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SECURITY INFORMATION

RESEARCH AID

METHODS AND MATERIALS ON THE MEASUREMENT OF INDUSTRIAL PRODUCTIVITY

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CONTENTS

(CRR Project 103-51) SECURITY INFORMATION

METHODS AND MATERIALS ON THE MEASUREMENT OF INDUSTRIAL PRODUCTIVITY

I. Statement of the Problem.

The purpose of this study is to examine the fundamental concept and the methods of measurement of industrial productivity and to survey the data that are available on this subject for the USSR and some other countries.

II. Summary

1. Various Concepts of Productivity.

In general terms, productivity refers to the relationship between the outputs of particular industries or groups of industries and the corresponding inputs of labor, materials, capital, and other factors of production. Frequently, attempts are made to express productivity in terms of only one of the several essential inputs. In a great majority of such cases, productivity is measured solely in terms of labor input. As explained more fully in III, below, such a measure is defective for most purposes and is valid for only very limited uses. In this paper, three other (and more general) expressions of the relationship between the output of a production process and the corresponding inputs are discussed. One such method makes use of a weighted composite index of several inputs, all relative to a given base year. Such a method has some validity for comparing changes over time in a given country but is not applicable to international comparisons. A second method, the production function, recognizes the separate influence of all of the various factors in the production process (machinery, resources, etc., as well as labor) in a given plant or industry. The technical coefficients for each factor of production in that function are, in effect, productivity ratios. The production function is useful as a guide in careful, logical analysis but has not been extensively developed for purposes of actual measurement. A third method, the formulation of inter-industry relationships along the lines of the Leontief input-output model, also may be used to reveal productivity relationships. These methods are examined briefly in III, below.

2. Labor Productivity: Limitations of Such Measures.

The subject of labor productivity, including its measurement in particular sectors, and in the economy as a whole, is the object of extensive study in several countries, particularly in the USSR, the US, and the UK. Soviet economists, in view of their Marxist approach, have no conceptual difficulty in treating output per worker as the only significant output-input relationship. A number of studies, both in Russian and in

English, describe the various ratios that can be calculated and develop precise statistical methods for doing so. This material is reviewed in the subsequent sections and annexes of this paper. In a few cases studies made by private and governmental agencies in the US and the UK and by the International Labor Office recognize the limitations and defects of the labor productivity ratio. Many productivity studies, however, are defective in the logic of their analysis. They seldom fully recognize or give proper weight to the essential nature of production in advanced industrial societies as a joint process involving several factors. Thus the labor productivity ratios (for example, gross output per worker) for given industries in various countries which appear to have a clear and definite meaning are in fact fundamentally ambiguous. For a given industry a relatively higher labor productivity ratio in one country than in another may be due to an intrinsic difference in the skill or willingness of workers to produce in the two countries, but, and equally likely, it may be due to differences in the use of capital, skill of management, availability or quality of basic resources, and scale of operations or to any one of several different combinations of these and other factors. Also, changes which involve a reduction in the use of materials or capital but which do not alter the output-labor relationships are completely obscured in the conventional labor productivity ratios. The conventional ratios, furthermore, are ratios of totals and give no indication of the marginal or incremental values which would be significant in the estimation of probable increases in output. Consequently great care is necessary in any use that is made of labor productivity ratios.

3. Available Productivity Statistics, Various Countries.

The second object of this study, the exploration of the available data, has yielded useful information for some countries. Although stated almost wholly in terms of labor productivity (thus subject to the limitations indicated above), and more adequate for earlier than for recent years, there is considerable information on this subject pertaining to a number of industries in the US, Germany, the USSR, and the UK and scattered data for some other countries.

The following examples illustrate the types of data that are available in some of the studies which compare output per worker in different countries. One of the most extensive efforts of this nature (by Laszlo Rostas for the UK National Institute of Economic and Social Research, 1948) shows comparative productivity per head in certain manufacturing and mining industries for the UK, Germany, and the US. Rostas' detailed tabulations, weighted with British net output and taking physical output per head in manufacturing and mining industries in the UK as 100, show comparable figures of 107 for Germany and 238 for the US, for corresponding (not identical) years 1935-1937.

A report by the Coal Mines Committee of the International Labor Organization published in 1951 undertakes a detailed theoretical and statistical study of productivity in coal mining. For example, in 1949 the output of coal in tons per man shift (underground and surface workers) is shown as 1.18 for England, 0.70 for France, 1.33 for Poland, 1.09 for Czechoslovakia as compared with 4.82 for bituminous (excluding opencast) and 2.55 for anthracite mining in the US. A similar comparison of Russian and US experience is given

in an excellent summary of Soviet productivity statistics by Walter Galenson (Rand Corporation P-126). Galenson estimates that in Russia before the war, coal output per man-day was 1.12 tons; which he compares with a US figure of 4.37 tons. On the basis of fragmentary data he observes that "coal fields devastated during the war had not recouped their 1940 labor productivity by the end of 1949, but that the decline may have been offset by a shift of output to the relatively more productive fields in the Urals and Asiatic Russia."

Several Russian sources (discussed more fully in IV, below) compare labor productivity in selected plants and industries in that country with similar ratios for the US, England, Germany and give scattered comparisons with other countries. For several years prior to 1937, productivity in Russia is compared with that in other countries in the form of data such as the following: iron smelted per worker, square meters of cloth produced per worker, and workers per kilowatt capacity in steam power stations. Also for several years, data are shown purporting to indicate the number of man-hours required to produce a wide variety of products such as shoes, lathes, and tractors, as well as aircraft, tanks, guns, and other military equipment. For still other industries, data are available in terms of output per worker in rubles. In most cases such information does not appear to be available for years after 1937. In that year Russian sources claim that productivity was 3.3 times that in 1913. For postwar years the meager reports on Russian productivity are limited largely to rates of change. For 1947 to 1950, Soviet authorities (Trud) report an annual increase of 12 to 15 percent and the attainment by the end of the latter year of a level of productivity 37 percent above that of 1940. For 1951, Pravda claimed an increase of 10 percent over 1950.

It is generally recognized that Russian indexes of physical output in manufacturing and mining industries (at least those that have been published) have an upward bias arising from the method of their calculation. (See Review of Economics and Statistics, November 1947). A corresponding upward bias probably exists in Russian estimates of productivity. Certain Russian estimates suggest that productivity in manufacturing and mining in that country in 1937 was 40 percent of that in the US. This figure, however, is too high. Moreover, not until 1948 did Russia exceed the prewar level of productivity. Since the latter year, production and productivity have continued to increase more rapidly in Russia than in the US.

4. Productivity Ratios as Estimating Devices.

Economic intelligence estimates, as is well known, frequently must be based upon scattered bits and pieces of information. We may desire, for example, to determine the amount of the output of a particular plant or industry but may have, or can secure, only such data as: the number of workers, the area of factory floor space, electric power consumed, train-loads of a key material input moving to one or a group of plants, etc. It may be necessary to estimate output as best we can from such bits of information together with known productivity ratios from other plants in a given country or ratios from plants or industries in other countries.

An examination of individual plants, however, even when they are all in the same country and, superficially, appear quite similar or even identical and thus are assumed to have the same productivity characteristics, often exhibit wide differences in output.* The marked differences that may be found in labor productivity ratios in different countries are examined in this study. For example, the number of man-hours of labor required per 1,000 kilowatt hours of electric power generated in steam power plants of comparable size may be in Russia from five to six times that in the US. Manifestly any productivity ratios which are extrapolated from one country to another should be corrected for observable differences between the two countries. Before any such specific productivity ratio (in terms of one input only) is used every effort should be made to determine not only the relative effectiveness of the particular input concerned, for example, "skilled labor," but also that of other factors such as: (a) the type of plant (extent to which electrical or mechanical power, improved machinery, automatic controls are used, etc.; (b) the grade of raw material inputs (e.g., ore of 30%, 40% or 50% iron content etc.); (c) comparability of the product output.

