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CHAPTER 4

Growth Trends: A Sample of Industries

THE picture of growth trends in Soviet industry may be brought into focus by looking first at the long-range performance of individual industries. A study of this sort has the obvious shortcoming that the industries included are necessarily the more mature ones in an economy, and hence their recent growth rates may understate the pace of development in some newer, more vigorously growing areas. Reinforcing this bias is the absence of data on rapidly growing industries associated with military production. Counteracting it is the tendency of Soviet statistics to overstate growth over the long run and the absence of data on declining and very slow-growing industries. For instance, only one declining industry (low-grade tobacco) finds its way into our list. We have no way of knowing the quantitative force of these biases, or which may outweigh the other. Despite these and other shortcomings, analysis of trends in individual industries reveals much about the structure of growth and serves as a useful orientation for more refined study, which we shall undertake at a later point.

A sample of seventy industries has been assembled for study (see Table 8), constituting a "basic" sample of the industrial categories for which output data covering the entire Soviet period have been published.¹ The output records of these industries are traced in Chart A-1 (Appendix A), and it can be seen there that almost every industry has displayed variations in short-term growth rates. In addition, output generally declined sharply in the periods immediately following the revolution and during World War II. Long-term growth rates have not been computed as averages of short-term rates for two reasons: first, because all output series have gaps, varying from one to another; and, second, because the breaks in the continuity of growth in the revolutionary and wartime periods make averaging of growth rates hard to justify in a study of growth trends. Growth rates have therefore been calculated from output in the terminal years involved, by means of the compound interest formula.²

¹ The basic data underlying all statistics in this chapter are given in Appendix B and in technical note 2 of Appendix A. This sample was compiled before the publication of Soviet statistical handbooks in 1957, and it is therefore somewhat smaller than one that could be assembled now.

² If we let a represent output in 1913 and $a(1+r)^{42}$ represent output in 1955, then the link relative of 1955 to 1913 is $(1+r)^{42}$; the annual relative is $(1+r)$, the geometric mean or the 42nd root of the link relative; and the average annual rate of growth is r , the annual relative minus unity. The latter is expressed as a percentage by multiplying it by 100.

A SAMPLE OF INDUSTRIES

TABLE 8
GROWTH TRENDS FOR FIXED SAMPLE OF SOVIET INDUSTRIES, 1913-1955

	Average Annual Growth Rate ^a (per cent)		Average Annual Growth Rate ^a (per cent)
Steam turbines	16.8	Sewing machines	4.3
Bicycles	16.4	Construction gypsum	4.2
Motor vehicle tires	16.1	Lumber	4.1
Natural gas	14.6	Red bricks	4.0
Lead	13.7	Rubber footwear	3.8
Power transformers	13.5	Boots and shoes	3.7
Asbestos shingles	12.9	Rails	3.7
Mineral fertilizer	12.5	Butter	3.6
Diesel engines	11.9	Soap	3.5
Electric power	11.2	Window glass	3.5
Zinc	11.1	Railroad freight cars	3.1
Machine tools	10.9	Matches	3.1
Roll roofing	10.1	Looms	3.0
Steam boilers	9.7	Salt	2.6
Canned foods	8.7	Industrial timber	2.5
Macaroni	8.6	Fish catch	2.4
Sulfuric acid	8.6	Crude alcohol	2.4
Peat	8.4	Linen fabrics	2.3
Clocks and watches	8.3	Raw sugar consumption	2.2
Rayon and mixed fabrics	7.5	Vegetable oil	2.2
Synthetic dyes	7.0	Woolen and worsted fabrics	2.1
Roofing tiles	6.7	Cotton fabrics	2.0
Cement	6.6	Beer	2.0
Coal	6.4	Meat slaughtering	1.8
Sausages	6.3	Railroad passenger cars	1.2
Copper	6.1	Starch and syrup	1.1
Construction lime	6.1	Felt footwear	1.0
Steel ingots	5.8	Silk fabrics	0.4
Caustic soda	5.7	Flour	0.3
Coke	5.6	Steam locomotives	0.2
Rolled steel	5.5	Vodka	-0.0
Paper	5.5	Low-grade tobacco	-0.9
Cigarettes	5.4		
Soda ash	5.4		
Red lead	5.1		
Pig iron	5.0	Median	5.0
Iron ore	5.0	1st quartile	8.5
Crude petroleum	5.0	3rd quartile	2.5

SOURCE: Table B-2.

^a Calculated from output in terminal years by the compound interest formula. Per capita rates are about 0.9 percentage points lower. Output in 1913 is taken for the inter-war territory; in 1955, for the territory of that date.

This procedure amounts to computing an annual percentage rate of growth that, if sustained year after year, would have accumulated to the observed percentage growth over a span of years.³

³ For example, if the output of steel ingots had in fact grown by 5.8 per cent every year from 1913 through 1955, the output in 1955 would have become 10.7 times the output in 1913, the multiple actually recorded in Soviet statistics.

GROWTH TRENDS:

We are interested in knowing not only the trend of growth, but also whether growth has been accelerating or retarding. This may be observed by computing growth rates for subperiods and comparing them. In all computations one must, of course, be careful not to pick periods or subperiods terminating in years whose output is abnormal in relation to the discernible trend; and to do this one must assume that he can distinguish trends from temporary fluctuations. Here is where statistical analysis becomes an art: the difference between a trend and a fluctuation cannot be defined by simple objective rules. And so it also is with the choice of periods for study. Judgments must be made, and they prove right or wrong depending on whether competent observers agree or disagree with them. We have made our judgments, and they will become apparent. Having made them, we try in the concluding section of this chapter to summarize evidence on the general trend of growth rates for individual industries.

Trends over the Soviet Period as a Whole

The growth rates for our sample fall within widely spaced bounds. At the one extreme, output of steam turbines rose at an average annual rate of 16.8 per cent; at the other, output of low-grade tobacco fell at 0.9 per cent. The divergence of these growth rates when applied to a span of forty-two years is shown by noting that between 1913 and 1955 output of low-grade tobacco fell by nearly a third, while output of steam turbines multiplied almost 700 times.

The boundaries of the middle half of growth rates are a better measure of dispersion than the simple range, since the latter depends on possibly unrepresentative extremes. Growth rates for the slowest-growing quarter of industries were lower than 2.5 per cent; for the fastest-growing quarter, higher than 8.5 per cent. This means that output for the middle half of industries multiplied within the range of 2.8 through 31 times during the period 1913-1955.

