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Volume Title: Growth of Industrial Production in the Soviet Union

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Volume Publisher: UMI

Volume ISBN: 0-87014-074-4

Volume URL: <http://www.nber.org/books/nutt62-1>

Publication Date: 1962

Chapter Title: Aggregative Growth Trends: Analysis

Chapter Author: G. Warren Nutter

Chapter URL: <http://www.nber.org/chapters/c1977>

Chapter pages in book: (p. 162 - 183)

CHAPTER 6

Aggregative Growth Trends: Analysis

HAVING made our production indexes, we turn now to analyze what they convey about the course of Soviet industrial growth.¹ In this chapter, we shall provide only a broad sketch, to be filled in more fully in the next one. Should it need repeating, we may say again that the qualifications spelled out in earlier chapters should remain constantly in the background, to dull the edge of deceptively sharp figures.

It is also worth re-emphasizing that broad indexes of production are, under the best of circumstances, only one kind of evidence useful for assessing growth trends. Their usefulness is more limited in the Soviet case than ordinarily because of the questionable reliability of Soviet data, the swift and radical changes that have taken place in the Soviet economy over the last thirty years, and the divergences among growth rates in different sectors. This is to say that the discussion that follows supplements rather than supplants what has come before.

Trends in Production

VARIATIONS IN GROWTH RATES OVER TIME

Average annual growth rates from moving-weight indexes are gathered together for different periods in Table 35. Certain relations hold among these growth rates no matter which production index is used. First, the rate is significantly higher for 1928–1955 than for 1913–1955. This is a trivial observation, since it has been made abundantly clear that there was virtually no growth in over-all production between 1913 and 1928. Second and much less obviously, the growth rate shows a decline between 1928–1940 and 1940–1955 and between 1928–1937 and 1950–1955, both relations suggesting a tendency for growth to retard during the Plan period.

In thinking about trends, one naturally wonders how the Soviet pace of industrial growth compares with the Tsarist pace.^{1a} The statistical record for the Tsarist period is, unfortunately, poor, and it is difficult to make any confident judgments on the reliability of such data as have

¹ Recall that industry is taken to include manufacturing, mining, logging, fishing, and generating of electricity.

^{1a} For an enlightening discussion of industrial development in the Tsarist period, see Alexander Gerschenkron, "The Rate of Industrial Growth in Russia since 1885," *The Tasks of Economic History*, Supplement VII to *Journal of Economic History*, 1947, pp. 144–174.

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TABLE 35
 AVERAGE ANNUAL GROWTH RATES OF INDUSTRIAL PRODUCTION:
 SOVIET UNION, SELECTED PERIODS, 1913-1955
 (per cent)

	Industrial Materials	Finished Civilian Products	All Civilian Products	All Products
1913-1955	4.0	3.7	4.3	4.4
1913-1928	0.1	-0.1	0.1	0.1
1928-1955	6.2	5.9	6.6	6.9
1928-1940	8.0	7.1	8.5	9.9
1940-1955	4.7	4.9	5.1	4.6
1928-1937	9.6	10.3	11.2	12.1
1950-1955	9.0	9.3	7.7	9.6

SOURCE: Moving-weight indexes, Table 30. Current territory except 1913, which covers interwar territory. Average annual growth rates calculated from data for terminal years by the compound interest formula.

been recorded. Production indexes have been constructed, perhaps the best known being the one made by Kondratiev in the 1920's.² If that index is revised to conform with the present Western methods of constructing production indexes and extended backward from 1885 through 1860, it shows an average annual growth rate of about 5.3 per cent applying to the last half century—and even the last quarter century—of the Tsarist period (see Table 36). A recomputation of the index directly from primary sources by Raymond Goldsmith and Israel Borenstein leads to virtually the same result, while a production index for industrial materials with 1913 weights shows a higher growth rate over 1860-1913 but about the same rate over 1885-1913.

It must be stressed that these indexes for the Tsarist period rest on a weak and unverifiable foundation, in terms of both the sample of industries covered and the reliability of the data.³ All this is to argue that these indexes cannot be considered as reliable as, say, those for the late nineteenth century in the United States, if only because there was nothing in Tsarist Russia to correspond with the periodic U.S. censuses. With this

² *Ekonomicheskii biulleten'* [Economic Bulletin], 1926, No. 2, pp. 17-21; discussed in detail by Ia. P. Gerchuk in *Voprosy koniunktury* [Problems of the Economic Situation], Moscow, 1926, Vol. II, Issue 1, pp. 79-95. This and the other indexes in Table 36 are discussed briefly in technical note 5 of Appendix A.

³ Our index covers the following numbers of industries: 1860-1880, fourteen; 1880-1885, fifteen; 1885-1888, sixteen; 1888-1895, twenty-one; 1895-1900, twenty-two; 1900-1910, twenty-five; and 1910-1913, twenty-three.

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TABLE 36

INDEXES OF INDUSTRIAL PRODUCTION: TSARIST RUSSIA, BENCHMARK YEARS, 1860-1913

	Revised Kondratiev Index	Borenstein-Goldsmith Index	Industrial Materials Index
	INDEX (1913 = 100)		
1860	9.0	8.8	5.7
1865	7.1	7.5	4.3
1870	11	11	6.4
1875	15	14	9.9
1880	19	18	13
1885	23	24	19
1888	25	26	23
1890	29	32	25
1895	40	44	39
1900	59	63	59
1905	61	61	60
1910	84	86	78
1913	100	100	100
	AVERAGE ANNUAL GROWTH RATE (PER CENT)		
1860-1880	3.9	3.6	4.2
1870-1890	5.0	5.5	7.1
1880-1900	5.8	6.5	7.9
1890-1910	5.5	5.1	5.9
1900-1913	4.1	3.6	4.1
1870-1913	5.3	5.3	5.4

SOURCE: Table A-19. Covers current Tsarist territory excluding Finland. For 1913, output of industrial materials (col. 3) in Tsarist territory is 118 per cent of output in interwar Soviet territory. Average annual growth rates calculated from data for terminal years by the compound interest formula.

reservation in mind, we note the average annual growth rate over 1870-1913 was higher than over 1913-1955 and lower than over 1928-1955, though the rate over 1880-1900 is very close to the latter, particularly if territorial gains are eliminated (see Table 38).