Even with the exercise of great care, a wide margin of error is likely, and should be clearly recognized, in an estimates of output based upon productivity ratios. To take an arbitrary but realistic illustration: we may list the output of a given plant as 1,000 units whereas all that we may know is that it is probable, in 9 cases out of 10, that the actual figure lies somewhere within the range between say 600 and 1,800. The statement of such a range is more complete, more "accurate" than a single figure.

In view of the widely differing proportions in which labor of various skills, machinery, power, and other factors may be used in different countries to produce closely similar products, estimates should be based, if at all possible, upon more than a single type of data and single productivity ratio. Thus, if output is estimated primarily by means of the number of workers and a labor productivity ratio, an effort should be made to check such a result by using floor space, number of facilities (as blast furnaces, presses, etc.) raw material inputs, or similar suitable measures of another major input. It is also possible to fill in some difficult gaps using the method of inter-industry flows (input-output analysis). For many basic industries (but not final products), the pattern of commodity flows between sectors is more nearly comparable in two countries than are the productivity ratios such as units of product per worker.

Forward projections of output for a given industry or for a country as a whole also are sometimes based upon productivity ratios and expected amounts of a factor of production in a future period such as numbers in the working force or augmented plant facilities. Such an estimate based solely upon one factor of production is fundamentally illogical and may prove to be incorrect. For example, an estimate based solely upon the number of workers and labor productivity is strictly valid only when the limiting factor is the

*Illustrations may be found, both in the UK and in the US, of plants built from identical designs and with working staffs of approximately the same size and composition whose outputs of identical products differed by as much as 20 to 30 percent. Also see Rand Corporation, RM 563, Estimating Output from Floor Space, March 1951.

number of persons in the working force. Even in the latter case the only productivity ratios available are gross averages and give no indication of the actual ratios for increments in production (the latter may be more or less than the average). There is, in fact, no single measure of productivity or future economic capability of a country which has general applicability. Over any appreciable period, say 3 or 4 years, the various factors of production can to some extent be substituted for one another (for example, more labor or machinery may be used to save scarce materials, or machinery may be permitted to run down in order to save scarce labor) but, what is even more significant, final products may be substituted for one another.

III. Concepts of Productivity and Methods of Measurement.

Productivity in its simplest terms is a relationship, a ratio of outputs to corresponding inputs, or, the converse, the amount of input per unit of output. Such a rate may apply to a particular establishment, an industry, or an entire national economy. It may deal with a single input factor or with several factors of production. There are many different ways in which productivity has been expressed, the most important of which are: labor productivity ratios, comparisons of composite indexes of outputs and inputs (particularly for agriculture), parameters of the variable factors in a production function, and the technical coefficients in a system of general interdependence (explained briefly below).

1. Labor Productivity Ratios: Methods of Measurement and Uses.

In the great majority of productivity studies, labor is the only input considered. The effects of changes resulting from other factors (resources, equipment, working capital, management) appear only as "labor" productivity. Measures of labor productivity usually take one of the following forms*:

a. Value of output (in constant prices) per unit of labor input in a given industry or establishment: (for example, annual output of the "machine building" industry in rubles, at 1926-1927 prices, divided by the number of workers in that industry.) This method is used extensively in the USSR, as well as in the UK, the US, and other countries.

*There is an extensive literature on this subject. See bibliography at end of this report. Some of the principal sources are: L. L. Kukulevich and M. A. Rubin, Planirovaniye i Analiz Trudovykl Pokazateley, 2d edition, Moscow, 1948.
Methods of Labor Productivity Statistics, International Labor Organization, Geneva, 1951.
Laszlo Rostas, Comparative Productivity in British and American Industry, Occasional Papers VIII, National Institute of Economic and Social Research, Cambridge University Press, 1948.
US Bureau of Labor Statistics, Summary of Proceedings of the Conference on Productivity, October 1946, Bulletin No. 913.

b. Physical units of output per unit of labor input: for example, tons of coal per man shift.

c. "Value added" in a particular industrial process per worker (or per any other unit of input).

d. Aggregate national product or national income at constant prices divided by total labor force. The labor figure sometimes is adjusted to allow for differences between countries or changes over time in number of working hours per day. The productivity measure thus appears as "total real national product per man-hour" as in Colin Clark, The Conditions of Economic Progress, 1951 edition, and The Economics of 1960.

e. Labor input per unit of product output: for example, man-hours per locomotives built. This is the reciprocal of b, above, and is sometimes designated "unit labor requirements."

Labor productivity ratios are used for many different purposes: such as: to indicate changes over time in the productive capability of a country or industry, to compare the "industry efficiency" of different countries, and to estimate future productive power (using expected labor force as multiplicand and a forward projection of labor productivity as the multiplier). They also are sometimes used for rough estimates of production in individual plants on the assumption that, for practical purposes, all factors are identical in the plant for which the estimate is to be made and that from which the ratio was calculated. Productivity norms or standards also have been used for comparison with corresponding figures calculated from output of individuals or plants as a basis for compensation or disciplinary action and as a propaganda measure in promoting greater effort by workers or by management. Notwithstanding their extensive use, labor productivity ratios by themselves are very inadequate measures for purposes of economic analysis.

2. Labor Productivity Ratios: Limitations and Defects.

The principal limitations of indexes of labor productivity (or average productivity ratios based upon any single input) are as follows:

a. Differences in labor productivity as such do not reveal the fundamental causes of the differences which they purport to measure. High (or low) output per man-hour may be due to (1) extensive (or little) mechanical or power-driven equipment or other real capital per worker; (2) adequate (or inadequate) working capital including inventory stocks; (3) availability (or lack) of high-grade raw material inputs; (4) sustained demand for products of industry at optimum level of output (or frequent fluctuation away from optimum level); (5) changes in character of aggregate production: shifts from less to more productive industries (or converse); (6) efficient (or inefficient) management; (7) advanced (or retarded) level of technical knowledge and extent of its impact on industrial practices; (8) the intrinsic skill, energy, ability, and willingness to work (or the absence of such qualities) of the workers themselves and other possible causes.

b. Some cost reducing (or increasing) changes may not even be reflected at all in measures of labor productivity. Reductions in raw material inputs (due to changes in design or processing methods), for example, or reductions in capital cost (two shift operations rather than single shift) may not disturb the output/labor ratio in any way but may have important effects on productive

efficiency.

c. Measures of labor productivity are useful in calculating future productive capacity only insofar as the mere total number in the labor force available to a given industry is the limiting factor.

d. Labor productivity in terms of direct labor does not give a true measure of the total labor required. It takes no account of supporting activities such as those for maintenance, distribution, new construction, etc. In the Russian statistics, engineering and technical personnel, administrative and clerical personnel, service personnel, and apprentices usually are excluded. Only the workers participating directly and engaged in physical labor are included. Some attempts have been made (especially by Marxist economists) to obviate this defect by an endeavor to calculate a measure of "total productivity" which includes hours of work "invested" in factors such as power, materials, and equipment. As is indicated elsewhere in this paper, such a method is based upon a false concept of the economics of production. The contribution of any given factor to total output bears no necessary relation to the number of man-days involved in its creation.

e. The usual productivity ratio is merely an overall "average" concept (total output divided by total units of labor). This ratio may differ at different levels of output. Logically, a marginal or incremental ratio should be used in any process of estimation of increased production level.

f. The relation of labor productivity to wage and price policy often appears in discussions of this character, but is not pertinent to the present inquiry.

g. There are also many statistical limitations such as lack of comparability of products, difference in length of work period in different countries (hours per day or week), differences in weights used in aggregation of industries etc. which are not examined in this paper but must be recognized in any attempted use of labor productivity statistics.