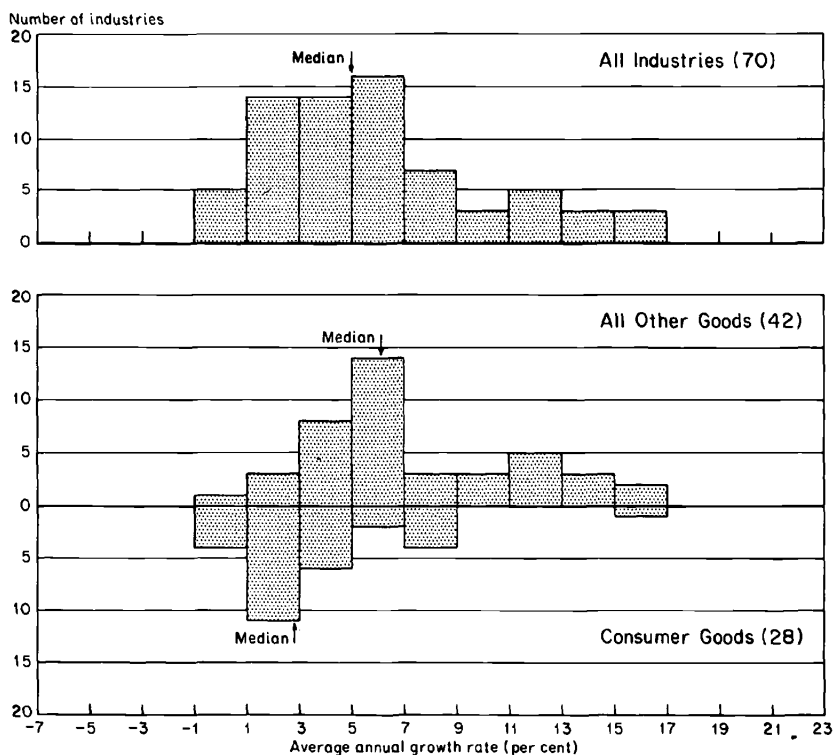
While output was growing at these rates, population was also increasing. Over the forty-two years in question, population within the relevant territorial limits multiplied 1.4 times, which implies an average growth rate of 0.9 per cent a year.⁴ For some purposes it is relevant to adjust growth rates for changes in population, and growth rates for per capita output are about 0.9 percentage points smaller than the rates recorded in Table 8. The per capita rates for the middle half of industries therefore range from 1.6 to 7.6 per cent a year.

⁴ These growth rates are derived from official Soviet data on population (Table C-3). For comments on their reliability, see note 5 in Chapter 6.

A SAMPLE OF INDUSTRIES

A useful way to illustrate the entire structure of growth rates is by a frequency distribution displaying the number of industries within each class of growth rates (see Chart 2, upper panel). The primary concentration occurs over the range of growth rates from 1 to 7 per cent.⁵ The

CHART 2
Frequency Distributions of Growth Rates for Fixed Sample
of Soviet Industries, by Number of Industries: 1913-1955



Source: Table 8.

frequencies taper off in both directions from this concentration, with a longer tail in the higher rates.

One reason for this longer right-hand tail is revealed on the lower panel, where the frequency distribution is divided into two parts: one

⁵ The differences in the frequencies for each of the three classes distinguished within this range are so small as to be statistically insignificant. Thus, the heaviest concentration (sixteen industries) is at 5 to 7 per cent, but in a larger sample of ninety-six industries the heaviest concentration (twenty-three industries) is at 3 to 5 per cent (see technical note 2, Appendix A).

GROWTH TRENDS:

for industries producing consumer goods and the other for industries producing all other goods—i.e., industrial materials and producer durables. Each of these categories has its own distribution with a primary concentration and a tapering off in both directions.⁶ The primary concentration for consumer goods occurs at a significantly lower class (1 to 3 per cent) than for all other goods (5 to 7 per cent); that is to say, the primary concentration for consumer goods overlaps the left-hand tail for all other goods. Industries producing consumer goods have grown at a slower pace than others in two respects: first, they dominate the lower ranges of growth rate; and second, they are distributed over a distinctly lower region of growth.

In looking at the distribution of growth rates in this way, small industries are counted equally with large ones, a disadvantage that can be partly overcome by weighting each industry by some index of its size. This is done in Chart 3, where each industry is represented by its value added in 1928.⁷ The resulting distribution of growth rates by value added of industries shows a decidedly more pronounced concentration than the distribution by number of industries, and the concentration occurs at a lower class of growth rates. Put another way, the median annual growth rates for the two types of distributions compare as follows:

	<i>Distribution by</i>	
	Number of Industries	Value Added of Industries (per cent)
All industries	5.0	2.7
Consumer goods	2.8	2.1
All other goods	6.1	4.9

It might be thought that the structure of growth in the Soviet period is related to the structure during the Tsarist period. Unfortunately, this conjecture cannot be thoroughly tested because the Tsarist statistical record is meager. Long-term growth rates for the two periods can be compared for only twenty-three industries in our fixed sample (see Table 9).

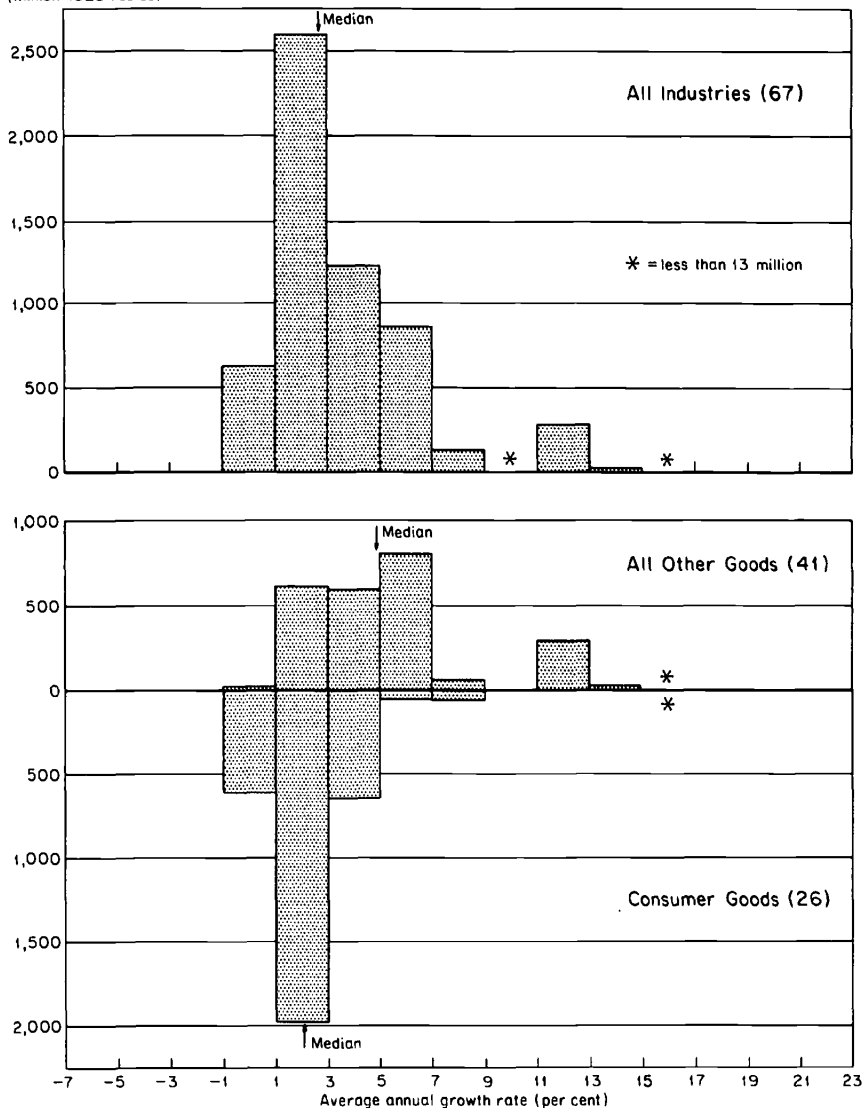
⁶ Division into consumer and other goods necessarily involves some rather arbitrary decisions. The twenty-eight industries classified as producing consumer goods are: flour, macaroni, butter, vegetable oil, meat slaughtering, sausages, fish catch, soap, salt, sugar, starch and syrup, canned food, beer, cigarettes, low-grade tobacco, matches, vodka, boots and shoes, rubber footwear, cotton fabrics, linen fabrics, pure silk fabrics, rayon and mixed fabrics, woolen and worsted fabrics, felt footwear, bicycles, household sewing machines, and clocks and watches.