INDUSTRIAL STRUCTURE OF GROWTH RATES

Rates of growth have differed substantially among the various sectors of Soviet industry as well as over time (see Table 37 and Chart 15). Dividing the civilian component of industry into ten industrial groups, we find average annual growth rates ranging from 2.3 per cent (food and allied products) to 12.9 per cent (consumer durables) over the entire Soviet period, or from 3.3 per cent (textiles and allied products) to 18.7 per cent (consumer durables) over the Plan period. If these ten groups are further condensed into three major categories, we find the following average

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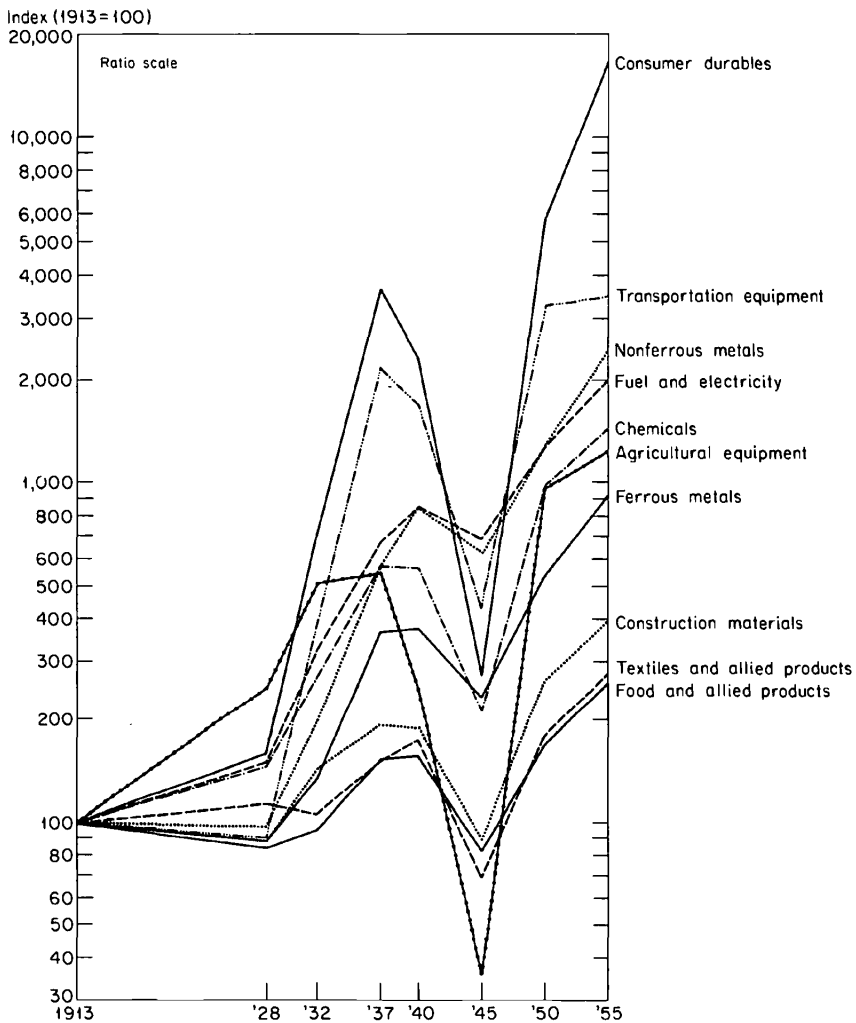
TABLE 37
 AVERAGE ANNUAL GROWTH RATES OF INDUSTRIAL PRODUCTION, BY INDUSTRIAL GROUP:
 SOVIET UNION, SELECTED PERIODS, 1913-1955
 (per cent)

	1913-1955	1913-1928	1928-1955	1928-1940	1940-1955	1928-1937	1950-1955
All products	4.4	0.1	6.9	9.9	4.6	12.1	9.6
All civilian products	4.3	0.1	6.6	8.5	5.1	11.2	7.7
Intermediate products	5.5	0.5	8.4	11.9	5.6	15.0	9.0
Ferrous metals	5.4	-0.8	9.0	12.8	6.1	17.1	11.2
Nonferrous metals	7.9	-0.2	12.7	19.8	7.2	21.7	13.2
Fuel and electricity	7.4	2.7	10.1	15.5	5.9	18.0	9.6
Chemicals	6.5	2.6	8.8	11.9	6.3	16.4	7.7
Construction materials	3.3	-0.8	5.7	6.6	5.1	9.1	8.5
Civilian machinery and equipment	8.4	2.4	11.9	18.9	6.7	31.0	2.6
Transportation equipment	8.8	-0.7	14.5	27.7	4.9	42.3	1.2
Agricultural machinery	6.2	6.3	6.1	-0.1	11.3	9.0	5.1
Consumer goods	2.6	-0.2	4.2	4.8	3.7	5.5	10.0
Food and allied products	2.3	-1.2	4.3	5.3	3.4	6.9	8.9
Textiles and allied products	2.4	0.8	3.3	3.7	3.1	3.3	9.0
Consumer durables	12.9	3.1	18.7	25.0	14.0	41.8	23.1

SOURCE: Tables 17 and 35. Current territory except 1913, which calculated from data in terminal years by the compound interest covers interwar Soviet territory. Average annual growth rates formula.

AGGREGATIVE GROWTH TRENDS:

CHART 15
 Indexes of Industrial Production, by Industrial Group:
 Soviet Union, Benchmark Years, 1913-1955



Source: Table 17, moving weights.

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annual growth rates for the entire Soviet period and the Plan period, respectively: intermediate industrial products, 5.5 and 8.4 per cent; civilian machinery and equipment, 8.4 and 11.9 per cent; and consumer goods, 2.6 and 4.2 per cent. These data merely confirm what was observed at an earlier point through the study of frequency distributions of growth rates for individual industries.

Although aggregate output increased very little between 1913 and 1928, the growth record varied considerably from one segment of industry to another. At one extreme, the average annual growth rate for agricultural machinery over this period was somewhat higher than it was over the Plan period. Output grew on the average in the cases of agricultural machinery, consumer durables, fuel and electricity, chemicals, and textiles and allied products. It declined in the cases of food and allied products, ferrous metals, construction materials, transportation equipment, and nonferrous metals.

The growth rate declined between 1928–1940 and 1940–1955 in the case of every industrial group except agricultural machinery, which showed an exceptional performance here as well. Similar declines are observed between 1928–1937 and 1950–1955 except for food and textiles, in which cases the growth rate rose. This pattern indicates that the retardation in growth recorded for all industry has been widely diffused through industrial segments.