3. Composite Productivity Indexes: Ratios of Aggregate Outputs Divided by Aggregate Inputs.

In recent years there has been developed in the US a composite measure of productivity in terms of several outputs and several input factors. Glen Barton and others of the US Department of Agriculture who have developed this method have made extensive studies of the relation of agricultural production to various separate inputs and to an aggregate measure of all inputs. The principal inputs considered separately are: land used for crops, farm labor, and farm power (animal and machine). An index of total physical inputs in agricultural production is derived by aggregating constant dollar costs of: all farm labor; net land rent; maintenance and depreciation (of buildings, motor vehicles, machinery and equipment); operation of motor vehicles; interest on investment (in machinery, livestock including horses and mules, crops, and vehicles); fertilizer and lime; and miscellaneous operating expenses. In aggregating these various components there were used either (a) physical units (for example, man-hours) multiplied by 1935-1939 unit costs or (b) estimated costs in current dollars deflated by a price index on a 1935-1939 base. The productivity ratio is

obtained for a given year by dividing an index of total production by the corresponding index of inputs (described above).

4. Production Function.

A more general, and logically more correct, formulation of the process of production, and the corollary productivity ratio, than either of the two methods discussed above is the well-known production function of a firm or industry. With the data at present available, this method is suitable for practical analysis in only a very few isolated cases. However, reference is made to it in this study because of its clear, comprehensive, and logical formulation of the production process. It is an excellent guide to analysis, and its consideration will often prevent serious errors in the study of the economics of production.

The production function is a general expression (usually for a firm or industry) of the various technical possibilities between the number of units of output of a given product and the corresponding quantities of all the pertinent factor inputs: materials; plant and equipment and working capital; power, transportation, and other services; and the various other factors. A determination of the optimum proportions of the factors usually involves the principle of maximization: maximum output from given resources or minimum inputs for given outputs. This method has important applications to the analysis of production in authoritarian as well as in free individualistic economies. In a given state of technique, relative availability of the factors, and period of time in which the inputs are considered to be variable there is a determinate relationship between the various levels of output and the optimum amount of each factor required.

The most significant "productivity" ratio is the small increment in production associated with a given small input of each factor taken separately. There is no assurance that this ratio for any factor will remain constant as production increases. These changes in output associated with given inputs at various levels can be determined or estimated only by study of the particular industry concerned. Crude labor-productivity ratios, as already indicated, assume a constant ratio over the entire range and completely ignore important aspects of production. The "productivity" of any factor may change as a result of a change in the level of output, in the relative availability of the various factors, and in the intrinsic quality of any of the factors, or it may change as a result of the introduction of new technical processes. (For a more complete discussion of the production function, see any good treatise on economic analysis).

5. General Interdependence.

The preceding section has considered productivity as a characteristic of a separate plant or industry. A more complete analysis of productivity from the point of view of its relation to the economic capability of a country requires a consideration of two additional elements: (a) the character of the demand for final end-products and (b) the interrelationships between the various industrial sectors of the entire economy.

An assessment of the productive capability of an economy can be made realistic only in terms of the particular purposes (civil and military) which it is expected to serve. In both an authoritarian and in a free enterprise economy, such an assessment will depend upon: (a) the structure of consumer demand for end-products, (b) the requirements for various products by the military and other government agencies, and (c) the requirements for economic growth (such as additions to productive facilities and other factors necessary to attain a desired future productive capacity). The essential difference, in this regard, between a free enterprise and an authoritarian economy is that the demand requirements of the latter are determined, largely or wholly, without regard to consumer preferences. The fundamental nature of the industrial processes and pattern of commodity flow, however, may be closely similar in the two countries. In both cases, the demand (requirements) as well as the supply (production) elements are essential to a definitive assessment of the economic capabilities of a country.

Moreover, production in a modern industrial economy is characterized by an elaborate division of labor among the various industrial sectors. These sectors are highly interrelated and interdependent. The dependence, for example, of the automobile or munitions industries upon electric energy, steel, copper, and many other materials and services and the dependence of the latter upon fuel, minerals, and other natural resources and upon transportation to particular places as well as the dependence of all of these industries upon the machinery industries for maintenance and expansion are simple facts of common observation. In this process there is some substitutibility: for example, if copper is scarce, aluminum can replace it for certain uses (if aluminum is not required for more urgent needs). This fundamental interdependence of the various sectors must be recognized in a complete analysis of any national economy.

We are led directly to the conclusion that a definitive analysis of the economic power or efficiency of any national economy must recognize the structure of demand and the general interdependence of the various industrial sectors. The most satisfactory method thus far developed for this purpose is the Leontief input-output model. It is not necessary, in this paper, to describe this method in detail. For such a description, reference is made to The Structure of the American Economy, second revised edition, Oxford, 1951, by Wassily Leontief or to a briefer statement by Duane Evans and Marion Hoffenberg in the Review of Economics and Statistics for May 1952.

In some ways this method seems simple, plain, and obvious where, in fact, it is exceedingly complicated. Only by the most diligent and persistent effort can it be made to yield useful results. It has been applied successfully only to a few countries, the US, the UK, and the Netherlands. It was tried, as an intelligence project, upon Germany during the second World War. A quick preliminary analysis for the USSR based primarily upon data found in the 1941 Plan was made by the Rand Corporation during the summer of 1952.

The first stage in such an analysis is the assembly for a given year, of all available data for each of the various sectors showing, wherever possible, output totals for the sector and the distribution of output to the

several using sectors. In arriving at the final values, a wide variety of data may be used: monetary values, physical quantities, percentage distribution of products to using industries, breakdown of costs in terms of various inputs, and similar information. Some data of this character are referred to in the abstracts from productivity studies in Annex B. In the initial application of this method to the Soviet Union, it may be necessary to start with a prewar year such as 1935 or 1941 for which considerable information is available on the distribution of products to industrial uses, etc. Such detailed information would be of assistance in establishing a system of technical coefficients which could be amended as necessary in the light of subsequent changes. Such a table at first probably will show more blank spaces than sectors for which data prove to be available (a very incomplete cross word puzzle). With the aid of specialists in various industries and their knowledge of product distribution and technical coefficients for other countries it should be possible, by careful estimation, to extend considerably, our description of the Soviet economy. The effort involved appears to be warranted by the fact that this is the only formal method by which indirect as well as direct requirements attributable to any appreciable increase in any sector (e.g., in military procurement) can be assessed and that no other method leads to a complete and consistent evaluation of the economic capability of a country.

The initial emphasis manifestly is upon securing descriptive data, directly where possible, otherwise by extrapolation from the experience of other countries by competent industry specialists. Elaborate algebraic analysis is not warranted until the most adequate data possible have been assembled and a reasonably accurate description of the Soviet economy provided for some recent period. The nature of the method is such, however, that algebraic analysis becomes very powerful for examining the consequences of forward projections of major changes in policy or changes in technology in particular sectors.