⁷ Three of the industries in the fixed sample—clocks and watches, roofing tiles, and sausages—are omitted from this distribution because of inadequate data on value added.

A SAMPLE OF INDUSTRIES

CHART 3
 Frequency Distributions of Growth Rates for Fixed Sample
 of Soviet Industries, by 1928 Value Added: 1913-1955

Value added of industries
 (million 1928 rubles)



Source: Tables 8 and A-2.

GROWTH TRENDS:

TABLE 9
GROWTH TRENDS FOR TWENTY-THREE INDUSTRIES IN THE TSARIST
AND SOVIET PERIODS

	Average Annual Growth Rate ^a		Rank of Growth Rate	
	(per cent)		1870-1913	1913-1955
	1870-1913	1913-1955	1870-1913	1913-1955
Steel ingots	15.8	5.8	1	7
Crude petroleum	14.3	5.0	2	14
Caustic soda	13.4 ^b	5.7	3	8
Coke	12.4 ^c	5.6	4	9
Soda ash	11.8	5.4	5	10
Coal	9.6	6.4	6	5
Macaroni	9.3 ^d	8.6	7	3
Sulfuric acid	8.9	8.6	8	4
Cigarettes	7.5	5.4	9	11
Rails	7.3 ^e	3.7	10	15
Matches	7.0 ^d	3.1	11	16
Pig iron	6.1	5.0	12	12
Iron ore	6.0	5.0	13	13
Raw sugar	5.9	2.2	14	19
Cotton fabrics ^f	5.3	2.0	15	20
Low-grade tobacco	4.8 ^g	-0.9	16	23
Copper	4.5	6.1	17	6
Zinc	3.7	11.1	18	2
Salt	3.4	2.6	19	17
Starch and syrup	1.4 ^d	1.1	20	21
Crude alcohol	1.1	2.4	21	18
Vodka	0.7	-0.0	22	22
Lead	-0.2	13.7	23	1
Median	6.1	5.0		
1st quartile	3.9	2.4		
2nd quartile	9.5	6.0		

SOURCE: Tables B-1 and B-2.

^a See Table 8, note *a*. For the period 1870-1913, output is taken for Tsarist territory excluding Finland.

^b From 1891.

^c From 1890.

^d From 1888.

^e From 1878.

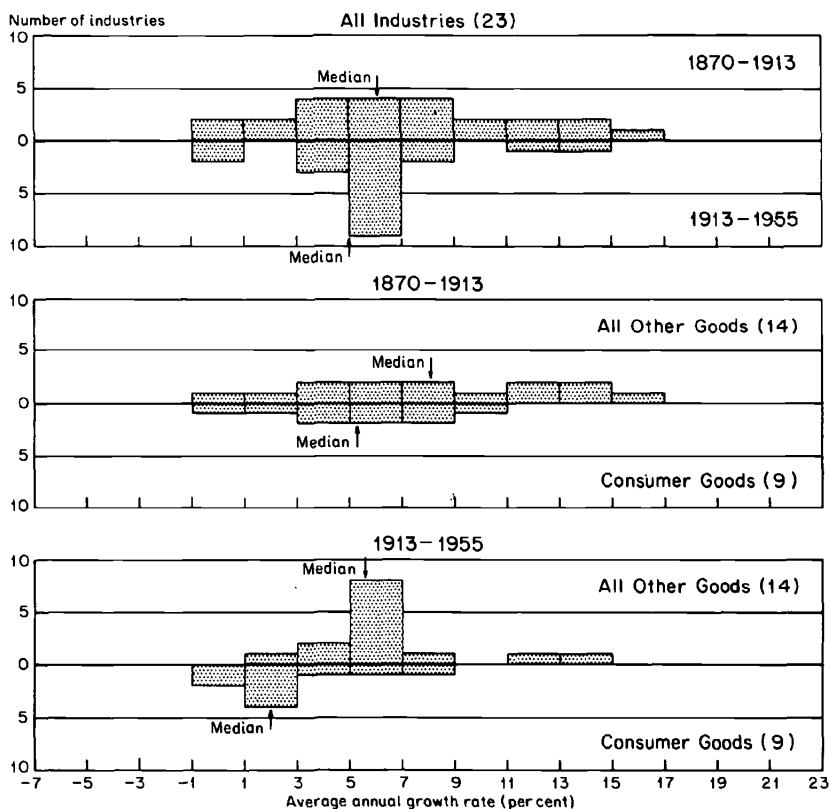
^f For 1870-1913, consumption of ginned cotton.

^g From 1881.

The middle half of these twenty-three industries occupies a higher region of growth rates for the Tsarist period than for the Soviet period: 3.9 through 9.5 per cent a year as compared with 2.4 through 6.0 per cent. The growth rates are also more uniformly dispersed for the Tsarist than for the Soviet period (Chart 4, top panel), and there is less difference between the distributions for consumer goods and all other goods (same chart, lower panels).

CHART 4

Frequency Distributions of Growth Rates for Twenty-Three Industries, by Number of Industries: Tsarist and Soviet Periods



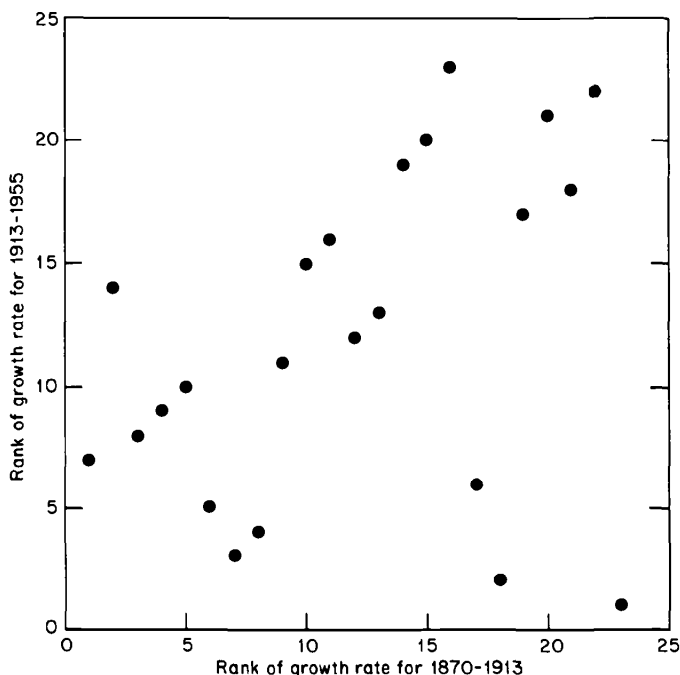
Source: Table 9.