INDUSTRIAL GROWTH AND TERRITORIAL EXPANSION

During and after World War II, the Soviet Union acquired the Baltic countries, about half of Poland, a part of Rumania, and some other scattered regions. Territory was expanded by about 700 thousand square kilometers (an area larger than France), and population by more than 20 million people as of 1939. The enlarged territory slightly exceeds in area the prerevolutionary territory; on the other hand, the population in 1913 was smaller within the post-1939 territory than within the prerevolutionary territory—159 million as opposed to 166 million.

It is impossible to make an accurate and precise measurement of the industrial gains realized from territorial expansion as of any specific date after 1939. The economic gains were resources that could be employed in a variety of uses, and the specific forms of those resources when acquired merely set temporary limits on their uses. By the nature of the problem, however, about the only way we can measure industrial gains is in terms of acquisitions of existing industrial resources. Ultimate gains will be understated to the extent that acquired areas have since been

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industrialized more rapidly out of their "own" resources than the rest of the Soviet Union, or overstated to the extent that they have been industrialized less rapidly. We do not have the data needed to shed light on matters of this sort, and it is doubtful that we could say anything very satisfactory under the best of circumstances.

If we keep these qualifications in mind, we may estimate very roughly the industrial gains from territorial expansion. In the first place, we may calculate the relative importance of industrial production in the acquired territories at the time of acquisition. The latest satisfactory date, from the point of view of both normalcy of conditions and availability of data, is 1937. In that year, the production of industrial materials (fifty products) was 6 per cent larger in the expanded territory than in the interwar territory when measured in 1928 prices,⁴ and 10 per cent larger when measured in 1955 prices. These figures understate gains for two reasons: first, because they do not fully reflect small-scale production in the acquired territories; and second, because by 1937 those territories had not fully recovered from the Great Depression.

Another approach is to calculate the relative share of industrial production accounted for by the territories lost after the Communist revolution, since, as mentioned above, these areas are in some respects roughly equivalent to those gained during and after World War II. The production of industrial materials (thirty-seven products) in those lost territories was in 1913 about 18 per cent of production within interwar boundaries, when measured in 1913 prices. This figure may also be an understatement in that small-scale production in the lost territories is not fully included.

It is perhaps reasonable to take the geometric average of these three estimates, or 11 per cent, as a rough measure of the increase in industrial production attributable to territorial expansion. On an average annual basis the percentage increase would be as follows: 0.3 per cent for 1913-1955; 0.4 per cent for 1928-1955; and 0.9 per cent for 1928-1940. Growth rates in production adjusted for territorial changes are given in Table 38.

INDUSTRIAL GROWTH AND POPULATION

The discussion of industrial growth in this chapter has been, up to this point, entirely in terms of raw growth rates, unadjusted for growth in population. For some purposes, it is useful to express growth in per

⁴ This estimate is identical with Naum Jasny's estimate for 1940. See his *The Soviet Economy during the Plan Era*, Stanford, 1951, p. 22. Our estimates are explained in Table D-1, notes *c* and *d*.

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TABLE 38

AVERAGE ANNUAL GROWTH RATES OF INDUSTRIAL PRODUCTION ADJUSTED FOR TERRITORIAL EXPANSION AND POPULATION GROWTH: SOVIET UNION, SELECTED PERIODS, 1913-1955 (per cent)

	<i>Production Adjusted to Constant Territory^a</i>				<i>Per Capita Production^b</i>			
	Industrial Materials	Finished Civilian Products	All Civilian Products	All Products	Industrial Materials	Finished Civilian Products	All Civilian Products	All Products
1913-1955	3.7	3.4	4.0	4.1	3.1	2.8	3.4	3.5
1913-1928	0.1	-0.1	0.1	0.1	-0.5	-0.7	-0.5	-0.5
1928-1955	5.8	5.5	6.2	6.5	5.1	4.9	5.5	5.8
1928-1940	7.0	6.1	7.5	8.9	5.5	4.7	6.1	7.4
1940-1955	4.7	4.9	5.1	4.6	4.7	4.9	5.1	4.6
1928-1937	9.6	10.3	11.2	12.1	8.5	9.2	10.1	11.0
1950-1955	9.0	9.3	7.7	9.6	7.2	7.5	5.9	7.8

SOURCE: Tables 35 and C-3. For effects of territorial expansion, see text surrounding this table.

^a Average annual growth in production attributable to territorial expansion is taken as: 0.3 per cent for 1913-1955; 0.4 per cent for 1928-1955; and 0.9 per cent for 1928-1940. Average annual growth rates calculated from data for terminal years by the compound interest formula.

^b Derived from unadjusted production and population. Average annual growth in population is taken as 0.9 per cent for 1913-1955; 0.6 per cent for 1913-1928; 1.0 per cent for 1928-1955; 2.3 per cent for 1928-1940; -0.0 per cent for 1940-1955; 1.0 per cent for 1928-1937; and 1.7 per cent for 1950-1955.

capita terms, particularly when one is interested in relating growth in output to growth in productive capacity.

Population is sometimes, however, a very poor indicator of productive capacity. At least during the interwar years of the Soviet period, a sizable fraction of the population was, for all practical purposes, economically unproductive: reducing the labor force in some sectors of the economy—especially agriculture—probably caused no perceptible reduction in output. This meant, for example, that the great loss of population through starvation in the 1920's and 1930's probably had the paradoxical result of increasing the concurrent per capita output: there were fewer mouths to feed and fewer bodies to clothe, so to speak, without a commensurate reduction in utilized productive capacity. We must also note that Soviet population statistics are of doubtful reliability for much of the Soviet period.⁵ Under such conditions, there are obvious difficulties in interpreting the meaning of per capita growth rates.

⁵ Full demographic details were last published in connection with the population census of 1926, though it appears more information than usual will be made public on the census of 1959. The census of 1937 was declared faulty by Stalin, and most of the

AGGREGATIVE GROWTH TRENDS:

Despite these difficulties, the picture of industrial growth would be incomplete without relating it to population, as is done in Table 38. As would be anticipated, the rates of population growth have varied from period to period during the Soviet era, reflecting, of course, the effects of territorial changes as well as internal demographic conditions. For the periods shown in Table 38, the per capita growth rates are less dispersed than the total growth rates, whether or not the latter are adjusted for territorial coverage. However, retardation is reflected in the per capita growth rates as well as in the total ones.

Trends in Labor Productivity

Growth in productive capacity springs from growth in resources or improved efficiency in their use. In studying the importance of each, the usual procedure is to measure the volume of resources employed, by means of an index combining capital and labor services, and to compare that with the volume of output. Unfortunately, statistics on capital inputs into Soviet industry are in such a poor state that we cannot make this kind of comparison.⁶ We must instead be content to compare output and employment of labor.

