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A RAND NOTE

Price Index for Soviet Machinery, 1965-1986

Vladimir G. Tremi

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Price Index for Soviet Machinery, 1965-1986

Vladimir G. Trembl

Prepared for the
Under Secretary of Defense for Policy

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FOREWORD

by Abraham S. Becker

The Soviet government's statistical office (formerly the Central Statistical Agency, TsSU; now the State Committee on Statistics, *Goskomstat*) publishes very little information on industrial price changes. Indexes of wholesale industrial prices, broken down by a handful of branch-of-industry clusters, were published in the statistical yearbooks until the late 1970s. For several years thereafter, these series were continued, although on a different base, in the statistical agency's journal, *Statistical Herald* (*Vestnik statistiki*). Since 1986, all official publication of this information has been discontinued.

Most of the data on indexes of wholesale prices for heavy industry since 1970 are shown in the following table, which indicates that the Soviets claim almost general and steady price reduction over the 1970s, except for small price increases in ferrous metallurgy and timber, wood, and paper. Only in 1982, during a general revision, were there price increases in electric power, fuel, ferrous metallurgy, timber, wood and paper, and construction materials; the average price level of machine-building and metalworking (MBMW) is supposed to have dropped in 1982. Thereafter, prices remained unchanged except in MBMW, where the monotonic downturn continued.

A considerable literature has been produced in the West detailing reasons why the Soviet claim must be challenged, based on both the deficiencies of the wholesale price index¹ and the characteristics of price information in Soviet industry.² These conclusions have been

¹The basic criticism of the official price index is that it seems to be based on an unchanging sample that became irrelevant quickly in an industry with high product turnover. See Morris Bornstein, "Soviet Price Statistics," in V. G. Trembl and J. P. Hardt (eds.), *Soviet Economic Statistics*, Duke University Press, 1972, pp. 357-362; and Abraham S. Becker, "The Price Level of Soviet Machinery in the 1960s," *Soviet Studies*, 26:3, July 1974, pp. 363-379. The sampling method was said to have begun in 1961, according to the statistical yearbooks of the early 1970s (*Narodnoe khoziaistvo SSSR v 19- godu*, hereafter abbreviated to *Narkhoz 19-*). Yet *Narkhoz 1977* states that the sample method was in use up to 1958. The 1977 formula is repeated in *Narkhoz 1978*, after which the yearbooks ceased to provide such methodological explanations and also discontinued publication of the price indexes. However, if the method of calculating the index was altered, it is not apparent in the index numbers themselves, which are unchanged throughout the 1970s.

²There is a very extensive English-language literature on this subject, of which we cite only a few works, e.g., Becker, "The Price Level of Soviet Machinery"; Joseph S. Berliner, *The Innovation Decision in Soviet Industry*, MIT Press, Cambridge, MA, 1976; James Steiner, *Inflation in Soviet Industry and Machine-Building and Metalworking (MBMW) 1960-1975*, Central Intelligence Agency, SRM 78-10142, July 1978; and Defense Intelligence Agency, *USSR: Inflationary Pressures*, DDB-1900-16-82, January 1982, pp. 11-22. Steiner's paper was attacked by Steven Rosefielde ("Are Soviet Industrial-Production Statistics Significantly Distorted by Hidden Inflation?") in *Journal of Comparative Economics*, 5(1981), pp. 185-199; Steiner responded in the same journal (6(1982), pp. 278-287), and Rosefielde replied in 7(1983), pp. 71-76. Rosefielde remains virtually alone among Western analysts in rejecting the general

formed in large part from the criticisms of many Soviet economists. To take a relatively recent example, G. I. Khanin has proposed a rate of concealed inflation in MBMW of about 3.5 to 4.5 percent per year in the 1970s.³ Khanin and V. Seliunin declare that the rate of inflation in machine-building prices averaged 27 to 34 percent from the Eighth Five Year Plan period through the Eleventh (1966–1970 through 1981–1985).⁴

These assertions point to the desirability of independent Western estimation of Soviet price indexes. However, few attempts have been made to measure the rate of price change in MBMW. The most serious efforts were undertaken at the CIA, but these efforts stopped at 1972–1973.⁵ The lack of systematic studies of price change in the 1970s is primarily due to the absence of detailed price information. The Soviet price revision of 1981–1982, the first important revision since the late 1960s, seemed to promise the opportunity for increased information, but regrettably, that opportunity was not realized.