Higher growth rates in the Tsarist period are not systematically related to higher (or lower) growth rates in the Soviet period (see Chart 5). Simple statistical tests show that the slight positive association between ranks of growth rates in the two periods could be attributed to peculiarities of the sample of industries.⁸

This lack of high positive correlation seems curious at first glance, because one would suppose that differential resource endowments would affect growth in the same way in the two periods. The explanation

⁸ The coefficient of rank correlation is 0.353, which is barely significant at the 10 per cent level.

CHART 5
Scatter Diagram of Relation Between Ranks of Growth Rates for
Tsarist and Soviet Periods, Twenty-Three Industries



Source: Table 9.

probably lies in several kinds of environmental change. First, foreign trade diminished sharply in importance during the Soviet period, as emphasis was placed on self-sufficiency. Second, the choice pattern of the market place was displaced by the quite different one of the central planning authorities, stressing investment in an effort to "catch up with the West." Third, as a result of the first and second changes, technological progress probably came to be much more unevenly distributed, being concentrated in the favored sectors and largely absent elsewhere.

While the relative speed of growth does not seem to be correlated in the two periods, growth rates tend to be lower, industry by industry, for the Soviet period than for the Tsarist period. Whether this has any bearing on the question of retardation in growth, in view of the turbulent history of the Soviet period, is a matter to be considered later. For the moment, we are concerned only with the facts. The growth rate has risen

over the two periods in the case of only four out of twenty-three industries: copper, zinc, crude alcohol, and lead. It is interesting that these four are among seven slowest growing industries in the Tsarist period. For the remaining nineteen industries, the growth rate declined.

These few descriptions about exhaust what can be said from direct comparison of growth rates in the Tsarist and Soviet periods. A more promising line of investigation has to do with the relation between speed of growth during the Soviet period and the "stage of development" from which an industry started. There is more evidence on this question and the findings seem to be significant.

Let us measure the "stage of development" of Russian industries in 1913 by comparing the structure of production in Russia that year with the structure in the United States, a country with a similar resource potential but far more "advanced" industrially at that time relative to its potential. As a rough index of development we may take output in Russia, industry by industry, as a percentage of output in the United States: the higher the percentage, the more advanced the industry is taken to be in comparison with others. This can be done for forty-eight of the seventy industries in our fixed sample.⁹ These forty-eight industries may then be ranked in decreasing order on the basis of the output ratios and also on the basis of growth rates (see Table 10). It is apparent from inspection (see Chart 6) that there is a fairly strong inverse relation between "the stage of development" in 1913 and the growth rate for 1913-1955; that is to say, the more advanced the "stage of development," the slower tends to be the growth rate. Statistical measures of rank correlation confirm that this inverse relation is too strong to be attributed solely to chance.¹⁰

As it stands, this finding should be taken as purely descriptive, with no obvious causal meaning. It says only that the Soviet industries with the most rapid growth have in general been those starting out with the lowest output relative to the United States. Such a pattern of growth could have been the result of planned design as well as of economic

⁹ Our measure of "stage of development" has obvious shortcomings in that the Soviet Union and the United States do not have the same differential resource endowments, technological achievements, or priorities. Moreover, as would be expected, a number of problems arise in trying to match Russian and American industries, some of which are discussed in Chapter 8.

¹⁰ The coefficient of rank correlation is -0.685 , which is significant at the 0.1 per cent level. It might be thought that this correlation is partly spurious, since output in 1913 appears in both measures being correlated. Spurious correlation seems unlikely, however, because the "stage of development" in 1913 has a strong positive correlation with the "stage of development" in 1928 (see Table 12). The coefficient of rank correlation is 0.832 , which is significant at the 0.1 per cent level.

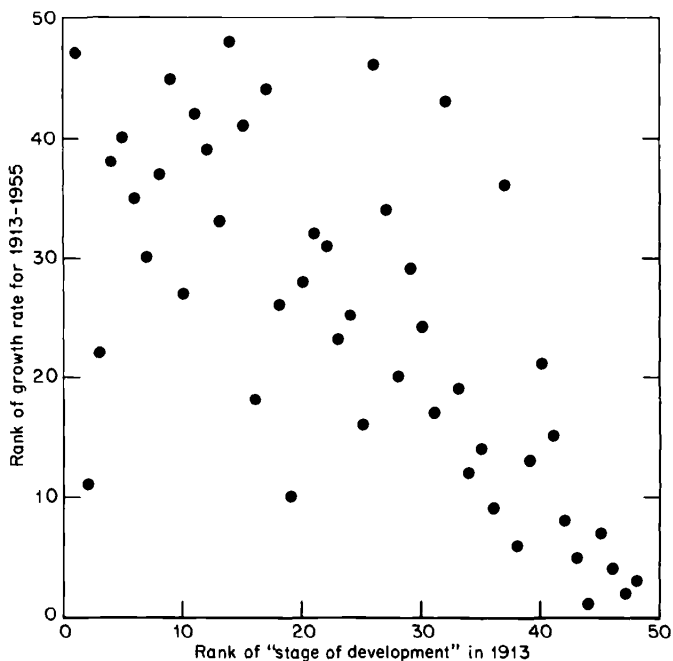
TABLE 10
RELATION BETWEEN GROWTH RATE FOR 1913-1955 AND
"STAGE OF DEVELOPMENT" IN 1913, FORTY-EIGHT SOVIET INDUSTRIES

	<i>Rank According to</i> "Stage of Development," 1913 ^a	Growth Rate, 1913-1955
Flour	1	47
Synthetic dyes	2	11
Cigarettes	3	22
Fish catch	4	38
Vegetable oil	5	40
Window glass	6	35
Rubber footwear	7	30
Salt	8	37
Railroad passenger cars	9	45
Sewing machines	10	27
Cotton fabrics	11	42
Raw sugar consumption	12	39
Butter	13	33
Steam locomotives	14	48
Woolen and worsted fabrics	15	41
Caustic soda	16	18
Meat slaughtering	17	44
Crude petroleum	18	26
Rayon and mixed fabrics	19	10
Construction gypsum	20	28
Rails	21	32
Boots and shoes	22	31
Soda ash	23	23
Iron ore	24	25
Construction lime	25	16
Silk fabrics	26	46
Soap	27	34
Rolled steel	28	20
Lumber	29	29
Pig iron	30	24
Steel ingots	31	17
Beer	32	43
Coke	33	19
Cement	34	12
Sausages	35	14
Sulfuric acid	36	9
Railroad freight cars	37	36
Electric power	38	6
Coal	39	13
Paper	40	21
Copper	41	15
Canned food	42	8
Mineral fertilizer	43	5
Bicycles	44	1
Zinc	45	7
Lead	46	4
Motor vehicle tires	47	2
Natural gas	48	3

SOURCE: Tables 8, B-2, and E-1.

^a Measured by ratio of output in Russia (interwar territory) to output in the United States, both as of 1913. For the United States, a nine-year average centered on 1913 has been used wherever possible. The ranking would not differ significantly if 1913 data were used instead of the centered average.

CHART 6
 Scatter Diagram of Relation Between Ranks of Growth
 Rate for 1913-1955 and "Stage of Development" in 1913,
 Forty-Eight Soviet Industries



Source: Table 10.

destiny. A closer look at historical details is needed to resolve questions of this sort.

