omitted the value of "consumer

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

services" from the personal consumption of the United States population in comparing the final product of the two countries.

The elements of the final product were compared by five groups:

1) personal consumption (in the USSR--net personal consumption not including depreciation of the housing stock, which is included in the overall indicator of depreciation; in the United States--personal consumption of the population without "consumer services");

2) capital investments (in the USSR--accumulation of fixed productive and nonproductive capital plus depreciation; in the United States--expenditures for private and public construction; in neither case is the growth of inventories and reserves included in capital investments);

3) government consumption (in the USSR--social consumption, expenditures for science and management, other expenditures; in the United States--government purchases at the federal, state and municipal level, not including outlays for government construction);

4) exports and

5) imports.

Comparison of Gross Outputs in Sectors of the USSR and United States Economies (Tables 4-6).[9] The gross social product of the USSR had by 1975 increased 4.4-fold over the 1955 level, while the growth in the United States over that same period was only 1.8-fold. The result of the faster growth of that indicator in the USSR was a sizable reduction of the gap between its levels in the USSR and the United States. In 1955 the difference in volumes of the gross product between the USSR and the United States was 77 percent, but by 1975 it was 43 percent.

Key to Tables 4-6:

1. Agriculture
2. Fuel industry
3. Construction
4. Food and tobacco industry
5. Textile and garment industry
6. Timbering, woodworking and furniture industry
7. Pulp and paper industry
8. Chemical industry
9. Leather footwear industry
10. Building materials industry
11. Metallurgy
12. Machinebuilding, not including transport machinebuilding
13. Transport machinebuilding
14. Other manufacturing industry
15. Transportation
16. Communications
17. Electric power
18. Trade
19. Other sectors
20. Gross social product
21. Gross industrial output

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

Table 4. Gross Output in the Sectors of the USSR and United States Economies, billions of rubles

Sector	USSR					United States*					United States**				
	1955	1960	1965	1970	1975	1955	1960	1965	1970	1975	1955	1960	1965	1970	1975
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
(1) Сельское хозяйство	51,5	73,8	91,8	105,9	134,9	128,8	152,8	183,2	211,3	249,3	100,5	119,3	142,9	164,9	194,5
(2) Топливная промышленность	12,6	17,0	17,6	26,4	40,7	49,3	52,9	62,4	70,7	78,0	23,4	25,1	29,6	33,6	37,0
(3) Строительство . . .	17,3	30,8	39,7	68,4	96,4	59,9	61,9	77,4	85,1	87,5	93,6	96,8	120,9	133,0	136,7
(4) Пищевая и табачная промышленность	32,1	48,0	73,6	102,6	139,5	92,9	99,8	111,5	125,5	145,5	142,2	152,7	170,6	192,0	222,7
(5) Текстильная и швейная промышленность	20,0	29,1	44,2	69,2	92,0	40,4	45,8	56,4	64,4	71,9	61,7	69,8	86,1	98,2	109,7
(6) Лесная, деревообрабатывающая и мебельная промышленность	7,5	11,3	11,5	16,8	24,2	28,4	32,4	39,2	45,3	50,6	16,2	18,4	22,3	25,8	28,8
(7) Целлюлозно-бумажная промышленность	0,8	1,2	1,6	2,7	3,9	13,8	15,5	20,0	23,1	26,3	11,7	13,1	16,9	19,6	22,2
(8) Химическая промышленность	4,6	6,7	12,3	23,7	35,7	33,4	39,4	56,8	67,6	75,8	25,6	30,2	43,5	51,8	58,0
(9) Кожевенно-обувная промышленность	3,6	4,7	7,4	12,4	16,9	6,3	6,7	7,0	7,9	8,9	11,6	12,4	13,0	14,5	16,5

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

Table 4 (continued)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
(10) Промышленность стройматериалов	4,5	7,8	10,6	17,1	23,7	15,4	18,3	22,0	26,1	29,2	10,6	11,8	14,3	16,9	18,9
(11) Металлургия	12,0	17,7	22,6	34,6	53,1	53,0	59,3	72,[illegible]	82,0	89,1	25,8	28,8	35,2	50,9	43,4
(12) Машиностроение, кроме транспортного	10,4	15,5	34,5	69,3	108,0	64,8	72,1	101,9	115,1	117,1	54,4	60,4	85,5	96,5	98,2
(13) Транспортное машиностроение . . .	2,6	4,1	7,5	15,2	23,5	57,3	62,5	83,3	93,5	95,2	26,9	29,0	38,7	43,4	44,2
(14) Прочая обрабатывающая промышленность	4,1	6,7	12,3	11,7	14,5	59,8	70,5	92,2	108,3	118,2	30,5	35,9	46,9	55,1	60,2
(15) Транспорт	7,2	11,2	16,9	25,4	39,5	36,7	41,4	50,2	57,8	66,4	38,2	43,0	52,2	60,2	69,1
(16) Связь	0,2	0,3	0,4	0,7	1,0	10,8	12,9	18,6	22,4	24,9	13,3	15,9	22,8	27,6	30,6
(17) Электроэнергетика	2,5	3,9	7,0	11,8	17,6	21,2	24,8	34,3	41,5	46,6	21,6	25,3	35,0	42,3	47,5
(18) Торговля	6,8	10,1	13,8	21,4	31,0	255,8	295,2	394,8	467,2	524,4	203,8	235,2	314,6	372,3	417,8
(19) Прочие отрасли . .	5,8	7,2	4,0	4,1	5,7	39,4	39,7	47,9	55,1	62,9	36,4	36,7	44,3	50,9	58,1
(20) Валовой общественный продукт . .	205,9	307,0	429,5	639,2	898,2	1068,1	1203,8	1531,6	1770,1	1967,8	947,3	1060,0	1335,4	1538,7	1714,4
(21) Валовая продукция промышленности	117,1	173,6	262,7	413,5	593,2	536,7	599,9	759,6	871,1	952,4	461,5	513,1	637,6	729,8	807,4

* Parities calculated on the basis of equivalent valuations.
** Ordinary parities.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

Table 5. Gross Outputs in Sectors of the USSR and United States Economies, billions of dollars