GROWTH IN INDUSTRIAL EMPLOYMENT

Comprehensive statistics on Soviet industrial employment, wage rates, or hours of work have yet to be published, so that here again we are forced to do the best we can with such partial information as has been made available. Our estimates are presented and discussed in technical note 7 of Appendix A, and we shall describe them only briefly here.

The basic estimates are for persons engaged in industry, expressed in full-time equivalents as measured by the average work-year (in days or

leading demographers participating in it were purged; the results were never published, except for a few fragments. A second census was conducted in 1939, and a few aggregative statistics were published. No further figures were published until 1956, when an official estimate for April 1956 was announced. The problems Western scholars have encountered in constructing estimates of population are demonstrated by the fact that Western estimates of population in 1956 had typically run about 10 per cent higher than the figure finally published (see *Statistical Handbook of the USSR*, Harry Schwartz, editor, New York, 1957, p. 16). Our population series (Table C-3) is taken from a working memorandum written by Harold Wool for this study.

⁶ Soviet authorities have recently expressed dissatisfaction with the official figures on industrial wealth and have indicated that a full count of inventory will be needed to put the facts in order (see, e.g., V. Starovskii, "Novye zadachi sovetskoi statistiki" [New Tasks of Soviet Statistics], *Kommunist* [The Communist], 1957, No. 14, p. 68). Some results of that count are provided in *Narodnoe khoziaistvo SSSR v 1959 godu* [The USSR National Economy in 1959], Moscow, 1960, pp. 65 ff.

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TABLE 39

INDEXES OF INDUSTRIAL EMPLOYMENT, BY INDUSTRIAL GROUP:
SOVIET UNION, BENCHMARK YEARS, 1913-1955
(1913 = 100)

	1913	1928	1933	1937	1940	1950	1955
	MAN-HOURS						
All products	100	74	105	151	203	253	284
	PERSONS ENGAGED ^a						
All products	100	92	149	210	225	275	333
Ferrous and nonferrous metals	100	66	135	147	142	235	264
Fuel and electricity	100	128	245	258	296	444	540
Fuel	100	127	230	235	272	400	481
Electricity	100	140	485	625	670	1,145	1,475
Chemicals	100	143	399	501	593	631	899
Construction materials ^b	100	76	178	175	204	276	345
Wood materials ^b	100	72	168	180	206	261	269
Mineral materials	100	96	225	152	197	347	502
Machinery and allied products ^c	100	109	408	515	559	721	886
Civilian machinery and equipment	100	129	268	604	412	622	857
Food and allied products	100	75	102	138	145	153	167
Textiles and allied products ^d	100	104	108	139	148	141	181

SOURCE: Table A-24. Note that some industrial groups have a different coverage from that in Table 37.

^a Full-time equivalents.

^b Covers paper and matches.

^c Covers civilian machinery, equipment, and metal products; military products; and consumer durables.

^d For 1937 and later years, covers furniture.

weeks) in large-scale industry. For all industry, persons engaged have been taken as the sum of workers and employees, members of industrial producer cooperatives, self-employed personnel, and workers in industrial enterprises attached to collective farms. In the virtual absence of data on wages by industrial categories, we are forced to use an unweighted aggregate. Recent evidence suggests that our totals progressively understate the true total after 1933, so that growth in employment since that year is probably significantly understated, perhaps by as much as 15 per cent.⁷

For benchmark years through 1933, persons engaged can be directly estimated for industrial groups as well as for all industry; for later years, the industrial breakdown must be derived indirectly by distributing the aggregate on the basis of published percentage distributions of production workers (*promyshlennye rabochie*). On the basis of evidence for 1933 and 1935, the latter procedure is likely to cause an understatement of persons engaged in producing electricity, machinery and equipment,

⁷ See technical note 7 in Appendix A.

AGGREGATIVE GROWTH TRENDS:

and possibly mineral construction materials; it is likely to cause an overstatement in the cases of other industrial categories. Hence, on this count, growth in employment since 1933 may be understated in the former categories and overstated in the latter. The estimates as they stand are given in Table 39.

It is, finally, possible to estimate the annual man-hours of employment in all industry on the basis of rather fragmentary data on average annual days and average daily hours worked by production workers in large-scale industry. Again, the information available is far from ideal, and it is impossible to say how much error there may be in applying it to all persons engaged, or in what direction the error lies. The average annual hours worked, estimated in this way, have fluctuated widely over the Soviet period, falling from 1913 through 1933, rising thereafter almost to the prerevolutionary level by 1950, and falling again through 1955, when they were still higher than in 1928 (see Table A-23 of Appendix A). Hence the total annual man-hours increased less, percentagewise, than total persons engaged over 1913-1955, but more over 1928-1955 (see Table 39).

TABLE 40
INDEXES OF INDUSTRIAL OUTPUT PER UNIT OF LABOR, BY INDUSTRIAL GROUP:
SOVIET UNION, BENCHMARK YEARS, 1913-1955
(1913 = 100)

	1913	1928	1933	1937	1940	1950	1955
	OUTPUT PER MAN-HOUR						
All products	100	137	146	188	157	155	218
	OUTPUT PER PERSON ENGAGED ^a						
All products	100	111	103	135	141	143	186
Ferrous and nonferrous metals	100	133	116	254	282	245	374
Fuel and electricity	100	118	150	259	287	284	369
Fuel	100	101	116	178	191	187	238
Electricity	100	184	173	298	371	410	593
Chemicals	100	101	76	130	109	186	181
Construction materials ^b	100	119	81	116	97	101	123
Wood materials ^b	100	121	88	101	90	98	134
Mineral materials	100	109	57	194	127	110	144
Machinery and allied products ^c	100	111	100	274	314	275	367
Civilian machinery and equipment	100	111	249	286	291	449	405
Food and allied products	100	112	91	111	108	110	156
Textiles and allied products ^d	100	109	94	109	118	127	152

SOURCE: Table A-24. Note that some industrial groups have a different coverage from that in Table 37.

^a Persons engaged in full-time equivalents.

^b Covers paper and matches.