Trends over the Pre-Plan and Plan Years

The Soviet period in Russia naturally divides itself into two major parts: the years before the five year plans (the pre-Plan years)¹¹ and the Plan years themselves. The point of division is roughly 1928, since the First Five Year Plan began in October 1928. It should be understood that this is not a simple division between a market economy, on the one hand, and a centrally directed economy, on the other. The pre-Plan years

¹¹ For many purposes, it is also useful to divide the pre-Plan years into the years up to 1921 (War Communism) and the following years (the New Economic Policy). Unfortunately, the output series for our sample of seventy products are not sufficiently continuous to analyze these periods separately. For a discussion of the difference in growth, see Chapter 7.

GROWTH TRENDS:

TABLE II
GROWTH TRENDS FOR FIXED SAMPLE^a OF SOVIET INDUSTRIES,
1913-1928 AND 1928-1955

	Average Annual Growth Rate ^b (per cent)		Rank of Growth Rate	
	1913-1928	1928-1955	1913-1928	1928-1955
Bicycles	5.4	23.0	12	1
Lead	2.9	20.1	18	2
Motor vehicle tires	10.4	19.4	4	3
Steam turbines	12.8	19.2	2	4
Zinc	-1.8	19.0	58	5
Diesel engines	0.7	18.7	35	6
Mineral fertilizer	4.8	17.1	14	7
Machine tools	1.9	16.3	26	8
Power transformers	10.0	15.5	6	9
Rayon and mixed fabrics	-4.5	14.7	63	10
Asbestos shingles	10.2	14.5	5	11
Electric power	6.5	13.9	8	12
Natural gas	17.0	13.4	1	13
Roll roofing	5.3	12.9	13	14
Canned food	1.9	12.8	28	15
Clocks and watches	2.1	11.9	25	16
Macaroni	3.1	11.8	17	17
Sulfuric acid	3.8	11.2	15	18
Silk fabrics	-16.4	11.3	69	19
Sausages	0.4	10.4	38	20
Copper	-0.2	9.8	46	21
Construction gypsum	-5.2	9.7	67	22
Cement	1.3	9.7	32	23
Construction lime	0.2	9.6	41	24
Iron ore	-2.7	9.5	59	25
Coal	1.3	9.3	31	26
Steel ingots	0.0	9.2	43	27
Steam boilers	10.7	9.1	3	28
Coke	-0.3	9.1	47	29
Rolled steel	-0.4	9.0	49	30
Pig iron	-1.7	9.0	57	31
Caustic soda	0.4	8.7	37	32
Peat	7.9	8.7	7	33
Rails	-3.2	7.7	62	34
Synthetic dyes	6.0	7.6	9	35
Soda ash	2.1	7.2	24	36
Paper	2.5	7.2	21	37
Red bricks	-1.6	7.2	56	38
Crude petroleum	1.5	6.9	30	39
Lumber	0.0	6.7	44	40
Sewing machines	0.3	6.6	39	41
Butter	-1.6	6.6	55	42
Crude alcohol	-4.5	6.5	64	43
Beer	-4.7	5.9	65	44
Railroad passengers cars	-6.5	5.8	68	45
Railroad freight cars	-1.4	5.6	52	46
Looms	-1.4	5.6	53	47
Cigarettes	5.5	5.3	11	48
Rubber footwear	1.8	4.9	29	49

A SAMPLE OF INDUSTRIES

TABLE 11 (concluded)

	Average Annual Growth Rate ^b (per cent)		Rank of Growth Rate	
	1913-1928	1928-1955	1913-1928	1928-1955
Red lead	5.6	4.8	10	50
Industrial timber	-1.5	4.8	54	51
Meat slaughtering	-2.8	4.5	61	52
Fish catch	-1.3	4.5	51	53
Soap	2.4	4.1	23	54
Window glass	2.5	4.0	22	55
Boots and shoes	3.7	3.7	48	56
Raw sugar consumption	-0.3	3.7	16	57
Salt	1.2	3.4	33	58
Starch and syrup	-2.7	3.3	60	59
Matches	2.6	3.3	19	60
Cotton fabrics	0.2	3.0	40	61
Woolen and worsted fabrics	0.7	2.9	34	62
Vodka	-5.0	2.8	66	63
Vegetable oil	1.9	2.4	27	64
Linen fabrics	2.5	2.1	20	65
Felt footwear	-0.2	1.7	45	66
Steam locomotives	0.0	1.2	42	67
Flour	-1.0	1.1	50	68
Low-grade tobacco	0.6	-1.7	36	69
Median	0.7	7.6		
1st quartile	3.0	11.4		
3rd quartile	-1.4	4.5		

SOURCE: Table B-2.

^a The sample covers sixty-nine industries here because output of roofing tiles around 1928 is not known.

^b See Table 8, note a.

were characterized by centralized governmental ownership and control of a large segment of industry, though there was also a significant area of (controlled) private enterprise. The comprehensive economic plan, covering all economic activities more or less systematically, is the feature distinguishing the later period.

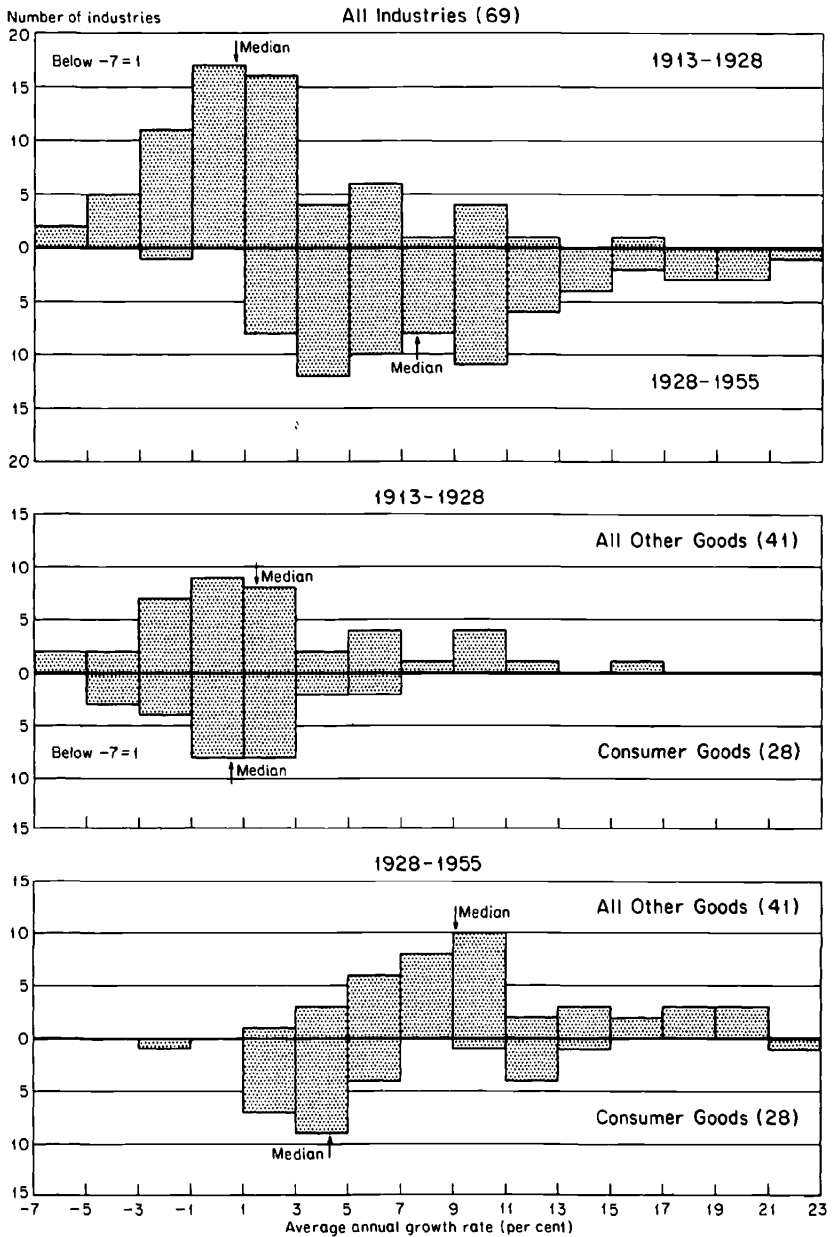
There is a marked difference in the patterns of industrial growth for the two sets of years (see Table 11 and Charts 7 and 8). More than a third of the industries in our fixed sample, accounting for almost a half of the sample's 1928 value added,¹² showed declines in output over the pre-Plan years, in one case (silk fabrics) by almost 17 per cent a year. The median growth rate is 0.7 per cent a year when based on both number