Table S.1
Official Soviet Indexes of Change in Wholesale Enterprise Prices of Output, 1970–1982:
Branches of Heavy Industry
(1970 = 100)

	1973	1975	1978	1979	1980	1981	1982	1983	1984	1985
Electric power	100	99	95	95	95	95	117	117	117	117
Fuel	n/a	100	100	100	101	101	163	163	163	163
Ferrous metallurgy	99	100	103	103	103	103	127	127	127	127
Chemical and petrochemicals	97	96	94	94	94	94	94	94	94	94
Machine-building & metalworking	87	84	79	78	78	78	77	77	76	75
Timber, wood, paper	99	99	100	101	102	102	124	124	124	124
Construction materials	100	98	98	98	98	98	119	119	119	119
All heavy industry	92	93	88	90	90	90	102	101	101	100

SOURCES: *Vestnik statistiki*, 1981, No. 9, p. 78; 1984, No. 9, p. 79, and 1986, No. 9, p. 79. The 1973 figures are interpolated from the series in *Narodnoe khoziaistvo SSSR v 1974 g*, Moscow, 1975, p. 211. See, however, Trembl's discussion of these data, below.

thesis of inflation in MBMW caused by the characteristics of Soviet price formation, particularly with respect to new products.

³Cited in Philip Hanson, "The CIA, the TsSU and the Real Growth of Soviet Investment," *Soviet Studies*, 36:4, October 1984, p. 577.

⁴G. Khanin and V. Seliunin, "Lukavaia tsifra," *Novyi mir*, 1987, No. 2, p. 187.

⁵CIA, *An Analysis of the Behavior of Soviet Machinery Prices*, reworked into Robert E. Leggett, "Measuring Inflation in the Soviet Machinebuilding Sector, 1960–1973," *Journal of Comparative Economics*, 5(1981), pp. 169–184; and CIA, *USSR and the United States: Price Ratios for Machinery, 1967 Rubles-1972 Dollars*, ER 80–10410, Vol. I, September 1980, pp. 39–42.

Professor Vladimir Trembl of Duke University has now assembled enterprise wholesale prices (i.e., net of turnover taxes and transportation and distribution charges) for 1981 for a large sample of Soviet machinery. He has also compiled output data in physical units for this sample, covering the years 1965-1986. Along with other estimates he has made of machine-building value of output for the same period, these data have enabled him to construct, with meticulous care, an independent estimate of price change in the Soviet machinery sector over two decades. The index is lucidly described and evaluated in this Note, which constitutes the first substantial and systematic study of Soviet machinery price change available to the Western reader since the CIA reports of the 1970s. Moreover, this study brings the story up to the beginning of Gorbachev's *perestroika*; a brief postscript extends the main results through 1988.

Professor Trembl concludes that Soviet machinery prices rose steadily through these two decades at an annual average rate of about 4 percent. This finding contradicts the official claims noted above, even as to direction of change. He suggests, however, that while the official index is a biased indication of overall price change, it accurately reflects change in a small part of total annual machine-building output.

Professor Trembl is the author of three books, the coauthor of a fourth, and an editor of and contributor to four others. He has published widely on various aspects of Soviet economics, particularly input-output, national income, prices, and alcoholism.

