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DIRECTORATE OF  
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# Intelligence Report

*Indexes Of Soviet Industrial Production, 1950-70*

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## CONTENTS

|   | <i>Page</i> |
|---|-------------|
| Introduction .....  | 1           |
| Background .....  | 1           |
| Description of SPIOER .....   | 3           |
| Evaluation of SPIOER .....  | 7           |
| Coverage of the Product Sample .....  | 7           |
| Reliability of the Quantity and Price Data .....  | 9           |
| Adequacy of the Value-Added Weights .....   | 13          |
| Comparison of SPIOER with Other Indexes of Soviet Industrial Production ...   | 19          |
| Comparison of SPIOER with Official GVO Indexes .....  | 19          |
| Comparison of SPIOER with Soviet Input-Output Indexes .....   | 22          |
| Comparison of the SPIOER Producer Durables Index with an Index of<br>Soviet Investment in Equipment .....             | 24          |
| Comparison of the SPIOER Consumer Durables Index with the Official<br>Series on Production of Consumer Durables ..... | 26          |
| Comparison of SPIOER with Western Indexes of Soviet Industrial Pro-<br>duction .....                                  | 27          |
| Evaluation of Western Indexes .....   | 28          |
| An Alternative Check on SPIOER .....  | 29          |
| Conclusions .....   | 33          |

## APPENDIXES

|   | <i>Page</i> |
|---|-------------|
| Appendix A. The SPIOER Sample .....   | 37          |
| Appendix B. USSR: SPIOER Indexes of Industrial Production and Out-<br>put of Industrial Materials, Machinery, and Consumer<br>Nondurables ..... | 45          |
| Appendix C. Derivation of Final-Product Weights for Civilian and Mili-<br>tary Machinery .....  | 47          |

## TABLES

|   | <i>Page</i> |
|---|-------------|
| 1. USSR: Indexes of Industrial Production .....     | 4           |
| 2. Soviet Ruble Series Incorporated in SPIOER ..... | 5           |

[p. ii blanks]

|   | <i>Page</i> |
|---|-------------|
| 3. Coverage of SPIOER Sample Compared with Soviet Gross Value of Output for 1960 .....  | 8           |
| 4. USSR: Derivation of 1960 Value-Added Weights at Factor Cost for Branches of Soviet Industry .....  | 14          |
| 5. USSR: Comparison of SPIOER Value-Added Weights, Alternative Base Years Moved to 1960 .....   | 15          |
| 6. Comparison of SPIOER Weights with Alternative Soviet Weights for 1960 .....  | 17          |
| 7. USSR: Derivation of 1960 Final-Product Weights for Civilian and Military Machinery .....   | 18          |
| 8. USSR: Comparison of Average Annual Rates of Growth Derived from SPIOER and from Official Soviet GVO Indexes of Industrial Production .....       | 20          |
| 9. USSR: Average Annual Rates of Growth, 1960-66 .....  | 23          |
| 10. USSR: Comparison of the SPIOER Index of Producer Durables with a Soviet Index of Investment in Equipment .....                                  | 25          |
| 11. USSR: Comparison of Sectoral Components of the SPIOER Indexes of Growth with Those of Western and Soviet Indexes of Industrial Production ..... | 30          |
| 12. Line Items Included in SPIOER .....   | 37          |

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CENTRAL INTELLIGENCE AGENCY

Directorate of Intelligence

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INTELLIGENCE REPORT

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Production, 1950-70

INTRODUCTION

The CIA index of Soviet industrial production (hereafter referred to by its acronym, SPIOER) serves as the basis for many CIA reports on the Soviet economy, including estimates of the growth of GNP and measures of the rate of growth of technical progress in the USSR. This report describes SPIOER and explains why an independent estimate of Soviet industrial production is necessary. It also examines the possible biases and range of uncertainty in SPIOER and compares SPIOER with the official Soviet index of industrial production. The report is one in a series of reports designed to present the major components underlying CIA estimates of the growth of Soviet GNP and to appraise their validity.\*

BACKGROUND

1. The industrial production indexes issued by the Central Statistical Administration (CSA) of the USSR are indexes of *gross value of output* (GVO) in constant prices (so-called). They measure the change in the value of output of a given branch or of industry as a whole, where output is defined as the total value of output of all the enterprises in the branch or industry. Therefore, a GVO index represents something more than just the net contribution of each enterprise to production (the value that each enterprise adds to a product as it passes through various stages of manufacture). GVO double counts many

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\*ER IR 69-10, The Gross National Product of the USSR, 1950-68, May 1969, SECRET, describes the accounting framework within which the estimation of Soviet economic growth takes place. ER IR 71-8, Soviet GNP in 1968 Prices, 1950-70, March 1971, SECRET, discusses the conversion of GNP estimates from a 1960 to a 1968 price basis.

Note: This report was prepared by the Office of Economic Research.

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of the inputs that enter into production by including in the value of output of each enterprise the raw materials, power, and semifinished products purchased from other enterprises and already counted once (or more) as output at an earlier stage of production.

2. Because of this and other biases the official Soviet index fails to meet the needs of intelligence estimates. The importance of industrial production in assessing Soviet capabilities in such areas as defense and foreign trade or in evaluating prospects for economic growth requires a more exact measure of the growth of industrial production. An alternative, then, to the official Soviet index must be constructed.

3. Ideally, one would like to measure the change in the net value of output of industry or of industrial branches—that is, gross value of output net of all material inputs other than capital and labor. A rigorous construction of such a net output index would require double deflation—that is, for each enterprise the value of output deflated to constant prices minus the value of material inputs also deflated. These separate series for outputs and inputs and the deflators are not obtainable on an annual basis in most countries and for the USSR not at all. The compromise approach used by the Federal Reserve Board (FRB) for industrial production in the United States is a sample index of industrial products weighted by value added in a base year.

4. SPIOER is CIA's alternative to the official index. It is intended to be comparable in form and construction, as nearly as the data permit, to the FRB industrial production index for the United States. In its unclassified form, SPIOER is generally known as the Greenslade-Wallace Index. This unclassified version of the index was prepared for the Joint Economic Committee (JEC) of the US Congress for inclusion in its 1962 publication, *Dimensions of Soviet Economic Power*, and has served as the basis of contributions on Soviet industrial production appearing in subsequent JEC publications.

5. A preliminary calculation of industrial production with 1968 value-added weights is presented in this report and is being used in CIA estimates of Soviet GNP in 1968 prices. Nevertheless, this report focuses analytically on SPIOER in its more common version—an index employing 1960 branch value-added weights and 1955 price weights for the aggregation of production within branches. The reasons for using the 1960-based version of SPIOER are twofold:

(a) So far, the 1968-based SPIOER is incomplete because the 1968 product prices necessary to replace the 1955 prices used since the inception of SPIOER are unavailable.

(b) The discussions of the relative merits of SPIOER and other Western indexes of Soviet industrial production have mostly concerned the 1960-based SPIOER presented in several JEC publications. In addition, these other Western indexes rely on 1955 product price weights, as does the 1960-based SPIOER. Therefore, a comparison of SPIOER and other Western indexes can be carried out more conveniently if the 1960-based SPIOER serves as the standard.

At the same time the properties of a 1968-based SPIOER are considered in this report, and it is clear that all of the judgments applicable to a SPIOER based on 1960 apply also to SPIOER on a 1968 base.\*

### DESCRIPTION OF SPIOER

6. SPIOER is a value-weighted index designed to measure the growth of a sample of industrial products. At present the sample contains 316 line items representing individual commodities or commodity classes within 14 major industrial branches.\*\* Physical production series are converted to value series by the use of 1955 prices. An annual index of output for each branch is constructed (with a few exceptions) directly from the total value of the sample items included in the branch. Each branch, in turn, is assigned a 1960 value-added weight computed from the wage bill, depreciation charges, and imputed interest on fixed and working capital.\*\*\* (Prices must be used for weighting items included in the branch samples because of the absence of value-added data for the smaller subdivisions of industry.) Aggregation of the 14 value-weighted branch indexes yields the index of total industrial production shown in Table 1.

7. The sample of physical commodities whose production is announced by the Soviet Central Statistical Administration is deficient in two respects. First, most of the reported categories tend to be highly aggregative, thereby obscuring important changes in product mix. Second, some important branches are omitted entirely for security or other reasons.

8. To reduce the impact of the first problem, the series in the SPIOER sample have been disaggregated wherever possible by estimating changes over time in the Soviet product mix. Production of motor vehicles, tractors, and railroad locomotives, for example, is broken down in SPIOER by model designation, permitting the addition of new models and the deletion of discontinued ones in the sample. The samples of such diverse commodities as ferrous metals, machine tools, cement, flour products, and consumer electronics (radios, tele-

\*There is little to choose between the 1960- and 1968-based indexes from the standpoint of their behavior. A substitution, where possible, of 1968 prices for 1960 prices has only a minor effect (see paragraph 35 ff), and a replacement of 1960 value-added weights by 1968 value-added weights has even less of an impact (see paragraph 43 ff).

\*\*For analytical purposes these 14 branches are subsumed under three industrial sectors—industrial materials, machinery (machine building and metalworking—MBMW), and consumer nondurable goods. The weights of the three sectors are predetermined by the value-added weights of the branches assigned to them and so have no independent significance. The commodity line items are allocated among the three sectors as in the accompanying tabulation.

| Secret                     | Number of Line Items |
|----------------------------|----------------------|
| Industrial materials ..... | 110                  |
| Machinery .....            | 177                  |
| Consumer nondurables ..... | 29                   |
| Total .....                | 316                  |

\*\*\*Ideally the index should have prices and weights for the same base year. Prices are taken largely from Soviet price handbooks, which are available only for 1955. Most of these prices, however, remained in effect until 1967, and thus can be regarded as 1960 prices.

Table 1

USSR: Indexes of Industrial Production

1960=100

| Branch   | 1960 Value-Added Weights <sup>a</sup>   |       | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 <sup>b</sup> |
|--|---|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------------------|
|  | Industrial materials <sup>c</sup> ..... | 47.02 | 40   | 45   | 48   | 52   | 58   | 65   | 71   | 78   | 85   | 94   | 100  | 106  | 114  | 122  | 131  | 140  | 150  | 160  | 169  | 176  | 188               |
| Electric power.....                            | 9.24                                    | 31    | 36   | 41   | 46   | 52   | 58   | 66   | 72   | 81   | 91   | 100  | 112  | 126  | 141  | 156  | 172  | 185  | 200  | 217  | 234  | 253  |                   |
| Coal products.....                             | 20.39                                   | 50    | 54   | 58   | 61   | 67   | 75   | 82   | 88   | 95   | 98   | 100  | 100  | 102  | 105  | 110  | 114  | 117  | 119  | 120  | 123  | 126  |                   |
| Petroleum products.....                        | 5.27                                    | 27    | 30   | 34   | 38   | 43   | 48   | 57   | 67   | 77   | 88   | 100  | 113  | 127  | 142  | 154  | 168  | 183  | 200  | 214  | 227  | 244  |                   |
| Ferrous metals.....                            | 14.42                                   | 39    | 45   | 50   | 55   | 61   | 68   | 73   | 78   | 84   | 93   | 100  | 109  | 117  | 125  | 136  | 146  | 158  | 168  | 176  | 182  | 193  |                   |
| Nonferrous metals.....                         | 8.84                                    | 39    | 44   | 49   | 55   | 60   | 70   | 75   | 79   | 84   | 92   | 100  | 109  | 118  | 128  | 138  | 149  | 163  | 178  | 194  | 208  | 220  |                   |
| Forest products.....                           | 18.48                                   | 51    | 58   | 59   | 61   | 69   | 73   | 75   | 81   | 89   | 99   | 100  | 101  | 105  | 111  | 116  | 118  | 121  | 128  | 133  | 136  | 147  |                   |
| Paper and paperboard.....                      | 2.01                                    | 45    | 51   | 56   | 64   | 70   | 73   | 79   | 86   | 92   | 96   | 100  | 106  | 113  | 120  | 129  | 145  | 160  | 174  | 182  | 192  | 198  |                   |
| Construction materials.....                    | 12.96                                   | 20    | 24   | 28   | 32   | 37   | 44   | 50   | 61   | 74   | 87   | 100  | 111  | 120  | 127  | 135  | 147  | 161  | 174  | 181  | 186  | 199  |                   |
| Chemicals.....                                 | 8.39                                    | 37    | 41   | 44   | 49   | 55   | 63   | 70   | 76   | 85   | 91   | 100  | 110  | 121  | 135  | 152  | 170  | 190  | 208  | 224  | 237  | 263  |                   |
| Machinery (MBMW) <sup>c</sup> .....            | 30.09                                   | 38    | 44   | 46   | 49   | 57   | 68   | 74   | 77   | 85   | 92   | 100  | 110  | 124  | 134  | 139  | 148  | 163  | 175  | 189  | 206  | 221  |                   |
| Civilian <sup>c</sup> .....                    | 60.00                                   | 30    | 30   | 32   | 38   | 44   | 53   | 63   | 73   | 83   | 89   | 100  | 111  | 124  | 136  | 144  | 153  | 169  | 184  | 201  | 221  | 242  |                   |
| Producer durables.....                         | 87.76                                   | 33    | 32   | 34   | 40   | 45   | 54   | 64   | 75   | 84   | 89   | 100  | 111  | 125  | 136  | 143  | 150  | 163  | 175  | 189  | 206  | 224  |                   |
| Consumer durables.....                         | 12.24                                   | 12    | 15   | 18   | 22   | 34   | 44   | 52   | 62   | 75   | 88   | 100  | 112  | 120  | 135  | 152  | 176  | 214  | 243  | 284  | 326  | 368  |                   |
| Military <sup>d</sup> .....                    | 40.00                                   | 50    | 66   | 66   | 66   | 75   | 90   | 90   | 83   | 89   | 96   | 100  | 109  | 125  | 131  | 133  | 140  | 152  | 163  | 170  | 183  | 190  |                   |
| Consumer nondurables <sup>c</sup> .....        | 22.89                                   | 43    | 50   | 54   | 60   | 66   | 71   | 77   | 81   | 87   | 94   | 100  | 106  | 111  | 114  | 118  | 126  | 133  | 144  | 153  | 162  | 171  |                   |
| Soft goods (light industry).....               | 56.04                                   | 41    | 49   | 53   | 58   | 66   | 71   | 77   | 80   | 87   | 94   | 100  | 104  | 109  | 111  | 113  | 122  | 134  | 146  | 157  | 165  |      |                   |
| Processed foods.....                           | 43.96                                   | 45    | 52   | 56   | 61   | 66   | 71   | 77   | 81   | 87   | 95   | 100  | 108  | 115  | 120  | 127  | 141  | 146  | 156  | 163  | 168  | 179  |                   |
| Total industrial production <sup>c</sup> ..... | 40                                      | 46    | 49   | 53   | 60   | 67   | 73   | 78   | 86   | 93   | 100  | 107  | 116  | 124  | 131  | 139  | 150  | 161  | 171  | 182  | 194  |      |                   |

<sup>a</sup> The weights within each sector have been adjusted to add to 100%.<sup>b</sup> Preliminary.<sup>c</sup> Sector and total indexes were calculated from less rounded indexes.<sup>d</sup> Excluding common-use durables already included in civilian machinery output.

vision sets, tape recorders, and phonographs) are also significantly disaggregated to reflect changes in the product mix.

9. A number of recently published Soviet series that show the production of various commodities in rubles (allegedly in constant prices) are believed to be constructed in a manner similar to that employed in SPIOER for motor vehicles, tractors, and railroad locomotives, as described above. Some of these series have been incorporated into the SPIOER sample, primarily to provide representation for groups of heterogeneous machinery products not otherwise included or inadequately represented in the reported sample of physical commodities (agricultural equipment, electronic and nonelectronic instruments, chemical equipment, and the like). The 12 Soviet ruble series which have been incorporated either directly or indirectly into SPIOER are listed below in Table 2.