Sector	USSR*					United States					USSR**				
	1955	1960	1965	1970	1975	1955	1960	1965	1970	1975	1955	1960	1965	1970	1975
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
(1) Сельское хозяйство	32,2	46,2	57,5	66,3	84,5	53,5	63,5	76,1	87,8	103,6	41,3	59,2	73,6	84,9	108,2
(2) Топливная промышленность	16,4	22,1	22,9	34,3	53,0	39,3	42,2	49,8	56,4	62,2	25,0	33,8	35,0	52,5	80,9
(3) Строительство . . .	34,7	61,8	79,7	137,3	193,5	100,3	103,7	129,6	142,6	146,6	22,2	39,5	51,9	87,8	123,8
(4) Пищевая промышленность	39,5	59,1	90,6	126,3	171,7	95,9	103,0	115,0	129,6	150,2	25,8	38,6	59,2	82,5	112,1
(5) Текстильная и швейная промышленность	20,8	30,3	46,0	72,0	95,8	36,5	41,3	50,9	58,1	64,9	13,6	19,8	30,1	47,1	62,7
(6) Лесная, деревообрабатывающая и мебельная промышленность	8,3	12,5	12,7	18,6	26,8	20,3	23,1	28,0	32,3	36,1	14,5	22,0	22,4	32,6	47,0
(7) Целлюлозно-бумажная промышленность	1,3	1,7	2,4	4,0	5,9	14,6	16,3	21,1	24,4	27,7	1,3	1,8	2,5	4,1	6,1
(8) Химическая промышленность	4,3	6,3	11,5	22,1	33,3	31,2	36,8	53,0	63,1	70,7	3,6	5,3	9,7	18,7	28,2
(9) Кожевенно-обувная промышленность	5,0	6,6	10,4	17,3	23,6	6,8	7,3	7,6	8,5	9,7	2,7	3,6	5,6	9,4	12,8

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

Table 5 (continued)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
(10) Промышленность стройматериалов	5,2	9,1	12,3	19,9	27,6	13,9	16,5	19,9	23,6	26,4	8,6	15,2	20,8	33,5	46,5
(11) Металлургия	13,6	20,1	25,7	39,3	60,4	40,3	45,1	55,1	62,4	67,8	22,2	32,8	41,5	64,0	98,3
(12) Машиностроение, кроме транспортного	13,1	19,5	43,4	87,2	135,9	77,0	95,6	121,1	136,7	139,1	16,1	23,9	53,3	107,1	166,9
(13) Транспортное машиностроение . . .	2,6	4,1	7,6	15,4	23,8	36,2	50,7	81,0	90,9	92,5	5,6	8,8	16,3	33,1	51,2
(14) Прочая обрабатывающая промышленность	4,4	7,3	13,4	12,7	15,8	54,6	64,3	84,1	93,8	107,3	8,7	14,3	26,3	25,0	31,0
(15) Транспорт	9,6	15,0	22,6	33,9	47,9	40,3	45,4	55,1	63,5	72,9	9,2	14,4	21,7	32,6	46,1
(16) Связь	0,3	0,4	0,6	1,1	1,6	14,0	16,8	24,1	29,1	32,3	0,3	0,3	0,5	0,9	1,3
(17) Электроэнергетика	3,8	6,1	10,9	18,5	27,6	25,5	29,9	41,3	49,9	56,1	3,3	6,0	10,7	18,1	27,0
(18) Торговля	7,0	10,3	14,1	21,9	31,7	225,0	250,6	347,2	410,9	461,2	8,7	13,0	17,7	27,5	39,8
(19) Прочие отрасли . .	6,9	8,5	4,7	4,8	6,7	38,4	38,7	46,7	53,7	61,3	7,5	9,2	5,1	5,2	7,3
(20) Валовой общественный продукт . .	229,0	347,0	489,0	753,1	1066,8	983,6	1100,0	1406,7	1622,3	1788,9	240,9	361,6	503,3	756,8	1097,0
(21) Валовая продукция промышленности	138,3	204,8	309,8	487,8	700,9	512,1	572,1	727,9	834,7	911,2	151,8	226,0	333,7	527,9	770,6

* Parities calculated on the basis of equivalent valuations

** Ordinary parities.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

Table 6. Comparison of Gross Outputs in Sectors of the USSR and United States Economies (geometric average)

Sector	USSR/United States,* %					USSR/United States,** %				
	1955	1960	1965	1970	1975	1955	1960	1965	1970	1975
(1) Сельское хозяйство	49,1	59,3	61,5	61,5	66,4	68,9	75,9	78,8	78,8	85,1
(2) Топливная промышленность	32,7	41,0	36,0	47,7	66,6	58,6	73,6	64,6	85,6	119,6
(3) Строительство	31,6	54,4	56,2	87,9	120,6	20,2	34,8	35,9	56,3	77,2
(4) Пищевая промышленность	37,7	52,5	72,1	89,3	104,7	24,6	34,3	47,1	58,3	68,4
(5) Текстильная и швейная промышленность	53,1	68,3	84,2	115,4	137,4	34,8	44,7	55,1	75,6	90,0
(6) Лесная, деревообрабатывающая и мебельная промышленность	32,7	43,5	36,5	46,2	59,5	57,4	76,4	64,1	81,1	104,5
(7) Целлюлозно-бумажная промышленность	7,3	9,0	9,7	13,8	17,9	8,1	9,9	10,7	15,1	19,7
(8) Химическая промышленность	13,7	17,0	21,6	35,0	47,1	14,4	17,9	22,8	36,8	49,5
(9) Кожевенно-обувная »	64,2	79,4	119,8	178,9	214,6	34,9	43,1	65,1	97,1	116,6
(10) Промышленность стройматериалов	33,0	48,3	54,6	74,3	92,1	53,3	78,0	88,1	119,8	148,4
(11) Металлургия	27,7	36,5	38,2	51,6	72,9	50,7	66,8	69,8	94,4	133,3
(12) Машиностроение, кроме транспортного	16,5	22,1	34,8	61,9	94,9	20,0	26,8	42,2	75,0	114,9
(13) Транспортное машиностроение	4,5	6,6	9,2	16,6	25,2	9,8	14,2	19,7	35,7	54,2
(14) Прочая обрабатывающая промышленность	7,4	10,4	14,6	11,8	13,4	14,6	20,4	28,6	23,2	26,3
(15) Транспорт	21,5	29,9	37,1	48,4	59,6	20,7	28,7	35,7	46,6	57,3
(16) Связь	2,0	2,3	2,3	3,4	4,4	1,7	1,8	1,9	2,7	3,5
(17) Электроэнергетика	13,2	18,0	23,2	32,5	43,1	12,9	17,6	22,8	31,8	42,2
(18) Торговля	2,9	3,7	3,8	4,9	6,4	3,6	4,6	4,7	6,2	8,0
(19) Прочие отрасли	16,3	20,0	9,1	8,2	9,9	17,6	21,6	9,9	8,8	10,7
(20) Валовой общественный продукт	21,2	28,4	31,2	40,9	52,2	23,1	30,9	33,9	44,3	56,7
(21) Валовая продукция промышленности	24,3	32,2	38,4	52,7	69,2	27,4	36,6	43,5	59,9	78,8

* Parities calculated on the basis of equivalent valuations.