As clearly implied above, the analysis of an economy in terms of general interdependence in no sense supplants the most careful and detailed observation of the various individual producing and consuming sectors, including their input-output behavior, changes in such inputs and outputs, their technical characteristics and prospects for expansion. The analysis of economic interdependence is, in a way, a consummation of such individual industry studies and a test of their consistency, each with the others. It brings into consideration also important factors (such as the secondary effects upon material supplying industries and capital goods industries) which are ignored in the study of isolated industries. One of its most useful purposes is to assess the capability of a country to meet the total requirements implied in a given military policy and program of economic expansion or to evaluate the consequences on the economic system of changes in policy or in technical progress in particular sectors. In almost every respect the analysis of economic interdependence and the analysis of particular industries are complementary methods.

IV. Available Productivity Statistics, with Special Reference to International Comparisons.

1. Introduction.

The extensive data on productivity which have been compiled in recent years are confined largely to particular industries and to single countries.

There are, however, a few quantitative studies which purport to compare the productivity in two or more countries. With only a few exceptions, these international comparisons are in terms of output per unit of labor input (number of workers, manshifts, or man-hours). The principal exceptions are in the field of agriculture where comparative outputs per acre or hectare are sometimes made.

The defects of labor productivity as a meaningful and accurate statistic have been pointed out elsewhere in this paper (Part III, Section 2). International comparisons introduce some further difficulties, such as differences in the quality and nature of products in the various countries and (if comparisons are made in value terms) suitable exchange rates. These difficulties in most areas are less serious, however, than the essential ambiguity of the output labor ratios as a fundamental measure of productive efficiency of a country. As already observed, direct comparison of physical production of strategic items or, much better, physical production in relation to the economic requirements for the support of a given military or other national policy is a far better method in this context than are productivity statistics, and are likely to be equally available.

Subject to these limitations there appears in the following sections of this report a review of the principal comparisons which have been made between productivity in various countries. In some cases, more extensive data are given in Annexes A and B.

2. UK and US Comparisons: Years 1924-1925.

Relative productivity in the UK and the US has been a subject of considerable interest for many years. An early study on this subject by Sir Alfred Flux appeared in the Quarterly Journal of Economics for November 1933. This article compared UK and US production, employment, mechanical horsepower, and other statistics for the years 1924 and 1925 respectively, and continued the comparison up to the UK census for 1930. Flux found that both wages-per-operative and net output per person in the US were more than double the UK figures.

The author observed that the physical output in the US was greater than that in the UK in much the same ratio as mechanical power used. (Subsequent investigations of individual industries have not fully supported the differences in mechanical power as the sole or major cause of differences in productivity).

Having examined the evidence, the report concludes, "It appears impossible to escape the evidence of a larger physical output, per person employed, in the US than in UK. an output more than double as great in the former country as in the latter."

3. Comparison UK, Germany, and US: Years 1935-1937.

The most thorough and detailed comparison of productivity in various industries in two or more countries is that by Dr. Laszlo Rostas for the UK, the US, and Germany. Rostas' studies cover several mining and manufacturing

industries as well as agriculture for all three countries. (See L. Rostas, in bibliography for specific citations). The following is abstracted from a longer table in the Economic Journal for April 1943.

Physical Output per Head in Certain Manufacturing Industries and Mining[a/]
(In Each Industry, UK taken = 100)

Trade	UK 1935	Germany 1936	US 1937
Coal (all countries for 1936)	100	143	263
Blast furnaces products	100	115	361
Smelting and rolling of iron & steel	100	114	168
Cement	100	92	106
Motor cars	100	98	419
Radio sets	100	70	482
Cotton spinning	100	120	120
Cotton weaving	100	68	130
Beet sugar manufacturing	100	34	162
All industries (many more than shown above)			
Weighted with British net output	100	107	238
Weighted with US net output	100	104	229

a/ Selected industries from Rostas. op.cit.; much fuller excerpt in Annex A UK.

Rostas' detailed studies yield much the same result as those of Flux for a period some ten years before. US output per worker in manufacturing and mining in 1937 was of the order of 2.3 times that in the UK for the nearest comparable year (1935).

In agriculture, the productivity in the US was only slightly higher than that in the UK, but in both countries it was higher than in Germany, as indicated in the following table.

Comparison of Productivity in Agriculture:
UK, US, Germany[a/]
(In year 1937 or 1937-1938)

	US	UK	Germany
Net Output per head	$584	£159	Rm 1,534
As index numbers based on purchasing parity rates	104	100	57

a/Above data from L. Rostas. Comparative Productivity in British and American Industry, op.cit., Table 100.

4. Anglo-American Council on Productivity: Years 1949-1950.

One of the most recent studies of productivity in the US and the UK is that during 1949 or 1950 by the various committees of the Anglo-American council on productivity. Combined labor-management survey teams have studied a wide range of different industries in the two countries. Although the results of these surveys are primarily qualitative, not quantitative, in character, they have, in general, confirmed the calculations of Flux and Rostas for earlier years that output per head in mining and manufacturing in the US is approximately twice that in the UK. The following are some of the principal factors to which the survey teams have attributed the higher productivity in the US.

(a) Psychological attitudes: "productivity consciousness" at all levels; readiness to accept technological and other changes; labor-management team spirit; individual attitude toward work.

(b) Technological progress: superior arrangement of processes and specialization of operations and standardization of products (long runs of standard products).

(c) Capital: greater availability of machines and other capital.

(d) Labor: more complete utilization; assignment of duties appropriate to skills; simple wage structure but with incentive provisions (reward for productivity).

(e) Management: facilitates consumer acceptance of standard products (by advertising); coordinates processes effectively (procurement, design, production, sales); has provided flexibility in productive facilities.

5. Russian Productivity: Galenson for Rand Corporation.

The most concise summary (in English) of Russian productivity statistics is a compilation and analysis by Walter Galenson. This material is available in two places: Industrial and Labor Relations Review, Cornell University, July 1951, and in Rand Corporation P-126, Russian Labor Productivity Statistics. Certain excerpts from the latter (Rand P-126, unclassified) are shown below.

Labor Productivity in Soviet Industry

1928 - 1940

Year	Index of Labor Productivity (1928=100)	Annual Increase in Productivity (Percent)
1928	100.0	
1929	112.9	12.9
1930	123.0	9.7
1931	133.3	7.6
1932	136.8	2.6
1933	148.7	8.7
1934	164.6	10.7
1935	181.1	10.1
1936	253.9	22.4
1937	249.9	6.6
1938	276.0	11.0
1939	342.1	16.3
1940	360.0	8.7

Sources: 1928-1935: Trud v SSSR, 1936, pp. 2-3
1936-1937: SSSR i Kapitalisticheskiye Strani, 1939, p. 75
1938 : Sotsialisticheskoye Stroitel'stvo Soyuza SSSR (1933-1938), p. 38
1939 : Akademiya Nauk SSSR, Proizvoditelnost Truda i Promishlennost SSSR, 1940, p. 8
1940 : Sh. Turetski, Proizvoditelnost Truda, 1947, p. 49

With /certain stated/ reservations, the trend of labor productivity in Russian industry is shown in the above table on the basis of direct Russian statements. These figures have been computed independently for the years for which the underlying data were available, with the following results:

Year	Average Number of Employed Workers (Thousands)	Annual Value of Product (in Millions of 1926/27 Rubles)	Annual Output per Worker (1926/27 Rubles)	Index of Productivity (1928=100)
1928	2558.0[a]	15,818	6184	100.0
1932	4668.5[a]	36,878	7899	127.7
1933	4576.4[b]	39,934	8726	141.1
1934	4949.0[b]	46,847	9466	153.1
1935	5588.6[a]	58,800	10521	170.1

Sources: (a) Trud v SSSR, 1936, p. 93. The 1928 figure in this source was adjusted by subtracting the number of apprentices, as given in Trud v SSSR, 1930, p. 12.
(b) Trud v SSSR, 1935, p.
(c) Trud v SSSR, 1936, p. 91