Table 2

Soviet Ruble Series Incorporated in SPIOER

| Soviet Ruble Series  | Share of Output<br>in SPIOER Sample in 1960 |
|--|---|
| Furniture .....  | 24.3% of forest products sample             |
| Agricultural machinery (excluding spare parts) ..  | 12.0% of producer durables sample           |
| Chemical equipment (including spare parts) ...   | 3.5% of producer durables sample            |
| Equipment for consumer-oriented industries (in-<br>cluding spare parts unless otherwise noted) | 8.3% of producer durables sample            |
| Equipment for trade and public dining .....  | 1.4% of producer durables sample            |
| Food processing equipment .....  | 2.9% of producer durables sample            |
| Milling, granary, and grain elevator equipment   | 0.8% of producer durables sample            |
| Papermaking equipment (possibly excluding<br>spare parts)                                      | 0.3% of producer durables sample            |
| Printing trade equipment .....   | 0.5% of producer durables sample            |
| Textile equipment  | 2.3% of producer durables sample            |
| Instruments, electronic and nonelectronic (in-<br>cluding spare parts)                         | 15.6% of producer durables sample           |
| Timepieces .....   | 15.5% of consumer durables sample           |
| Sewn garments .....  | 40.0% of soft goods sample                  |

10. Although these Soviet ruble series account for only about 3% of the total value of the SPIOER sample in 1960, they carry a significant weight in their respective components of the sample: forest products (24%) and civilian machinery (36%). Within civilian machinery, the Soviet rubles series account for 39% of the producer durables sample and 16% of the consumer durables sample.

11. The SPIOER sample is limited insofar as possible to the final products of each branch in order to minimize the incidence of double counting that characterizes the Soviet GVO index. A number of SPIOER series are adjusted to net out production that is included as inputs into other series in the same branch. Products of the extractive industries such as ores, rough-hewn timber, and crude oil are omitted entirely from SPIOER or are included only to the extent that they are consumed directly outside their respective branches in unprocessed form. Net production of crude oil, for example, is computed for the index as a residual, by subtracting from gross production of crude oil that portion which goes on to be refined. The series that are adjusted to eliminate

or minimize double counting within branches are identified in the accompanying tabulation:

| Series   | Adjusted to Exclude   |
|--|---|
| Electric power .....                               | Electric power consumed by power stations in the generation of electricity.   |
| Crude oil .....                                    | Crude oil used as stock in the production of refined petroleum products.  |
| Cement .....                                       | Cement used in precast concrete articles, asbestos cement shingles and pipe, and concrete blocks.   |
| Rock products .....                                | Rock products used in precast concrete articles, cement, lime, concrete blocks, and bricks.   |
| Gypsum .....                                       | Gypsum used in cement and dry gypsum plaster board.   |
| Military machinery .....                           | Common-use durables, such as trucks, tractors, construction equipment, and instruments which are produced by the military but already counted as part of civilian machinery production. |
| Industrially processed meat ..                     | Meat consumed in the production of canned meat.   |
| Fish and fish products (usable part of fish catch) | Fish included in the production of canned fish.   |
| Granulated sugar .....                             | Granulated sugar undergoing further refining.   |
| Vegetable oil .....                                | Vegetable oil consumed in the production of margarine.  |

12. The forest products, chemicals, soft goods, and processed foods branches of the SPIOER sample contain significant amounts of internal double counting, but it was impossible to make appropriate adjustments to all line items in these branches. Therefore, internal value-added weights were introduced within each of the four branches to dampen the effect of such double counting.

13. Although most of the production series in the SPIOER sample are taken directly, or are derived indirectly, from Soviet open sources, publication of production data for uniquely military products and some strategic materials is expressly prohibited in the USSR. These components of industrial production are too important to be ignored, so certain production estimates must be made for SPIOER. Data in the following series in the SPIOER sample are estimates (S denotes that the estimate relies on material classified SECRET)\*:

NONFERROUS METALS

|              |                |              |
|--------------|----------------|--------------|
| Aluminum (S) | Magnesium      | Titanium (S) |
| Antimony (S) | Mercury (S)    | Tungsten (S) |
| Cadmium (S)  | Molybdenum (S) | Zinc         |
| Copper       | Nickel (S)     |              |
| Lead         | Tin (S)        |              |

CHEMICALS

|                 |                       |
|-----------------|-----------------------|
| Benzol (S)      | Phenol (S)            |
| Chlorine (S)    | Synthetic ammonia (S) |
| Ethyl alcohol   | Synthetic rubber      |
| Nitric acid (S) | Toluol (S)            |

MACHINERY

|                           |
|---------------------------|
| Civilian aircraft (S)     |
| Civilian shipbuilding (S) |
| Military machinery (S)    |

*\*In addition to these 24 series that are estimated almost in toto for all years, the breakdown by model of motor vehicles, tractors, and railroad locomotives is also estimated for all years, with reported total unit production serving as a control figure. Similarly, most of the net production series described above are also estimated for all years but on the basis of adjustments in reported gross production statistics. A number of other series in the SPIOER sample are estimated or interpolated for individual years that have been omitted from Soviet statistical reporting.*

14. The most critical of these estimates for SPIOER is the series on the production of military machinery (including space hardware). In the absence of any official Soviet information on this significant category of production, a classified series on military procurements of machinery and equipment, expressed in 1955 rubles and estimated by the Office of Strategic Research, is adjusted by OER for use in the index. The "military machinery" index is then combined with the civilian machinery index using 1960 weights based on the value of output of the two categories of machinery.

#### EVALUATION OF SPIOER

15. Because SPIOER is such an important element of many CIA reports on the Soviet economy, it is important to know its strengths and weaknesses. Some notion of these can be gained by considering the adequacy of (1) the product sample, (2) the price, quantity, and value data used to construct the indexes of growth for individual products, and (3) the weights that are used to combine component indexes into more aggregated indexes.

##### Coverage of the Product Sample

16. The SPIOER sample of 316 line items is not the result of a random selection of products but rather of a conscious effort to assemble as complete and representative a basket of final products as possible.\* The sample appears to be reasonably representative of the major branches of industry, although the total number of products is not as great as might be desired. The FRB Index of US industrial production, for example, is based on an average of 1,400 series (but includes goods at all stages of production—raw materials, intermediate goods, and final products).

17. Actually, a simple count of the number of line items in the sample is not a complete indication of the size or relevance of the sample. In many cases, a large number of differentiated products are subsumed under one line item in the SPIOER sample. A more valid comparison of coverage is the share of total value-added in industry that is represented by the products in the SPIOER sample. On this basis, the SPIOER sample covers about 75% of the FRB sample (instead of about 25% in terms of the number of line items). Similarly, in terms of value, the SPIOER sample of final products amounted to 64% of Soviet official industrial gross production in 1960 (see Table 3), although it includes only a fraction of all the items in the Soviet industrial classification code. Furthermore, the coverage of SPIOER is substantially larger than 64% since the official GVO includes proportionately more double counting than does the total value of output of the SPIOER sample.

18. The comparison of the value of final products in the SPIOER sample with the GVO values indicates that the SPIOER sample equals half or more of the gross output in all branches except nonferrous metals and machinery. The very low percentage in these branches reflects heavy double counting in the Soviet GVO, and perhaps inadequate coverage of the SPIOER sample, or a combination of these factors. The SPIOER coverage appears to be best in the case of electric power, fuels (coal products and petroleum products), forest products, paper and paperboard, and processed foods. The very large percentage shown

\*For a list of the commodities included in the SPIOER sample, see Appendix A, Table 12.

Table 3  
Coverage of SPIOER Sample Compared with Soviet Gross Value of Output for 1960

| Branch                                | 1960 Gross Output*<br>(Billion Rubles) |                    | SPIOER Sample as a<br>Percent of Soviet GVO |
|---------------------------------------|--|--------------------|---|
|                                       | SPIOER                                 | Soviet GVO         |   |
| Industrial materials                  |  |                    |   |
| Electric power . . . . .              | 4.4                                    | 3.8                | 116   |
| Coal products . . . . .               | 3.8                                    | 7.8 <sup>b</sup>   | 64 <sup>b</sup>                             |
| Petroleum products . . . . .          | 1.2                                    |                    |   |
| Ferrous metals . . . . .              | 4.3                                    | 8.6                | 50  |
| Nonferrous metals . . . . .           | 1.4                                    | 3.9                | 36  |
| Forest products . . . . .             | 5.9                                    | 8.5                | 69  |
| Paper and paperboard . . . . .        | 0.7                                    | 1.0                | 70  |
| Construction materials . . . . .      | 4.0                                    | 6.6                | 61  |
| Chemicals . . . . .                   | 3.6                                    | 6.7                | 54  |
| Machinery . . . . .                   | 15.0                                   | 34.0               | 44  |
| Consumer nondurables                  |  |                    |   |
| Soft goods . . . . .                  | 18.8 <sup>c</sup>                      | 35.3               | 53  |
| Processed foods . . . . .             | 36.6 <sup>c</sup>                      | 35.4               | 103   |
| Total industrial production . . . . . | 99.7                                   | 155.2 <sup>d</sup> | 64  |

<sup>a</sup> Enterprise wholesale prices of 1 July 1955.

<sup>b</sup> For the fuels industry (coal, petroleum, peat, and other fuels combined).

<sup>c</sup> Enterprise wholesale prices have been approximated by deducting estimated turnover taxes and distribution margins from the value of the sample in retail prices.

<sup>d</sup> Global figure, including 3.6 billion rubles of gross output produced by other branches of industry not covered by the SPIOER sample.

for electric power results from SPIOER's coverage of electric power in installations attached to enterprises in sectors outside the electric (and thermal) power branch of industry.\*

19. Finally, the types of products not represented in SPIOER are believed to be either relatively unimportant or fairly typical in terms of growth so that their absence does not greatly affect the index: minor fuels (peat and shale), some glass and porcelain products, abrasives, pots and pans, spare parts for some types of machinery,\*\* bearings, jewelry, sporting goods, musical instruments, some metal products, civilian communication equipment, toys, drugs and toiletries, publishing, and office supplies.

\*There may be other factors than coverage which account for the differences between the values in Table 3: possible deviations of SPIOER prices from true "average" prices, conceptual differences in the method of computing and aggregating output at the branch level, and possible errors in the estimates of GVO branch values. In the machinery branch, for example, the SPIOER value is lower than the GVO value because it does not include the large amount of secondary production (products produced by machinery plants which should be classified in the output of another branch) turned out by the machinery sector.

\*\*Several of the published ruble-value series used in SPIOER (see Table 2) include spare parts production, but other output of spare parts is not included in SPIOER. Soviet ruble series on spare parts production are available for some products but are not used in SPIOER, because evidence indicates that these include only centralized production of spare parts. For most types of spare parts, however, the bulk of the output is apparently produced by the users themselves, the so-called noncentralized production.

### Reliability of the Quantity and Price Data

20. The majority of line items in SPIOER are based directly on official Soviet production series expressed in physical units. In most cases these time series are now complete for all years between 1950 and 1969. Of course, the USSR does not report all categories of industrial production, nor are all of those it does report expressed in physical units. As indicated above, a handful of categories are reported in rubles.

21. The commonly held view of Western scholars is that Soviet production series expressed in physical units are reliable in the sense that they reflect quite accurately the actual number of given items produced throughout the Soviet economy during a given period.\* State control over statistical reporting is highly centralized, the relatively simple process of counting and recording physical units of production precludes some of the problems that arise when calculating the value of production, and the physical production data are susceptible to verification through invoices and records pertaining to the final disposition of industrial goods.

22. Similarly, the reported prices obtained for the various commodities in the SPIOER sample seem adequate. Most of these prices were taken from two multivolume price lists issued by the Soviet government for the use of planning, financial, and control organs throughout the economy.\*\* These are lists of so-called "enterprise wholesale prices," which are set by the government with the aim of making them uniform throughout the economy and operative for long periods of time.\*\*\*

23. Although the available statistics on physical production series and the reported wholesale prices probably are reliable, they may be inadequate in several respects for the purpose of constructing an index of industrial production. These difficulties are discussed in the following sections.

### New Products and Changing Product Mix

24. Not all of the physical series can be disaggregated sufficiently to take care of the effect of new products and changing product mix. This is a serious handicap because the entire output of a given commodity or commodity class has to be given a single "average" or "representative" unit price. If changes in product mix within aggregative series of a given branch should tend to raise the average quality of the commodity group, then branch indexes relying on the aggregate total alone will understate the actual growth in production of final products by the branch.†

\*See, for example, Gregory Grossman, *Soviet Statistics of Physical Output of Industrial Commodities*, Princeton, 1960.

\*\*USSR, Ministry of Finance, *Spravochnik tsen na stroitel'nyye materialy i oborudovaniye (Handbook of Prices for Construction Materials and Equipment)* Moscow, 1956, and USSR, Ministry of the Coal Industry, *Materialy i oborudovaniye primenyayemye v ugol'noy promyshlennosti: spravochnik (Handbook of Prices for Materials and Equipment used in the Coal Industry)*, Moscow, 1955.

\*\*\*The enterprise wholesale prices established on 1 July 1955 remained in effect with only minor adjustments until 1 July 1967. Despite much controversy about the role prices should play in the Soviet economy, they have tended to fill primarily an accounting rather than an allocational function.

†The problem, however, is not unique to SPIOER. Even the FRB index is alleged to understate the growth of US industrial production as a result of failing to measure increases in the average quality of products.

25. The SPIOER treatment of ferrous and nonferrous metals indicates the nature of the product mix problem. The ferrous metals sample is broken down into 17 categories of finished steel products, allowing SPIOER to reflect changes in the product mix. The nonferrous metals sample, however, is based on the output of 13 different nonferrous metals in their crude form, precluding recognition of changes that may be occurring in the mix of finished products of each of the nonferrous metals. Other series in SPIOER which may not adequately reflect changes in the product mix include the series for synthetic fibers and plastics in the chemical industry sample. These are areas where significant quality change may have been occurring, but where the SPIOER samples are not disaggregated enough to reflect these quality changes. Similarly, the SPIOER series on such consumer durables as refrigerators, washing machines, and sewing machines are not broken down by model and thus do not reflect changes in quality or complexity over time.

#### *The Representativeness of Soviet Announced Value Series*

26. In a number of cases—generally involving great heterogeneity in output—the USSR publishes ruble series of output in place of physical production series. Although complete time series for all years since 1950 have not been published, these ruble series have been used in SPIOER for the following reasons. Since the ruble-value series presumably cover all products in a given category, they have the merit of including new products and reflecting changes over time in the product mix. In addition, in some cases there is no other information available for constructing series covering the product lines in question. The principal caveats in using the ruble-value series are that the composition of the products is not known (there may be some intermediate or component products included with final products), and the prices, although allegedly those of 1 July 1955, may include some temporary prices that introduce an upward bias.\*

27. As noted earlier, the SPIOER series for tractors, motor vehicles, and locomotives are broken down by model and thus should also reflect changes in product mix or average quality. These series, however, may also be subject to a price bias. Soviet list prices are used to value the new models, and it is often uncertain whether the difference in price between new and old models represents quality improvement or a hidden price increase.

28. The bulk of the ruble-value series as well as the series disaggregated by model are found in the SPIOER sample of civilian machinery. Furthermore, the share of these quality-adjusted series in the SPIOER producer durables sample increased from 72% in 1950 to 78% in 1969, with physical quantity series representing the remainder. Because such quality-adjusted series (particularly those of Soviet origin) overstate growth due to the "new product" pricing problem while machinery series not adjusted for quality change tend to understate growth, combining these two types of series into one sample results in an index which, if not precisely calibrated, probably falls within an acceptable range.