** Ordinary parities.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

The difference between the volumes of industrial output has decreased to a still greater degree. Whereas in 1955 the gross industrial output of the USSR was 27.4 percent of the corresponding United States figure, in 1975 it was already 78.8 percent. The output of USSR agriculture in 1975 was only 15 percent below that of the United States. In the construction industry of the USSR gross output was 80 percent less than the United States in 1955 and 23 percent less in 1975.

A number of sectors of the USSR national economy had by 1975 exceeded the level of the United States with respect to the gross volume of output: the fuel industry by 19.6 percent, the timbering, woodworking and furniture industry by 4.5 percent, the leather footwear industry by 16.6 percent, the building materials industry by 48.4 percent, metallurgy by 3.33 percent, machinebuilding (not including transport machinebuilding) by 14.9 percent. The gross volumes of output of the group of sectors included in the fuel and electric power industry stood at 38.5 percent of the United States level in 1955 but already at 79.3 percent in 1975.

There is still a sizable lag behind the United States level in the gross volume of output of such sectors of the USSR economy as pulp and paper (19.7 percent), the chemical industry (49.5 percent) and transport machinebuilding (54.2 percent).

Comparison of the Final Product of the USSR and the United States (Tables 7-9). Between 1955 and 1975 the final product of the USSR increased from 98.2 billion rubles 415.2 billion rubles, i.e., 4.2-fold. Personal consumption grew 3.8-fold, and capital investments 5.5-fold. Since the growth rates of capital investments were higher, the share of personal consumption in the final product dropped 5 percent, and the relative share of capital investments in the economy increased 7 percent. Taking into account the growth of inventories and reserves, the share of capital investments changed from 28.3 percent in 1955 to 36.5 percent in 1975.

The final product of the United States grew 1.7-fold over the period under consideration, and its composition changed. Personal consumption increased 1.7-fold, and the volume of capital investments 1.5-fold. The share of personal consumption in the United States was 55-60 percent of the final product, and the share of capital investments 30-26 percent.

Thus even when "services" are not included in personal consumption, the share of personal consumption is approximately 5 percent higher in the United States than in the USSR, and the relative share of capital investments is 4 percent lower.

Over the 20 years of the base period the ratio of the volume of the final output of the USSR national economy to the corresponding indicator of the United States increased 2.7-fold and in 1975, according to our calculations, stood at 67.7 percent. According to data of the USSR Central Statistical Administration, the ratio of the national income of the USSR to the national income of the United States was 67 percent.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

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Table 7. Composition of the Final Product of the USSR and United States

Indicators	USSR					United States*					United States**				
	1955	1960	1965	1970	1975	1955	1960	1965	1970	1975	1955	1960	1965	1970	1975
In billions of rubles															
(1) Личное потребление	59,8	89,7	122,5	168,3	228,1	260,6	285,5	348,2	408,0	456,9	246,0	267,4	320,0	373,6	418,4
(2) Капиталовложения	22,7	41,1	56,3	91,7	125,6	91,0	98,3	137,7	147,4	144,1	101,0	107,5	144,7	153,8	150,0
(3) Государственное потребление	10,3	13,5	19,7	28,1	38,3	42,8	43,3	55,3	72,1	70,6	37,2	38,0	48,9	66,1	67,9
(4) Прирост запасов и резервов	5,0	7,3	14,6	20,0	26,0	16,5	7,1	13,7	5,5	—12,8	12,0	4,9	9,7	4,0	—9,4
(5) Внешнеторговое сальдо	0,3	0,0	0,1	0,8	—2,8	4,5	5,9	9,4	1,8	26,6	2,7	3,9	7,8	2,0	22,3
(6) Конечный продукт	98,2	151,5	213,2	309,0	415,2	415,3	440,1	564,3	634,8	685,5	398,9	421,9	531,1	599,5	649,3
In %															
(1) Личное потребление	60,9	59,2	57,5	54,5	54,9	62,7	64,9	61,7	64,3	66,7	61,7	63,4	60,3	62,3	64,4
(2) Капиталовложения	23,1	27,1	26,4	29,7	30,3	21,9	22,3	24,4	23,2	21,0	25,3	25,5	27,2	25,7	23,1
(3) Государственное потребление	10,5	8,9	9,2	9,1	9,2	10,3	9,8	9,8	11,4	10,3	9,3	9,0	9,2	11,0	10,5
(4) Прирост запасов и резервов	5,1	4,8	6,8	6,5	6,3	4,0	1,6	2,4	0,9	—1,9	3,0	1,2	1,8	0,7	—1,5
(5) Внешнеторговое сальдо	0,3	0,0	0,0	0,2	—0,7	1,1	1,4	1,7	0,2	3,9	0,7	0,9	1,5	0,3	3,5

* Parities calculated on the basis of equivalent valuations.
** Ordinary parities.

Key:
1. Personal consumption
2. Capital investments
3. Government consumption
4. Growth of inventories and reserves
5. Trade balance
6. Final product

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Table 8. Composition of the Final Product of the USSR and United States