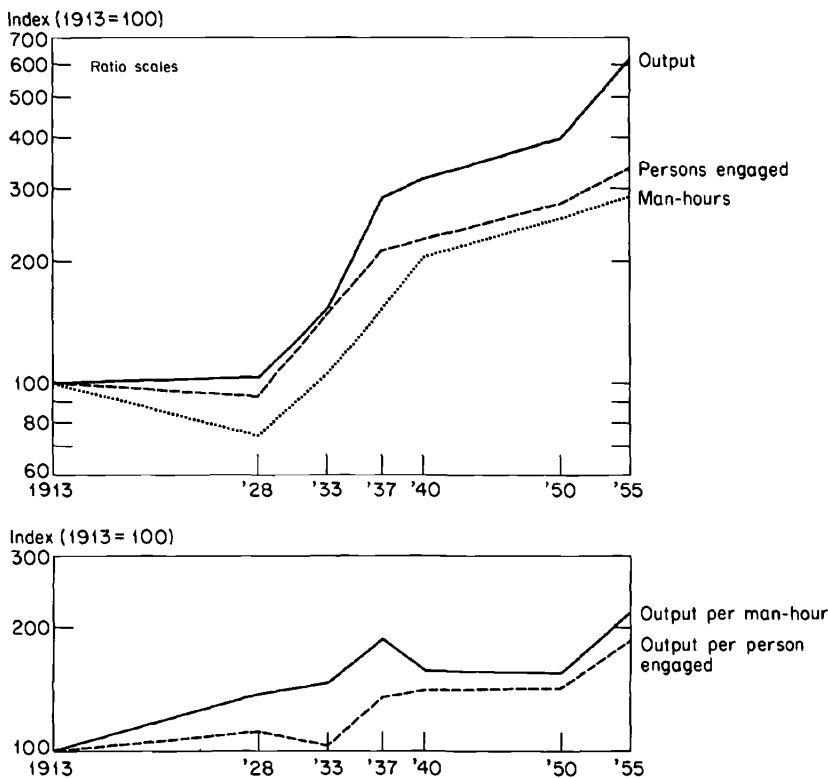
^c Covers civilian machinery, equipment, and metal products; military products; and consumer durables.

^d For 1937 and later years, furniture is covered for persons engaged but not for output. This latter omission is not likely to be significant.

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CHART 16

Indexes of Industrial Output and Employment: Soviet Union,
Benchmark Years, 1913-1955



Source: Tables 40 and A-24.

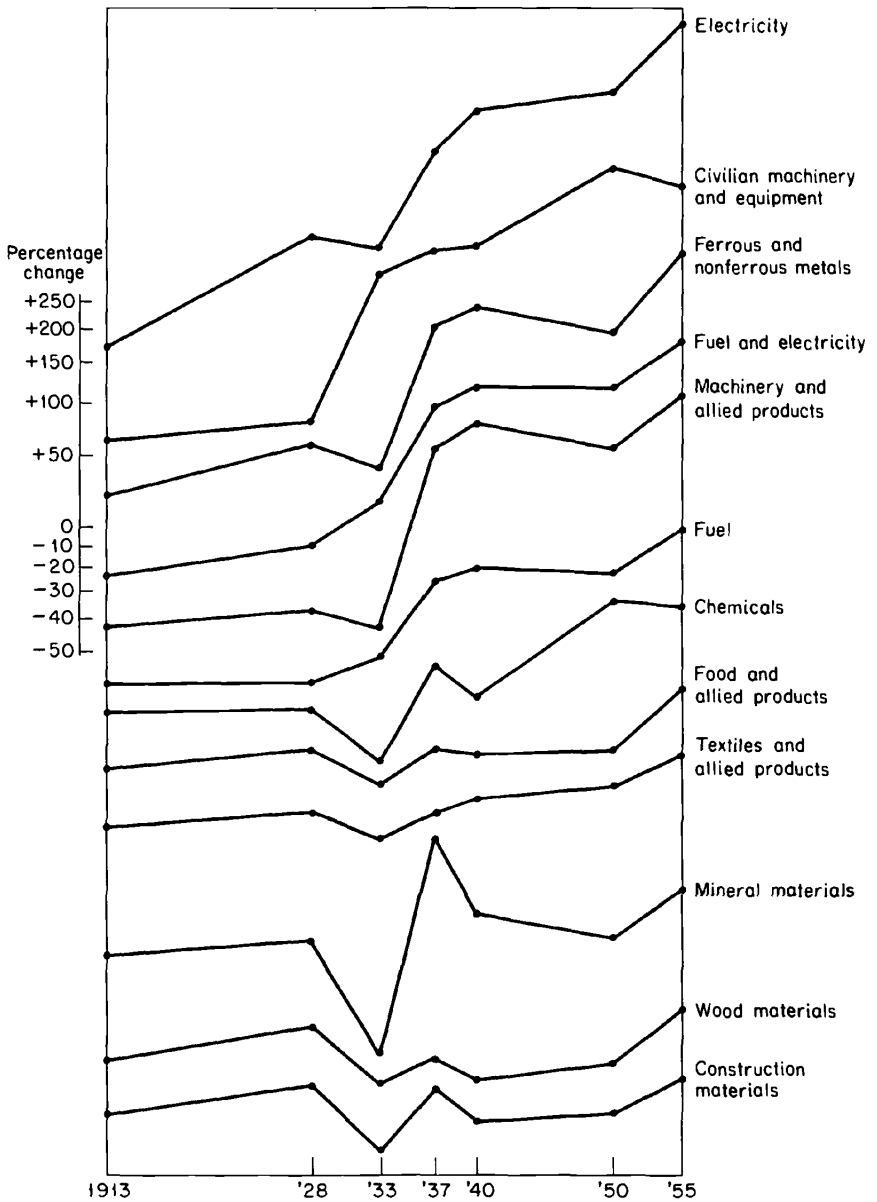
GROWTH IN OUTPUT PER UNIT OF LABOR

Our estimates of movements in Soviet industrial output per unit of labor employed are presented in Tables 40 and 41 and in Charts 16 and 17. According to these estimates, output per man-hour multiplied about 2.2 times between 1913 and 1955 and about 1.6 times between 1928 and 1955, growing at average annual rates of 1.9 and 1.7 per cent; output per person engaged multiplied about 1.9 and 1.7 times, growing at average annual rates of 1.5 and 1.9 per cent. Within shorter spans of years, the two types of measures have differed more markedly from each other, output per man-hour showing a faster growth than output per person engaged in some periods and a slower growth in others. This

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CHART 17

Indexes of Industrial Output per Person Engaged, by Industrial Group:
Soviet Union, Benchmark Years, 1913-1955



Source: Tabl 40.