#### *Possible Divergence Between Growth of Final Output and Growth of Net Output*

29. Even if SPIOER were to measure accurately the growth of final output in a branch or sector, it does not necessarily follow that it would reflect the

\*For a discussion of this problem, see paragraph 67 ff.

growth in net output of that branch or sector. Algebraically, final output and net output are differentiated as follows:

- (1) Final output=gross output minus sales of sector to itself;
- (2) Net output=final output minus material purchases from other sectors

or

Net output=gross output minus total material purchases.

In other words, purchases from other sectors are included in final output, but not in net output. The relation between growth of final output and net output, then, will depend on how the ratio of final output to purchases from other sectors changes.

30. It could be argued that over time the production of increasingly complex products requires more processing and hence greater value added or net output per unit of final output. Even when the nature of the product remains the same, the value of net output per unit of production may rise if production methods become more efficient in the use of raw materials. The SPIOER branch indexes, many of which rely on physical production series unadjusted for changes in product complexity and all of which assume fixed proportions of inputs to output, might well be challenged on this count.

31. Nevertheless, the available evidence suggests that for industry as a whole there is not an appreciable divergence between the growth of final output and the growth of net output. According to the CSA, total gross output in industry grew at virtually the same rate as net output between 1958 and 1966. Of course, even if valid, the CSA findings could have been the result of net output rising faster than gross output in some branches and more slowly in others. Preliminary results from a comparison of the 1959 and 1966 Soviet input-output (I-O) tables (which are presented in a later section\*) seem to indicate that this is indeed the case. Differences between the growth of final output and the growth of net output among the branches tended to be offsetting.

#### *Possible Bias Due to the Price Weights*

32. Two questions arise with regard to the price weights employed in constructing the SPIOER indexes of branch production: (1) are the indexes seriously affected by the use of some estimated prices and (2) how good are the 1955 prices for the intended purpose? Ideally, all commodities in the SPIOER sample should be represented by enterprise wholesale prices of 1 July 1955, thus assuring uniformity in the valuation of all products in the sample and an appropriate relative weighting of products. A number of the commodities listed in SPIOER, however, were not represented in the available price lists, so enterprise wholesale prices had to be found elsewhere or somehow devised.

33. The absence of 1 July 1955 enterprise wholesale prices primarily affects the consumer goods indexes. Enterprise wholesale prices of consumer durables were estimated by simply reducing 1957 retail prices a blanket 50% to eliminate turnover taxes and distribution charges. Because retail prices of consumer goods include a large percentage of turnover tax which varies over time and from product to product, it is highly unlikely that this uniform reduction factor (which preserved the relative prices of the retail price list) resulted

\*See paragraph 59 ff.

in correct relative weights for consumer durables.\* In the case of consumer non-durables (soft goods and processed foods) the prices adopted for use in SPIOER were retail sales prices adjusted for trade charges (but inclusive of turnover tax). Here too, this procedure probably produced a set of relative price weights for the consumer goods sample different from the price weights which would result from using wholesale prices. Unfortunately, so little is known of individual turnover tax rates that the direction of the index bias cannot be determined. To minimize possible distortions arising from the price weights, soft goods and processed foods have been aggregated into subbranches and assigned value-added weights.

34. Assuming that most of the SPIOER prices represent the actual enterprise wholesale prices of 1 July 1955 accurately, a more important question is whether such prices reflect the relative economic cost of producing different products within a branch. The 1955 prices have been criticized for not covering the full cost of the capital used as well as for allowing wide variations in branch profit rates. After promising a price reform for several years, the Soviet government carried out a thoroughgoing revision of industrial prices in mid-1967. Capital costs were taken into account in the pricing formulas, which were designed to insure roughly equal profit rates for all types of production. After the price reform, the dispersion of profit rates narrowed, most subsidies disappeared, and thus the new prices would seem to be a better index of relative costs than the 1955 prices. But so far, the basic price documents necessary to reprice the SPIOER commodity sample in 1967 prices have not appeared.

35. For some branches, however, enough information about the new prices has been published to permit a test of how much the substitution of 1967 prices for the 1955 prices would change the SPIOER branch production indexes. The comparison for production of ferrous metals, nonferrous metals, petroleum products, construction materials, and the soft goods branches is shown in the accompanying tabulation.

|                               |             | Average Annual Rates of Growth (Percent) |         |         |
|-------------------------------|-------------|--|---------|---------|
|                               |             | 1951-69                                  | 1951-60 | 1961-69 |
| Ferrous metals .....          | 1955 prices | 8.4                                      | 9.9     | 6.9     |
|                               | 1967 prices | 8.4                                      | 9.8     | 6.8     |
| Nonferrous metals .....       | 1955 prices | 9.2                                      | 9.9     | 8.5     |
|                               | 1967 prices | 9.2                                      | 9.9     | 8.5     |
| Petroleum products .....      | 1955 prices | 11.8                                     | 13.9    | 9.5     |
|                               | 1967 prices | 11.8                                     | 13.9    | 9.5     |
| Construction materials* ..... | 1955 prices | 9.6                                      | 14.3    | 4.6     |
|                               | 1967 prices | 9.6                                      | 14.4    | 4.5     |
| Soft goods .....              | 1955 prices | 7.2                                      | 9.2     | 5.2     |
|                               | 1967 prices | 7.2                                      | 9.0     | 5.2     |

\* The comparison is for only 12 of the 23 items in the construction materials sample because 1967 prices could not be identified for the full sample.

36. In these branches, at least, a conversion of price weights from a 1955 to a 1967 base is hardly worth the trouble. There is reason to believe that the

\*In at least one case, subsequent information has shown the price to have been in great error. The price for watches and clocks derived using the above-described methodology (17.4 rubles per unit) resulted in a total value of production in 1950 of 66 million rubles, whereas a recently published Soviet figure computed using the same methodology as SPIOER (except that each unit was weighted by its own true price) showed that the total production of all "timepieces" amounted to only 26 million rubles in enterprise wholesale prices.

same is true for most of the other branches. Where the sample is essentially limited to a single homogeneous commodity—as in coal and electric power—new internal price weights will not affect the branch production index. The forest products branch index has internal weights based on shares of branch employment for its four separate production series, so new prices would not change the index. Not enough is known about relative price changes in the food and chemical industries to judge whether the SPIOER production index would be greatly affected, but here again any significant price changes would be muted by the use of internal value-added weights for the major subbranches.

37. Substitution of 1967 prices for 1955 prices would probably have as its major impact a reduction in the growth of the machinery index. Prices of heavy machine building products were raised in mid-1967 by 30% to 40% while products of the instrument and radio industry were cut by 25% and prices on electronic products were reduced by 19%. Enterprise wholesale prices were reduced, for example, for television sets, radios, watches, and refrigerators. The percentage changes do not represent the difference between 1955 and 1967 prices in those cases where prices changed between mid-1955 and mid-1967, but their net effect would surely be to lower the weights of the faster growing machinery products relative to those of slower growing machinery products.

38. A partial test of the effect of introducing 1967 price weights into the producer durables sample can be made. In 1968 the CSA published the ratios of 1967 prices to 1955 prices for all of the ruble-value series (39% of the value of the SPIOER producer durables sample in 1960).<sup>\*</sup> By restating the ruble-value series in 1967 prices, the growth of the ruble-value series is reduced from 11.5% to 11.2%, and the growth of producer durables from 8.4% to 8.0% a year in 1961-69. As the physical production series are predominantly heavy machinery items, presumably their weight would rise if they could be valued in 1967 prices. If so, the rate of increase of civilian machinery would be pared still further.

### Adequacy of the Value-Added Weights

#### *Formulation of the Weights*

39. SPIOER's weights are of two kinds: the value-added weights for the major branches of industry and the price weights for the individual products within the branches. As explained above, the sample of products in most branches is simply aggregated into branch indexes by the use of wholesale prices. Value-added weights would be preferable, but there is no way of calculating value added in the production of individual commodities.

40. The weights employed in aggregating the branch indexes into sectoral indexes and the index of total production, however, are true value-added weights in that they attempt to measure the earnings of the productive factors that account for the value added by each branch in a base year. To conform with the 1960 base-year weights employed until now in the estimation of Soviet GNP, 1960 was selected as the base year. The steps in the derivation of the SPIOER 1960 branch weights are set out in Table 4.

<sup>\*</sup>The ratios of 1967 prices to 1955 prices were: instruments, 0.69; agricultural machinery, 1.08; chemical equipment, 1.01; food processing equipment, 0.87; textile industry equipment, 0.95; equipment for trade and public dining enterprises, 0.79; paper industry equipment, 1.05; and printing trade equipment, 0.98.

Table 4

USSR: Derivation of 1960 Value-Added Weights  
at Factor Cost for Branches of Soviet Industry

Billion New Rubles (1960 Prices)

| Branch                     | Wages and<br>Other<br>Income <sup>a</sup> | + Depre-<br>ciation | Imputed<br>+ Interest<br>Charge <sup>b</sup> | = Value Added<br>at<br>Factor Cost | Percentage<br>Distribution of<br>Value-Added<br>Weights |
|----------------------------|---|---------------------|--|------------------------------------|---|
| Electric power .....       | 0.69                                      | 0.31                | 0.84   | 1.84                               | 4.35  |
| Coal products .....        | 3.15                                      | 0.28                | 0.63   | 4.06                               | 9.59  |
| Petroleum products .....   | 0.40                                      | 0.14                | 0.51   | 1.05                               | 2.48  |
| Ferrous metals .....       | 1.82                                      | 0.27                | 0.78   | 2.87                               | 6.78  |
| Nonferrous metals .....    | 1.17                                      | 0.20                | 0.39   | 1.76                               | 4.16  |
| Forest products .....      | 3.05                                      | 0.10                | 0.53   | 3.68                               | 8.69  |
| Paper and paperboard ...   | 0.20                                      | 0.14                | 0.06   | 0.40                               | 0.94  |
| Construction materials ... | 1.96                                      | 0.17                | 0.45   | 2.58                               | 6.09  |
| Chemicals .....            | 1.09                                      | 0.15                | 0.43   | 1.67                               | 3.94  |
| Machinery .....            | 9.90                                      | 0.60                | 2.24   | 12.74                              | 30.09   |
| Soft goods .....           | 4.63                                      | 0.05                | 0.75   | 5.43                               | 12.83   |
| Processed foods .....      | 2.85                                      | 0.32                | 1.09   | 4.26                               | 10.06   |
| <i>Total</i> .....         | <i>30.91</i>                              | <i>2.73</i>         | <i>8.70</i>                                  | <i>42.34</i>                       | <i>100.00</i>   |

<sup>a</sup> Including social insurance.<sup>b</sup> Calculated as an 8% charge on fixed and working capital.

41. The data in Table 4 are based largely on Soviet statistics that are considered reliable. Value added to output in the form of wages and other income was computed using fairly detailed information on annual average wages and employment, social insurance rates, and the like, reported by branch of industry. Depreciation allowances were calculated using amortization rates reported by branch of industry and reflect the cost of capital consumption.\* Finally, interest charges were estimated by imputing an 8% charge on the fixed and working capital in each branch of industry. No separate provision for profits was made in computing the value-added weights inasmuch as the imputed return on capital conceptually covers profits. The 8% charge is somewhat arbitrary, but preferable to accepting profits as a measure of the return to capital.\*\* Soviet pricing in 1960 permitted excessive variation in branch profit rates.

\*The amortization rates introduced on 1 January 1963 were used in preference to those actually in effect in 1960 because they are believed to reflect more accurately the actual service lives of fixed assets. Only that part of the amortization rate that relates to replacement (in contrast to capital repair) was used to calculate depreciation.

\*\*The imputation of an 8% rather than some other charge on capital is largely of academic importance insofar as the behavior of the index is concerned. To test this proposition, charges of 0% and 20% were assumed as the extremes of a range within which the true rate would fall. As shown below, the difference in growth rates resulting from these various assumptions about the rate of return on capital is very slight.

| Imputed Interest Rate | Average Annual Rates of Growth<br>(Percent) |         |         |
|-----------------------|---|---------|---------|
|                       | 1951-70                                     | 1951-60 | 1961-70 |
| 0% .....              | 8.1   | 9.5     | 6.7     |
| 8% .....              | 8.2   | 9.6     | 6.9     |
| 20% .....             | 8.4   | 9.7     | 7.0     |

**Branch Weights for Different Years**

42. Value-added weights computed for the year 1955 were used in SPIOER at first. These weights consisted only of estimated wages and depreciation. In 1966, new value-added weights were calculated for the year 1960. In concept, the 1960 weights were quite different from the 1955 weights, not only because of the selection of a different base year but also because of more complete and reliable statistics on employment and wages and the inclusion of an imputed interest charge on fixed capital. In 1969 the 1960 base-year weights were further revised to include an imputed interest charge on working capital. Finally, in 1970, value-added weights were calculated for base year 1968 as part of a preliminary estimate of Soviet GNP in 1968 prices. Despite these changes in the methodology used in calculating the weights, the actual differences in the weights are small, as can be seen in Table 5. Under the revised procedures, the weights of most of the materials branches and the processed foods industry are somewhat higher while the weight of machinery is lower.

43. Changing base-year value-added weights does not affect overall industrial growth significantly. Substitution of the earlier and somewhat cruder 1955

**Table 5**

**USSR: Comparison of SPIOER Value-Added Weights,  
Alternative Base Years Moved to 1960**

| Branch                                   | Percent                             |                                     |                                     |
|--|-------------------------------------|-------------------------------------|-------------------------------------|
|  | 1955 Base-Year Weights <sup>a</sup> | 1960 Base-Year Weights <sup>b</sup> | 1968 Base-Year Weights <sup>c</sup> |
| Industrial materials .....               | 45.9                                | 47.0                                | 50.2                                |
| Electric power .....                     | 3.1                                 | 4.3                                 | 4.7                                 |
| Coal products .....                      | 6.9                                 | 9.6                                 | 9.3                                 |
| Petroleum products .....                 | 2.8                                 | 2.5                                 | 4.6                                 |
| Ferrous metals .....                     | 5.0                                 | 6.8                                 | 7.6                                 |
| Nonferrous metals .....                  | 3.8                                 | 4.2                                 | 4.0                                 |
| Forest products .....                    | 10.8                                | 8.7                                 | 9.0                                 |
| Paper and paperboard .....               | 0.6                                 | 0.9                                 | 1.0                                 |
| Construction materials .....             | 8.7                                 | 6.1                                 | 5.6                                 |
| Chemicals .....                          | 4.2                                 | 3.9                                 | 4.4                                 |
| Machinery .....                          | 34.2                                | 30.1                                | 27.4                                |
| Civilian .....                           | 21.6                                | 18.1                                | 16.7                                |
| Military .....                           | 12.6                                | 12.0                                | 10.7                                |
| Consumer nondurables .....               | 19.9                                | 22.9                                | 22.4                                |
| Soft goods .....                         | 12.6                                | 12.8                                | 12.6                                |
| Processed foods .....                    | 7.3                                 | 10.1                                | 9.8                                 |
| <i>Total industrial production</i> ..... | <i>100.0</i>                        | <i>100.0</i>                        | <i>100.0</i>                        |

<sup>a</sup> Weights for 1955 were moved forward to 1960 by branch indexes so as to facilitate comparison with 1960 base-year weights. The 1955 weights were in use during 1962-65.

<sup>b</sup> These 1960 weights were adopted in 1969.

<sup>c</sup> Weights for 1968 were moved back to 1960 by branch indexes to facilitate comparison with 1960 weights. These weights are now being used in the calculation of GNP in 1968 prices.

weights does not yield very different results from the 1960 weights, as shown in the accompanying tabulation.

| Base-Year Weights                 | Average Annual Rates of Growth<br>(Percent) |         |         |         |         |
|-----------------------------------|---|---------|---------|---------|---------|
|                                   | 1951-70                                     | 1951-55 | 1956-60 | 1961-65 | 1966-70 |
| 1955 <sup>a</sup> .....           | 8.4   | 11.1    | 8.6     | 6.9     | 7.1     |
| 1960 (revised) <sup>b</sup> ..... | 8.2   | 11.0    | 8.3     | 6.9     | 6.9     |
| 1968 <sup>c</sup> .....           | 8.3   | 10.9    | 8.4     | 7.0     | 6.9     |

<sup>a</sup>Based on value-added weights in use during 1962-65, moved forward to 1960.