Indicators	USSR*					United States					USSR**				
	1955	1960	1965	1970	1975	1955	1960	1965	1970	1975	1955	1960	1965	1970	1975
In billions of dollars															
(1) Личное потребление	61,1	91,3	129,6	180,4	248,4	237,6	260,7	317,5	371,6	416,2	54,2	80,4	111,7	152,9	210,9
(2) Капиталовложения	40,1	72,0	95,9	158,6	218,7	117,2	126,7	172,1	182,7	178,4	31,2	56,0	78,1	126,0	173,3
(3) Государственное потребление	12,3	15,4	22,7	32,0	43,8	45,7	52,2	64,0	82,6	82,9	15,6	19,0	27,4	38,2	52,0
(4) Прирост запасов и резервов	6,4	8,4	15,0	26,9	47,4	7,7	4,4	11,3	4,3	—10,1	5,5	7,3	13,9	23,1	39,7
(5) Внешнеторговое сальдо	0,5	0,2	0,7	4,1	6,3	4,7	5,5	8,1	1,4	23,5	1,5	1,9	3,3	9,6	20,0
(6) Конечный продукт	120,5	187,4	263,9	402,0	564,7	412,9	449,5	573,0	642,6	690,5	108,0	164,6	234,3	349,8	495,8
In %															
(1) Личное потребление	50,7	48,7	49,1	44,9	44,0	57,5	58,0	55,4	57,8	60,2	50,2	48,9	47,7	43,7	42,5
(2) Капиталовложения	33,7	38,4	36,3	39,4	38,7	28,4	28,2	30,0	28,4	25,8	28,9	34,0	33,3	36,0	35,0
(3) Государственное потребление	10,2	8,2	8,6	8,0	7,8	11,1	11,6	11,2	12,9	12,0	14,4	11,5	11,7	10,9	10,5
(4) Прирост запасов и резервов	5,3	4,5	5,7	6,7	8,4	1,9	1,0	2,0	0,7	—1,5	5,1	4,4	5,9	6,6	8,8
(5) Внешнеторговое сальдо	0,5	0,2	0,3	1,0	1,1	1,1	1,2	1,4	0,2	3,5	1,4	1,2	1,4	2,7	4,0

* Parities calculated on the basis of equivalent valuations.
** Ordinary parities.

Key:
1. Personal consumption
2. Capital investments
3. Government consumption
4. Growth of inventories and reserves
5. Trade balance
6. Final product

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Table 9. Comparison of the Final Product of the USSR and the United States (geometric average)

Year	Personal Consumption	Capital Investments	Government Consumption	Exports	Imports	Final Product
		USSR/United States (ordinary parities), %				
1955	23.5	24.5	30.7	13.0	11.4	25.4
1960	32.2	41.1	35.9	17.2	17.3	36.3
1965	36.7	42.0	41.5	19.1	19.0	40.5
1970	43.1	64.1	44.3	20.9	13.2	53.0
1975	52.5	90.2	59.5	34.7	33.5	67.7
		USSR/United States (parities calculated on basis of equivalent evaluations), %				
1955	24.3	29.2	25.5	10.2	10.5	26.3
1960	33.2	48.7	30.3	13.7	15.9	37.9
1965	37.9	47.7	35.6	15.5	17.7	41.7
1970	44.8	73.5	38.9	16.7	13.5	55.2
1975	54.6	103.4	53.5	27.6	34.7	70.4

Of the various elements of the final product of the USSR the volume of capital investments came closest to the United States level. In 1955 the ratio of the volume of capital investments in the USSR to the corresponding figure in the United States was 24.5 percent, but in 1975 it was already 90.2 percent. According to an estimate made by the USSR Central Statistical Administration, the ratio for 1975 was 100 percent.

Comparison of Labor Productivity in the USSR and United States. In 1975 the work force in material production of the USSR was 94.9 million persons, which is 1.5-fold more than in 1955. In the material production of the United States over that same period the work force increased 1.5-fold, and in 1975 stood at 51.9 million persons.

Table 10. Comparison of Average Estimates of Labor Productivity in the USSR and United States (on the basis of gross output in 1972 comparable prices)

Year	USSR/United States, %			
	National Economy	Industry	Agriculture	Construction
1955	16.9	27.9	17.1	11.4
1960	20.4	28.7	18.3	15.2
1965	20.9	29.7	15.8	16.0
1970	25.8	37.7	13.3	21.9
1975	31.0	44.2	14.0	23.2

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

The work force in material production of the USSR was approximately 40 million larger than in the material production of the United States. Nevertheless, thanks to the faster growth rates the gap in productivity of social labor has closed considerably (Table 10). For instance, over the 20 years the level of labor productivity in the USSR economy almost doubled relative to the United States--from 16.9 percent in 1955 to 31.0 percent (40 percent according to the figures of the USSR Central Statistical Administration) in 1975.

In the industrial sector the size of the work force at the beginning of the base period was almost the same (17.4 million in the USSR and 17.7 million in the United States). In 1975 the size of the work force in the industrial sector of the USSR was already 1.8-fold larger.

Industrial output over that period increased 5.1-fold in the USSR and 1.8-fold in the United States. As a consequence labor productivity rose 2.6-fold in the industrial sector of the USSR and 1.7-fold in the industrial sector of the United States. In 1955 labor productivity in USSR industry stood at 27.9 percent of the United States level, but in 1975 it already stood at 44.2 percent (55 percent according to the figures of the USSR Central Statistical Administration).

The size of the work force in the agriculture of the USSR decreased approximately 15 percent over the 20 years, while in the United States agriculture it decreased 49 percent. In 1975 the work force in USSR agriculture was 26.2 million persons, while in the agriculture of the United States it was 4.3 million persons, i.e., one-sixth as many. Gross agricultural output of the USSR had by 1975 grown 2.6-fold over the 1955 level, while in the United States it increased 1.9-fold over the same period.

As a result labor productivity in the agriculture of the USSR stood at 17.1 percent of the United States level in 1955 and 14.0 percent of that level in 1975 (20-25 percent according to the figures of the USSR Central Statistical Administration).

In the construction industry the size of the work force in the base period increased from 5.0 to 11.5 million in the USSR, which is 2.3-fold, while in the United States it increased from 2.8 to 3.46 million (1.2-fold). At the same time the growth rates of the gross output of construction were far higher in the USSR than in the United States. As a result it increased 5.6-fold over the period under review in the USSR and 1.4-fold in the United States. As a consequence labor productivity in the construction industry of the USSR stood at 11.4 percent of the same indicator in the United States in 1955 and 23.2 percent in 1975 (65 percent according to the figures of the USSR Central Statistical Administration).

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ECONOMIC FACTORS IN PLACEMENT OF INDUSTRIAL PRODUCTION REVIEWED

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA GEOGRAFICHESKAYA in Russian No 5, Sep-Oct 79 pp 50-59

[Article by R. T. Semina and L. I. Tatevosova: "An Economic Evaluation of the Factors Involved in the Long-Range Placement of Industrial Production (From the Example of Factors Related to the Utilization of Natural Resources)"]

[Text] The article examines the essence, the criteria and the procedural concept for an economic evaluation of the factors in the placement of industrial production as related to the use of natural resources. Basic attention has been given to forecasting the economic estimates of the placement factors related to the use of fuel-power, raw material and water resources considering the economic loads, the change in the economic situations, scientific and technical progress in equipment and the methods of utilizing natural resources (in the sectorial and territorial aspects).

