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REGIONAL VARIATIONS OF LABOR PRODUCTIVITY IN THE USSR  
FUEL AND METALLURGICAL INDUSTRIES

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There is no direct method of calculating labor productivity by means of quantitative measurement of dissimilar production. All existing methods (gross production, net production, and the index method) reflect, not the level of labor productivity, but rather its dynamics; and all these methods are far from being perfect. However, the level of labor productivity can be measured by: (1) the individual productivity of workers in branches of industry engaged in similar production; and (2) production expenditures and especially production cost which is the most important part of production expenditures.

Let us consider in a regional cross section the productivity of workers and production costs of the most important branches of industry engaged in similar production. We shall consider the fuel and metallurgical industries, the production cost of which exercises a decisive influence on the production cost in industry as a whole.

Coal

Before the war, labor productivity in the new coal basins of the Eastern USSR was from 40 to 83 percent higher than the average for the USSR coal industry and from 1,5 to 2 times higher than in the Donets Basin. Higher productivity of labor in the eastern regions determines the lower production cost of coal in these regions. In 1940 the cost of coal extraction in the eastern regions constituted from 58 to 71 percent of the average production cost of coal in the Soviet Union and was substantially lower than in the Donets Basin.

In the postwar period the difference in the level of labor productivity of the new and old coal fields of the USSR became even more pronounced. The production cost of the Donets coal is considerably higher than that of the eastern regions, in spite of the fact that in 1940 the Council of Ministers USSR, taking into account the severe working conditions in the Urals, Siberia, and the Far East, increased by 20 percent the wages of workers and engineering-technical personnel engaged in the coal, ore, petroleum, and metallurgical industries, and in construction, loading and unloading work in those regions.

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One factor influencing the difference in labor productivity and production cost of the old and new coal fields is the technological factor. Most of the eastern coal fields were started during the Soviet period and are being exploited with up-to-date machinery, while in the Donets Basin the application of modern machinery is limited by the character of mines inherited from the prerevolutionary period.

Another factor influencing labor productivity and production cost in coal mining is the way in which coal seams occur in the various regions. In most of the eastern coal fields the coal seams occur close to the surface. Thus, the depth of occurrence of Kuznetsk coal mined during the prewar period fluctuated between 100 and 200 meters and averaged 150 meters. Karaganda coal is mined at a depth of 65-100 meters. Coal of the Cherekhovo Basin, which is the principal fuel base of Eastern Siberia, is mined almost exclusively by the open pit method since the coal, as a rule, occurs at a depth of 25 meters. In the Donets Basin, on the other hand, coal was mined during the prewar period at a depth of 200 to 800 meters, averaging 450 meters. The occurrence of coal at shallow depths in the eastern deposits accounts for their lower production cost, since expenditures on coal transport, maintenance of surface structures, and ventilation are lower.

Coal mining in eastern deposits is also made easier by the great thickness of the coal seams and heavy concentration of coal in small areas. Thus, the thickness of coal seams in the Kuznetsk Basin attains 12 to 14 meters and averages 4 meters, while the highest thickness of the Donets coal seams is only 1.5-2 meters and averages 0.95 meter. The average thickness of seams in the Karaganda Basin is 2.31 meters. The coal-bearing coefficient in the Karaganda and Kuznetsk coal basins is also considerably higher than in the Donets Basin. In the Kuznetsk Basin that coefficient is as high as 7 percent and sometimes even 12 percent, and in the Karaganda Basin it averages 4.65 percent, as compared to an average of 0.64-0.68 percent in the Donets Basin.

Furthermore, the eastern coal basins are characterized by the presence of abruptly-falling layers the mining of which requires a lesser expenditure of labor.

When all these factors are taken into account, the relative labor productivity in the principal coal basins of the USSR can be represented in the following table:

<u>Basins</u>	<u>Labor Productivity</u>
Donets	100.0
Kuznetsk	120.0
Karaganda	111.4
Cherekhovo	180.0
Kizel	114.3

In arriving at these figures, the thickness of the seams in the eastern coal deposits have not been taken fully into account. Recent experiments have shown that it is possible to mine thick seams without casing (zrkladochnyye raboty). Under these conditions, productivity of labor in the Kuznetsk and Karaganda Basins should be even higher than is indicated in the table.