¹² One industry (roofing tiles) is omitted from all analyses for lack of 1928 output data, and two more (sausages and clocks and watches) are omitted from the analysis involving value added for lack of those data.

GROWTH TRENDS:

CHART 7

Frequency Distributions of Growth Rates for Fixed Sample of Soviet Industries, by Number of Industries: 1913-1928 and 1928-1955

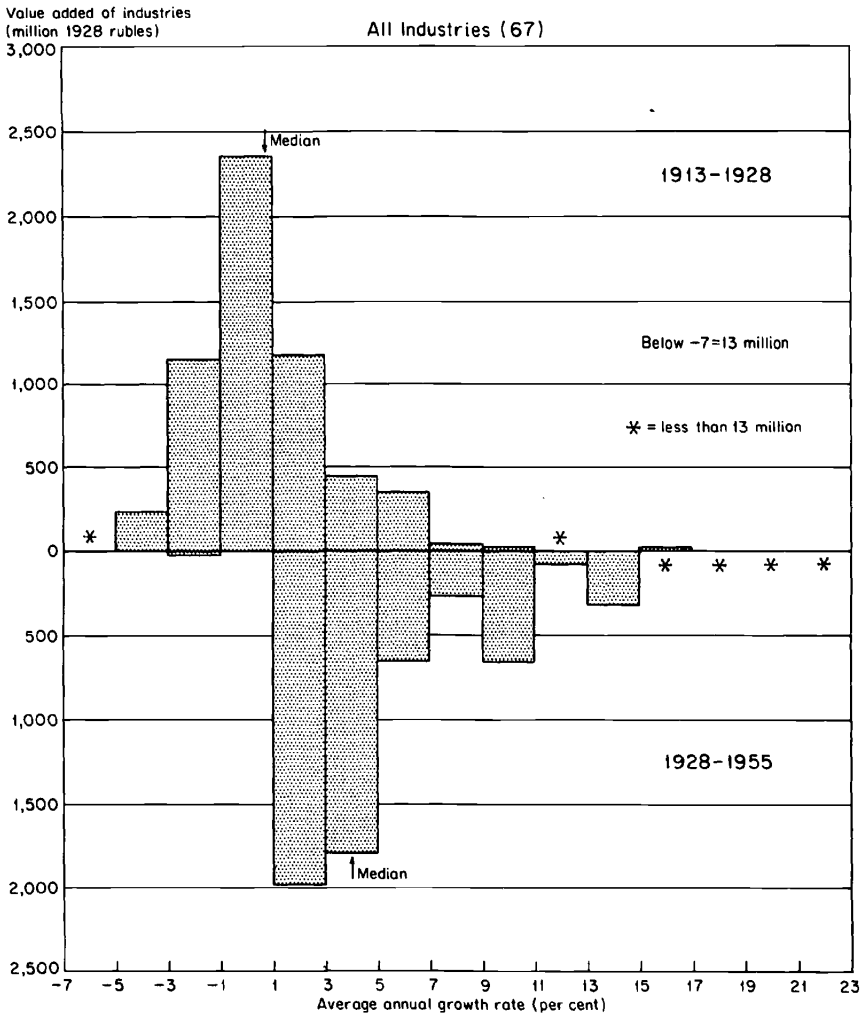


Source: Table 11.

A SAMPLE OF INDUSTRIES

CHART 8

Frequency Distributions of Growth Rates for Fixed Sample of Soviet Industries, by 1928 Value Added: 1913-1928 and 1928-1955

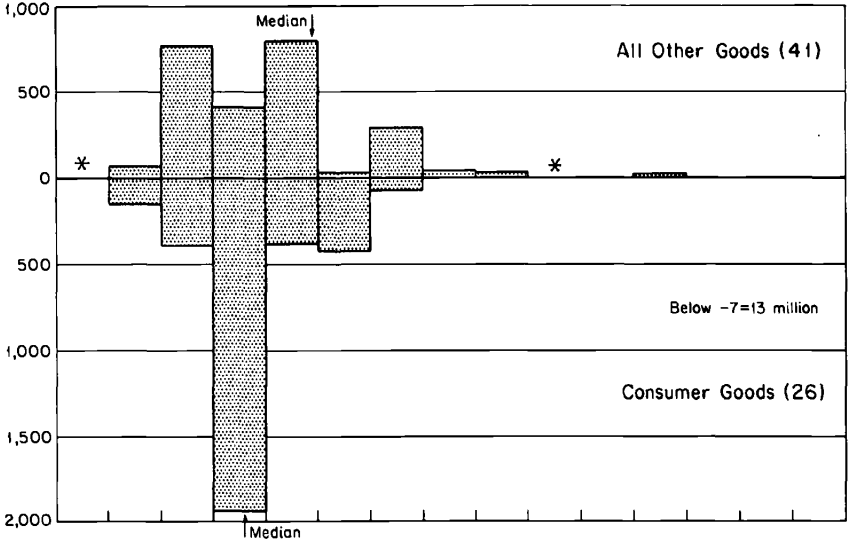


GROWTH TRENDS:

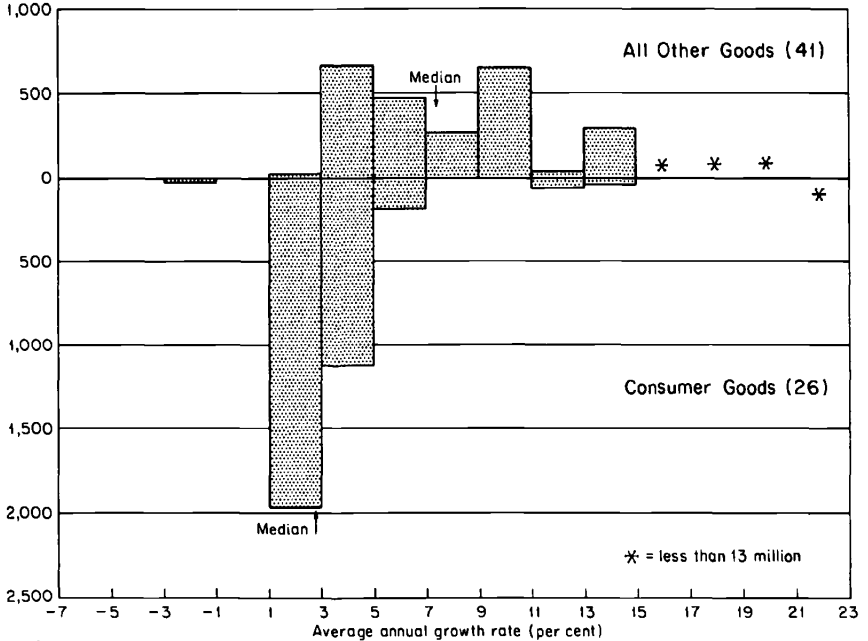
CHART 8 (concluded)

Value added of industries
(million 1928 rubles)

1913-1928



1928-1955



Source: Tables II and A-2.

A SAMPLE OF INDUSTRIES

and value added of industries, and it occurs within the primary concentration of growth rates, with a rather smooth tapering off in both directions. There is little difference between the medians for consumer and other goods. Over this period, population increased by 0.5 per cent a year, so that per capita growth rates are about 0.5 percentage points smaller than given.

If generalizations of this sort are warranted at all, it may be said that the pre-Plan years represent a period of almost no growth in the aggregate. This generally poor performance is not surprising for a country experiencing a losing war, a radical economic and social revolution, and violent civil strife over about half the fifteen years under review. Moreover, the remaining half could hardly be counted as normal times in the ordinary sense of the term.

To the extent that our sample of data can be believed and generalized, industrial output rose swiftly in the Plan years—making up, it would seem, for lost time. The median growth rate is 7.6 per cent a year when based on the number of industries and 4.0 per cent when based on the value added of industries. Each frequency distribution of growth rates for the Plan years occupies a higher region of growth than its counterpart for the pre-Plan years. Growth rates for consumer goods are generally much lower than those for all other goods. This, taken together with the similarity in distributions of growth rates for the two categories during the pre-Plan years, makes it clear that the pronounced divergence in growth between consumer and other goods is a phenomenon of the Plan years alone.

The difference in pace and pattern of growth in the two periods is rather sharply revealed in the median annual growth rates derived from the frequency distributions just discussed and summarized below:¹³

Distribution by

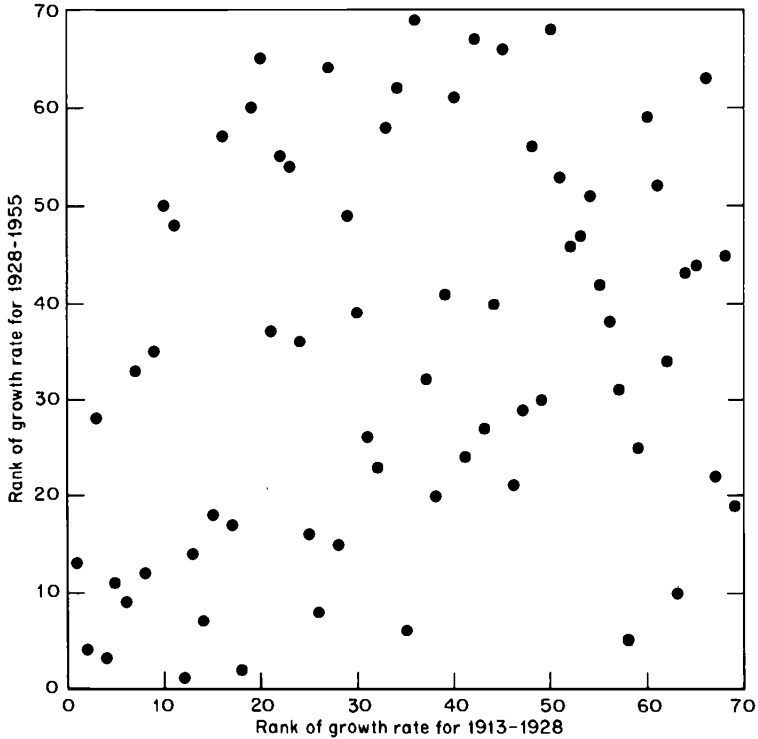
	Number of Industries		Value Added of Industries	
	1913–1928	1928–1955	1913–1928	1928–1955
All industries	0.7	7.6	0.7	4.0
Consumer goods	0.4	2.3	0.2	2.7
All other goods	1.5	9.1	0.8	7.4

¹³ In assessing the significance of differences in annual growth rates, they should be compared with each other in the form of annual relatives (see footnote 2 above). For example, the annual relatives for consumer and other goods would be 1.004 and 1.015 in the first column and 1.023 and 1.091 in the second. From this formulation, it is apparent that the divergence between the two growth rates is relatively larger in the second than in the first column.

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Study of changes in growth rates, industry by industry, conveys the same impression of a markedly faster pace of growth in the Plan than in the pre-Plan years. For sixty-three out of sixty-nine industries, the growth rate rose from one period to the next. The six exceptions are natural gas,

CHART 9
Scatter Diagram of Relation Between Ranks of Growth Rates for 1928-1955 and 1913-1928, Fixed Sample of Soviet Industries



Source: Table II.

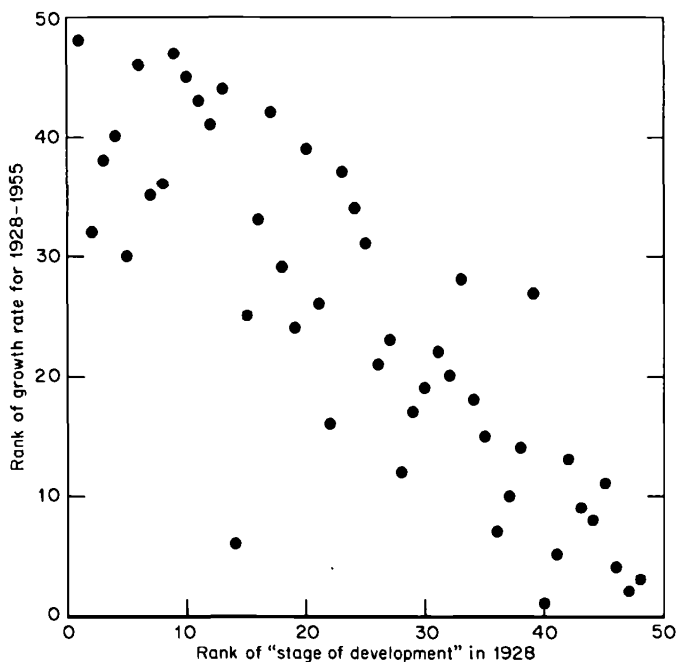
steam boilers, cigarettes, red lead, boots and shoes, and linen fabrics. There seems to be little relation between the structures of growth in the two periods (see Chart 9).¹⁴

When growth rates are adjusted for population changes, the differences between the two periods are somewhat narrowed, since population has grown at the annual rate of 1.1 per cent during the Plan years as compared

¹⁴ The coefficient of rank correlation of growth rates is 0.313, which is significant at slightly less than the 1 per cent level.

with 0.5 per cent during the pre-Plan years. This means, for example, that the middle half (based on number of industries) of growth rates on a per capita basis ranges from about -1.9 to about 2.7 per cent for the pre-Plan years, and about 3.0 to about 11.1 per cent for the Plan years.