The positing of the problem. For the resource evaluation question in economic geography, as was emphasized by A. A. Mints (1972), along with solving the general theoretical problems, one of the most important questions is the elaboration of the methodological bases for a quantitative determination of the intensity of the impact of natural factors on various aspects of production.

As was correctly pointed out by S. A. Nikolayev, to one degree or another virtually all literature on the placement of the productive forces is devoted to studying the placement factors. But in a majority of works, the placement factors are not an independent object of study. As a rule, these analyze the effect of individual factors on the placement of the industrial and agricultural sectors, and on the territorial production structure on various levels. The works of the Economics Institute of the USSR Academy of Sciences ("Osobennosti i Faktory...," [see the bibliography], 1960) and the monograph of S. A. Nikolayev (1971) are particularly devoted to studying the placement factors.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

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In recent years greater interest has been shown in the questions of evaluating the placement factors in line with solving a vast range of problems in optimizing the placement of the productive forces, since the indicators for the economic evaluations of the placement factors act as the initial information in solving them. The present stage in studying the placement factors is related precisely to their formalization. Here "by placement factors one understands those conditions and resources the value characteristics of which in principle can operate as coefficients of a specific function in the corresponding placement problems" (Nikolayev, 1971).

In turn, the solving of the optimization problems has provided an opportunity to put the research of questions concerning the direction and force of the effect of individual factors on the placement of industrial production on a qualitatively new procedural basis, as it makes it possible to examine their entire aggregate on an integral basis.

The questions of evaluating specific territorial features in the placement of production under the conditions of the scientific and technical revolution in our country have assumed ever more substantial significance. This has been due to the movement of large-scale and basically the extracting industry into new areas with extremal natural and economic conditions (the North of the European USSR, Siberia and the Far East, the desert and semidesert of Central Asia and Kazakhstan), where are concentrated the basic resources of the national predicted reserves of oil, natural gas, copper, nickel, gold and many other minerals with better mining and geological stratification conditions and higher quality.

The effect of scientific and technical progress on their use is manifested in various areas. On the one hand, the development of "regional" equipment and production methods has contributed to the more successful adaptation of industrial production in a difficult and complicated natural and economic situation. On the other hand, due to technical progress in transportation, an ever broader range of products can be involved in interregional exchange, and opportunities are increased for the spatial separation of production.

What tasks confront the economic geographers in line with the working out of economic evaluations of the placement factors in industrial production?

The variations for the placement of the productive forces, the choice of the areas for using the natural resources, and so forth are worked out, as a rule, by the sectorial and regional economic institutes. For providing compatibility of the results for the regions of the country and for alternative variations of their development, the placement factors should be considered using a uniform procedure. Because of this the economic geographer is confronted with a task that is very essential for forecasting the placement of the productive forces, that is, to work out both a procedural general concept for the evaluation as well as the immediate economic characteristics of the basic placement factors over the long run.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

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Over the long-range period, the economic evaluations of the various placement factors change substantially in line with progress in the equipment and methods of exploiting the natural resources, due to ecological restrictions on their use, to changes in the economic situations, and so forth. An elaboration of the forecast values for the indicators of the economic evaluations of the placement factors comprises the subject of the given article.

We have conducted the research using the example of placement factors related to territorial differences in natural resources (fuel-power, mineral raw material, and water). The choice of this group of placement factors has been dictated by the following considerations: In the first place, by the unity of the procedural approach to an economic evaluation of the use of multipurpose natural resources as prerequisites for the territorial division of labor; secondly for the research placement factors have been selected predominantly of interregional significance,[1] and their generalized evaluations can be used for solving problems related to the placement of industrial production on a level of interregional analysis. For increasing the homogeneity of the intraregional characteristics for the natural resources, as S. A. Nikolayev (1971) pointed out, it is essential to zone the territory specifically for these purposes in order to achieve the greatest possible homogeneity for the prerequisites of the territorial division of labor in each territorial taxonomic unit of a single level.

The essence and criteria of an economic assessment of the placement factors. It is impossible to agree with the often encountered identification between the concepts of "the measurement of any economic phenomenon in value terms" and its "economic evaluation." L. I. Mukhina (1973) has written completely correctly that "the measurement of value in the monetary form is still not an evaluation."

An economic evaluation of the placement factors should consider, in our opinion, the *territorial differences in the economic efficiency of the various types of production activities* related to the effect of one or another placement factor.

For a valid economic evaluation of the regions in terms of the impact of the placement factors on the individual aspects of industrial production, usually an indicator of the aggregate national economic calculated expenditures is employed.[2] The change in calculated expenditures reflects, although indirectly, a change in the aggregate expenditures of social labor, and the achieving of a minimum of calculated expenditures shows a maximum rise in the productivity of social labor.

The amount of the economic evaluation of the factors is determined from the difference in the calculated expenditures related to the effect of one or another placement factor. Here the amount of the calculated expenditures for which the economic evaluation of the placement factors is made, would be in an inverse relationship to the conclusions on the degree

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of suitability of a region in terms of the various placement conditions. And the difference in the calculated expenditures is an indicator of the economic gain brought by a certain placement factor.

Thus, an *economic evaluation* differs from the quantitative measurement of any phenomenon in a value form in the fact that it *is given on the basis of a comparison of the phenomena (objects) considering the criterion of economic efficiency.*

A regional differentiation in the economic evaluations is reflected in the calculated expenditures. Here for the various factors there are differences in the procedural approaches for calculating the individual expenditure elements related to one or another placement factor. This notion will be illustrated below in examining the individual factors.

Procedural approaches to the economic evaluation of placement factors. The *systems concept* is the basic procedure for evaluating the various types of natural resources as the prerequisites for the territorial division of labor. According to this concept the natural resources are viewed as interrelated elements of a certain territorial system employing them considering all the subsystems (surveying--exploration--mining--dressing--moving--use of the resources). At present real systems have developed for utilizing the resources of a varying spatial hierarchical level (for the supply of energy resources, these encompass the major macroregions of the nation due to the development of the unified transportation network, power systems and network of oil and gas lines in utilizing water resources their control and redistribution are carried out, as a rule, within the limits of the river basins).

A comprehensive approach is achieved by evaluating all the placement factors in each system using the method of marginal expenditures which make it possible to consider the functional dependence of the regions in utilizing highly efficient but restricted resources.[3] Leading scientific organizations (Central Mathematical Economics Institute of the USSR Academy of Sciences, the Siberian Power Institute, the Council for the Study of the Productive Forces under the USSR Gosplan) are engaged in working out this method, and its essence has been described in detail in the literature (Albegov, 1968[4]; "Ekonomicheskiye Problemy...," 1973; "Rukovodyashchiye Ukazaniya...," 1974; Nekrasov, 1978).