PREFACE

Soviet machinery price and output indexes published regularly in standard Soviet statistical sources are faulty to the point of being useless for analytical purposes. As an alternative, this study offers a version of a weighted aggregate price index for the entire machine-building industry (machine-building, metalworking and repair, or MBMW) for the 1965-1986 period based on a method specially designed to accommodate the limited available Soviet output and price statistics.

The study is limited to the explanation of the method employed in construction of the price index and of the underlying data, a description of corrections for certain identified biases, and the examination and testing of the results. Because of time and space constraints, it does not examine existing Western and Soviet price indexes or the rich literature on Soviet machinery prices and price information.

This work was started while the author was at the Department of Economics, University of California, Berkeley, under the Ford Visiting Research Professorship program. The author is grateful to Abraham Becker and Gregory Hildebrandt of RAND, and to Professors Morris Bornstein, Gregory Grossman, and Yasushi Toda for their extensive comments; and to Clifford Gaddy, Timothy Heleniak, and Ludmilla Pashina for their assistance with data collection and processing. The responsibility for the methodology developed in the study and the errors is, of course, the author's.

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SUMMARY

Scarcity of data is the main reason for the absence of an accurate ruble price index for Soviet machinery. To accommodate the limited available Soviet machinery output and price data, this study departs from standard statistical practices in constructing a price index for 1965–1986. The index is built on four datasets:

- 1981 wholesale enterprise (producers') prices for a large sample of individual machines.
- Matching output data in physical units for the same sample for 1965–1986.
- Independently estimated gross value of output (GVO) for all machine-building and metalworking (MBMW) in current enterprise prices for the same period.
- GVO of 25 sectors constituting the whole MBMW industry in 1972 in enterprise prices, drawn from the 1972 input-output table.

A set of price indexes with shifting weights is obtained, measuring changes in prices between any given year and 1981. Dividing the 1981 index by itself and then by each succeeding year's price index yields an index on a constant 1965 quantity-weighted base.

Prices of Soviet machinery rose steadily throughout the two decades after 1965. The cumulative increase was 100 percent or more, depending on particular adjustments of the basic series. The average annual rate of price change was about 4 percent, ranging from +8 percent (1969) to -1 percent (1974). Except for short periods in the early and late 1970s, the price rise was monotonic. Thus, the record indicates that the declared government policy of controlling and containing inflation in machinery production failed.

The official machinery price index shows a steady downward trend and thus diverges sharply from the calculated index. Most Soviet and Western specialists consider the official index useless because it records officially posted cuts but disregards increases in so-called "temporary prices." The disappearance of wholesale industrial price indexes from official statistical publications can be interpreted as government admission of the serious defects in these indexes.

There are four sources of bias in the calculated index. First, the sample underrepresents intermediate machinery goods in the MBMW mix, producing an upward bias in the index. An experimental, illustrative adjustment suggests that the bias may amount to a few percentage points in the cumulative 1965–1986 index number.

Second, the sample is not random. It consists of 178 separate machines or machine groups, distributed as follows: 50 intermediate products; 92 final-use products; and 36 consumer appliances and durables. In 1981, the sample accounted for 30 percent of MBMW GVO in 1981 prices. Some 17 machinery categories (e.g., ships, railroad equipment, mainframe computers, armaments) are not represented in the sample at all; chemical industry equipment, precision instruments and computers, radio-electronic products (except for consumer use), and metal products are seriously underrepresented. The nature of the bias resulting from omissions and underrepresentation will depend on the shares of the indicated machinery groups in MBMW output and the divergence between the rates of growth of included and omitted machinery output.

The largest problem of omission concerns armaments, but the evidence suggests that this gap does not significantly bias the calculated index. Other omissions are smaller in production weight and have contrasting growth patterns, tending to minimize the bias. In summary, incomplete coverage of the sample probably did not introduce a significant bias in the price index.

Third, there are two caveats concerning the prices used in construction of this index: (1) Subsidization of sales of tractors and agricultural machinery and equipment to state and collective farms means that the calculated price index is not applicable to the machinery purchased by farms; and (2) the index is upwardly biased—by perhaps as much as 1 percentage point over the entire period—because the method of calculation unavoidably includes export supplements, whereas the index is intended to measure prices paid by domestic purchasers.