<sup>b</sup>Value-added weights adopted in 1969.

<sup>c</sup>Value-added weights for 1968 based on industrial value-added at factor cost.

Moreover, indexes aggregated using value-added weights for 1968 (which reflect the 1967 price reform) show rates of growth of industrial production that are almost identical with those calculated using 1960 weights.\*

### Product vs. Establishment Weights

44. In SPIOER, the industrial activity represented by the branch weights and the branch product samples do not match precisely. The weights are computed using wage, employment, and capital statistics based on an establishment classification of the branches of industry, whereas the indexes are constructed using final products wherever produced in the economy.

45. Under an establishment classification, the output of a given branch of industry represents the activities of the producing units (establishments) that formally "belong" to the industry (usually on the basis of ministerial subordination). Statistics on employment, wages, fixed and working capital, amortization, and gross value of output of a given branch of industry are computed simply as the sum of the corresponding statistics reported by the individual producing units within the industry. For some branches of industry, particularly machine building, metallurgy, and chemicals, many producing units have "captive" plants and shops engaged in the production of secondary goods that are produced mainly in some other branch of industry. Therefore, the statistical data published on an establishment basis do not precisely match the statistical data on final products as far as classification is concerned.

46. To evaluate the effect of the mismatching, a set of alternative value-added branch weights based on a product classification were constructed from the 1959 Soviet I-O table. This set of alternative value-added weights is only marginally different from the SPIOER set (see Table 6), so the substitution of

*\*The rates of growth of individual branch indexes are unaffected by the choice of base year weights. The rates of growth of SPIOER sector indexes derived using 1968 weights are shown in the accompanying tabulation.*

| Sector                         | Average Annual Rates of Growth<br>(Percent) |         |         |         |         |
|--------------------------------|---|---------|---------|---------|---------|
|                                | 1951-70                                     | 1951-55 | 1956-60 | 1961-65 | 1966-70 |
| Industrial materials .....     | 8.3   | 10.5    | 9.1     | 7.3     | 6.2     |
| Machinery .....                | 9.2   | 12.1    | 8.1     | 8.2     | 8.5     |
| Consumer nondurables .....     | 7.0   | 10.5    | 7.0     | 4.5     | 6.2     |
| Total industrial production .. | 8.3   | 10.9    | 8.4     | 7.0     | 6.9     |

The indexes from which these rates of growth are derived are given in Appendix B, Table 13.

Table 6

Comparison of SPIOER Weights with Alternative Soviet Weights for 1960

| Branch                            | Percent             |                  |                  |
|-----------------------------------|---------------------|------------------|------------------|
|                                   | SPIOER <sup>a</sup> | I-O <sup>b</sup> | GVO <sup>c</sup> |
| Industrial materials .....        | 47.0                | 51.5             | 31.4             |
| Electric power .....              | 4.3                 | 4.6              | 2.4              |
| Coal products .....               | 9.6                 | 10.2             | 5.1              |
| Petroleum products .....          | 2.5                 | 3.1              | ...              |
| Ferrous metals .....              | 6.8                 | 7.0              | 5.7              |
| Nonferrous metals .....           | 4.2                 | 3.8              | 2.6              |
| Forest products .....             | 8.7                 | 9.7              | 5.6              |
| Paper and paperboard .....        | 0.9                 | 0.8              | 0.6              |
| Construction materials .....      | 6.1                 | 7.1              | 5.0              |
| Chemicals .....                   | 3.9                 | 5.2              | 4.4              |
| Machinery .....                   | 30.1                | 27.1             | 22.3             |
| Consumer nondurables .....        | 22.9                | 21.4             | 46.3             |
| Soft goods .....                  | 12.8                | 11.1             | 23.1             |
| Processed foods .....             | 10.1                | 10.3             | 23.2             |
| Total industrial production ..... | 100.0               | 100.0            | 100.0            |

<sup>a</sup> Value-added weights derived from an establishment classification of industrial wages, employment, and capital.

<sup>b</sup> Weights derived from the 1959 Soviet input-output table and moved forward to 1960 by SPIOER branch indexes to facilitate comparison.

<sup>c</sup> Estimated from Soviet data on the percentage of gross output claimed by the major branches of industry classified on an establishment basis. The Soviet data have been adjusted so that the shares of the branches add to 100%.

the I-O weights for the SPIOER weights has an insignificant effect on the measured growth of total industrial production (see the accompanying tabulation). In fact, even the substitution of Soviet GVO weights—which are at much greater variance with the SPIOER weights (see Table 6)—does not produce substantially different growth rates. The lower rate of industrial growth obtained using GVO weights is largely explained by the fact that the GVO weight for the slow-growing consumer nondurables is inflated not only by the many stages of processing that occur in the soft goods and processed foods industries (most of which are counted cumulatively) but also by the inclusion of a sizable amount of turnover tax. These distortions are absent in the SPIOER and I-O value-added weights.

|                            | Average Annual Rates of Growth <sup>a</sup> |         |         |
|----------------------------|---|---------|---------|
|                            | (Percent)                                   |         |         |
|                            | 1951-70                                     | 1951-60 | 1961-70 |
| SPIOER (value-added) ..... | 8.2   | 9.6     | 6.9     |
| I-O (value-added) .....    | 8.2   | 9.6     | 6.9     |
| GVO (gross output) .....   | 8.0   | 9.4     | 6.6     |

<sup>a</sup> Based on 1960 weights.

47. The lack of sensitivity of the index to alternative value-added weights demonstrates that the accuracy of SPIOER does not depend much on the particular set of branch weights used, although the revised 1960 weights adopted in 1969 are conceptually superior to the weights used in the earlier years.

### Military Machinery Weight

48. In at least one instance, however, the choice of weights makes a difference. The growth of output of military hardware has varied markedly over time from the trend in the production of civilian machinery, so the behavior of the overall machinery index depends on the share of output assigned to military products. In the absence of value-added weights for the various branches of machine building, final product weights for 1960 were constructed for the civilian and military components of machinery production on the assumption that the final product in each component is roughly proportional to the value added.\* The same procedure is used to separate civilian machinery into producer durables and consumer durables.\*\*

Table 7

USSR: Derivation of 1960 Final-Product Weights for Civilian and Military Machinery<sup>a</sup>

|                                  | Value of Output<br>(Billion New Rubles) <sup>b</sup> | Weight<br>(Percent) |
|----------------------------------|--|---------------------|
| Civilian machinery .....         | 11.95  | 59.9                |
| Producer durables .....          | 8.96   | 44.9                |
| Consumer durables .....          | 1.25   | 6.3                 |
| Spare parts for repair .....     | 1.12   | 5.6                 |
| R&D .....                        | 0.62   | 3.1                 |
| Military machinery .....         | 8.00   | 40.1                |
| Procurement of end items .....   | 5.00   | 25.1                |
| Operations and maintenance ..... | 1.04   | 5.2                 |
| R&D .....                        | 1.96   | 9.8                 |
| Total .....                      | 19.95  | 100.0               |

<sup>a</sup> For the derivation of these values, see Appendix C.

<sup>b</sup> Enterprise wholesale prices of 1 July 1955.

49. The present method of deriving 1960 final product weights relies on estimates of the value of final products manufactured in the machinery sector in 1960. These estimated values—and the weights derived from them—are shown in Table 7. It should be noted that military-space R&D is assumed to be a purely industrial activity and is assigned wholly to the machinery sector, while only half of civilian R&D is assumed to originate in machinery.

50. The weights allocated to producer durables and consumer durables within the SPIOER machinery sector are also based on the final-product weights shown in Table 7. If it is assumed that the outlays for spare parts and for R&D are divided proportionally between producer durables and consumer durables, then weights may be calculated directly from the values shown for producer durables and consumer durables (8.96 billion rubles and 1.25 billion rubles, respectively).

\*There is not sufficient information available on the pricing of military machinery in the USSR to prove or disprove the validity of this assumption. There is reason to believe that in 1960 the profit margin in the prices of military machinery was less than in the prices of civilian machinery. However, the present method of valuing the final product of military machinery for use as a weight in SPIOER largely circumvents this problem.

\*\*Separate weights for producer durables and consumer durables were first introduced into SPIOER in 1969. The two sets of machinery weights are shown in Table 7.

## COMPARISON OF SPIOER WITH OTHER INDEXES OF SOVIET INDUSTRIAL PRODUCTION

51. SPIOER may be compared with other indexes of Soviet industrial production. The most important of the Soviet indexes is, of course, the official Soviet index of industrial GVO, but other Soviet data—particularly the Soviet input-output tables for 1959 and 1966, a Soviet series on investment in equipment, and an official series on the production of consumer durables—invite comparison with SPIOER branch and total indexes. Second, two Western indexes—the Nutter and Moorsteen-Powell indexes—resemble SPIOER in concept and will be compared with it. In addition, another Western index recently devised by Judith Thornton deserves mention, as it rests on a quite different method of estimation. Finally, SPIOER is compared with an index of Soviet industrial production derived from the statistical relation in other countries between industrial production and the output of certain basic industrial commodities.

### Comparison of SPIOER with Official GVO Indexes

52. *A priori* there is reason to expect SPIOER and GVO indexes, both branch and aggregate, to be at sixes and sevens. Indeed, for several reasons the GVO indexes should grow faster than the corresponding SPIOER indexes. First, the GVO of a given sector represents a good deal of double counting. Should double counting increase over time, as would occur with increased specialization in production, a GVO index would be inflated. SPIOER attempts to avoid this problem by measuring the output of final products and excluding intermediate stages of production. Second, the introduction of new products at inflated "temporary" prices could inflate the GVO index. But measures of GVO may diverge from SPIOER for other reasons. GVO measures all production whereas SPIOER is based on a sample, and this could cause the growth of the two indexes to differ. Since the GVO index of a given branch includes production of secondary products by that branch, whereas SPIOER measures only primary products, indexes will generally differ on this account. For the industrial output as a whole, the GVO weights used to aggregate the branch indexes differ markedly from those used in SPIOER (see Table 6), introducing another discrepancy.

53. Table 8 compares average annual growth in 1951-60 and 1961-70 for all the branches of industry included in the SPIOER sample with corresponding Soviet GVO branch indexes. The growth registered by GVO indexes in all cases exceeds the corresponding SPIOER indexes, but in no case is the discrepancy as great as in the respective machinery indexes (civilian and military machinery combined). The difference of 4.7 percentage points between the SPIOER machinery index and the GVO index of machinery during 1951-70 certainly qualifies as a credibility gap. For the materials and consumer goods sectors combined (that is, total industrial production minus the machinery sector), the difference between the average annual growth rates of SPIOER and GVO during 1951-70 is only about 0.7 of a percentage point. Although partly due to the particularly large weight given to processed foods and soft goods in the GVO index (see Table 6), this comparison nevertheless shows that the bulk of the 1.9 percentage points difference between the two indexes of total industrial production is due to the differences in the machinery indexes.

54. The pattern of divergence is significant. Machinery and chemicals are the only two branches where the difference between growth in GVO and growth

Table 8

USSR: Comparison of Average Annual Rates of Growth Derived from SPIOER and from Official Soviet GVO Indexes of Industrial Production

| Branch                                  | 1951-70    |             |              |              | 1951-60     |            |              |              | 1961-70    |     |              |              |
|---|------------|-------------|--------------|--------------|-------------|------------|--------------|--------------|------------|-----|--------------|--------------|
|   | SPIOER     | GVO         | Difference   |              | SPIOER      | GVO        | Difference   |              | SPIOER     | GVO | Difference   |              |
|   |            |             | (GVO-SPIOER) | (GVO-SPIOER) |             |            | (GVO-SPIOER) | (GVO-SPIOER) |            |     | (GVO-SPIOER) | (GVO-SPIOER) |
| Industrial materials.....               | 8.1        | 9.9         | 1.8          | 9.7          | 11.4        | 1.7        | 6.5          | 8.4          | 1.9        |     |              |              |
| Electric power.....                     | 11.0       | 12.3        | 1.3          | 12.3         | 14.0        | 1.7        | 9.7          | 10.6         | 0.9        |     |              |              |
| Fuels.....                              | 6.2        | 7.7         | 1.5          | 8.2          | 9.3         | 1.1        | 4.2          | 6.1          | 1.9        |     |              |              |
| Ferrous metals.....                     | 8.3        | 8.6         | 0.3          | 9.9          | 10.5        | 0.6        | 6.8          | 6.8          | .....      |     |              |              |
| Nonferrous metals.....                  | 9.0        | 10.7        | 1.7          | 9.9          | 11.4        | 1.5        | 8.2          | 10.0         | 1.8        |     |              |              |
| Forest products.....                    | 5.4        | 6.3         | 0.9          | 7.0          | 7.8         | 0.8        | 3.9          | 4.7          | 0.8        |     |              |              |
| Paper and paperboard.....               | 7.6        | 8.8         | 1.2          | 8.2          | 9.3         | 1.1        | 7.1          | 8.2          | 1.1        |     |              |              |
| Construction materials.....             | 12.0       | 13.5        | 1.5          | 17.2         | 18.7        | 1.5        | 7.1          | 8.5          | 1.4        |     |              |              |
| Chemicals.....                          | 10.4       | 14.1        | 3.7          | 10.6         | 14.9        | 4.3        | 10.1         | 13.3         | 3.2        |     |              |              |
| Machinery.....                          | 9.2        | 13.9        | 4.7          | 10.1         | 15.8        | 5.7        | 8.3          | 12.1         | 3.8        |     |              |              |
| Consumer nondurables.....               | 7.2        | 7.5         | 0.3          | 8.8          | 9.1         | 0.3        | 5.5          | 6.1          | 0.6        |     |              |              |
| Soft goods.....                         | 7.2        | 7.5         | 0.3          | 9.2          | 9.6         | 0.4        | 5.1          | 5.5          | 0.4        |     |              |              |
| Processed foods.....                    | 7.1        | 7.7         | 0.6          | 8.3          | 8.8         | 0.5        | 6.0          | 6.6          | 0.6        |     |              |              |
| <i>Total industrial production.....</i> | <i>8.2</i> | <i>10.1</i> | <i>1.9</i>   | <i>9.6</i>   | <i>11.7</i> | <i>2.1</i> | <i>6.9</i>   | <i>8.5</i>   | <i>1.6</i> |     |              |              |

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in the SPIOER index is consistently greater than 3 percentage points. In all of the other branches except ferrous metals and soft goods the gap ranges from  $\frac{1}{2}$  to 2 percentage points. Ferrous metals and soft goods are the best behaved matches by far, the difference amounting to just  $\frac{1}{3}$  of a percentage point. Thus the difference between GVO and SPIOER growth is greatest in the branches where the assortment of products is the largest, the problem of new products is most important, and the opportunities for increased specialization in production have been most obvious.

55. It is revealing that one of the smallest differences between a GVO and a SPIOER index is found in ferrous metals, where the coverage is fairly complete and the information on the assortment of steel products is reasonably detailed, the sample consisting of a list of finished steel products. Thus the SPIOER ferrous metals index has been able to reflect the widespread shift in steel output from hot-rolled to cold-rolled products which causes the SPIOER index to grow at 8.3% a year in 1951-70, while steel ingots increased by 7.5% a year. On the other hand, the production data for nonferrous metals are not detailed enough to reflect the trend to a more finished product that undoubtedly has taken place—particularly in view of the rapidly changing requirements of the space, military, and electronics sectors.