The indicators for marginal expenditures are differentiated on a territorial breakdown and in terms of the resource quality as follows:

1) The marginal expenditures in the region have the same values regardless of the source of obtaining the resource (of the same quality);

2) The interregional difference in the marginal expenditures for one or another resource in the direction of the optimum flow is determined by the expenditures on transporting it;

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

3) The difference in the evaluation of different-quality resources is determined by the amount of the effect obtained for the marginally effective consumer (for the marginal consumer the resource is utilized last and provides the least economic effect).

The method of marginal expenditures provides an evaluation of the power, raw material, water, lumber and other factors from *national economic positions*, as it makes it possible to consider the consequences of utilizing limited national resources of a given type with different variations of production placement. Thus an opportunity is created to approach an evaluation of fuel supply conditions proceeding from the place of the region in the optimum power balance of the nation. And thus an evaluation of the water factor is determined not by the expenditures on the preparation and supply of water from a specific water source, but rather is formed on the basis of the regional water management balances of the river basins considering the national economic expenditures on building the facilities of the river systems which provide the territorial redistribution of water resources.

Thus, using the method of marginal expenditures is most applicable, in our opinion, for *evaluating natural resources as placement factors for industrial production*, since the marginal expenditures provide an opportunity to compare the placement conditions of industrial production over the regions of the nation as elements of a national economic whole. But the use of the marginal expenditures and the indicators calculated on their basis (net income) is of limited value in evaluating the absolute value of the resources as such because of various natural properties, as they [the marginal expenditures] at the same time bear the load of socioeconomic factors. Thus, for evaluating the natural fertility of land, it is essential to utilize a system of indicators which consider differences in production intensification and these to a significant degree determine social labor productivity (Nikolenko, 1968; Pulyarkin, 1974).

There are also other limitations in using the marginal expenditure indicators for solving a number of placement problems. Since the evaluations of the placement factors in terms of marginal expenditures depend upon the territorial structure and the amounts of resource consumption and production, they cannot be employed for selecting the placement variations for production with significant amounts of consumption of the corresponding resources which would make substantial changes in their flows and correspondingly in the production and consumption balance. For example, the indicators for the marginal expenditures on fuel cannot be employed for selecting the placement variations of major complexes of energy-intensive production, for optimizing the basic subsystems of the power system, and so forth.

In evaluating the placement factors which are related to the use of natural resources, an *ecological-economic* approach is important and necessary for reflecting the ecological heterogeneity of using the resources in the evaluations. The resources of the different quality groups are extremely

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unequal in ecological terms. Thus, of the energy resources natural gas excels in ecological purity, while the use of coal and high-sulfur mazut involves great expenditures on environmental protection.[5] This leads to an improvement in the economic evaluations of natural gas and low-sulfur mazut. To a significant degree expenditures are differentiated on the reproduction of replaceable but qualitatively depleted water resources due to their ecological heterogeniety (the particular features of the hydrological conditions, the assimilating and diluting capacity of the water coarses). As a result it is essential to include the expenditures on ensuring an acceptable level of the effect of economic activities on the environment in utilizing the resources in the expenditures which are a measurement of an economic evaluation of placement factors.

As the criteria for the acceptable loads on such natural components as water and air, at present the maximum tolerable impurity concentrations worked out by hygienists on a level of a biological danger for the health of the population are used. In addition to this it is advisable to work out limitations for water and air of varying functional purpose (the threshold impurity concentrations an exceeding of which causes economic harm to social valuable materials or to fisheries, and so forth) as well as the indicators of the acceptable loads on other natural components (the maximum livestock loads [or concentrations] for pasture lands, the acceptable plowing up of land, and so forth). For each level of the acceptable loads on the various natural components there will be a corresponding normative minimum of conservation measures for ensuring this (the level of purification for waste water and exhaust gases, the composition of antierosion measures, and so forth).

A condition for the comparability of ecological-economic evaluations should be their conformity to the most efficient direction of conservation measures. Such a conformity is achieved by a comprehensive examination of measures relating to environmental protection for all stages through which the path of the resource passes. For example, in using coal a reduction in harmful wastes can be achieved not only in the stage of its direct utilization through the building of purification units, but also in the stage of mining and processing due to coal enrichment or gasification. The most efficient direction for the nature conservation measures is selected from the minimum of expenditures. In utilizing water resources, a reduction in the pollution level is achieved in different elements of the ecological-economic system of their utilization such as: the instruments for monitoring and controlling the pollution level, the enterprise (depending upon its water intensity, the type of utilized raw material and the method of recovering the wastes), the treatment installations and devices, and the treatment water management facilities (reservoirs for diluting waste water, structures for the storing of waste water, and devices for intensifying the processes of water self-purification).

Let us move from examining the overall procedural approaches to their regional interpretation on the basis of the energy, raw material and water factors.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

The energy factor. Let us remember that the marginal fuel of the nation is the basis for the forming of the marginal expenditures on all types of fuel and energy for which the evaluations of the energy factor are given. This is the fuel of one or several deposits which are not fully utilized in the optimum plan and are the "marginal element" in the fuel and energy balance of the nation or group of regions, that is, they take up the fluctuations which occur here in the expenditures and resources of fuel. The functions of the marginal fuel of the nation at present and over the medium term are carried out jointly by the Donets and Kuznetsk coals. In accord with the optimum balance the Ukraine and the Caucasus will be the basic zone for using the Donets power coal. In the remaining regions of the European USSR, the marginal expenditures on fuel are determined by the indicators of Donets coal; here an exception is made for the regions of the Northwest which are supplied by Pechora coal.

In the forecast period there are to be significant changes in the conditions for forming the fuel and energy balance, and the values of the evaluations of the energy factor will require an appropriate change.

An economic evaluation of the factors related to the natural resources is the result of the impact of many factors related to the natural properties of the given source of the resources as well as to the natural and economic features of the region of its location. Of these each in turn can be viewed as an independent object of study. In particular, the evaluation of the energy factor is influenced by the degree of geological study and preparation of the energy resources, by the mining and geological conditions of their stratification, by the technical possibility of mining and processing, by the expenditures on producing the fuel (energy), by the interregional fuel movements, by the structure of the energy balance and by the composition of the marginal consumers of the fuel.