"The computed data consistently indicate a somewhat lower productivity increase than that claimed by the Russians, the differences varying between 6 and 12 percent for individual years. The source of the divergence is not clear, for the computations were based upon the series which it would have appeared logical for the Russians to have used, and upon the concept explicitly indicated in the Russian sources. However, the magnitude of the differences is certainly not sufficiently great to impugn the internal consistency of the Russian data, or to warrant dismissal of the Russian productivity data as meaningless. Further analysis may well reveal that the origin of the discrepancy lies in differences in the particular output and employment series used in the respective calculations.1/

"Even allowing for the several reservations indicated above, the productivity gains claimed by the Russians for the period 1928 to 1940 are high indeed. The increase in output per worker in American manufacturing rose by only 11.2 percent during the entire period 1928 to 1939, 2/ and this is precisely the average annual gain indicated by the Russian statistics for the same period. However, the Russian productivity claim is not thereby rendered absurd, for it is quite apparent that their 1928 productivity base was extremely low. In 1937, by which time their productivity index, based upon 1928, had risen to 250, the Russians themselves conceded that labor productivity in Soviet industry had attained only 40 percent the United States level.3/ Intuitively, as well as on the basis of comparison that may be made for individual industries, the Russian "concessions" would seem quite high, particularly when it is recalled that British man-hour productivity during the period 1935-1939 has been estimated at about 36 percent of the American level. 4/

"Wartime and postwar productivity trends in the USSR cannot be linked to the pre-war data because of the absence of a common base. The wartime productivity experience can be estimated as follows:

Year	Index of Labor Productivity (1941=100)	Annual Increase in Productivity (Percent)
1941	100	
1942	119	19
1943	127	7
1945	140	5

1/ In this respect, see Trud v SSSR, 1936, p. 369, footnote 3, which suggests that a more inclusive employment category was used in the Russian computation than in the computation shown in the text.
2/ L.Rostas, Comparative Productivity in British and American Industry.
3/ I. I. Kuzminov, Stakhanovskoye Dvizheniye, Moscow, 1940, p. 189.
4/ L. Rostas, op. cit., p. 27

Sources: 1941-1943: Voznesenski, op. cit., p. 113.
1945 : Turetski, op. cit., p. 49

"The great productivity increase in 1942 compared with 1941 was undoubtedly due to the low level of 1941 productivity occasioned by the disruption of production attendant upon the German invasion. For the four war years, the average productivity increase per year was 9 percent.

"For the first three years of the Fourth Five Year Plan, the following labor productivity experience is claimed:

Year	Index of Labor Productivity (1946=100)	Annual Increase in Productivity (Percent)
1946	100	
1947	113	13
1948	130	15

Sources: 1947: Pravda, January 18, 1948
1948: Pravda, January 20, 1949

"It is stated that in 1948, labor productivity in industry exceeded the prewar (presumably 1940) level, implying that during the years 1941 to 1947, labor productivity was substantially below 1940."

Comparison of Calculated and Direct Russian Statements of Annual Output per Worker in Coal Mining 1928-1937

Year	(1) Estimated Output per Worker (Metric Tons)	(2) Stated Output per Worker (Metric Tons)
1928	144	
1929	156	174
1930	170	
1931	172	
1932	170	
1933	188	189
1934	227	224
1935	260	257
1936		306
1937		315
1938		326

"Even with the substantial productivity gains allegedly achieved in Russian coal mining during the first three five year plans, output per worker remained far behind the US level. The Russians have stated that output per worker in Russian coal mining in 1936 was 38 percent the 1929 US level.

"Output per man-shift in US bituminous coal mining in 1938 have been estimated at 4.37 tons. For the USSR, annual output per worker in 1938 was 326 tons, and the number of days worked per year in the vicinity of 290, yielding 1.12 tons per day. On the basis of these data, Russian coal productivity would seem to have been only 26 percent of the current US level in 1938. Whichever of the figures, 38 percent and 26 percent, more nearly represented the actual circumstances, the general conclusion regarding relative pre-war productivity is clear.

"There are not sufficient data to permit the formulation of definite conclusions on the course of labor productivity since 1940. It is possible only to record a few impressions, and to wait until the release of additional information by the Russians permits further analysis."

* * *

"It seems reasonable to conclude that the coal basins which had been occupied during the war had not recouped their 1940 productivity by the end of 1949."

* * *

"The total industry productivity figures released since the conclusion of the war are as follows:

Increase in productivity from:

Second quarter 1947 to second quarter 1948 - 11 percent.
Third quarter 1947 to third quarter 1948 - 10 percent.
First quarter 1948 to first quarter 1949 - 11 percent.
Second quarter 1948 to second quarter 1949 - 13 percent.
Third quarter 1948 to third quarter 1949 - 14 percent.

"There is also a reference to a six percent productivity increase during 1948, which does not seem to square with the 1948 data immediately above, as well as the statement that "the growth of labor productivity /in coal mining/ still lags behind the prewar level."

6. Russian Productivity: Various Sources.

Russian literature on productivity and related subjects contains extended discussions of theory, methods of calculating indexes of productivity, conditions which affect labor productivity, and calculation of productivity norms (worker performance requirements). The statistical materials are shown most frequently in terms of relative changes from one period to another, such as in Akademeya Nauk SSSR, 1940 (op. cit., Bibliography 2), which reports, for example,

that annual production per industrial worker in 1937 averaged 3.3 times the 1913 figure, while hourly production was 4.5 times that figure; and that during the second five year plan, annual production per worker rose 82 percent; also, that the greatest increase occurred in ferrous metallurgy, the 1937 figure being 226.3 percent of the 1932 figure. The same source also reports such data as: the value of average annual production per worker in 1934 (in 1926-1927 prices) was 1,700 rubles in lumbering, 2,344 rubles in coal mining, 7,220 rubles in ferrous metallurgy, and 13,180 rubles in the food industry.

A few direct comparisons of Russian data with those for other countries such as the following are found in the Russian literature. Vladimirov (op. cit., Bibliography 2) estimates that in 1937 an average of 756 tons of iron was smelted per worker in the USSR, 548 in England, 505 in Germany, and 1,620 in the US. He also refers to a production of 8,200 square meters of cloth per worker in the cotton industry in the USSR in 1937 as compared with 16,800 in the US in 1929.

Kuz'minov (op. cit., Bibliography 2), in addition to statistics showing changes from year to year in Russia, gives the following data for coal and iron production per worker in the USSR and other countries.

Coal Mined Per Worker

Tons per Year

Country	1913	1929	1933	1934	1935	1936	1937
USSR	149	174	189	224	257	306	315
England	264	275	272	287	299	309	314
France	203a/	184	196	212	215	210	195
Belgium	156	177	188	210	216	230	238

a/Prewar boundaries

Iron Smelted Per Worker

Tons per Year

Country	1913	1929	1932	1933	1934	1935	1936	1937
USSR	205		240	265	370	486	640	756
Germany	400	612	474	461	530	590	543	
England	356	366	326	410	455	484	530	513
Belgium	470	525	(----------	----------	not known	----------	----------	-)

He also states that the annual output of steel per worker in USSR rose from 190 tons in 1934 to 460 tons in 1937 compared with his estimate of 406 tons in Germany in the latter year. Kuz'minov's book contains productivity figures for a number of other industries and some individual plants with comparative figures for other countries in a few cases. Two such examples relate to steam power stations and "machine building" factories. He states that the average

number of persons employed in Soviet steam power stations per thousand kilowatts of capacity is 6 times that in comparable stations in the US. Also the "Kalinin Machine Building Factory," Germash Trust, employed 1,695 blue and white-collar workers in 1936 while the Byron-Jackson "Machine Building Factory" in the US of similar capacity, employed only 622.