56. In some instances, the differences between the GVO and SPIOER indexes are plainly the result of differences in coverage. Two examples are electric power and construction materials, branches where the product list is narrow and quality change has not been significant. The SPIOER electric power index covers all electric power wherever produced while the GVO index (1) excludes electricity generated in powerplants attached to enterprises classified in other branches of the economy but (2) includes the generation of centrally supplied heat. Since large, independent installations have supplied an increasing share of total electricity and thermal power has also grown rapidly, the SPIOER index is better than the GVO index in describing trends in the total output of electricity alone. One difference in the product list accounts for virtually all of the margin separating the GVO and SPIOER indexes for construction materials. The SPIOER sample includes glass and refractory materials, but the CSA classifies them in the glass-porcelain and ferrous metals industries, respectively. Removal of these products from the SPIOER construction materials index raises the growth rate from 12.0% to 13.1% a year in 1951-70, only 0.4 of a percentage point less than the growth rate registered by the GVO index.

57. The GVO-SPIOER comparison for fuels is a special case in that the relative weight of the different fuels in the GVO index is uncertain. Some understatement on the part of SPIOER is possible as the average value of the refined oil products probably increased over time. As for the remaining branches of industry—forest products, soft goods, paper and paperboard, and processed foods—the SPIOER samples seem to be fairly representative. While they may not be disaggregated enough to identify some changes in the average quality (of clothing or processed foods, for example), the GVO indexes are probably biased upward by increased double counting. Soviet consumers have been buying more ready-to-wear clothing instead of buying fabrics to sew their own garments, and more of the basic products of the food industry (like flour and sugar) undergo further processing before being consumed.

58. In sum, the differences between SPIOER growth rates and Soviet GVO growth rates might be explained in part by differences in coverage, but mostly by biases in the GVO indexes and changes in the extent of double counting reflected in the GVO indexes. The question of coverage has been explored at some length above. The amount of bias caused by the new product pricing problem cannot be measured but is judged to be important in the case of machine building and chemicals. With regard to changes in double counting in GVO, the Soviet input-output tables provide some interesting evidence.

#### Comparison of SPIOER with Soviet Input-Output Indexes

59. The input-output (I-O) tables for 1959 and 1966 are a relatively recent development in Soviet statistical reporting. These tables, reconstructed by Western analysts,\* can be compared with the SPIOER and official GVO indexes, but three major caveats must be observed in their use. First, because the data in the I-O tables is in current prices while both official GVO and SPIOER indexes are based on data in constant prices, the I-O data must be converted to constant prices with the help of official price indexes which are themselves open to question. Furthermore, the I-O values are given in purchaser's prices which differ from the enterprise wholesale prices used in SPIOER and the official GVO index by the amount of turnover tax and trade and marketing costs, elements which may change over time and hence influence the growth shown by I-O data. Finally, errors undoubtedly have occurred in the reconstruction of the Soviet I-O tables.

60. Table 9 compares the average annual rates of growth of SPIOER and GVO branch indexes in 1960-66 with corresponding branch indexes derived from I-O data. Because of certain incomparabilities in the reconstructed 1959 and 1966 tables, machinery must be aggregated with "other industry" in the I-O calculations.

61. First, those changes in double counting large enough to deserve attention are indicated by the comparison of I-O gross output and I-O final output. These comparisons show that gross output grew faster than final output in fuels, forest products, machinery, and soft goods. This was the result of a relatively more rapid growth of intrabranched deliveries, which are included in GVO but not in final output. In the metals, electric power, and processed foods sectors, the growth of gross output and final output was roughly the same, while in chemicals and construction materials final output grew faster than gross output, suggesting that growth of gross output in these branches is not inflated because of increased double counting. The comparison of course covers only seven of the years since 1959 and makes use of a preliminary reconstruction of the 1966 I-O table in constant 1959 prices. Nevertheless, the comparison is substantial enough to support the view that increased double counting accounts for a large part of the difference between growth of Soviet GVO and the growth of SPIOER in the fuels, forest products, and soft goods industries and a significant part of the difference in machinery.

\*Vladimir G. Trembl, *Research Analysis Corporation, RAC-T-P137, The 1959 Soviet Intersectoral Flow Table, McLean, 1964, vols. I and II; and Trembl et. al., Research Analysis Corporation, The Structure of the Soviet Economy, A Reconstruction of the 1966 Input-Output Table, McLean, 1970.*

Table 9

USSR: Average Annual Rates of Growth, 1960-66

| Branch  | Percent           |                 |                   |        |                                |
|---|-------------------|-----------------|-------------------|--------|--------------------------------|
|   | Gross Output      |                 | Final Output      |        | Net Output<br>I-O <sup>b</sup> |
|   | I-O               | Official<br>GVO | I-O <sup>a</sup>  | SPIOER |                                |
| Metals .....                                      | 8.4               | 9.2             | 8.3               | 8.1    | 9.3                            |
| Fuels .....                                       | 5.4               | 6.6             | 5.0               | 4.5    | 4.6                            |
| Electric power .....                              | 11.4              | 11.8            | 11.4              | 10.7   | 11.9                           |
| Machinery .....                                   | 12.8 <sup>c</sup> | 12.7            | 11.7 <sup>c</sup> | 8.5    | 11.3 <sup>c</sup>              |
| Chemicals .....                                   | 12.6              | 13.8            | 13.2              | 11.0   | 15.9                           |
| Forest products and paper<br>and paperboard ..... | 3.9               | 4.9             | 3.3               | 3.4    | 2.5                            |
| Construction materials ..                         | 9.3               | 10.4            | 9.8               | 9.3    | 11.3                           |
| Soft goods .....                                  | 6.0               | 4.0             | 3.8               | 3.9    | 4.6                            |
| Processed foods .....                             | 6.5               | 6.5             | 6.3               | 6.4    | 6.8                            |
| Industry .....                                    | 8.1               | 8.7             | 7.1               | 7.1    | 7.9                            |

<sup>a</sup> Gross output less intra-industry shipments (sales of sector to itself).

<sup>b</sup> Gross output less total purchases, or final output less purchases from other sectors.

<sup>c</sup> Machinery plus "other industry." Other industry represented 17% of the total GVO of these two sectors in 1959.

62. Comparison of the growth of I-O gross output and I-O final output with the growth of official Soviet gross output and SPIOER, respectively, yields ambiguous results. In most cases the growth of official GVO and I-O gross output diverge significantly. This, however, may be the result of the price and reconstruction problems mentioned above and the fact that official gross output includes production of secondary products while I-O gross output includes only primary product production. On the other hand, the branch I-O final output indexes and the branch SPIOER indexes for 1960-66 match very closely except for machinery and chemicals. Although narrower than the gap between the growth of official GVO and SPIOER, the difference between growth of I-O final output and SPIOER final output in machinery and chemicals is considerable, suggesting that a major portion of the difference cannot be explained by increased double counting.

63. The average annual rates of growth of gross output and final output which are shown in Table 9 for industry as a whole are incomparable because the branch weights used in the I-O tables differ from those used by either the CSA in calculating official GVO or by OER in calculating SPIOER. The I-O branch gross output and final output weights include turnover taxes and trade and distribution charges which are excluded from the official CSA branch weights. If branch rates of growth of gross output are aggregated with a common set of weights—that is, the SPIOER value-added weights—then I-O gross industrial output increases by 8.8% a year in 1960-66 and official GVO increases by 9.0% a year. Thus much of the discrepancy in the rates of growth of gross output shown in Table 9 disappears.

64. Conversely, the apparent identity of growth of the final output of industry as measured by SPIOER and I-O comparisons is misleading. The I-O final output weights are based on the value of shipments destined for use outside

of industry (and include any turnover tax or distribution charges on these shipments) while the SPIOER weights are value-added weights. If the I-O branch rates of growth of final output are aggregated with SPIOER value-added weights, the I-O final output of industry increases by 8.1% a year in 1960-66 instead of 7.1% a year.

65. Finally, in six of the nine sectors I-O net output grew faster than I-O final output. The difference was particularly striking in metallurgy, chemicals, and construction materials. This implies that in these sectors the raw materials and other inputs required per unit of output declined. Thus the SPIOER indexes, based on final output, may understate the actual growth in net output for these sectors. On the other hand, I-O final output exceeds the increase in net output in machinery, fuels, and forest products and paper and paperboard—branches with high value-added weights. Aggregating branch rates of growth of I-O final output and I-O net output with a common set of (SPIOER) weights results in an identical rate of growth of industrial final output and industrial net output—8.1% a year. Therefore, at the level of industry as a whole, SPIOER probably does not understate growth in net output because of its reliance on trends in final output as a measure of change in net output in individual branches.

#### Comparison of the SPIOER Producer Durables Index with an Index of Soviet Investment in Equipment

66. Another, partial confrontation of SPIOER with official Soviet indexes is possible by comparing the SPIOER producer durables index with an index of Soviet investment in equipment adjusted to a production basis.\* These series are compared in Table 10. The similarity of the growth of the two indexes is apparent. At first glance this is encouraging, since the adjusted investment series is a global production series with each individual product valued at its own price. Thus the SPIOER producer durables sample index would appear to reflect accurately the growth of this part of the machinery sector.

67. The investment series may inflate growth, however, because of the "new product pricing" problem. Although the CSA claims that new or custom-made products are given prices comparable to the 1 July 1955 prices attached to the other products, Soviet authorities continue to express concern over the abuses associated with the formation and use of prices for serially produced new products.\*\* New products are assigned "temporary" prices set high enough to permit producers to recover expenses of the enterprise connected with research, development, and the tooling up for production. These prices are supposed to remain in effect only for the first year or two of production. Later, a permanent list price is supposed to be established based on normal production cost plus

\*The official Soviet data on investment in equipment is lagged one year (on the assumption that equipment "invested" this year was produced last year) and reduced by the amount of net imports of equipment.

\*\*Under Khrushchev the regional economic councils (sovnrarkhozy) were authorized to establish prices for new products, with the result that enforcement of various regulations got out of hand. In recent years there has been significant tightening of both regulations and control by the State Committee on Prices, but some abuses apparently still continue.

Table 10

USSR: Comparison of the SPIOER Index of Producer Durables with a Soviet Index of Investment in Equipment

|   | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 |
|---|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| SPIOER.....   | 33   | 32   | 34   | 40   | 45   | 54   | 64   | 75   | 84   | 89   | 100  | 111  | 125  | 136  | 143  | 150  | 163  | 175  | 189  | 206  | 224  |
| Official Soviet series on investment in equipment adjusted to a production basis <sup>a</sup> ..... | 30   | 31   | 33   | 40   | 49   | 61   | 67   | 78   | 85   | 91   | 100  | 111  | 121  | 138  | 149  | 157  | 173  | 189  | 190  | 212  | N.A. |

<sup>a</sup> Rush V., *Greenlade, Industrial Production Statistics in the USSR, prepared for the Conference on Soviet Statistics, Duke University, 3-5 November 1969, revised 27 April 1970, p. 40. The index is derived directly from the official series on gross fixed investment in machinery and equipment (expressed in prices of 1 July 1955) as reported in Soviet statistical handbooks. The official series is lagged one year to reflect the time lag between the production of equipment and its acquisition for investment and adjusted to exclude net imports of machinery and equipment and trade and distribution markups.*

profit.\* But according to the Soviet critics, the temporary prices are often allowed to run on for years, and even when they do not, Soviet statisticians apparently do not go back and replace temporary prices in the production series of previous years. The net effect of practices of this kind is a built-in price inflation embedded in the official indexes of production. Investment data could be similarly affected, but not necessarily to the same degree. If so, the alignment of the SPIOER index of producer durables with Soviet investment in equipment may indicate that SPIOER overstates the growth of producer durables.

68. A partial check may be performed by viewing the growth of the SPIOER producer durables sample excluding Soviet ruble production series (that is, excluding those series most likely to be affected by price inflation) and substituting for the deleted series, where possible, a series based on a fixed sample. The growth of such a series is compared to the growth of SPIOER producer durables and Soviet investment in equipment in the accompanying tabulation.

|                                      | Average Annual Rates of Growth<br>(Percent) |         |         |
|--------------------------------------|---|---------|---------|
|                                      | 1951-69                                     | 1951-60 | 1961-69 |
| SPIOER producer durables             |   |         |         |
| Including value series .....         | 10.1  | 11.8    | 8.4     |
| Excluding value series .....         | 8.0   | 9.5     | 6.2     |
| Soviet investment in equipment ..... | 10.9  | 12.9    | 8.7     |

The growth of the SPIOER index which excludes the producer durables reported in rubles does diverge significantly from the other series. This may indicate that the indexes of Soviet investment and SPIOER producer durables are biased somewhat by price inflation. The exact amount of such bias, however, cannot be determined, since the alternative SPIOER index (without the value series) understates growth by failing to record changes in quality and assortment.

#### Comparison of the SPIOER Consumer Durables Index with the Official Series on Production of Consumer Durables

69. The CSA publishes the ruble value of the production of "goods of cultural-living significance and domestic use." Mainly, the CSA series includes consumer durables of the kind included in the SPIOER consumer durable series, but the coverage of the CSA series is broader. The CSA series includes, for example, a number of household articles (like kitchen utensils, sporting goods, some electrical appliances, and metal furniture) which are produced in the machinery sector but which are not included in the SPIOER sample. The CSA series, however, also includes such goods as wooden furniture and musical instruments which are not produced in the machinery sector. Beyond this, the CSA boundaries of the series are unclear: school supplies, nonmetal toys, and jewelry may be encompassed in CSA's definition of "goods of cultural-living and domestic significance."

70. To improve comparability with the SPIOER index of output of consumer durables, wooden furniture and musical instruments have been removed

*\*For many machinery items no "price-list" price is ever set, inasmuch as such prices are limited to products that enter serial or large-batch production.*

from CSA's ruble series. The result presents a challenge to the SPIOER index, as the accompanying tabulation shows.

|                                      | Average Annual Rates of Growth<br>(Percent) |         |         |
|--------------------------------------|---|---------|---------|
|                                      | 1951-69                                     | 1951-60 | 1961-69 |
| SPIOER consumer durables index ..... | 19.1  | 23.6    | 14.0    |
| CSA ruble series <sup>a</sup> .....  | 13.2  | 14.3    | 12.0    |

<sup>a</sup> "Goods of cultural-living significance and domestic use" less value of output of wooden furniture and musical instruments.

Surprisingly, the CSA series grows more slowly than the SPIOER consumer durables sample, particularly in the 1950s.

71. The explanation for the divergence appears to lie primarily in the absence from the SPIOER series of basic household articles such as pots and pans and tableware. These items probably formed a major part of consumer durables output before TV sets, refrigerators, and washing machines were produced in more than token quantities. During the 1950s, the production of housewares increased but not nearly as fast as the products included in the SPIOER sample. Moreover, the CSA ruble series probably includes a number of other commodities whose production lagged or even declined in the 1950s and 1960s. Presumably such items would be covered under the ruble series, although the CSA tends to regard sluggish production series as unworthy of being reported individually. Because of this spotty reporting of individual series and because of the incomplete recording of the ruble series, the ruble series could not be substituted readily for the SPIOER sample, even if such a substitution seemed warranted.

72. Another possible reason for the difference between the SPIOER and the official series is the use of relative retail prices in the SPIOER sample of consumer durables. The official series, on the other hand, is given in wholesale prices and the gap between retail and wholesale price (mainly turnover tax) varies a good deal from product to product. It may be that the faster growing components of the SPIOER sample have higher than average turnover tax rates and are weighted too heavily in the SPIOER index of consumer durables output.

73. Thus, the SPIOER consumer durables series—especially in the 1950s—probably overstates actual growth. Still, the weight of consumer durables in the SPIOER machine building index is relatively slight before 1960 (2% in 1950 and 5% in 1955), so the impact of an exaggerated consumer durables index is not great. Since 1960 the electrical and electronic appliances and the other items in the SPIOER sample have dominated the production of consumer durables, and the SPIOER index should be quite representative.