Over the long run the structure of the fuel and energy balance is to change because of the curtailment of the role of oil and natural gas as a power fuel. This is related, on the one hand, to the stabilizing of oil production, and on the other, to the constantly growing demand of the national economy for them as an irreplaceable raw material for the chemical and petrochemical industry, and to the increase in the value of exporting these types of energy resources.

The change in the structure of the fuel and power balance over the long-range period will also influence the amount of the marginal expenditures on solid fuel in the regions of the European USSR. To replace the oil and gas which are withdrawn from the fuel and energy balance, here it will be necessary to expand the mining of the more expensive and poorer quality coals for energy needs. Over the longer run it will be possible to add to them the processed Kansk-Achinsk coal which can carry out the marginal functions for the entire territory of the nation, but the expenditures on this will also grow due to the enrichment and transporting (the Kansk-Achinsk coal has limitations in terms of transportability, and at present serves as the marginal fuel for large Siberian power plants).

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

In the forecast period, in evaluating the energy factor for such an energy source as heat, it will become necessary to consider the ecological demands on the quality of the employed heating resource. In the European regions there will be a significant rise in the evaluations of the energy factor for thermal energy due to the necessity of utilizing ecologically pure high quality types of fuel for which expenditures will rise over the long run (due to the extension of mining into remote and inaccessible areas), since the heat supply systems are located in the centers of production loads with a high level of environmental pollution.

Over the foreseeable future, both in the nation generally and in its European regions, the steadiest will be the marginal expenditures on electric power and correspondingly the evaluations of the energy factor for this power source. This is determined by the rise in the production rate of electric power due to the predominant building of atomic power plants which will be the marginal power plants in the European regions of the nation. In the Siberian regions, the marginal expenditures on electric power will also rise insignificantly, since the power situation will be determined by the Kansk-Achinsk coals.

In evaluating the power factor, it is essential to take into consideration that in many processes over the long-range period it will be effective to supplant such power sources as fuel and heat with electric power. The increased cost and limited opportunities for mining high quality fuel with the future high development pace of nuclear engineering and the insignificant rise in the cost of electric power show the opportunities for a significant broadening of the sphere of use of electric power. In accord with such a trend, the evaluation of the energy factor for 1990 and particularly for the year 2000 cannot be based on the energy sources presently used in the individual sectors. This must be carried out on the basis of the optimum energy source for the given sector and region.

We have made tentative calculations for the economic evaluation of the energy factor. In a general form the results of the calculations are shown in Table 1 for the two macroregions of the nation (the European USSR and Siberia). The evaluation has been given for the stages of the long-range period depending upon the nature of the energy sources and the type of fuel to be employed (the choice of this will be determined by the condition of the environment in the designated region).

The raw material factor. In an economic evaluation of the raw material factor, as a rule, it is essential to use the indicators of the corresponding *marginal raw material.*[6] At present, there has not been an optimization for the development of raw material sources for all the industrial sectors and the marginal expenditures have not been determined for the corresponding type of resource. In line with this the task has been posed of working out the procedural provisions and carrying out experimental calculations for selecting the type of marginal raw material over the long run (using the example of phosphorus production).

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

Table 1

Change in the Economic Evaluations of the Energy Factor in % (expenditures in the European USSR over the immediate future have been taken as 100%)

1 Виды энергоносителей / 2 Срок прогноза	3 Высококачественное топливо	4 Уголь	5 Электроэнергия	6 Теплоэнергия: 7 на высококачественном топливе	8 на угле
European USSR					
a) Ближайшая перспектива	100	100	100	100	100
b) Среднесрочная перспектива	160—250	120—150	110—120	180—250	not planned
c) Долгосрочная перспектива	360—500	165—175	115—125	350—500	»
Siberia					
a) Ближайшая перспектива	55—70	12—15	55—65	50—75	10—13
b) Среднесрочная перспектива	120—200	25—30	65—75	140—200	30—35
c) Долгосрочная перспектива	320—450	30—35	75—85	400—425	35—40

Key: 1--Types of energy sources; 2--Forecast period; 3--High quality fuel; 4--Coal; 5--Electric power; 6--Thermal power; 7--From high quality fuel; 8--From coal; a--Short-term; b--Medium-term; c--Long-term.

The ascertaining of the deposits of the marginal raw material in methodological terms should be based upon a comprehensive examination of reproduction in the corresponding sector as a whole, that is, it is essential to consider the expenditures in all stages of using the raw material (mining--transporting--refining--consumption). This is caused by the fact that the choice of the deposits of the marginal resource depends not only upon the facility of the mining conditions and the possible productivity, but also upon the location in relation to the regions of its optimum processing.

The realization of this principle is achieved by the *joint optimizing of two subsystems: mining of the raw material and its processing*. Thus, the sequence of developing the deposits of phosphorus-containing raw materials can be established economically only together with an optimization of the placement of basic production, that is, yellow phosphorus (with the given amounts of demand for the raw material). The solving of this problem includes three stages.

In the first place, of the 150 examined deposits of phosphorus-containing raw materials, only nine deposits were selected which met the quality and quantity requirements of modern production (Table 2). Their choice was influenced by the degree of study, the level of preparation, the mining

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

and geological conditions for the stratification of the deposits, the economic indicators and the possible mining level.

Table 2

Comparison of Deposits of Phosphorus-Containing Raw Materials in Terms of the Economic Indicators for Mining and the Development Sequence as Established in the Process of Optimizing the Location of Phosphorus Production (according to calculations of the authors)

Ranking of Deposits (by economic indicators of mining)	Sequence of Utilizing Deposits Established in the Process of Optimizing Placement of Phosphorus Production
1. Yeno-Kovdorskoye	1. Beloziminskoye
2. Beloziminskoye	2. Yeno-Kovdorskoye
3. Khibinskoye	3. Kara-Tausskoye
4. Aktyubinskoye	4. Khibinskoye
5. Kara-Tausskoye	5. Belkinskoye
6. Telekskoye	6. Vyatsko-Kamskoye
7. Belkinskoye	7. Oshurkovskoye
8. Oshurkovskoye	8. Telekskoye
9. Vyatsko-Kamskoye	9. Aktyubinskoye

Secondly, the transport expenditures were determined over the long run for delivering the phosphorus-containing raw materials to the regions of the possible location of enterprises involved in processing it following the shortest routes the search for which was carried out by the authors using a Ford algorithm.

Thirdly, in accord with the selected deposits, an optimization was made for the placement of phosphorus production, and in the process of this more than 300 placement variations were examined in 18 basic economic regions of the nation on the basis of utilizing the raw materials of the nine selected deposits.