Demchenko (op. cit., Bibliography 2) and Begidzhonov (op. cit., Bibliography 2) give more recent statistics on production of but not comparable in detail with those in the above-mentioned sources. Begidzhonov also states that the campaign for a rapid increase in labor productivity embraces all Soviet industry, all branches of production, and that labor productivity in 1950 was scheduled to exceed the prewar level by 36 percent in industry (manufacturing and mining) and 40 percent in construction.

Maslova (op. cit., Bibliography 2) shows changes in output per worker in a considerable number of industries. He also gives for several years (1913 to 1937) the number of man-hours required to produce a large number of products such as pig iron, textiles, shoes, lathes, and tractors as well as to build specific types of aircraft, tanks, guns and other military equipment. Other interesting materials in Maslova are a breakdown of costs in various years (materials, administrative cost, amortization, and wages, the latter showing marked increases in "profits" of state enterprises). This publication is reviewed in some detail in Annex B.

7. Productivity in Coal Mining, International Labor Office.

A recent study by the Coal Mines Committee of the International Labor Organization gives comparative data on productivity in coal mining for several countries. For example, in 1949, the output of coal in tons per man-shift (underground and surface workers) as shown in the 1951 Report of that Committee was as follows:

UK	1.18
Western Germany	1.05
Saar	0.84
France	0.70
Poland (1948)	1.33
Belgium	0.64
Netherlands	1.41
Czechoslovakia (1948)	1.09
Canada a/ (underground)	2.44
US (1948)	
Bituminous	4.82
Anthricite	2.55

a/ US and Canadian data are from separate tables. Data shown above do not include open cast mining.

8. Changes in Productivity 1935-1938 to Recent Years in Various Countries.

Index Numbers showing the changes over time in the rate of output per worker have been made for many countries. Such indexes are not comparable between countries except as to relative rates of change. An illustration of compilation of this character is shown below for several European countries.

Changes in the Level of Output per Man in Industry in Selected Countries a/
(Index numbers for each country based on 1935-1938 =100) b/

Country	1935-1938 = 100		
	1947	1948	1949
Austria (c)	47	65	76
Belgium (c)	81	85	93
Czechoslovakia (c)	89	100	102
Denmark	90	95	97
Finland	93	102	107
France	84	95	102
Germany - West. zone	39	52	72
Ireland	102	111	113
Italy	88	92	98
Netherlands	72	77	81
Norway	88	91	94
Poland (d)	87	99	105
Sweden	110	116	118
UK	106	113	118
Total of Countries Listed:			
Including Germany (a)	79	88	96
Excluding Germany	93	100	105

(a) From the Economic Survey of Europe in 1949 published by the United Nations, Economic Commission for Europe, Geneva, 1950.
(See Annex A for more complete tables.)
(b) The index numbers for each country are the ratio of the index of industrial production and the index of employment in manufacturing industries, mining and gas, water and electricity supply. For those countries in which there have been territorial changes, productivity in the postwar territory has been related to 1938 productivity in the prewar area. The totals for all countries listed, however, have been adjusted to constant (postwar) territories for all years.
(c) 1937= 100. The base of the index of production for Belgium is 1936.
(d) 1938= 100.
(e) Western zones only.

9. International Productivity Comparison by Colin Clark.

The most extensive compilations of statistics showing international comparisons of output per worker are those compiled by Colin Clark, particularly in his The Conditions of Economic Progress, 1951 edition, and The Economics of 1960, London, 1943.

The following is abstracted from a table compiled by Mr. Clark, and printed separately, showing estimates for some years 1800 to 1947 for some forty countries.

Levels of Real National Product per Man-hour
(in International Units)

	1850	1900	1913	1920	1930	1933	1940	1944	
US	0.24	0.42	0.55	0.61	0.77	0.72	1.00	0.96	
Spain		0.24	0.27	0.31	0.35	0.37	0.31	0.40	d/
UK	0.22a/	0.30	0.37		0.51	0.51	0.57	0.61	
France	0.10	0.19		0.24	0.31	0.32	0.34	0.21	
Germany		0.26	0.31		0.34	0.38	0.47	0.49	
USSR		0.15	0.17	0.10b/	0.15	0.12	0.18	0.14	c/
Japan		0.03	0.05	0.06	0.14	0.15	0.19	0.18	
Australia		0.43	0.49	0.43	0.64	0.68	0.61	0.63	

a/ 1860.
b/ 1921.
c/ 1945.
d/ 1947.

An international unit as defined by Clark is the amount of goods and services purchased by one dollar in the US in base period 1925-1934. Comparable figures for other countries are obtained by translating real national income per man-hour (i.e., corrected for price changes) into US dollars. Clark's figures are highly regarded in many circles. They involve, however, major statistical difficulties and discrepancies, such as differences in the scope and coverage of national income statistics for various countries (e.g., a larger part of economic activity is in money terms in the US than in Russia or Japan). They also involve discrepancies between the relative real purchasing power of money and the official exchange rates. Consequently, figures for the various years in any one country are likely to be much more reliable than country to country comparisons. It is recommended that the Clark's figures for the latter (country to country) be used only after confirmation or correction following a careful examination of the basic data in each case.

10. Conclusion

The above examples indicate the types and range of productivity statistics that are available for a number of countries. In some instances these productivity ratios may prove to be the only data available on any aspect of production for an industry in a particular country. In such cases, for want of anything else, it may be tempting to use them in one way or another

as a means of estimating production, as a means of estimating future changes in production, or as a direct means of comparing productive efficiency in two or more countries. For the first two possible uses, employment statistics also will be required. In many situations suitable employment data will prove to be quite as difficult to secure or to estimate as data on production itself. Since the productivity ratio is fundamentally ambiguous, we recommend in conclusion, that great care be exercised in any use that is made of such statistics and that research effort be concentrated to the fullest extent possible on direct estimates of actual production.

V. Selected Bibliography of Books, Articles, and Other Material on Industrial Productivity

The following list of references includes the materials which have been examined in connection with this study. It is fairly extensive but does not purport to be complete. The listing below consists of two parts: (1) General and Non-Soviet sources and (2) Material in English and Russian languages on the Soviet Bloc:

1. General and Non-Soviet Sources.

Anglo-American Council on Productivity Team Reports

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Grey Iron Founding Productivity Team, Grey Iron Founding, London and New York, Sep 1950.

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Packaging Productivity Team, Packaging, London and New York, Sep 1950.

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b. Material in Russian --

Akademiya Nauk SSSR, Institut Ekonomiki, Ekonomika Sotsialisticheskoy Promyshlennosti, Moscow, 1940, 598 pp. (LC HC335.A62).

Contents:

1. Stages of development of socialist industry.

2. Production program of socialist industry. Volume, rate, and factors affecting increase of industrial production. -- Structure of industrial production and relation of branches of industry. -- Industry and other branches of the national economy. - Organization and methods of planning a production program for industry.

3. Development of the technical foundations of socialized industry.

4. Concentration, specialization, cooperation, and combination in socialized industry.

5. Distribution of Soviet industry.

6. Capital building in Soviet industry.

7. Basic funds in socialist industry.

8. Productive capacity and its utilization.

9. Utilization and saving of circulating production funds in industry.

10. Labor productivity and wages in Soviet industry.

11. Cost and quality of production.

12. Finance in socialist industry.

13. Organization of management and planning in socialist industry.

Comment: Comprehensive analysis of Soviet production and productivity. Contains statistics for many subjects discussed. Considerable data are available in excerpts from this volume in Annex B.