An important factor in estimating the economic advantages of the new coal regions is the value of capital investment per ton of coal. In the past capital investments in the eastern coal regions were higher than in the coal mines already in operation. In the east these investments included not only expenditures for the construction of mines, but also outlay on housing, transport, municipal construction, and cultural establishments. Furthermore, the

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mining of thick seams in the Kuznetsk basin was carried on by means of casing work, which increased capital investment by about 30 percent on the average. However, recent technological advances make it possible now to dispense with casing, and capital investment per ton of coal in the eastern coal fields will be considerably lower than in the Donets Basin. All available data relating to capital investment, productivity of labor, and cost of production point to the conclusion that, of all the coal regions in the USSR, those in the east have the greatest advantages from the point of view of labor economy and higher productivity.

Into the total cost of coal enters not only cost of mining, but also cost of delivery to the consumer. When considered from this angle, the economic advantages of the eastern coal regions will be seen to be even greater than advantages accruing from the higher level of labor productivity and lower production costs. In the eastern regions the development of industry, and of the coal industry in particular, brings the producer closer to the consumer and reduces coal transportation expenditures. Computations made before the war established that economy in railroad transport resulting from the development of local coal fields amounted in 1937 to 15.75 billion ton-kilometers, which in monetary terms amounted to 300 million rubles.

#### Petroleum

The economic consequences of the development of petroleum industry in the eastern regions of the USSR is no less notable. Delivery of petroleum and petroleum products from the Urals and the Volga has resulted in enormous transportation savings.

The central regions of the USSR are among the largest consumers of the petroleum which is shipped from Azerbaydzhan and the Urals. The comparative cost to the consumer of petroleum shipped in 1941 from the two areas is illustrated in the following table (in rubles):

<u>Route</u>	<u>Production Cost per Ton</u>	<u>Transportation Cost per Ton</u>	<u>Cost to Consumer</u>
Baku-Moscow	16.6	76.0	92.6
Groznyy-Moscow	25.8	58.0	83.8
Chernikovka-Moscow	24.1	46.0	70.1
Syzran-Moscow	39.7	27.0	66.7
Groznyy-Gor'kiy	25.8	58.0	83.8
Chernikovka-Gor'kiy*	24.1	38.0	62.1

\*Chernikovka is the shipping point for the Ishimbay petroleum.

The cost of Baku petroleum in Moscow is 92.6 rubles per ton. If Baku petroleum is shipped by water to Astrakhan' and Yaroslavl' and then by rail to Moscow, the cost per ton is 81.2 rubles; when shipped by water to Astrakhan' and then by rail to Moscow, the cost per ton of Baku petroleum is 78.9 rubles.

#### Ferrous Metallurgy

Before the revolution, Russia's principal metallurgical base was in the Ukraine. The development of ferrous metallurgy in the eastern regions of the USSR was attended by a number of difficulties arising from conditions peculiar

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to those regions. The distance between the coal and iron ore deposits in the east is considerably greater than in the Ukraine. Thus, the Kuznetsk coal basin is about 2,300 kilometers removed from the Magnitogorsk iron ore deposits, while in the Ukraine the distance between the coal and iron ore deposits averages 500-600 kilometers. However, in spite of this disadvantage the cost of metal produced at the Magnitogorsk, Kuznetsk, and Novo-Tagil' plants is lower, and the productivity of labor higher than in the Ukrainian plants, as shown in the following table:

<u>Name of Plant</u>	<u>Labor Productivity</u>		<u>Cost of Pig Iron</u>	
	<u>1940</u>	<u>1948</u>	<u>1940</u>	<u>1949 (3d qu)</u>
Urals				
Magnitogorsk Plant	100.0	100.0	100.0	100.0
Novo-Tagil' Plant	-	81.0	-	136.8
West Siberia				
Kuznetsk Plant	84.9	89.8	125.2	104.0
Ukraine				
Krivoy Rog Plant	56.7	-	160.7	} av 170.1
Azovstal' Plant	46.6	36.8	159.8	
Plant imeni Kirov	69.9	42.2	158.9	
Plant imeni Dzerzhinskiy	25.3	25.5	152.1	
Plant imeni Petrovskiy	25.1	20.3	156.7	

The Table shows that both in the prewar and postwar periods the productivity of labor in the new plants constructed during the Soviet period greatly exceeded that of the Ukrainian plants, and that the discrepancy between labor productivity and production costs in the Ukrainian plants became even wider than that in the eastern plants, in the postwar years.