As a result of an analysis of the variation calculations in accord with the forecasted demand for phosphorus containing raw materials, a sequence was established for the use of the raw material sources, and over the long run the marginal deposits of phosphorus raw materials were determined with the corresponding expenditures on the marginal resource with the present level of geological study. The marginal expenditures in the regions of the optimum processing of phosphorus-containing raw materials will have the following values over the medium term: 25-26 rubles per ton of 100 percent phosphorus oxide in Eastern Siberia and 27-33 rubles in Kazakhstan.

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

The water factor. The basis for the economic evaluation of the water factor is the *marginal expenditures on water* in the region, point, and so forth.[7] The significance of the latter have been worked out by the Council for the Study of the Productive Forces under the USSR Gosplan and are given in the literature (Podol'skiy, 1973; Yegorov et al., 1973). The numerical values of the marginal evaluations for water are calculated per unit of the rise in the available resource of the water system with the completion of the marginal water project. The values of the marginal expenditures on water vary from 0.1 kopeck per cubic meter (Siberia) up to 17 kopecks per cubic meter (Central Asia). Over the long run their extremal values in the deficient water management regions of the USSR such as the south of the European USSR, Kazakhstan and Central Asia, can reach 40 kopecks per cubic meter. This is related to a rise in water consumption by the national economy and the necessity of building new, less economic projects (Levin, 1973).

An economic evaluation of the water factor, in addition to the amount of the marginal expenditures, depends also upon the volume of water consumption by the corresponding production, the demands made upon the quality of the employed water, the composition of the industrial waste water and the degree of their pollution, as well as upon the range of treatment measures and the dilution factor of the waste water to the maximum acceptable concentrations of harmful substances. Here the evaluation depends upon a number of variables related to the nature of industrial production and which determines the water intensiveness of the product and the volume and composition of the waste water. For this reason the economic evaluation of the water factor is best measured per ton of produced product. If the evaluation is calculated per unit of resource, then it will reflect only the variables related to the nature of the water course (its supply and quality).

How can the volume of water consumption be determined? This exists not only of the irrecoverable consumption of water resources, but also of the entire volume of fresh water which is influenced by production activities. Consequently, in determining the volume of the consumed fresh water it is essential to consider its expenditure on the dilution of waste water purified by modern methods. With the present level of technology, for a majority of types of production, as a rule, there must be an amount of fresh water that is 12-15 times greater (and significantly more for a number of types of production) to be used for diluting the waste water to provide the achieving of the required standard quality of surface water, since the existing hygienic maximum acceptable concentrations in terms of ingredients at present are unattainable economically and technically.

Due to the regional differences in the hydrological conditions and the assimilating capacity of the water course, there must be a differentiated approach to determining the amount of fresh water to be used for dilution. In regions with a large amount of water available, for example in Siberia, the required water quality is achieved by the repeated diluting of the

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

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waste waters in large river arteries. In the central and southern regions of the European USSR, due to the small capacity of the water courses and because of their high pollution load, there must be additional regulating of the water sources for diluting the water or diverting the waste water into storage capacity (for a series of sectors in the metallurgical and chemical industries).

The following calculation formulas are proposed for an economic evaluation of water resources. In locating enterprises in regions with a taut water management balance:

$$E_{\Sigma} = (p - r)S_w + E_t + E_d + \alpha \cdot r \cdot S_w. \quad (1)$$

In locating the enterprises in regions with a surplus water management balance:

$$E_{\Sigma} = (p - r)S_w + E_t + E_d, \quad (2)$$

where E_{Σ}--aggregate expenditures on water, rubles (calculated per ton of product);
p--the volume of required fresh water, m^3/ton of product;
r--recovery of normally purified water, m^3/ton of product;
S_w--marginal expenditures on water in source, kopecks/m^3;
α--dilution factor of diverted waste water;
E_t--expenditures on treating waste water, rubles/ton of product;
E_d--expenditures on diverting waste water, rubles/ton of product.

The economic evaluation of the water factor is formed from the expenditures on the unrecoverable consumption of fresh water in the production process and the water conservation expenditures the consideration of which is particularly essential for water resources due to their specific feature of repeated use. The last term in the calculation formula (1) considers expenditures on the control of water resources for the diluting of insufficiently treated courses by fresh water. Such a differentiated approach to evaluating the water factor proceeds from the fundamental regional differences in the water management balances and makes it possible to consider the increased expenditures on maintaining the purity of rivers in the densely populated water-scarce regions of the European USSR.

Thus, an analysis of the influence of different variables on the amount of the economic evaluations of placement factors for industrial production makes it possible to determine for the forecast period the trends in the change of their values which are extremely differentiated in a space-time aspect.

FOOTNOTES

[1]It is essential to note a certain conditionality in the discussed group of placement factors. Thus, the water factor has been considered by us

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200040040-1

as an interregional one considering not only the quantitative but also the qualitative depletion of water resources.

[2]The amount of the calculated expenditures (E) is the total of the operating expenditures (O) and deductions from capital investments (K) proportional to the standard efficiency coefficient (P_n): $E = O + P_n \cdot K$. Everywhere below in the text expenditures are understood to be calculated expenditures.

[3]In a number of the sectorial procedures it has been proposed that the evaluation be made for placement factors characterizing the conditions for utilizing limited national resources in terms of the direct expenditures on a specific type of utilized resource. The basic drawback of thi this method is that the evaluation of the designated factors is approached without considering the specific factors in the use of the designated resources, that is, their limitation at the corresponding point, region, and so forth, and the varying degree of effective use by numerous consumers.

[4]As a result of interregional exchange the use of a cheap but limited resource in one region inevitably causes an increase in other regions in the use of less favorable and expensive substitute resources the exploitation of which is required by the conditions of the production and consumption balance of the corresponding group of resources, that is, for the so-called marginal resource. The marginal projects can be the less economic deposits of fuel and mineral raw materials which have poorer mining conditions, the more distant forested areas, and water facilities which supply the balance in a water management region.

[5]For example, for each 0.5 percent reduction of the sulfur content in coal and high-sulfur mazut, enrichment must be carried out and this increases the cost of the fuel by 3 rubles per ton.

[6]In the instance when the mined resource does not enter into regional exchange and is supplied only to one industrial complex the needs of which determine its development, the resource should be valued by the direct expenditures on its mining and transportation (for example, for the enterprises of the cement, soda and chlorine industries).

[7]Only in regions with a surplus water management balance is it possible to evaluate the water resources in terms of the direct (actual) expenditures on the preparation and supply of the water.

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