TABLE 41
 AVERAGE ANNUAL GROWTH RATES OF INDUSTRIAL OUTPUT PER UNIT OF LABOR, BY INDUSTRIAL GROUP:
 SOVIET UNION, BENCHMARK YEARS, 1913-1955

	1913-1955	1913-1928	1928-1955	1928-1940	1940-1955	1928-1937	1950-1955
	OUTPUT PER MAN-HOUR						
	1.9	2.1	1.7	1.2	2.2	3.6	7.1
All products			OUTPUT PER PERSON ENGAGED				
All products	1.5	0.7	1.9	2.0	1.9	2.2	5.4
Ferrous and nonferrous metals	3.2	1.9	3.9	6.5	1.9	7.7	8.8
Fuel and electricity	3.2	1.1	4.3	7.7	1.7	9.1	5.4
Fuel	2.1	0.1	3.2	5.5	1.5	6.5	4.9
Electricity	4.3	4.1	4.4	5.3	3.2	5.5	7.7
Chemicals	1.4	1.1	2.2	0.6	3.4	0.5	-0.5
Construction materials	0.5	1.2	0.1	-1.7	1.6	-0.3	4.0
Wood materials	0.7	1.3	0.4	-2.4	2.7	-2.0	4.0
Mineral materials	0.9	0.6	1.0	1.3	0.8	6.6	3.1
Machinery and allied products	3.1	0.7	4.5	9.1	1.0	10.6	3.5
Civilian machinery and equipment	3.4	0.7	4.9	8.4	2.2	11.1	-2.0
Food and allied products	1.1	0.8	1.2	-0.3	2.5	-0.1	7.2
Textiles and allied products	1.0	0.6	1.2	0.7	1.7	0.0	3.7

SOURCE: Table 40. Average annual growth rates calculated from data for terminal years by the compound interest formula.

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follows, of course, from the fluctuations in hours of work for the average worker already commented on.

How much has growth in labor productivity contributed toward growth in output? This question may be answered obliquely by pointing out that, had there been no improvement in output per man-hour (or person engaged), output of all industrial products would have multiplied 46 per cent (or 54 per cent) as much as it did over 1913–1955 and 63 per cent (or 60 per cent) as much over 1928–1955. Hence improved labor productivity may be thought of as accounting for 46 to 54 per cent of the multiplication in output over 1913–1955 and 37 to 40 per cent over 1928–1955, the percentage depending on whether productivity is measured in terms of persons engaged or man-hours.

It is interesting that output per man-hour apparently grew faster over 1913–1928 than over 1928–1955. Despite the fact that industrial output showed no net increase over the pre-Plan years, productive capacity apparently grew at an impressive rate. The growth in output per man-hour over the pre-Plan years was associated with a sharp decline in annual hours of work for the average person engaged in industry, which may have had something to do with the marked improvement in hourly labor productivity. In any event, output per person engaged grew at a much slower average pace than output per man-hour: 0.7 per cent a year compared with 2.2 per cent.

Within the Plan years, labor productivity seems to have accelerated. This seems particularly clear in the case of output per man-hour: the average annual growth rate rose between 1928–1940 and 1940–1955, and between 1928–1937 and 1950–1955. Growth in output per person engaged also accelerated between the latter pair of periods, although it retarded very slightly between the former pair. The difference in behavior of the two measures can be explained by the increase in hours of work in the years surrounding World War II.

The picture for industrial groups is much more mixed. Growth in output per person engaged seems to have retarded over the Plan period in the cases of fuel, mineral construction materials, and machinery and allied products; it seems to have accelerated in the cases of wood construction materials, food and allied products, and textiles and allied products. The trend of growth rates is doubtful in the cases of ferrous and nonferrous metals, electricity, and chemicals.

COMPARISON OF OUR ESTIMATES WITH OTHERS

Few studies of Soviet industrial labor productivity have been made by Western scholars, the two best known probably being those of Hodgman

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TABLE 42

COMPARISON OF NBER AND HODGMAN INDEXES OF SOVIET INDUSTRIAL OUTPUT
PER UNIT OF LABOR, BENCHMARK YEARS, 1928-1950

	OUTPUT PER MAN-YEAR			OUTPUT PER MAN-HOUR		
	NBER ^a	Hodgman Actual ^b Adjusted ^c		NBER ^a	Hodgman Actual ^b Adjusted ^c	
			INDEX (1928 = 100)			
1928	100	100	100	100	100	100
1933	93	103	63	107	113	69
1937	122	155	91	137	167	98
1940	127	169		115	167	
1950	129	201	115	113	183	105
			LINK RELATIVE (INITIAL YEAR OF PERIOD = 100)			
1928-1933	93	103	63	107	113	69
1933-1937	131	150	144	128	148	142
1937-1940	104	109		84	100	
1940-1950	102	119		98	110	
1937-1950	106	130	126	82	110	107

SOURCE: Table 40; Hodgman, *Soviet Industrial Production*, pp. 113 and 117; and as indicated below.

^a Based on persons engaged. Covers all industry (including military products) except repair shops.

^b Based on production workers. Output covers large-scale industry in 1928, with the coverage expanding to all industry by around 1933; workers cover almost all industry in all years (see footnote 13 of this chapter).

^c Hodgman's adjusted production index (see Table 34) divided by our adjusted version of his employment index (see Table 43, columns 2 and 5). Both output and employment cover large-scale industry, with the coverage expanding to all industry by around 1933 (see text).

and Galenson.⁸ In addition, there is the very recent estimate by Kaplan and Moorsteen, which is based on a more comprehensive study of Soviet industrial growth.⁹ All differ from ours in coverage of output and employment and other important respects, commented on below. The Hodgman and Kaplan-Moorsteen estimates of labor productivity, like ours, are derived from aggregative indexes of output and employment, while Galenson's are based on physical output and employment for a small number of narrowly defined industries, covering only a small segment of industry.¹⁰

There is very little correspondence between the movements of our indexes of labor productivity and Hodgman's (see Table 42). This is

⁸ Donald Hodgman, *Soviet Industrial Production, 1928-1951*, Cambridge, Mass., 1954, pp. 109-122; Walter Galenson, *Labor Productivity in Soviet and American Industry*, New York, 1955.

⁹ N. M. Kaplan and R. M. Moorsteen, "Indexes of Soviet Industrial Production" (mimeographed), RAND Corporation, RM-2495, Santa Monica, 1960, pp. 152 ff.