#### Comparison of SPIOER with Western Indexes of Soviet Industrial Production

74. Although a number of Western scholars have constructed either partial or total indexes of Soviet industrial production, three have been selected for comparison here—the Nutter, Moorsteen-Powell (M-P), and Thornton indexes. The Nutter and Moorsteen-Powell indexes resemble SPIOER in concept, and the Moorsteen-Powell index has the further advantage of having been recently extended forward to 1966. Thornton, on the other hand, first

reconstructs value added in Soviet industry and then deflates it by the Soviet official price index. For contrast, the rates of growth of SPIOER and these other independently constructed indexes are compared with the rates of growth of official industrial GVO in the accompanying tabulation.

|   | Average Annual Rates of Growth |                   |         |
|---|--------------------------------|-------------------|---------|
|   | (Percent)                      |                   |         |
|   | 1951-66                        | 1951-58           | 1959-66 |
| Total industrial production                 |                                |                   |         |
| SPIOER                                      | 8.6                            | 10.0              | 7.2     |
| Nutter <sup>a</sup>                         | na                             | 9.5 <sup>b</sup>  | na      |
| Moorsteen-Powell <sup>c</sup>               | 8.2                            | 9.9               | 6.6     |
| Thornton <sup>d</sup>                       | na                             | 11.3 <sup>e</sup> | 8.4     |
| Soviet GVO                                  | 10.6                           | 12.1              | 9.1     |
| Civilian industrial production <sup>f</sup> |                                |                   |         |
| SPIOER                                      | 8.8                            | 10.4              | 7.3     |
| Nutter <sup>g</sup>                         | na                             | 7.6               | na      |
| Moorsteen-Powell <sup>c</sup>               | 8.4                            | 10.3              | 6.5     |

<sup>a</sup> Warren G. Nutter, *The Growth of Industrial Production in the Soviet Union*, Princeton, 1962, p. 196.

<sup>b</sup> Average for 1951-55.

<sup>c</sup> Norman Kaplan, *RAND Memorandum 6169*, *The Record of Soviet Economic Growth, 1928-65*, Santa Monica, 1969, p. 57, and Abraham Becker, Richard Moorsteen, and Raymond Powell, *Two Supplements to Richard Moorsteen and Raymond P. Powell, The Soviet Capital Stock, 1928-62*, Yale, 1968, p. 51.

<sup>d</sup> Judith Thornton, "Value-Added and Factor Productivity in Soviet Industry," *The American Economic Review*, December 1970, p. 869.

<sup>e</sup> Average for 1956-58.

<sup>f</sup> Thornton does not estimate an index of civilian industrial production.

<sup>g</sup> Nutter, p. 527.

75. In the one comparable period, the Nutter, Moorsteen-Powell (M-P), and SPIOER indexes of total industrial production are remarkably similar.\* These three Western indexes of industrial production fall short of the average annual rate of growth of the Soviet GVO index in 1951-58 by 2 to 2½ percentage points. The Thornton index, however, is closer to the official GVO index than to the other Western indexes.

### Evaluation of Western Indexes

76. The similarity between the Thornton and the official GVO index is hardly accidental. Thornton uses official data on the distribution of GVO by cost category to derive value added for industry as a whole, and she deflates value added by an official price index. As Thornton recognizes, however, it is statistically precarious to deflate a value-added series by an output price index. Above all, the Soviet industrial price index is so biased that its use virtually guarantees an overstatement of growth of industrial output in constant prices.\*\*

\*In the case of the Nutter index, however, the overall resemblance is somewhat misleading in that it conceals the fact that the civilian index of industrial production grows much slower and his index of military production rises much faster than the comparable M-P and SPIOER indexes. For a further discussion of the Nutter index see CIA/RR ER 63-29, *Index of Civilian Industrial Production in the USSR, 1950-61*, September 1963, p. 41 ff, UNCLASSIFIED.

\*\*Thornton relates that a group of economists at the Central Economic Mathematical Institute in Moscow criticized her results on the grounds that "the official price index provides an incomplete measure of the rise in the average price of new and nonstandard products."

77. Table 11 compares the behavior of the major components of the other industrial production indexes; the Thornton index has no branch or sector components. Because the M-P index of military machinery has very little basis in reported Soviet data or in independent analysis, the examination centers on indexes of civilian output. The most interesting features of the comparison are (1) the relative closeness of the Moorsteen-Powell and SPIOER indexes of production of producer durables through 1963 coupled with a striking divergence thereafter and (2) the general similarity of all the indexes (including GVO) with respect to production of materials and consumer goods—that is, total industrial production exclusive of machinery.

78. Since the machinery indexes are so critical to the behavior of the overall industrial index, they deserve further examination. Because the Moorsteen-Powell index of consumer durables is classified in the consumer goods sector, whereas in SPIOER it is part of civilian machinery, only producer durables can be considered in comparing the SPIOER civilian machinery index with the M-P index.\* (These indexes are also compared with the series representing Soviet investment in equipment which was discussed above—paragraph 66 ff). This comparison of average annual percentage rates of growth of producer durables in 1951-66 is shown in the accompanying tabulation.

| Source of the Index                  | 1951-66 | 1951-58 | 1959-66 |
|--------------------------------------|---------|---------|---------|
| SPIOER .....                         | 10.6    | 12.5    | 8.7     |
| Moorsteen-Powell .....               | 11.0    | 13.0    | 8.9     |
| Official investment (adjusted) ..... | 11.6    | 14.0    | 9.3     |

79. The Moorsteen-Powell machinery series is derived from the Soviet index of investment in equipment. In its original version the Moorsteen-Powell machinery index was a sample series, but this index was dropped and the investment series used as a surrogate for machinery production. Because the Moorsteen-Powell machinery series is based on the official Soviet series for investment in equipment (adjusted to a production basis), it is subject to the same criticisms as this latter series.\*\*

#### An Alternative Check on SPIOER

80. An alternative method of measuring total Soviet industrial growth provides another check on SPIOER.\*\*\* In 1958, Francis Seton used regression analysis to estimate the relationship between the growth of consumption of certain key products (steel, fuel, and electricity) and the growth of manufacturing in a cross section of 14 countries. He then applied the average relationship to Soviet data to estimate an index of Soviet industrial production. The Seton index was specifically designed to be "rough and ready," using only a small number of products for which information was readily available.

81. Although the Seton method rests on an oversimplified assumption concerning the relationship between the production of certain major commodities

*\*Ideally, the consumer durable components of the Moorsteen-Powell index should be added to their respective machinery components to make them comparable with the civilian machinery component of SPIOER. Unfortunately, the necessary data on consumer durables are not available from the Moorsteen-Powell index for the period after 1958, so it is necessary to adjust the SPIOER civilian machinery data to conform with the Moorsteen-Powell classification.*

*\*\*See paragraph 67.*

*\*\*\*Francis Seton, "The Tempo of Soviet Industrial Expansion," Bulletin of the Institute of Statistics, Oxford, February 1958, pp. 1-28.*

Table 11

USSR. Comparison of Sectoral Components of the SPIOER Indexes of Growth with Those of Western and Soviet Indexes of Industrial Production 1950=100

|  | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959  | 1960  | 1961  | 1962  | 1963  | 1964  | 1965  | 1966  | 1967  | 1968  | 1969  | 1970  | 1970  |  |
|--|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--|
| Indexes of civilian machinery:                               |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       |       |       |  |
| SPIOER.....  | 100  | 100  | 107  | 126  | 147  | 174  | 209  | 243  | 275  | 296   | 332   | 368   | 411   | 450   | 478   | 508   | 562   | 609   | 667   | 734   | 802   | 802   |  |
| Producer durables.....                                       | 100  | 98   | 104  | 123  | 140  | 165  | 197  | 228  | 257  | 274   | 306   | 338   | 381   | 415   | 437   | 459   | 500   | 536   | 580   | 632   | 686   | 686   |  |
| Consumer durables.....                                       | 100  | 128  | 151  | 190  | 287  | 371  | 444  | 527  | 639  | 742   | 847   | 949   | 1016  | 1142  | 1290  | 1486  | 1808  | 2058  | 2406  | 2760  | 3113  | 3113  |  |
| Moorsteen-Powell (revised) <sup>a</sup> .....                | 100  | 105  | 102  | 113  | 135  | 167  | 211  | 233  | 266  | 288   | 307   | 338   | 378   | 415   | 466   | 495   | 528   | ..... | ..... | ..... | ..... | ..... |  |
| Indexes of materials and consumer goods production combined: |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       |       |       |  |
| SPIOER.....  | 100  | 114  | 123  | 134  | 149  | 165  | 179  | 193  | 211  | 230   | 245   | 261   | 278   | 293   | 311   | 333   | 354   | 380   | 402   | 421   | 448   | 448   |  |
| Moorsteen-Powell.....  | 100  | 115  | 124  | 136  | 150  | 163  | 177  | 192  | 207  | 224   | 235   | 247   | 258   | 272   | 284   | 305   | 323   | ..... | ..... | ..... | ..... | ..... |  |
| Soviet GVO.....  | 100  | 116  | 127  | 140  | 157  | 171  | 187  | 203  | 220  | 242   | 260   | 278   | 299   | 315   | 334   | 359   | 386   | 412   | 453   | 478   | 514   | 514   |  |
| Indexes of materials production:                             |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       |       |       |  |
| SPIOER.....  | 100  | 113  | 122  | 132  | 147  | 164  | 179  | 195  | 215  | 236   | 252   | 268   | 288   | 307   | 330   | 354   | 378   | 404   | 425   | 444   | 474   | 474   |  |
| Moorsteen-Powell.....  | 100  | 113  | 122  | 131  | 145  | 160  | 173  | 190  | 207  | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |  |
| Soviet GVO.....  | 100  | 116  | 129  | 141  | 158  | 179  | 195  | 215  | 240  | 269   | 294   | 320   | 349   | 381   | 416   | 451   | 489   | 534   | 575   | 611   | 661   | 661   |  |
| Indexes of consumer goods production:                        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |       |       |       |       |       |       |       |  |
| SPIOER.....  | 100  | 117  | 126  | 139  | 154  | 166  | 180  | 188  | 203  | 220   | 233   | 249   | 260   | 265   | 275   | 293   | 309   | 335   | 358   | 378   | 399   | 399   |  |
| Moorsteen-Powell.....  | 100  | 119  | 127  | 143  | 158  | 170  | 184  | 195  | 206  | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |  |
| Soviet GVO.....  | 100  | 117  | 127  | 140  | 157  | 167  | 183  | 196  | 210  | 229   | 241   | 254   | 269   | 278   | 288   | 307   | 329   | 359   | 384   | 405   | 433   | 433   |  |

<sup>a</sup> The Moorsteen-Powell civilian machinery index is actually an index of producer durables production. Consumer durables are classified in the consumer goods sector.

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and industrial output, his results suggest that there is much to recommend the method, particularly when the aim is to express the industrial output of a country like the USSR in terms comparable with market-oriented industrialized nations. The Seton method sidesteps distortions due to problems of valuation and likewise avoids the difficulties encountered in trying to assemble a sufficient amount of data on quantity and price to construct adequately representative indexes of Soviet industrial production.

82. Seton's original methodology has been modified to estimate the index presented in this report. Instead of using a cross sectional approach involving a single time period and a number of countries, observations based on four countries—the United States, the United Kingdom, Japan, and West Germany—were taken for each year in 1950-68. Another modification was the addition of paper to the list of independent variables (steel, fuel, and electric power). Two variants of the regression were run. First, the rate of growth of manufacturing in each of the four countries was regarded as a function of rates of growth of the consumption of steel, fuel, electricity, and paper.\* In the second variant, the rate of growth of industrial production (manufacturing plus mining and utilities) was regarded as a function of the rates of growth of the same four independent variables.\*\* In both cases, the resulting regression coefficients from each country were applied to the corresponding Soviet data to estimate indexes for manufacturing and industrial production, respectively.\*\*\* The indexes thus derived were averaged to obtain a single index of Soviet manufacturing or industrial production.

\*The results of the regressions run in connection with the derivation of the "Modified Seton" index of manufacturing are shown in the following equations, where M, F, S, E, and P are the rates of growth of manufacturing, fuel consumption, steel consumption, electric power production, and paper production, respectively:

(1) United States:

$$M = -0.2556 + 0.0800F + 0.2635S + 0.5276E - 0.0444P; R^2 = 0.75$$

(2) United Kingdom:

$$M = 1.1641 + 0.2415F + 0.1104S + 0.0771E + 0.1280P; R^2 = 0.51$$

(3) Germany:

$$M = -3.0281 + 0.0519F + 0.1285S + 0.9415E + 0.2017P; R^2 = 0.87$$

(4) Japan:

$$M = 8.7037 + 0.8071F + 0.2675S - 0.5997E + 0.0093P; R^2 = 0.65$$

\*\*The results of the regressions run in connection with the derivation of the "Modified Seton" index of industrial production are shown in the following equations, where I is the rate of growth of industrial production and the other variables are defined as in the footnote above:

(1) United States:

$$I = -0.4923 + 0.1103F + 0.2428S + 0.5647E - 0.0610P; R^2 = 0.77$$

(2) United Kingdom:

$$I = 1.4076 + 0.1730F + 0.0929S + 0.0595E + 0.1023P; R^2 = 0.48$$

(3) Germany:

$$I = -2.6234 + 0.0519F + 0.1374S + 0.8682E + 0.1695P; R^2 = 0.89$$

(4) Japan:

$$I = 7.5159 + 0.7734F + 0.2373S - 0.4760E - 0.0008P; R^2 = 0.68$$

\*\*\*Because of difficulties in obtaining good consumption data for the USSR and because foreign trade still plays a relatively minor role in the Soviet economy, production data were used instead of consumption data for all the products except steel.

83. The results presented in the accompanying tabulation show that the growth of indexes based on an average of the four regression indexes compares favorably with the corresponding SPIOER indexes over the whole period 1950-68. The fit is not as good for the subperiods 1951-60 and 1961-68 or for indexes based on individual country regressions. The index of industrial production estimated from regression data in 1951-68 varied from an average annual rate of 5.1% for the United Kingdom to 10.5% a year for West Germany. These results therefore are not conclusive. Nevertheless, SPIOER's rate of increase does fall within the range predicted by the correlation between industrial output and key industrial products in major industrial countries with quite different industrial structures.

| USSR                   | (1950=100) |      |      | Average Annual Rates of Growth<br>(Percent) |         |         |
|------------------------|------------|------|------|---|---------|---------|
|                        | 1950       | 1960 | 1968 | 1951-68                                     | 1951-60 | 1961-68 |
| Manufacturing          |            |      |      |   |         |         |
| SPIOER .....           | 100        | 252  | 438  | 8.5   | 9.7     | 7.1     |
| Regression index ..... | 100        | 245  | 453  | 8.8   | 9.4     | 8.0     |
| Industrial production  |            |      |      |   |         |         |
| SPIOER .....           | 100        | 250  | 428  | 8.4   | 9.6     | 7.0     |
| Regression index ..... | 100        | 237  | 426  | 8.4   | 9.0     | 7.6     |

## CONCLUSIONS

84. The CIA index of Soviet industrial production (SPIOER) is the most comprehensive of such indexes constructed to date in the West. The product sample comprises 315 civilian series and one consolidated military series based on classified estimates of Soviet procurements of military and space equipment. It resembles the Federal Reserve Board Index of US industrial production in form.

85. The SPIOER branch indexes represent the total value, expressed in 1955 wholesale prices, of those items in the SPIOER sample which are produced within the given branches.\* The branch indexes are, in turn, aggregated using 1960 value-added weights to estimate the index of total industrial production. SPIOER is thus a hybrid index rather than an "ideal" index of net output. In an attempt to minimize the effects of this departure from the ideal, the SPIOER sample of 316 products is limited to final products insofar as possible to curtail "double counting" of intermediate industrial products. SPIOER's explicit assumption is that the trend in final output of a branch corresponds to the trend in net output in that branch.