Finally, in view of the impossibility of constructing hedonic price indexes for Soviet machine-building, alternative measures of output were used to provide a partial solution. Physical measures of output capability (horsepower, tons of steam, kilowatt-amperes, etc.) were used in addition to standard measures for ten machinery groups, accounting for 19 percent of sample GVO in 1981, and an alternative price index was constructed. The alternative price index yields a somewhat lower price change during 1965–1985 than does the series with standard output measures.

Recent Soviet publication of additional machinery output information permits improvement of the accuracy of the index and its extension by two years, although the numbers for 1988 are less reliable than those of 1986–1987 because of some missing output data. The new information indicates that machinery price increases continued under Gorbachev in 1985–1988, at annual rates of between 3 and 7 percent; these increases raised the overall increase in the machinery price level for 1965–1988 to 2.1 to 2.5 percent (from 1.9 to 2.3 percent for 1986 in the main text calculation).

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1. CONSTRUCTION OF THE PRICE INDEX

ALGEBRA OF PRICE INDEX CONSTRUCTION

The absence of an accurate price index for Soviet machinery is primarily due to a scarcity of data. The construction of the 1965-1986 price index for Soviet machinery presented in this study does not follow standard statistical practices and is based on a method that was specially designed to accommodate the limited Soviet machinery output and price data. It is therefore necessary to describe these data before the step-by-step computation of the price index can be explained. The data, collected by the author, are as follows:

1. A set of 1981 enterprise (producers') prices for a large sample of individual machines.
2. A matching set of output data in physical units for the same list of machines for 1965-1986.
3. An independently estimated series of gross value of output (GVO) for the whole machine-building and metalworking (MBMW) industry measured in current enterprise (producers') prices for the same period.
4. A set of GVOs for the 25 sectors comprising the whole MBMW industry in current 1972 enterprise prices derived from the 1972 input-output table.

It would be useful at this point to compare the basic set of data used in the construction of the price index in this study with data sets needed for the computation of two standard price indexes used in statistics.

To construct a price index of n products over a period of t years the following data are used:¹

	Standard Laspeyres Index	Standard Paasche Index	Index prepared in this study
Prices	$n \times t$ matrix	$n \times t$ matrix	n prices for 1981
Quantities	n quantities for year 0	n quantities for year t	$n \times t$ matrix of quantities
Values	none	none	set of $\sum_{t=1}^n Q_t P_{1981}$ for each year

¹A Laspeyres price index uses fixed base period (0) quantities as weights, and a Paasche index uses varying current or last year's quantities as weights. There are more than two variants of price indexes and of weights, but these two will suffice for this example. Differences between aggregate or total and sample variables are disregarded in the summary above.

Construction of the price index is described below. The following symbols are used:

- Q = output in physical units
- P = prices
- i = the year (i = 1965 ... 1986)
- j = a specific machinery type or sector (j = 1, 2, ..., n)
- w = the weight (share) of the given group of machines or a machinery sector in total MBMW GVO in 1972
- r = output indexes for specific sectors
- R = output indexes for the whole sample

For convenience, summation signs will be omitted. A superscript t will indicate that Q^S and P^S refer to the entire machinery industry, and a bar superscript will indicate that the aggregates are based on (weighted) sample data.