Akademiya Nauk SSSR, Institut Ekonomiki, Proizvidtel'nost' Truda v Promyshlennosti SSSR, Gosplanizdat, Moscow, 1940. (LC HD 57.A431).

Contents: D. L. Markus, Inexhaustible reserves for increasing labor productivity. -- P. A. Khromov, Labor productivity in Soviet industry and in capitalist countries. -- A. A. Arakelyan, Labor productivity in Soviet ferrous metallurgy. -- S. I. Ghul'kina, Labor productivity in Soviet iron mining. -- P. D. Duz', Labor productivity in the Soviet coal industry. -- N. N. Nikolayevskiy, Labor productivity in the Soviet petroleum industry. -- K. I. Klimenko, Labor productivity in the Soviet machine-building and metallurgical industry. -- A. I. Kats, Labor productivity in the Soviet basic chemical industry. -- P. A. Khromov, Labor productivity in the Soviet cotton industry. -- L. V. Opatskiy, Labor productivity in the Soviet sugar industry.

Comment: Useful. Contains statistics of actual production and productivity.

Arakalian, A., Upravlenie Sotsialisticheskoi Promyshlennosti, (Administration of Socialist Industry), Moscow, 1947. (LC HC 335.A824)

Contents: The first 75 pages are an attack on the American and West European system of industrialization, and a praise of the system existing in the satellite countries.

The second chapter discusses the historical development of forms of administration in the USSR industry.

The third chapter describes the usual basic principles of the organization of administration of socialist industry (1 manager, choice of cadres, and personnel, control, "Khozraschet", etc). The rest of the book (pp. 139 through 231) discusses the organization structure of government and cooperative industry in

the USSR, the problems in organization of industry during and after the war, and the role of party and trade union organizations in the administration of industrial production.

In the entire book, there were only two points at which something else than theory was discussed, namely (1) on page 190:

"The specific weight of the Eastern regions of the Soviet Union will increase":

	Percentage of Total Production in Eastern Regions	
	1940	1950
Cast Iron	29%	44%
Steel	34%	51%
Rolled Metal	34%	51%

and (2) on page 198: % of specialists with a higher education used on January 1 in 1946: in industrial ministries and departments: 25.6% - directly on production; 23.1% - plant administration; 51.3% - in middle and higher links of administration.

Begidzhanov, N., Tekhnicheskoye Normirovaniye i Vnedreniye Progressivnykh Norm, Moscow, 1950, 44 pp. (LC T58.B295)

Contents: Increased labor productivity is a law of socialist economics. -- Problems concerning technical norms in Soviet industry. -- roductive operations and their structure. -- Technical norms and methods of setting them. -- Technical and economic indices of utilization of equipment and consumption of materials. -- Setting labor norms and their role in socialist competition.

Comment: Good for terminology. Especially good for a study of norms.

Berri, L., Spetsializatsiya i Kooperirovaniye v Promyshlennosti SSSR, Moscow, 1946. 87 pp. Akademiya Nauk SSSR, Institut Ekonomiki. (LC HC 335.B38).

Contents: Development of specialization and cooperation in Soviet industry. -- Specialization and cooperation as a method of mobilizing industry. -- Specialization and cooperation in socialist industry during the Fatherland War. -- Some problems in the field of specialization and cooperation in the postwar period.

Comment: Contains production figures for individual plants and products. Book discusses advisability of limiting assortment in individual factories.

Demchenko, Mariya Safronovna, Puti Povysheniya Proizvoditel'nosti Truda v Sotsialisticheskoy Promyshlennosti, Moscow, 1950. 50 pp. (LC T58.D37

Contents: Importance of steadily increasing labor productivity in socialist economics. -- Important methods of increasing labor productivity. -- Indices of labor productivity. -- Toward a new increase in labor productivity.

Comment: Useful for theory of labor productivity and of indices.

Ermakov, S.F., Osnovy Organizatsiy Truda i Tekhnicheskogo Normirovaniya, published by the Ministry of the River Fleet, Moscow, 1948. (LC T58. E68).

Contents:

1. Labor productivity.

2. Technical norms. Productive operations and their components parts. -- Technical time-norm and output norm. -- Analysis of working time. -- Methods of setting norms. -- Norms in effect in enterprises under the Ministry of the River Fleet. -- Studying working time by observation. -- Photography of the working day. -- Analysis of photographic observation. -- Normal balance of working time. --

2. Organization of labor and wages. Division of labor, assignment of workers, and brigades. -- Working instructions. -- Organization, installation, and operation of the shop. -- Filling the working day. -- Labor discipline. - Safety. - Analysis of wages and level of labor productivity. - Analysis of utilization of workers' qualifications. - Collective agreements. -- Preparation of personnel. - New methods of labor in river transport. -- Terminology.

Comment: Theoretical and highly technical; contains many formulae for computing various factors. Contains no actual statistics.

Gurin, L. E., Voprosy Organizatsiy Zarobotnoy Platy na Mashinostroitel'nykh Predpriyatiyakh, Moscow, 1950. 276 pp. (LC Law KK 2520.G8).

Contents:

1. Socialist principle of distribution according to work; problems of organization of wages in socialized industry.

2. Regulation of wages and the wage-scale system.

3. Forms of wages and wage systems.

4. Calculation of the necessary wage funds and regulations limiting wages.

5. Analysis of disbursement of funds and structure of wages.

6. Measures for improving the utilization of funds and practical organization of wages.

Appendices: 15 laws concerning wages.

Comment: Of no direct value for a study of productivity. Analysis of the relation between labor productivity and wages. (pp. 233-239).

Kantor, L. M., ed. Organizatsiya Vnutrizavodskogo Khozrascheta, Gosplanizdat, Moscow, 1950. (LC TA 183.K3).

Contents: Includes a discussion (page 16) of the need for inclusive clear expression of gross and commodity goods production in terms of labor output, physical units, and value.

Comment: Material seems to be directed towards the setting up of efficient cost-accounting systems.

Kukulevich, I. L., and Rubin, M. A., Planirovaniye i Analiz Trudovykh Pokazateley, 2d ed., Moscow, 1948. (LC HD 5796. K8)

Contents:

Part I: Planning Labor Indices

Part II: Analysis of Labor Indices

1. Analysis of workers' labor productivity.

2. Analysis of expenditure of wage fund.

Comment: One of the most useful sources, from the theoretical point of view. Does not contain statistics of actual productivity or production.

Kuz'minov, I. L., Stakhanovskoye Dvizheniye-Vysshiy Etap Sotsialisticheskogo Sorevnovaniya, Akademiya Nauk SSSR, Institut Ekonomiki, Moscow, 1940. 219 pp. (LC T58.K88).

Contents: Capitalist and socialist labor cooperation. ... The Stakhanov movement and average Soviet labor productivity.

Comment: Concerned chiefly with the Stakhanov movement. pp. 176-197 give considerable useful data on productivity.

Maslova, M.S., Proizvoditel'nost' Truda v Promyshlennosti SSSR, Moscow, 1949. Akademiya Nauk SSSR, Institut Ekonomiki. (LC HD 57.M3).

Contents:

1. Dynamics of labor productivity in Soviet industry. Labor productivity during World War I. -- During the revolutionary period. -- During the Stalin Five-Year Plans. -- During World War II and the postwar Stalin Five-Year Plan.

2. Basic factors in the growth of labor productivity in Soviet industry. New techniques, mechanization of labor, automatic equipment. -- Raising the standard of living of workers. -- Increasing of workers' qualifications. -- Organization of production and labor. -- Socialist principle of pay according to labor. -- Socialist competition and the Stakhanov movement.