The higher productivity of labor in the eastern metallurgical plants, as compared with those in the Ukraine, is to be explained by the higher technological level. The Magnitogorsk plant has the lowest production costs. This is due primarily to the exceptionally low cost of the iron ore which the plant is using. The ore of the Magnitogorsk deposit occurs in thick seams and is mined by the open pit method. Magnitogorsk ore is about 3 times as cheap as the Krivoy Rog ore; while the agglomerate of the Magnitogorsk ore, which the Magnitogorsk plant is utilizing principally at present, is about 2.5 times as cheap as the Krivoy Rog agglomerate.

The cost of coke used at the Magnitogorsk plant is also cheaper than the Ukrainian coke. To be sure, transportation charges for shipping Kuznetsk and Karaganda coal to Magnitogorsk are relatively high, and in 1940 they amounted to 25 rubles per quantity of coal required for the production of one ton of pig iron. The same charges for delivery of coal to the Dnepr and Krivoy Rog plants amounted to 5-7 rubles, and in the case of the Kuznetsk plant imeni Stalin and the Donbass metallurgical plants which are located close to coal deposits, coal transportation charges were only 2-3 rubles. However, the higher transportation charges for the Kuznetsk and Karaganda coals are compensated for by their lower production cost, which in turn lowers the cost of Kuznetsk and Karaganda coke.

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Furthermore, Kuznetsk coal is of high quality and has a lower sulfur content than the Donets coal; hence, the quality of Kuznetsk coke is also higher and its expenditure per ton of steel is lower in the eastern metallurgical plants than in the Ukraine.

High-grade ore and coke require smaller amounts of flux than do low-grade ore and coke. Furthermore, Magnitogorsk has the lowest production cost of limestone in the Soviet Union.

Savings in the cost of ore, coke, and fluxes, together with the smaller quantities required, more than compensate for the higher transportation charges incidental to the shipment of coal to the Magnitogorsk plant. Raw material expenditure per ton of pig iron at Magnitogorsk is 1.5 times lower than in Ukrainian plants. Furthermore, owing to superior technology, large-scale units, and high labor productivity, the cost of pig iron reduction at the Magnitogorsk plant is considerably lower than in the Ukrainian plants. Even in the new metallurgical plants constructed in the Ukraine during the Soviet period, the cost of pig-iron reduction is almost twice as high as in the eastern plants.

The cost of pig iron at the Kuznetsk plant -- another metallurgical giant of the Eastern USSR -- is higher than at the Magnitogorsk plant, but is lower than in the Ukrainian plants. This is to be explained by the following circumstances. The smelting of one ton of pig iron requires more iron ore than coal (approximately 1.1-1.2 tons of coal but not less than 2 tons of ore). Therefore, all other things being equal, transportation charges for shipping iron ore to a metallurgical plant will always be higher than for shipping coal. Before the war, the Kuznetsk plant used Magnitogorsk iron ore almost exclusively, and in 1940, for example, transportation costs per quantity of iron ore needed to produce one ton of pig iron amounted to 65 rubles. On the other hand, transportation costs of Kuznetsk coal needed to produce one ton of pig iron at the Magnitogorsk plant was only 25 rubles. The high shipping costs of iron ore made the Kuznetsk mixture more expensive than that of the Ukrainian plants.

At present, however, the Kuznetsk plant is using iron ore mined locally at the Gornaya Shoriya deposits. But the cost of mining here is relatively high, on account of the smallness of the deposits and the unfavorable occurrence of the ore. Furthermore, the Gornaya Shoriya ores, with the exception of those mined at the Tashtagol'sk deposit, require concentration. Therefore, the cost of the mixture at the Kuznetsk plant is even now relatively high, although the local ore and its agglomerate are less expensive than the ore shipped from Magnitogorsk. The high cost of ore, however, is more than compensated for by the low cost of Kuznetsk coal. Thus, in 1940 the price per ton of Kuznetsk coke amounted to 47.8 rubles, while the Donets coke used in the Donbass plants cost 67 rubles and in the Dnepr plants 76.9 rubles. Similar price relationships prevail at present. The high quality and low cost of the Kuznetsk coke, together with the low cost of pig iron reduction, result in a lower cost of pig iron at the Kuznetsk plant than at plants in the Ukraine.

The cost of steel is similarly subject to the operation of the above-mentioned factors. The cost of steel is lowest at Magnitogorsk and Kuznetsk plants. In the Ukrainian plants the cost of steel is higher, although not to the same extent as pig iron. This is explained by the larger proportion of iron and steel scrap used in the Ukrainian open-hearth furnaces, as compared with the eastern plants, and the fact that the price of scrap is lower than that of pig iron smelted in Ukrainian plants.

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