Using the data sets described above, we can calculate the output of each machinery sector for any year, in 1981 prices. That is, we have the following tabulations:

	1965	1966		1981		1982
Sector 1	$Q_{65}^1 P_{81}^1$	$Q_{66}^1 P_{81}^1$	...	$Q_{81}^1 P_{81}^1$	...	$Q_{86}^1 P_{81}^1$
Sector 2	$Q_{65}^1 P_{81}^1$	$Q_{66}^1 P_{81}^1$	...	$Q_{81}^1 P_{81}^1$	...	$Q_{86}^1 P_{81}^1$
...	...	...	...	...	...	...
Sector n	$Q_{65}^1 P_{81}^1$	$Q_{66}^1 P_{81}^1$	...	$Q_{81}^1 P_{81}^1$	...	$Q_{86}^1 P_{81}^1$

(1)

As the second step, we calculate output indexes (r) for all sectors in 1981 prices:

	$\frac{1981}{1965}$		$\frac{1981}{1966}$	
Sector 1	$\frac{Q_{81}^1 P_{81}^1}{Q_{65}^1 P_{81}^1} = r_{65}^1$		$\frac{Q_{81}^1 P_{81}^1}{Q_{66}^1 P_{81}^1} = r_{66}^1$	...
Sector 2	$\frac{Q_{81}^1 P_{81}^1}{Q_{65}^1 P_{81}^1} = r_{65}^1$		$\frac{Q_{81}^1 P_{81}^1}{Q_{66}^1 P_{81}^1} = r_{66}^1$	...
...	...		...	...
Sector n	$\frac{Q_{81}^1 P_{81}^1}{Q_{65}^1 P_{81}^1} = r_{65}^1$		$\frac{Q_{81}^1 P_{81}^1}{Q_{66}^1 P_{81}^1} = r_{66}^1$	...

(2)

Weighting the set of r_i^j for each year by appropriate weights, we calculate output indexes in constant 1981 prices for the whole sample of machinery for each year i :

$$\sum_{j=1}^n r_i^j \cdot w^j = R_i \quad (i = 1965, 1966, \dots, 1986). \quad (3a)$$

We can rewrite Eq. (3a) for easier interpretation as:

$$\frac{\bar{Q}_{81} \bar{P}_{81}}{Q_i \bar{P}_{81}} = R_i. \quad (3b)$$

Division of the R_i calculated above into an output index for the entire MBMW industry in current prices (dataset III) yields the following index for any year i :

$$\frac{Q_{81}^t P_{81}^t}{Q_i^t P_i^t} \cdot \frac{\bar{Q}_{81} \bar{P}_{81}}{Q_i \bar{P}_{81}} = \text{Index}_{81/i}. \quad (4a)$$

As a first approximation, this index can be taken as a price index of a varying (current period quantities) weights type. This can be seen in the following. Rearranging Eq. (4a):

$$\frac{Q_{81}^t P_{81}^t}{Q_{81} \bar{P}_{81}} \cdot \frac{\bar{Q}_i \bar{P}_{81}}{Q_i^t P_i^t} = \text{Index}_{81/i}. \quad (4b)$$

Clearly, the larger and the more representative the sample, the closer this index will be to a true Laspeyres index.² Even if the sample is not large, the index will be identical to a Laspeyres price index if all Q s increase at the same rate between any two years. Suppose all Q s increased at a rate α ; that is,

$$\alpha \bar{Q}_i = \bar{Q}_{81} \quad \text{and} \quad \alpha Q_i^t = Q_{81}^t.$$

Substituting and canceling:

²Some of these points are relevant to all calculations involving sets of variables and price indexes derived from a sample drawn from these sets.

$$\frac{\alpha Q_i^t P_{81}^t}{\alpha \bar{Q}_i \bar{P}_{81}} \cdot \frac{\bar{Q}_i \bar{P}_{81}}{Q_i^t P_i^t} = \frac{Q_i^t P_{81}^t}{Q_i^t P_i^t} = L_{81/i} \quad (4c)$$

In summary, as long as the sample is relatively large and the overall changes of Qs between any two years are relatively stable and without violent shifts, and expecting that some changes in Qs and Ps in different directions will cancel each other, the index derived will be close to a Laspeyres (or a hybrid Laspeyres-Paasche) price index.