¹⁰ For interwar years beginning with 1928, Galenson's indexes cover the seven industries shown in Table 42; for years beginning with 1932 and generally ending with 1936, they also cover four industries producing durable producer goods (see Galenson, *Labor Productivity*, p. 234).

AGGREGATIVE GROWTH TRENDS:

TABLE 43

COMPARISON OF NBER AND HODGMAN INDEXES OF LABOR INPUTS INTO SOVIET INDUSTRY,
BENCHMARK YEARS, 1928-1950

	MAN-YEARS			MAN-HOURS		
	<i>Hodgman, Production Workers^a</i>		<i>NBER, Persons Engaged^c</i>	<i>Hodgman, Production Workers^a</i>		<i>NBER, Persons Engaged^c</i>
	Actual	Adjusted ^b		Actual	Adjusted ^b	
	INDEX (1928 = 100)					
1928	100	100	100	100	100	100
1933	187	304	161	170 ^d	277 ^d	141
1937	240	407	228	223	379	203
1940	254		244	257		272
1950	322	560	297	354	616	340
	LINK RELATIVE (INITIAL YEAR OF PERIOD = 100)					
1928-1933	187	304	161	170	277	141
1933-1937	128	134	142	131	137	144
1937-1940	106		107	115		134
1940-1950	127		122	138		125
1937-1950	134	138	130	159	163	167

SOURCE: Tables A-23 and C-1; Hodgman, *Soviet Industrial Production*, pp. 112 and 116.

^a Includes repair shops.

^b Based on series of production workers as given in footnote 13 of this chapter, covering large-scale industry in 1928 and all industry thereafter.

^c Excludes repair shops.

^d Man-years in 1933 times average annual man-hours in 1932 as given by Hodgman, *Soviet Industrial Production*, p. 116.

due in part to significant differences between the underlying production indexes, commented on at some length elsewhere.¹¹ It is also due to differences in employment indexes, though these are much less marked despite the fact that Hodgman's index covers only production workers while ours covers all persons engaged (see Table 43). The greatest discrepancy in the movements of the employment indexes occurs over the periods 1928-1933 and 1933-1937 and is explained by the fact that there was a great bulge in employment in repair shops—included in Hodgman's index but excluded from ours—around 1933. In accord with standard custom, it seems doubtful that repair shops should be included in industry.

Two general shortcomings of Hodgman's data deserve further comment. First, military products are covered directly by employment data but only indirectly—and, as Hodgman observes,¹² inadequately—by production data. This seems to make most difference over the period 1940-1950.

¹¹ See the last section of the preceding chapter and technical note 4 of Appendix A.

¹² Hodgman, *Soviet Industrial Production*, p. 88. See also our discussion surrounding Table 31.

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According to our indexes, production of civilian products increased by 44 per cent, production of all products by 23 per cent, persons engaged by 22 per cent, and man-hours by 25 per cent. If the production index for civilian products were used to compute changes in labor productivity, we would find that output per person engaged increased by 18 per cent and output per man-hour by 15 per cent, which are close to the increases of 19 and 10 per cent shown by Hodgman's calculations. If, however, the production index for all products is used, we find that output per person engaged increased by only 2 per cent while output per man-hour decreased by 2 per cent.

Second, the coverage of Hodgman's production index is restricted to large-scale industry in 1928 and gradually expands to encompass all industry around 1933. His employment index, on the other hand, apparently covers all industry in all years, beginning with 1928.¹³ If his employment data are adjusted to the same coverage as his output data—as we have done in columns 2 and 5 of Table 43—the movements of his labor productivity indexes are markedly changed, primarily over the

¹³ Hodgman uses "industry section" data on production workers in large-scale industry, and these encompass many industries assigned in output statistics for the late 1920's to small-scale industry (see *Socialist Construction in the USSR*, Moscow, 1936, p. 394). While "labor section" data are, for other reasons (see *ibid.*), not strictly comparable in coverage to output data, the definition of large-scale industry was at least consistently applied over those early years. The two sets of data are as follows (average annual number of wage earners in thousands from D. Redding, "USSR Industrial Employment and Its Distribution" (mimeographed), Council for Economic and Industry Research Report No. A-8, Washington, 1955, p. 8):

	1928	1933
Large-scale industry		
"Industry section" data	3,699	6,901
"Labor section" data	2,558	4,784
All industry		
"Industry section" data	n.a.	7,900
"Labor section" data	3,865	7,866

To be comparable with his production index, Hodgman's employment data should cover large-scale industry for 1928 and total industry for 1933 onward. In terms of production workers ("industry section" wage earners), the series would run as follows (average annual number in thousands):

1928	2,600
1933	7,900
1937	10,579
1950	14,562

The figure for 1928 has been extrapolated by the "labor section" data given above: the figures for 1937 and 1950 are taken from Barney Schwalberg, *Industrial Employment in the USSR, 1933, 1937, 1950, and 1955*, Bureau of the Census, Series P-95, No. 55, Washington, 1960, p. 51.

AGGREGATIVE GROWTH TRENDS:

period 1928–1933 (see columns 3 and 6 of Table 42). We also note, by comparing these revised indexes with our counterparts, that over this period output per unit of labor showed a much sharper decline within the segment of industry covered by Hodgman than within industry as a whole, from which we can conclude that labor productivity fell in large-scale industry but rose in (at least what was formerly) small-scale industry. The former overbalanced the latter in man-year productivity, but the reverse was true in man-hour productivity, which is probably more significant. More detailed evidence confirming these conclusions will be presented in the next chapter.

Galenson's findings on labor productivity diverge even further from ours than Hodgman's do, as may be seen from Table 44. The primary explanation seems to lie in the small and unrepresentative sample of industries covered by Galenson. Only seven industries were studied for the period 1928–1937, their production workers accounting in the aggregate for 19 per cent of total industrial employment in 1928, 15 per cent in 1933, and 13 per cent in 1937. The coverage is much higher for metals (ranging from 56 to 72 per cent) and fuel (ranging from 52 to 61 per cent); somewhat higher for food and allied products (ranging from 22 to 27 per cent); and much lower for textiles and allied products (ranging from 6 to 9 per cent). Other industrial groups are not covered at all—electricity, chemicals, and construction materials. In general, the covered industries show a more rapid growth in labor productivity than the industrial groups they represent (if we may use our indexes for the latter), and the better represented groups show a more rapid growth than the more poorly represented ones (see Tables 44 and 40). Both factors work to make Galenson's combined index much higher than our aggregate index.