86. The SPIOER sample of commodities and commodity classes is more complete than a numerical count of line items would indicate. The final products in the SPIOER sample represent about 75% of the coverage of all the value-added series (final and intermediate products) in the FRB index of US industrial production and about 64% of Soviet GVO.

87. In order to cover the most important industrial commodities, production of 21 nonferrous metals and chemical products for which the USSR does not publish statistics has been estimated by CIA/OER from collateral information. Also, a handful of Soviet ruble-value series, which appear to be constructed in the same manner as several SPIOER series and which take account of changes in product assortment, are included in the sample to provide coverage of important heterogeneous categories of machinery that would otherwise not be represented at all or would be only inadequately represented. The SPIOER series which reflect changes in product mix (motor vehicles, tractors, and railroad locomotives) and most of the Soviet ruble-value series (agricultural machinery, chemical equipment, equipment for consumer industries, and electronic and nonelectronic instruments) consist largely of producer durables and are the dominant influence on the producer durables index within the machinery sector.

88. Although the production and price data used in SPIOER are considered reliable, they are deficient in a number of respects for purposes of index construction. Except for the machinery series cited above, physical production reported by the Soviet Central Statistical Administration (CSA) is very often

\*Aggregation, however, is carried out for a number of subbranches in the chemicals, forest products, soft goods, and processed foods industries.

too aggregative to indicate changes in average quality resulting from changes in the product mix. While the CSA series are probably a reasonable representation of the growth of many relatively homogeneous products—electric power, coal, bricks, lumber, and the like—they are less suitable for more differentiated commodities. In the case of several SPIOER series (ferrous metals, cement, flour products, and consumer electronics) adjustments have been introduced to allow for changes in average quality arising from changes in product mix. Although it is impossible to assess with certainty the net effect of these quality adjustments, many of the remaining biases are probably offsetting. The SPIOER indexes that are not adjusted for quality change may have a downward bias, but the Soviet ruble-value series included in SPIOER probably are biased upward as a result of the procedures used in pricing new products in the USSR.

89. Several pieces of evidence suggest that in some branches the actual growth in net output may differ from the growth in final output by a percentage point or two per year. Nevertheless, the information is contradictory with respect to the trend in the ratio of material purchases to final output in individual branches. On balance, it appears that SPIOER's use of final product as a measure of change in branch value added leads to overstatement of growth as often as it leads to understatement.

90. Insofar as the SPIOER prices are concerned, the available Soviet sources listed only producer goods. Even for producer goods such a large number and wide range of prices was reported for some products that a median price had to be selected as the "representative" price. The "wholesale" prices for consumer durables are derived from 1957 retail prices and, in the case of consumer nondurables, include turnover tax.

91. Except for some categories of machinery, the 1955 prices employed by SPIOER are relatively reliable in terms of what they purport to represent—the transaction prices of that period. The 1955 prices, however, did not represent the relative costs of production of different products very well. Profit rates varied enormously. After some abortive attempts at price reform, the USSR carried out a reform of industrial prices in 1967 in which the relative prices of products were changed significantly, especially in the industrial materials branches. But the substitution of the new prices for the 1955 prices as weights for the branch samples of physical production does not affect the SPIOER branch indexes appreciably.

92. The SPIOER branch value-added weights for 1960 are sound. First, they are formally correct and have been derived quite rigorously. Second, the substitution of alternative weights alters the overall index of industrial production very little. The estimate of annual increases in industrial production is almost unchanged if 1955 or 1968 base-year weights are used instead of 1960 weights, and the SPIOER index is almost as insensitive to the substitution of Soviet GVO or I-O value-added weights.

93. The major weighting improvement that could be made in SPIOER would be to introduce value-added weights for subbranches of the civilian machinery sector. This sector is large and diverse, and the SPIOER sample represents some

subbranches more completely than others. Therefore, growth of some of the subbranches may influence unduly the aggregate index of civilian machinery output.

94. Confidence in SPIOER as a measure of final output is bolstered by comparing it with official Soviet indexes and with other independent reconstructions of an index of Soviet industrial production. The growth of Soviet GVO exceeds the growth in SPIOER for all branches of industry. The difference is the greatest, however, in those branches (chemicals and machinery) in which questionable procedures for valuing new products and/or increased double counting bias the Soviet index upward. Furthermore, confidence in SPIOER is buttressed by the fact that the SPIOER civilian machinery index agrees well with reported Soviet investment in equipment, the dominant component of civilian machinery. Although the SPIOER index of producer durables increases slightly slower than reported investment in equipment, the official statistics on investment in equipment overstate actual growth according to knowledgeable Soviet experts. Thus, SPIOER's approach to the problem of quality change in the output of producer durables yields a credible average of growth for civilian machinery of about 11% a year in 1951-70. Other Western indexes corroborate SPIOER in most industrial branches. Where differences appear—as in the machinery branch—SPIOER has the advantage of a larger and more representative sample. In addition, the trend of SPIOER over the period 1950-68 is supported by a regression index keyed to the production of four basic industrial commodities.

95. Our evaluation of SPIOER indicates that, despite drawbacks due largely to the limited availability of Soviet data, this index is a more reliable indicator of Soviet industrial growth than other indexes of either Soviet or Western origin. Still, because no absolute standard exists against which to measure the reliability and accuracy of SPIOER, this evaluation is necessarily an interim report.

96. In this connection, parts of SPIOER clearly require further improvement as the availability of Soviet data permits. When the SPIOER index of chemical products, for example, is compared with the Soviet GVO for the chemical industry, the large discrepancy is not explained conclusively by bias in the GVO index. The SPIOER index of chemical products therefore may need to be expanded and adjusted for quality changes, if that is possible. Other areas open to improvement in SPIOER include enlargement of the product sample in some branches, further disaggregation of production series, verification of "representative" prices used, and the derivation of price coefficients enabling a definitive conversion of the index from prices of 1 July 1955 to prices of 1 July 1967.

97. Finally, an industrial production index with 1968 value-added weights is presented in this report. It does not differ significantly from the index with 1960 weights. However, since it is more up to date, it will be used as the standard CIA index of Soviet industrial production.

## APPENDIX A

### The SPIOER Sample

Table 12 lists all line items included in the SPIOER sample of Soviet industrial production. Unless otherwise noted, the line items incorporated in SPIOER are based on official Soviet physical production series as reported by the CSA. When these series are unavailable, however, Soviet reported ruble-value series (designated in the listing as RS), CIA estimated physical production series (EPS), or CIA estimated ruble-value series (ERS) are used.

A simple count of the series detailed in Table 12 reveals that there are 316 line items in the SPIOER sample. In this count, different models which are assigned the same wholesale price weight are regarded as being one line item in their respective branch sample. For example, the Moskvich-402, 403, 407, and 408 passenger cars all have a unit wholesale price of 1,180 rubles and hence are counted as one line item.

Table 12  
Line Items Included in SPIOER

| <u>Line Item</u>                 | <u>Unit of Production</u> |
|----------------------------------|---------------------------|
| Industrial materials sector      |                           |
| Electric power branch            |                           |
| Electric power generation .....  | KWH                       |
| Coal products branch             |                           |
| Coking oil .....                 | Metric tons               |
| Lignite .....                    | "                         |
| Noncoking hard coal .....        | "                         |
| Petroleum products branch        |                           |
| Crude oil .....                  | "                         |
| Refined products .....           | "                         |
| Associated natural gas .....     | "                         |
| Natural gas .....                | "                         |
| Ferrous metals branch            |                           |
| Rails and rail accessories ..... | "                         |
| Wire rod .....                   | "                         |
| Plain wire .....                 | "                         |
| Seamless pipe and tube .....     | "                         |
| Welded pipe and tube .....       | "                         |
| Light sections .....             | "                         |
| Heavy sections .....             | "                         |
| Plate .....                      | "                         |
| Hot-rolled sheet .....           | "                         |
| Cold-rolled sheet .....          | "                         |
| Electrical sheet .....           | "                         |
| Tinplate sheet .....             | "                         |

[p 36 blank]

Table 12 (Continued)

| Line Item                                 | Unit of Production       |
|---|--------------------------|
| Galvanized sheet                          | Metric tons              |
| Products for reprocessing in other plants | "                        |
| Foundry pig iron                          | "                        |
| Iron ore exports                          | "                        |
| Pig iron exports                          | "                        |
| Nonferrous metals branch                  |                          |
| Copper (EPS)                              | "                        |
| Lead (EPS)                                | "                        |
| Zinc (EPS)                                | "                        |
| Aluminum (EPS)                            | "                        |
| Tin (EPS)                                 | "                        |
| Magnesium (EPS)                           | "                        |
| Antimony (EPS)                            | "                        |
| Mercury (EPS)                             | "                        |
| Nickel (EPS)                              | "                        |
| Titanium (EPS)                            | "                        |
| Cadmium (EPS)                             | "                        |
| Tungsten (EPS)                            | "                        |
| Molybdenum (EPS)                          | "                        |
| Forest products branch                    |                          |
| Industrial logs                           | Cubic meters             |
| Fuelwood                                  | "                        |
| Lumber                                    | "                        |
| Furniture (RS)                            | Rubles                   |
| Paper and paperboard branch               |                          |
| Newsprint                                 | Metric tons              |
| Wrapping and packing paper                | "                        |
| Printing paper                            | "                        |
| Writing paper                             | "                        |
| Sacking                                   | "                        |
| Offset printing paper                     | "                        |
| Cover paper                               | "                        |
| Winding paper                             | "                        |
| Deep printing paper                       | "                        |
| Lithographic paper                        | "                        |
| Cartographic paper                        | "                        |
| Cable insulation                          | "                        |
| Capacitor paper                           | "                        |
| Waxing paper                              | "                        |
| Other                                     | "                        |
| Paperboard                                | "                        |
| Construction materials branch             |                          |
| Cement                                    | "                        |
| Construction lime                         | "                        |
| Gypsum                                    | "                        |
| Ceramic tiles for facings and floors      | Square meters            |
| Soft roofing                              | "                        |
| Roofing tile                              | "                        |
| Asbestos cement shingle                   | Million standard units   |
| Asbestos cement pipe                      | Standard km. 200-mm pipe |
| Fire clay                                 | Metric tons              |
| Dinas (refractory brick)                  | "                        |
| Magnesite, chrome magnesite articles      | "                        |
| Magnesite powder (metallurgical)          | "                        |
| Window glass                              | Square meters            |
| Polished glass                            | "                        |
| Precast concrete                          | Cubic meters             |
| Prestressed concrete                      | "                        |
| Mineral wool insulation                   | "                        |

Table 12 (Continued)

| Line Item                                    | Unit of Production            |
|--|-------------------------------|
| Ceramic sewer pipe .....                     | Metric tons                   |
| Construction brick .....                     | Standard bricks               |
| Dimension and field stone .....              | "                             |
| Large concrete and silicate wall block ..... | "                             |
| Other wall materials .....                   | "                             |
| Rock products .....                          | Cubic meters                  |
| Chemicals branch                             |                               |
| Nitrogen fertilizers .....                   | Metric tons                   |
| Phosphorite fertilizers .....                | "                             |
| Phosphorous fertilizers .....                | "                             |
| Potassium fertilizers .....                  | "                             |
| Sulfuric acid .....                          | "                             |
| Soda ash .....                               | "                             |
| Caustic soda .....                           | "                             |
| Ethyl alcohol (EPS) .....                    | Gallons                       |
| Oleoresin, baros, and rosin .....            | Metric tons                   |
| Raw and refined turpentine .....             | "                             |
| Turpentine oil .....                         | "                             |
| Synthetic dyes .....                         | "                             |
| Artificial and synthetic fibers .....        | "                             |
| Synthetic rubber (EPS) .....                 | "                             |
| Plastics .....                               | "                             |
| Dry zinc whites .....                        | "                             |
| Enamels and primers .....                    | "                             |
| Litharge and red lead .....                  | "                             |
| Natural drying oil .....                     | "                             |
| Oksol drying oil .....                       | "                             |
| Oil varnishes and siccatives .....           | "                             |
| Nitrocellulose varnishes and solvents .....  | "                             |
| Synthetic ammonia (EPS) .....                | "                             |
| Benzol (EPS) .....                           | "                             |
| Chlorine (EPS) .....                         | "                             |
| Nitric acid (EPS) .....                      | "                             |
| Phenol (EPS) .....                           | "                             |
| Toluol (EPS) .....                           | "                             |
| Motor vehicle tires .....                    | Units                         |
| Machinery sector                             |                               |
| Civilian machinery                           |                               |
| Producer durables                            |                               |
| Boilers branch                               |                               |
| Steam boilers—high capacity .....            | Metric tons of steam capacity |
| Steam boilers—medium capacity .....          | "                             |
| Steam boilers—low capacity .....             | "                             |
| Electric power equipment branch              |                               |
| Steam and gas turbines .....                 | KW                            |
| Hydraulic turbines .....                     | "                             |
| Generators for steam and gas turbines .....  | "                             |
| Generators for hydraulic turbines .....      | "                             |
| Electric motors over 100 KW .....            | "                             |
| Power transformers .....                     | KVA                           |
| Electric bulbs .....                         | Units                         |
| Metal cutting machine tool branch            |                               |
| Lathes .....                                 | Units                         |
| Turret lathes .....                          | "                             |
| Automatic and semi-automatic lathes .....    | "                             |
| Plano-milling machines .....                 | "                             |
| Gearmaking machines .....                    | "                             |
| Jig-boring machines .....                    | "                             |
| Planers .....                                | "                             |

Table 12 (Continued)

| <u>Line Item</u>                                  | <u>Unit of Production</u> |
|---|---------------------------|
| Shapers .....                                     | Units                     |
| Slotters .....                                    | "                         |
| Horizontal broaching machines .....               | "                         |
| Internal grinding machines .....                  | "                         |
| Drill grinders .....                              | "                         |
| Vertical drills .....                             | "                         |
| Radial drills .....                               | "                         |
| Special, specialized and unit type .....          | "                         |
| Grinders, polishers, bolt threaders .....         | "                         |
| Railway machine building branch                   |                           |
| Refrigerator cars, mainline freight .....         | "                         |
| Box cars, mainline freight .....                  | "                         |
| Flat cars, mainline freight .....                 | "                         |
| Gondola cars, mainline freight .....              | "                         |
| Tank cars, mainline freight .....                 | "                         |
| Cement cars, mainline freight .....               | "                         |
| Steam locomotives                                 |                           |
| L (EPS) .....                                     | "                         |
| Sum (EPS) .....                                   | "                         |
| LV (EPS) .....                                    | "                         |
| P36 (EPS) .....                                   | "                         |
| Diesel locomotives                                |                           |
| TE-1 (EPS) .....                                  | "                         |
| TE-2 (EPS) .....                                  | "                         |
| TE-4 (EPS) .....                                  | "                         |
| TE-3, 7, 10, 30 diesel electrics (EPS) .....      | "                         |
| TE-50, TEP-60, IE-40 (EPS) .....                  | "                         |
| G-1, Gas turbine (EPS) .....                      | "                         |
| TGP-50, TS-102, 106 diesel hydraulics (EPS) ..... | "                         |
| Electric locomotives                              |                           |
| VL-22M, direct current (EPS) .....                | "                         |
| VL-8, 10, T-8, direct current (EPS) .....         | "                         |
| VL-23 electric (EPS) .....                        | "                         |
| N-0 electric (EPS) .....                          | "                         |
| N-8 electric (EPS) .....                          | "                         |
| N-60 electric (EPS) .....                         | "                         |
| VL alternating current (EPS) .....                | "                         |
| Railroad passenger cars .....                     | "                         |
| Trolley cars .....                                | "                         |
| Subway cars .....                                 | "                         |
| Trolley buses .....                               | "                         |
| Motor vehicles branch                             |                           |
| Passenger cars                                    |                           |
| Moskvich-400 sedan (EPS) .....                    | "                         |
| Moskvich cabriolet model (EPS) .....              | "                         |
| Moskvich station wagon (EPS) .....                | "                         |
| Moskvich-402, 403, 407, 408 sedan (EPS) ..        | "                         |
| Moskvich-423N, 424 (EPS) .....                    | "                         |
| ZIS limousine .....                               | "                         |
| ZIM sedan (EPS) .....                             | "                         |
| GAZ-67 jeep (EPS) .....                           | "                         |
| GAZ-69 and GAZ-69A jeeps (EPS) .....              | "                         |
| Pobeda (EPS) .....                                | "                         |
| GAZ-21 (Volga) (EPS) .....                        | "                         |
| ZAZ-965, 966 (Zaporozhets) (EPS) .....            | "                         |
| GAZ-13 (Chayka) (EPS) .....                       | "                         |