These calculations will enable us to obtain a set of indexes with shifting weights measuring changes in prices between any given year and 1981:

$$\begin{array}{ll} 1965 & \frac{Q_{65} P_{81}}{Q_{65} P_{65}} \\ \\ 1966 & \frac{Q_{66} P_{81}}{Q_{66} P_{66}} \\ \\ 1967 & \frac{Q_{67} P_{81}}{Q_{67} P_{67}} \\ \\ \dots & \dots \\ \\ 1980 & \frac{Q_{80} P_{81}}{Q_{80} P_{80}} \\ \\ 1981 & \frac{Q_{81} P_{81}}{Q_{81} P_{81}} \end{array} \quad (5)$$

As the last step, we compute standard price indexes with a constant Q₆₅ base by dividing the 1981 index first by itself and then by each succeeding year price index:

$$\begin{aligned}
 1965 \quad & \frac{Q_{65}P_{81}}{Q_{65}P_{65}} \cdot \frac{Q_{65}P_{65}}{Q_{65}P_{81}} = 1.000 \\
 1966 \quad & \frac{Q_{65}P_{81}}{Q_{65}P_{65}} \cdot \frac{Q_{66}P_{66}}{Q_{66}P_{81}} \approx \frac{Q_{65}P_{66}}{Q_{65}P_{65}} \\
 1967 \quad & \frac{Q_{65}P_{81}}{Q_{65}P_{65}} \cdot \frac{Q_{67}P_{67}}{Q_{67}P_{81}} \approx \frac{Q_{65}P_{67}}{Q_{65}P_{65}} \\
 & \dots \dots \dots \\
 1981 \quad & \frac{Q_{65}P_{81}}{Q_{65}P_{65}} \cdot \frac{Q_{81}P_{81}}{Q_{81}P_{81}} = \frac{Q_{65}P_{81}}{Q_{65}P_{65}} \\
 1986 \quad & \frac{Q_{65}P_{81}}{Q_{65}P_{65}} \cdot \frac{Q_{86}P_{82}}{Q_{86}P_{81}} \approx \frac{Q_{65}P_{86}}{Q_{65}P_{65}}
 \end{aligned} \tag{6}$$

Using the same set (Eq. (5)), we calculate year-by-year price indexes, with 1965 = 1.000:

$$\begin{aligned}
 1965 \quad & \frac{Q_{65}P_{81}}{Q_{65}P_{65}} \cdot \frac{Q_{65}P_{65}}{Q_{65}P_{81}} = 1.000 \\
 1966 \quad & \frac{Q_{65}P_{81}}{Q_{65}P_{65}} \cdot \frac{Q_{66}P_{66}}{Q_{66}P_{81}} \approx \frac{Q_{65}P_{66}}{Q_{65}P_{65}} \\
 1967 \quad & \frac{Q_{65}P_{81}}{Q_{66}P_{66}} \cdot \frac{Q_{67}P_{67}}{Q_{67}P_{81}} \approx \frac{Q_{66}P_{67}}{Q_{66}P_{66}} \\
 & \dots \dots \dots \\
 1986 \quad & \frac{Q_{85}P_{81}}{Q_{85}P_{85}} \cdot \frac{Q_{86}P_{86}}{Q_{86}P_{81}} \approx \frac{Q_{85}P_{86}}{Q_{85}P_{85}}
 \end{aligned} \tag{7}$$

Prices and output indexes so calculated are given in Sec. 3.

THE NATURE OF PRICES USED IN THE INDEX

Prices used in this study are wholesale enterprise prices (*tsey ny predpriiatii*), as defined in Soviet accounting practices, which correspond to the Western concept of wholesale or producers' prices. The term means that prices are net of trade and transportation markups and net of turnover and other sales-type taxes (such as radio and television users' fees or special markups).