To the extent that they may be directly compared, the Kaplan-Moorsteen indexes of labor productivity behave much more like ours than those of Hodgman and Galenson. As we stated toward the end of the preceding chapter, the Kaplan-Moorsteen indexes appeared too late to make it possible for us to analyze them thoroughly and compare them meaningfully with ours. One comparison that seems justified without extensive adjustments is presented in Table 45, applying to intermediate industrial products—referred to by Kaplan and Moorsteen as "producers' goods other than machinery." Their and our indexes of output per man-year for this sector move in a rather parallel fashion, such differences as there are probably being explainable in terms of the following factors: different weight bases for the production indexes—1950 for theirs and a

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TABLE 44

COMPARISON OF NBER AND GALENSON INDEXES OF SOVIET INDUSTRIAL
OUTPUT PER UNIT OF LABOR, BENCHMARK YEARS, 1928-1937^a
(1928 = 100)

	1928	1933	1937
NBER, all products	100	93	122
Galenson, 7 industries combined			
1928 employment weights	100	120	174
1936 employment weights	100	116	177
NBER, ferrous and nonferrous metals	100	87	191
Galenson, iron ore mining	100	142	319
Galenson, iron and steel	100	106	247
NBER, fuel	100	115	176
Galenson, coal mining	100	135	189
Galenson, crude oil and gas extraction	100	154	200 ^b
NBER, food and allied products	100	81	99
Galenson, beet sugar	100	109	157
NBER, textiles and allied products	100	86	100
Galenson, cotton cloth	100	120	142
Galenson, shoes	100	60	88

SOURCE: Table 40; and Galenson, *Labor Productivity*, pp. 234 and 236.

^a For NBER, derived from output and persons engaged in all industry; for Galenson, from physical output and production workers in the large-scale segment except for the shoe industry, which is fully covered.

Employment covered by Galenson accounts for the following fractions of all persons engaged excluding those in repair shops (Galenson, *Labor Productivity*, pp. 16, 91, 99, 123, 186 f, 214, 216, and 224; and this monograph, Table A-20):

	1928	1933 (per cent)	1937
All industries	19.4	15.3	12.9
Ferrous and nonferrous metals	71.9	56.4	57.5
Fuel	61.4	52.2	60.5
Food and allied products	9.4	6.1	6.4
Textiles and allied products	27.3	22.4	26.3

The coverage given here for all industries is smaller for all years than that given by Galenson (p. 242), but we have not been able to reconcile his coverage ratios with the underlying data he cites.

^b 1938.

moving base for ours; different weighting systems for product groups in the production indexes—estimated wage-bills for theirs and estimated employment for ours; different product coverage in the production indexes—nonferrous metals are excluded from theirs and included in ours, along with other differences in the treatment of individual products; and different concepts of employment—production workers for theirs and persons engaged for ours.

AGGREGATIVE GROWTH TRENDS:

TABLE 45

COMPARISON OF NBER AND KAPLAN-MOORSTEEN INDEXES OF SOVIET OUTPUT PER MAN-YEAR OF LABOR FOR INTERMEDIATE INDUSTRIAL PRODUCTS, BENCHMARK YEARS, 1928-1955

	Output of Intermediate Industrial Products		Man-Years			
			Kaplan-Moorsteen, Production Workers		NBER, Persons Engaged	
	Kaplan-Moorsteen ^a	NBER ^b	Output per Man-Year		Kaplan-Moorsteen	NBER
1928	100	100	100	100	100	100
1932	192	184	179		108	
1933		198		222		89
1937	311	351	188	229	164	153
1940	334	386	218	260	151	148
1950	467	567	315	363	146	156
1955	748	872	392	423	186	206

SOURCE: Tables 53 and A-20; Kaplan and Moorsteen, "Indexes of Soviet Industrial Output," pp. 235, 268, and 269.

^a Based on 1950 Soviet weights.

^b Based on moving Soviet weights.

There remains, finally, to be considered the official Soviet index of labor productivity (see Table 46). The exact nature of this index is a mystery, apparently even to Soviet economists, though it seems most likely—as the well-known Soviet economist Strumilin has assumed—that it refers to gross output per production worker in large-scale industry.¹⁴ As would be expected from the exaggerated measure of industrial production in the official Soviet index, this index of labor productivity shows a much more rapid growth over the Plan period than ours does.

Concluding Remarks

We have seen that Soviet industrial output multiplied about six times (5.5 times, if territorial gains are eliminated) between 1913 or 1928 and 1955, which is less than the growth over the last forty years of the Tsarist period and more than the growth over the last twenty-five years. Output multiplied about nine times in the case of intermediate industrial products, twenty to thirty times in the case of civilian machinery and equipment, and three times in the case of consumer goods. On a per capita basis, these factors would be about 70 per cent as large for 1913-1955 and 76 per cent as large for 1928-1955.

Over 1913-1955, employment of labor multiplied 2.8 times in terms of man-hours and 3.3 times in terms of man-years; over 1928-1955, the

¹⁴ For some rather convincing comments on the nature of this index, see Schwalberg, *Industrial Employment*, pp. 11 ff.

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TABLE 46
COMPARISON OF NBER AND OFFICIAL SOVIET INDEXES OF INDUSTRIAL
OUTPUT PER MAN-YEAR OF LABOR, BENCHMARK YEARS, 1928-1955
(1928 = 100)

	<i>Output per Man-Year^a</i>		<i>Employment</i>	
	NBER	Official Soviet	NBER ^b	Implied Official Soviet ^c
1928	100	100	100	100
1932		141		231
1933	93		161	
1937	122	258	228	293
1940	127	343	243	317
1950	129	470	297	406
1955	168	679	360	534

SOURCE: Tables 39 and 40; and *Promyshlennost'*, 1957, pp. 25 and 31.

^a The NBER index refers to output per person engaged; the official Soviet index, apparently to output per production worker in large-scale state and cooperative industry, with varying coverage (see Schwalberg, *Industrial Employment*, pp. 11 ff).

^b Persons engaged, from Table 39.

^c Apparently production workers in large-scale industry (see note *a* above). Derived from official Soviet index of large-scale industrial production divided by official Soviet index of output per unit of labor (second column of this table).

comparable factors are 3.8 and 3.6. Employment has therefore accounted for 44 to 56 per cent of the multiplication in output over 1913-1955 and for 60 to 63 per cent over 1928-1955, with improved labor productivity accounting for the remainder. Put another way, output per man-hour (or person engaged) multiplied about 2.2 (or 1.9) times over 1913-1955 and 1.6 (or 1.7) times over 1928-1955.