Table 12 (Continued)

| Line Item                                      | Unit of Production |
|--|--------------------|
| Trucks   |                    |
| GAZ-51 (EPS) .....                             | Units              |
| GAZ-63 (EPS) .....                             | "                  |
| GAZ-53F, 53A, 66 (EPS) .....                   | "                  |
| ZIL-157, 157K (EPS) .....                      | "                  |
| ZIL-164, 164A (EPS) .....                      | "                  |
| ZIL-150 (EPS) .....                            | "                  |
| ZIL-151 (EPS) .....                            | "                  |
| ZIL-585 (EPS) .....                            | "                  |
| URAL ZIS-335, 355M, 356, 358 (EPS) .....       | "                  |
| ZIL-130, 131 (EPS) .....                       | "                  |
| YaAZ-200, 210, 214, 219, 221, 222 (EPS) .....  | "                  |
| KRAZ-214, 219, 221, 222 (EPS) .....            | "                  |
| MAZ-200, 205 (EPS) .....                       | "                  |
| MAZ-500, 501, 502, 503, 509 (EPS) .....        | "                  |
| MAZ-525 (EPS) .....                            | "                  |
| BELAZ-528, 529, 531, 540, 548, 549 (EPS) ..... | "                  |
| MOAZ-542, 546, 522 (EPS) .....                 | "                  |
| KAZ-120 (EPS) .....                            | "                  |
| KAZ-588+B, 583+V (EPS) .....                   | "                  |
| KAZ-602, 606, 608 (EPS) .....                  | "                  |
| KAZ-600+A, 600B+V (EPS) .....                  | "                  |
| GAZ-AA (EPS) .....                             | "                  |
| URAL-ZIS-5 (EPS) .....                         | "                  |
| Moskvich-430, 432 (EPS) .....                  | "                  |
| UAZ-450 (EPS) .....                            | "                  |
| ABZ-50 and miscellaneous others (EPS) .....    | "                  |
| Buses  |                    |
| KUAZ-651 (EPS) .....                           | "                  |
| PAZ-651, 652, 652B (EPS) .....                 | "                  |
| ZIL-115, 118, 127, 155, 158 (EPS) .....        | "                  |
| TA-6 (EPS) .....                               | "                  |
| LAZ-695, 695E (EPS) .....                      | "                  |
| LAZ-698, 699A (EPS) .....                      | "                  |
| RAF-251, 976, 977V, 977D (EPS) .....           | "                  |
| Tractors                                       |                    |
| DT-54 (EPS) .....                              | "                  |
| KD-35 (EPS) .....                              | "                  |
| KDP-35 (EPS) .....                             | "                  |
| KT-12A (EPS) .....                             | "                  |
| ASKHTZ-NATI (EPS) .....                        | "                  |
| S-80 (EPS) .....                               | "                  |
| KHTZ-7 (EPS) .....                             | "                  |
| International 15/30 (EPS) .....                | "                  |
| Belarus (EPS) .....                            | "                  |
| DT-24 (EPS) .....                              | "                  |
| DT-14 (EPS) .....                              | "                  |
| DT-28 (EPS) .....                              | "                  |
| U-1, U-2, U-3, U-4 (EPS) .....                 | "                  |
| Others (EPS) .....                             | "                  |
| Agricultural machine building branch           |                    |
| All agricultural machine building equipment    |                    |
| (RS) .....                                     | Rubles             |
| Construction and road equipment branch         |                    |
| Excavators (multibucket) .....                 | Units              |
| 0.15-0.20 single-bucket excavators .....       | "                  |
| 0.25-0.30 single-bucket excavators .....       | "                  |
| 0.35-0.80 single-bucket excavators .....       | "                  |

Table 12 (Continued)

| Line Item   | Unit of Production |
|---|--------------------|
| 1-1.25 single-bucket excavators   | Units              |
| 3-8 single-bucket excavators  | "                  |
| 10 or more single-bucket excavators   | "                  |
| Bulldozers  | "                  |
| Scrapers  | "                  |
| Motor graders   | "                  |
| Hoist-transport equipment branch  |                    |
| Railroad cranes   | "                  |
| Truck cranes  | "                  |
| Tower cranes  | "                  |
| Pneumatic tire cranes   | "                  |
| Elevators   | "                  |
| Mining and other equipment branch   |                    |
| Metallurgical (except rolling mills)  | Metric tons        |
| Rolling mill equipment  | "                  |
| Coal combines   | Units              |
| Coal cutting machines   | "                  |
| Rock loading machines   | "                  |
| Electric mine locomotives   | "                  |
| Petroleum equipment (refinery)  | Metric tons        |
| Deep well pumps   | Units              |
| Turbodrills   | "                  |
| Chemical equipment (RS)   | Rubles             |
| Equipment for consumer industries branch  |                    |
| For the paper industry (RS)   | "                  |
| For trade and public dining enterprises (RS)  | "                  |
| For the printing industry (RS)  | "                  |
| For mills, elevators, and granaries (RS)  | "                  |
| For the food processing industry (RS)   | "                  |
| For the textile industry (RS)   | "                  |
| Civilian shipbuilding branch  |                    |
| Civilian shipbuilding (ERS)   | "                  |
| Civilian aircraft branch  |                    |
| Civilian aircraft (ERS)   | "                  |
| Sanitary technical equipment branch   |                    |
| Bath water heaters  | Units              |
| Enameled iron bathtubs  | "                  |
| Heating boilers   | Square meters      |
| Heating radiators   | "                  |
| Sewer pipe and fittings   | Metric tons        |
| Instruments branch  |                    |
| Power optical instruments and apparatus (RS)  | Rubles             |
| Electrical measuring instruments (RS)   | "                  |
| Radio measuring instruments (RS)  | "                  |
| Computer engineering equipment (RS)   | "                  |
| Instruments for the mechanization and automation of engineering and control work (RS) | "                  |
| Instruments for the control and regulation of technological processes (RS)            | "                  |
| Instruments for physical research   | "                  |
| Instruments for the measurement of mechanical magnitudes (RS)                         | "                  |
| Instruments for medicine, physiology, and biology (RS)                                | "                  |
| Consumer durables   |                    |
| Consumer electronics branch   |                    |
| Consumer electronics (ERS)  | "                  |

Table 12 (Continued)

| <u>Line Item</u>                   | <u>Unit of Production</u> |
|------------------------------------|---------------------------|
| Household durables branch          |                           |
| Timepieces (RS) .....              | Rubles                    |
| Cameras .....                      | Units                     |
| Bicycles .....                     | "                         |
| Motorcycles .....                  | "                         |
| Electric irons .....               | "                         |
| Electric hot plates .....          | "                         |
| Electric tea and coffee pots ..... | "                         |
| Refrigerators .....                | "                         |
| Sewing machines .....              | "                         |
| Vacuum cleaners .....              | "                         |
| Washing machines .....             | "                         |
| Kerosene burners .....             | "                         |
| Portable home food grinders .....  | "                         |
| Military machinery (ERS) .....     | Rubles                    |
| Consumer nondurables sector        |                           |
| Soft goods branch                  |                           |
| Cotton fabrics .....               | Square meters             |
| Linen fabrics .....                | "                         |
| Silk fabrics .....                 | "                         |
| Wool fabrics .....                 | "                         |
| Sewn garments (RS) .....           | Rubles                    |
| Knit outerwear .....               | Pieces                    |
| Knit underwear .....               | "                         |
| Hosiery .....                      | Pairs                     |
| Leather footwear .....             | "                         |
| Processed foods branch             |                           |
| Bread (ERS) .....                  | Rubles                    |
| Meat and meat products .....       | Metric tons               |
| Fish and fish products .....       | "                         |
| Sugar, granulated (net) .....      | "                         |
| Sugar, refined .....               | "                         |
| Butter .....                       | "                         |
| Margarine products .....           | "                         |
| Vegetable oil (net) .....          | "                         |
| Cheese .....                       | "                         |
| Macaroni products .....            | "                         |
| Flour .....                        | "                         |
| Confectionery goods .....          | "                         |
| Soap .....                         | "                         |
| Canned goods .....                 | 400 gram cans             |
| Cigarettes .....                   | Units                     |
| Beer .....                         | Dekalitres                |
| Champagne .....                    | Bottles                   |
| Vodka and vodka products .....     | Dekalitres                |
| Wine and vodka products .....      | "                         |
| Whole milk .....                   | "                         |

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## APPENDIX B

USSR: SPIOER Indexes of Industrial Production and Output of Industrial Materials, Machinery, and Consumer Nondurables <sup>a</sup>

1968=100

| Sector                           | 1968                          |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |                   |
|----------------------------------|-------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|-------|-------------------|
|                                  | Value-Added Weights (Percent) | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968  | 1969  | 1970 <sup>b</sup> |
| Industrial materials.....        | 50.14                         | 22.8 | 25.7 | 27.9 | 30.2 | 33.6 | 37.6 | 41.0 | 44.9 | 49.4 | 54.3 | 58.2 | 62.1 | 66.8 | 71.6 | 77.2 | 82.8 | 88.6 | 94.9 | 100.0 | 104.6 | 111.8             |
| Machinery.....                   | 30.11                         | 20.2 | 23.5 | 24.2 | 26.1 | 30.0 | 35.8 | 39.0 | 40.8 | 45.1 | 48.6 | 52.8 | 58.2 | 65.6 | 70.5 | 73.6 | 78.2 | 86.0 | 92.9 | 100.0 | 109.2 | 117.3             |
| Consumer nondurables.....        | 19.75                         | 28.6 | 33.4 | 35.8 | 39.6 | 43.8 | 47.1 | 50.9 | 52.8 | 57.7 | 62.3 | 65.9 | 69.6 | 73.4 | 75.1 | 77.5 | 82.2 | 86.8 | 93.8 | 100.0 | 105.4 | 111.2             |
| Total industrial production..... |                               | 23.2 | 26.6 | 28.4 | 30.8 | 34.6 | 38.9 | 42.4 | 45.2 | 49.8 | 54.2 | 58.1 | 62.4 | 67.8 | 72.0 | 76.2 | 81.3 | 87.5 | 94.1 | 100.0 | 106.1 | 113.4             |

<sup>a</sup> The SPIOER indexes of the production of industrial materials, machinery, and consumer nondurables and the index of total industrial production in this Appendix are the result of aggregating branch indexes (calculated in 1955 prices) with 1968 branch value-added weights.

<sup>b</sup> Preliminary.

## APPENDIX C

### Derivation of Final-Product Weights for Civilian and Military Machinery

To help explain the derivation of final-product weights for civilian and military machinery, Table 7 is reproduced below. Comments are keyed to the row headings.

|                                  | Billion New Rubles<br>(Enterprise Wholesale<br>Prices of 1 July 1955) | Weight<br>(Percent) |
|----------------------------------|---|---------------------|
| Civilian machinery .....         | 11.95   | 59.9                |
| Producer durables .....          | 8.96  | 44.9                |
| Consumer durables .....          | 1.25  | 6.3                 |
| Spare parts for repair .....     | 1.12  | 5.6                 |
| R&D .....                        | 0.62  | 3.1                 |
| Military machinery .....         | 8.00  | 40.1                |
| Procurement of end items .....   | 5.00  | 25.1                |
| Operations and maintenance ..... | 1.04  | 5.2                 |
| R&D .....                        | 1.96  | 9.8                 |
| <i>Total</i> .....               | 19.95   | 100.0               |

The two major categories—civilian machinery and military machinery—as well as total machinery are simply derived as the sum of their respective components.

The value of producer durables is derived from their value as investment goods. The equipment component of investment in 1961 (10.8 billion rubles in investment prices of 1 July 1955) is taken to represent industrial output of producer goods in 1960 on the assumption that there is about a one-year lag between the production of goods and the acquisition of them for investment purposes. This figure is reduced by 15% (to 9.2 billion rubles) to convert the valuation from investment prices, which include the cost of packaging, handling, and transportation, back to enterprise wholesale prices. To this value is added an increase of 0.1 billion rubles in inventories of uninstalled equipment (producer durables produced during 1960 but not entering into investment). One further step required to complete the adjustment is the elimination of net imports of equipment amounting in 1960 to 0.335 billion rubles (derived by adjusting the value of net imports of producer durables as reported in Soviet foreign trade handbooks to domestic prices using a ratio of 1 to 0.7). The resulting figure of 8.96 billion rubles represents the final-product value of Soviet producer durables in 1960 expressed in enterprise wholesale prices of 1 July 1955.

[p.46 blank]

The value of consumer durables is taken directly from the SPIOER sample and excludes passenger cars. (Conceptually, some passenger cars belong in the consumer durables rather than the producer durables category, but only about one-fourth of all the passenger cars produced in the USSR are, in fact, sold as consumer goods. The value of passenger cars sold to the public probably did not exceed 0.05 billion rubles in 1960.) The total value shown in this table is the sum of the following two categories:

|   | Billion New Rubles<br>(Enterprise Wholesale<br>Prices of 1 July 1955) |
|---|---|
| Consumer durables (nonelectronic) ..... | 0.653   |
| Consumer electronics .....              | 0.597   |
| <i>Total consumer durables</i> .....    | <u>1.250</u>  |

This total is thought to represent very nearly the universe of consumer durable production in 1960 (allowing for the exclusion of passenger cars) on the basis of the flows of machinery to consumption shown in the Soviet statistical handbook—USSR, Central Statistical Administration, *Narodnoye khozyaystvo SSSR v 1964 godu* (The National Economy of the USSR in 1964), p. 582, UN-CLASSIFIED. The consumption figures in the handbook are on an input-output basis and the purchaser prices in current rubles shown there must, of course, be significantly adjusted when making a comparison with enterprise wholesale prices of 1 July 1955.

A sizable part of the output of Soviet machine building consists of spare parts which are used in the repair of producer and consumer durables but are not included in the value of final product going to investment and consumption. Consequently an estimate of civilian spare parts production originating in the machine building sector is an important element in determining the SPIOER weights for civilian and military machinery. The production of spare parts originating in the machine building sector is predominantly "centralized" production (in distinction to "noncentralized" production of spare parts, which is generally carried out in the using sector). Because the value-added weights in SPIOER are based on an establishment classification, the value of "centralized" production of spare parts is most appropriate for use in constructing the weights in the machinery sector. Centralized production of spare parts for motor vehicles, tractors, and agricultural equipment in 1960 was planned at 1.03 billion rubles (in enterprise wholesale prices of 1 July 1955). It is estimated that production of these spare parts alone constituted 62% of the total centralized production (civilian and military) of spare parts, based on the ratio of the deliveries of the various machinery branches to the machinery repair sector as shown in the 1959 Soviet I-O table. The resulting total of 1.66 billion rubles is reduced by one-third to reflect the division between civilian final products and spare parts.

The R&D figure for civilian machinery is estimated as one-half of total civilian R&D for the economy (1.25 billion rubles in 1960).

Procurements of military and space hardware—roughly equivalent to production—are estimated by OSR.

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The category of operations and maintenance, also estimated by OSR, consists largely of spare parts but also includes some materials used in the maintenance and repair of military machinery.

The figure for military-space R&D is estimated by OSR from announced Soviet expenditures on science. It excludes outlays for investment in science inasmuch as such outlays are covered conceptually in the producer durables category of civilian machinery.

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