Comment: Contains goods statistics for 1913 and subsequent years. A valuable source. Shows changes in output per worker in various industries in considerable detail. Man-hours required in various years (1913-1937) to produce various products, lathes, tractors, pig iron, textiles, shoes and many other products. Also gives man-hours required to build types of aircraft, tanks, guns and other military equipment.

Motkin, A. I., Proizvodstvennaya Programa Promyshlennosti, Moscow, 1941. Vsesoyuznyy Sovet Nauchnykh Inzhenerno-Tekhnicheskikh Obshestv. (LC HD 2326.M6).

Contents: Volume of industrial production. -- Rates of increase and factors affecting increase in Soviet industrial production. -- Structure of industrial production. -- Securing a production program. -- Indices of the program of industrial production.

Rubinshteyn, M. I., ed., Voprosy Organizatsiy i Ratsionalizatsiy Proiz Proizvodstva vo Vtorom Pyatiletiy, Moscow, 1933. 342 pp. (LC HC 335.R7)

Contents: Engr. D. Sanoshinskiy, Socialistic organization and rationalization of production. -- Engr. P. P. Faynguz and M. I. Stanishevskiy, Problems of organization and rationalization of production in heavy industry. -- Engr. V. E. Lunev, Problems of new building. -- B. Levinson and No. Stroganov, Dispatching. -- Engr. V. V. Spiridonov, Planned plant repair. -- Engr. N. G. Belyaev, Methods of rationalizing production in light industry. -- Engr. Ya. B. Faygin, Organization and rationalization of production in the food industry. -- Engr. A. A. Voronets, Organization and rationalization of production in the wood industry. -- P. K. Sunnikov, Problems of technical norms in state collective-farm production. -- Engr. A. I. Sizov, Intraplant planning.

Stefanov, B., Development and Locating of the Productive Forces of the USSR in the 3rd Stalin 5-Year Plan, Leningrad, 1939 (LC H 335 .S76).

Contents:

1. First part: theory and quotations.

2. Second part: A few statistics - machine constructions will increase 229% from 1937 to 1942, volume of all industry will increase 192% in the same period.

3. (Page 21) Volume of industrial production of the Soviet Union in 1936 increased 7.3 times in comparison with 1913. (15.9 times in White Russia, 18.6 times in Georgia, 95 times in Kirgiz SSR, 116 times in the Tadzhik SSR).

(Page 22) Output of agriculture increased 3.7 times from 1926 to 1939. In 1938, there were 483,500 tractors, 153,500 combines, 195,800 hauling machines. 80,000 agronomists, etc.

Volume of capital investment for 3rd 5-Year Plan: 19? billion roubles.

(Page 24) General increase in the capacity of electric construction for the 3rd 5-Year Plan must be: 9 million kilowatts.

(Page 25) Production in the chemical industry must be 2.4 times greater in 1942 than in 1937. - 13-15 new synthetic rubber plants, 16 tire plants, etc.

(Page 27) 11,000 kilometers of railways.

(Page 29-32) Discussion of the necessity to use local resources.

Tsentral'Noye Upravleniye Narodno-Khozyaystvennogo Ucheta Gosplana SSSR, Sotsialisticheskoye Stroitel'stvo SSSR, Moscow 1936. (LC HA 1435 .6 2nd Set - Slavic Room).

A large volume of tables giving official Soviet economic statistics for 1933 and 1934 and some earlier years.

Contents:

Summary: (Includes tables such as the following) Basic indices of the socialist development of the USSR; Comparison of industrial and agricultural production; Rate of growth of the main branches of the economy; Average annual employment of blue and white-collar workers by branch; Capital investment in the socialist economy; Average output per worker in large scale industry; Shifts in the structure of large-scale industry; Concentration of over-time in the economy in 1933, and other tables, some of which go back to 1913.

Industry: (Includes tables such as following) Production of large-scale industry; Basic indices of large-scale industry; Output of important industrial products; Average output per worker; Classification of large-scale and small-scale industry by number of workers in 1933; Gross production of large-scale industry in 1934; Basic indices of large-scale industry in 1934.

Similar detailed tabulations under the following general headings: Agriculture; Construction; Transportation and Communications; Labor; Population; Health; Culture; Distribution (trade) Finance; Foreign Trade.

Comment: Valuable source of Soviet Economic Statistics.

Similar volumes were published in 1934 and 1935. A less complete report was published in 1939 (bears same title as above plus "1933-1938") (LC HA 1431.A38). English translation, published in Moscow 1936, available in CIA Library.

Tsentral'noe Upravleniye Narodno-Khozyaystvennogo Ucheta Gosplana SSSR, Trud v SSSR. (1934 god.), Moscow, 1935.

Contents consists wholly of tables of Soviet labor statistics.

Comment: Invaluable for actual figures.

Turetskiy, S. N., Proizvoditel'nost' Truda I Snizheniye Sebestoimosti v Novoy Pyatiletke, Moscow, 1947. (LC HC 335. T83)

Content: Increasing labor productivity, lowering costs, and socialist accumulation. - Improving the quality indices in socialized industry during World War II. - Increasing socialist accumulation and lowering costs during the new (i.e. post-war) Stalin Five-Year Plan. - Increasing labor productivity during the new Five-Year Plan. - Improving the utilization of material resources as a factor in lowering costs. - Reduction of administrative expenses and elimination of unproductive consumption and wastes. - Lowering costs, accelerating the production processes, and increasing the profits of socialist industry.

Comment: Practically all figures are given as percentages

Vasil'ev, P., Engr. Econ., Ekonomika i Organizatsiya Truda po Materialam Lesnogo i Derevoobrabatyvayushchego Proizvodstva, Moscow, 1932. 204 pp. (LC HF 5549, V35).

Contents: Problems and Factors in Labor Productivity. -- Planning and Principles of Labor Organization. -- Planning and Organization of Working Time. -- Analysis and Organization of Wages. -- Calculation and Analysis of Labor Productivity Measurement and calculation of intensiveness and productivity of labor. -- Practical methods of calculating labor productivity. -- Calculation of production output. -- Value method. -- Physical-unit method. -- Accounting-unit method. -- Norm-time method. -- Selection method. -- Methods of calculation of the dynamics of labor productivity by groups. -- Calculation of labor productivity in lumbering. -- Principles of Planning Labor productivity and wages (Relative growth of labor productivity and wages). -- Economy in respect to wages. -- Plan for enterprises which fulfill the labor-productivity plan. -- Calculation of indices for the growth of labor productivity. Indices in terms of working hours. -- Calculation by value indicators. -- Calculation of wage-increase indicators.

Agencies responsible for labor organization and management, their structure and function.

Comment: Contains much useful material on theory. Also considerable useful data on composition of labor force, women in industry, employment by industry in considerable detail for 1933 and 1934.

Vladimirov, I., Proizvoditel'no Rabotat' vse 480 Minut, Moscow, 1940. 47 pp. (LC T58, V57).

Comment: Contains good statistics on productivity. Shows labor requirements for comparable facilities in Russia and the United States; blast furnaces, open hearths, complete steel mills, power plants, coal mines and other industrial units. Also some political exhortation to work in three shifts.

Zil'Bergleyt, P. B., Proizvoditel'nost' Truda v Kamennougol'noy Promyshlennosti, Kharkov, 1930. 107 pp. (LC HD 9555.R83D6s)

Contents: Discusses increase in coal production in the Donets Basin (1924-1928), rate of mechanization of the mines and categories of workers.

Comment: Contains tables giving productivity of various classes of workers. Period covered not very useful for present purposes.