The topic of subsidies and their effect on Soviet enterprise prices is complex. A number of machines are sold at prices that result in losses to the manufacturer. Such losses are covered out of profits earned on sales of other machines produced in the same enterprise or in the same ministry. Technically speaking, these machines are subsidized, but these subsidies should not concern us here, and the established enterprise price is the proper price to use in the preparation of the price index. A more difficult case is that of tractors and agricultural machinery and equipment. Sales of these machines to *kolkhozy* and *sovkhozy* have been subsidized since 1967; in the early 1980s, the total subsidy amounted to several billion rubles. The subsidy is handled through *Goskomtekhnika* (the state organization for distributing machinery to agriculture), which sells the machinery at lower prices than it pays the manufacturer, with the difference covered by the state budget. Thus, two different sets of wholesale prices of agricultural machinery exist—the higher price collected by the manufacturer and the lower price paid by the buyer. The price received by the manufacturer corresponds to the true enterprise price as defined in Soviet statistics and will be used in this study. But it should be noted that because of this subsidy, the price index derived here cannot be applied to machinery purchased by state agriculture.

One aspect of Soviet pricing should be mentioned in this connection, since it does affect the accuracy of the price index. Prices of a certain, probably significant, share of Soviet machinery products manufactured for export include so-called "export price supplements," i.e., markups in the price allowed by Soviet price authorities to compensate the export manufacturers for additional costs incurred because of higher quality requirements of world markets and other factors such as special markings and packaging, foreign language instructions, and the like. We do not have enough information to estimate the average level of special export price supplements, but we know that in many cases they range from 30 to 40 percent over the price of comparable machinery produced for domestic users. Furthermore, export price supplements are included not only in the prices of machinery manufactured directly for export but also in the prices of assemblies and components supplied to the export manufacturers by outside contractors (Treml, 1981, pp. 200–221).

This aspect of machinery pricing creates a problem in the construction of price indexes that are derived as ratios of GVOs in current and constant prices. The price index in this

study is derived essentially by dividing the GVO of MBMW in current prices by machinery output measured in constant 1981 prices. Special export price supplements are included in enterprise prices and are thus counted in gross value of output of MBMW in enterprise prices. On the other hand, without exception, all 1981 prices used in the preparation of the price index in this study are enterprise prices paid by domestic buyers, that is, prices without export supplements. This characteristic of the basic data will thus generate an upward bias in the index, particularly since during the period under study, export of Soviet machinery was increasing faster than total machinery output. It is impossible to estimate and to correct for this bias, but very rough estimates indicate that this factor probably generated less than 1 percentage point in the index over the entire period.³

STRUCTURE AND SECTOR CLASSIFICATION OF THE MACHINE-BUILDING INDUSTRY

Two broad types of Soviet industrial statistics are collected and published: administrative (*vedomstvennaia*) and branch (*otraslevaia*).⁴ Administrative statistics encompass various production and distribution data generated by producing enterprises subordinated to administrative units, such as productive associations, ministries, state committees, and other state administrative entities. Branch statistics cover the same data, reorganized by state statistical agencies to reflect groupings of enterprises manufacturing similar products.

In terms of administrative classification, MBMW consists of three major divisions: eight union, or union-republican, ministries producing civilian or general-purpose machinery (such as the Ministry of Automobile Production); nine union ministries comprising the defense complex (such as the Ministry of Aircraft Production); and miscellaneous organizations of union, union-republican, or republican subordination. The division of machinery output into civilian and defense is not as exact as implied by the existing

³The problem with this bias is that we do not have reliable statistics on Soviet machinery exports in domestic prices and on the level of "special price export supplements." The following very rough estimates give some idea of the order of magnitude involved. We will assume at a first approximation that the conversion factor for foreign to domestic machinery prices is 1. On the basis of this assumption and the published Soviet foreign trade statistics, we estimate the value of Soviet machinery exports in 1965 at 1.5 billion current rubles and the value in 1986 as 11.2 billion current rubles. These values correspond to 3.1 percent and 4.5 percent of MBMW GVO in, respectively, 1965 and 1986. We will further assume that "special export price supplements" increase the domestic value of machinery exports by 25 percent. In this case, the growth of MBMW GVO in current prices in the 1965-1986 period would be 405 percent, including the price supplements; it would be 403 percent if the supplements were excluded. Thus, the upward bias produced by the inclusion of "special export price supplements" in the value of the MBMW GVO in current prices but not in constant prices would amount to less than 1 percent over the entire period.