CHART 10
Scatter Diagram of Relation Between Ranks of Growth Rate for 1928–1955 and “Stage of Development” in 1928, Forty-Eight Soviet Industries



Source: Table 12.

Finally, we may note that there is a strong inverse relation between the rate of growth during the Plan years and the “stage of development” at the beginning of those years (see Table 12 and Chart 10).¹⁵ This relation is even more pronounced than the one already described for the Soviet period as a whole, thereby supporting the conjecture that this relation is at least in part the result of planned design. This seems all the more plausible because the pattern of growth during the Plan years is, as already

¹⁵ The coefficient of rank correlation is -0.803 , which is significant at the 0.1 per cent level. Recall that the coefficient of rank correlation between growth rates for 1913–1955 and the “stage of development” in 1913 is -0.685 (see footnote 10 above).

TABLE 12
RELATION BETWEEN GROWTH RATE FOR 1928-1955 AND
"STAGE OF DEVELOPMENT" IN 1928, FORTY-EIGHT SOVIET INDUSTRIES

	<i>Rank According to</i> "Stage of Development," 1928 ^a	Growth Rate, 1928-1955
Flour	1	48
Beer	2	32
Fish catch	3	38
Window glass	4	40
Sewing machines	5	30
Vegetable oils	6	46
Cigarettes	7	35
Rubber footwear	8	36
Steam locomotives	9	47
Woolen and worsted fabrics	10	45
Salt	11	43
Boots and shoes	12	41
Cotton fabrics	13	44
Rayon and mixed fabrics	14	6
Synthetic dyes	15	25
Railroad passenger cars	16	33
Raw sugar consumption	17	42
Lumber	18	29
Rails	19	24
Soap	20	39
Soda ash	21	26
Construction lime	22	16
Meat slaughtering	23	37
Railroad freight cars	24	34
Butter	25	31
Rolled steel	26	21
Caustic soda	27	23
Sausages	28	12
Iron ore	29	17
Steel ingots	30	19
Pig iron	31	22
Coke	32	20
Crude petroleum	33	28
Coal	34	18
Cement	35	15
Electric power	36	7
Sulfuric acid	37	10
Construction gypsum	38	14
Paper	39	27
Bicycles	40	1
Mineral fertilizer	41	5
Copper	42	13
Canned food	43	9
Natural gas	44	8
Silk fabrics	45	11
Zinc	46	4
Lead	47	2
Motor vehicle tires	48	3

SOURCE: Tables 11, B-2, and E-1.

^a Measured by ratio of output in the Soviet Union to output in the United States, both as of 1928. For the United States, a nine-year average centered on 1928 has been used wherever possible. The ranking would not differ significantly if 1928 data were used instead of the centered average.

pointed out, strikingly different from those in earlier periods, both Soviet and Tsarist. That is to say, one could argue without being contradicted by the available evidence that an important reason why growth has been more rapid for relatively less advanced than for relatively more advanced industries is because development has been planned that way.

The turbulence of pre-Plan years has already been mentioned. To complete the record, it must also be noted that the Plan years contained violent disturbances covering at least ten of the twenty-seven years: the collectivization of agriculture, the widespread political purges, and World War II. It is not easy to assess their net effect, since, with the exception of the war, they were basic to the establishment of a system of rigid central control. The war itself had a net depressive effect, though even here there are compensatory factors that should not be overlooked, as we shall discuss later (in Chapter 7). The importance of matters such as these depends on the uses to be made of the various indicators of growth gathered together here. This issue has been commented on in our introductory chapter and will be reviewed again later.

Retardation in Growth

It has been widely observed and well documented that individual industries in an economy tend to slow down in growth as they get older and larger, a phenomenon that goes by the name "retardation in growth."¹⁶ We turn now to see whether this phenomenon also characterizes the Soviet economy.

Some pertinent evidence is summarized in Table 13. For every pair

TABLE 13
MOVEMENTS IN GROWTH RATES FOR INDIVIDUAL SOVIET INDUSTRIES,
VARIOUS PERIODS

	<i>Number of Industries</i>		Total
	Declines in Growth Rate	Rises in Growth Rate	
A. 1870-1913 to 1913-1955	19	4	23
B. 1928-1940 to 1940-1955	60	10	70
C. 1928-1937 to 1950-1955	46	24	70
Both A and B	19	0	23 ^a
Both A and C	12	0	23 ^a

SOURCE: Tables 9 and B-2.

^a Industries unaccounted for showed a decline in one pair of periods and a rise in the other.

¹⁶ See Simon Kuznets, *Secular Movements in Production and Prices*, New York, 1930, Chapters I-III, and A. F. Burns, *Production Trends in the United States since 1870*, New York, NBER, 1934, pp. 96 ff.

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of periods compared, the number of industries showing a decline in growth rate exceeds by a significant margin those showing a rise. The smallest discrepancy occurs in comparing the periods 1928-1937 and 1950-1955. Interestingly, only consumer goods, the slowest-growing industrial sector, show more rises than declines over that pair of periods (see Table 14).

TABLE 14
MOVEMENTS IN GROWTH RATES FOR FIXED SAMPLE OF SOVIET INDUSTRIES,
BY INDUSTRIAL GROUP: 1928-1940 TO 1940-1955 AND 1928-1937 TO 1950-1955

	Declines in Growth Rate	<i>Number of Industries</i> Rises in Growth Rate	Total
		1928-1940 to 1940-1955	
Metals	7	0	7
Fuel and energy	6	0	6
Chemicals	9	0	9
Construction materials	10	1	11
Machinery	7	2	9
Consumer goods	21	7	28
Total	60	10	70
		1928-1937 to 1950-1955	
Metals	7	0	7
Fuel and energy	5	1	6
Chemicals	7	2	9
Construction materials	8	3	11
Machinery	6	3	9
Consumer goods	13	15	28
Total	46	24	70

SOURCE: See Table B-2.

For twenty-three industries, there are output data spanning both the Tsarist and Soviet periods. Of these, nineteen showed a retardation in growth both from 1870-1913 to 1913-1955 and from 1928-1940 to 1940-1955; twelve showed a retardation both from 1870-1913 to 1913-1955 and from 1928-1937 to 1950-1955. None of these twenty-three industries showed an acceleration in growth throughout both pairs of periods in either of the two comparisons made.

Concluding Remarks

Analysis of growth trends in samples of industries has revealed certain structural characteristics of Soviet industrial growth, and in doing so has

set the stage for more refined analysis. It has also provided some tentative generalizations about the pace of over-all industrial growth. In the next chapter we turn to more complex measures of over-all growth and consider how they may be constructed and what problems are encountered in constructing them.