⁴There is a third classification, termed "pure" (*chistaia*), in which statistics are grouped according to identical products regardless of the producing enterprise or the ministry. The "pure" product or commodity statistics are used only in input-output tables and do not concern us in this study.

administrative structure, however. The eight civilian ministries are known to produce military end-products—for example, the Ministry of Automobile Production may be manufacturing armored troop carriers. The nine defense-complex ministries, on the other hand, produce general-purpose ships and aircraft, consumer radio-electronic products, and a variety of other civilian durables.

In branch statistics, the MBMW is divided into some 25 machinery sectors that produce civilian and general-purpose machinery, such as machine tools and railroad rolling stock, an unknown number of defense machinery sectors, and sectors producing metal products and machinery repair services.

The aggregate measure of output, the GVO, should be the same for either the branch or administrative classification. We will assume, like most Soviet and Western authors, that the term MBMW and various aggregate MBMW measures, such as price and output indexes used in standard Soviet statistical sources (e.g., the *Narodnoe khoziaistvo SSSR* compendia, hereafter referred to as *Narkhoz*), always include both the civilian and the defense production. We will also assume that in published Soviet statistical compendia such as *Narkhoz*, sectoral data are defined in branch and not in administrative terms. For example, we interpret annual rates of growth of machine tools and instruments in *Narkhoz* as referring not to the output of the Ministry of Machine Tools and Instruments, but to the aggregate of these products measured in accordance with the branch definition.

The MBMW GVO in this study is defined in standard terms as the gross value of output of all machinery—final and intermediate, civilian and defense—metal products, and machinery repair services produced in a given year. The machinery sample prepared in this study encompasses only civilian and general-purpose machinery defined in branch classification terms. Thus it excludes all arms, weapons, communications equipment, and radio-electronic products. With the exception of consumer radio-electronic products, it also excludes two large civilian machinery groups produced in the defense group—ships and aircraft—because the necessary data are not available.

2. PREPARATION OF THE SAMPLE

DESCRIPTION OF THE SAMPLE

The key element in the construction of the 1965–1986 MBMW price index is a specially prepared sample of machinery for which 1965–1986 output data and 1981 prices were found in the Soviet literature or were estimated on the basis of reliable data.

The composition of the sample can be described as follows:

Total number of separate machines or machine groups included in the sample	178
Intermediate machinery products	50
Final (end-use) machinery	92
Consumer appliances and durables	36
Value of machinery included in sample as percent of 1981 estimated MBMW GVO measured in 1981 prices	29.9
Number of machinery sectors included in sample ¹	23

Machinery types or sectors completely absent from the sample:

Casting machinery and equipment
Tools and dies
Woodworking and paper industry machinery and equipment
Ships and shipbuilding
Machines for the construction materials industry
Railroad equipment other than rolling stock (switches, blocks)
Hand tools and implements
Trade and public dining equipment
Consumer sports equipment, musical instruments
Measuring instruments and gauges
Mainframe computers
Electronic parts and components
Aircraft
Abrasives
Medical instruments

¹Based on the standard 27-sector classification of the MBMW industry used in the 1972 input-output table (see Gallik et al., 1983, pp. 95–99).

Machinery components such as reducers, gears, drives valves, fittings, etc.

Arms and weapons

Machinery types or sectors seriously underrepresented in the sample:

Chemical industry equipment

Precision instruments and computers

Radio-electronic products (except consumer radio products)

Metal products

Physical output series for the 1965–1986 period and 1981 prices are available for 173 of the 177 products included in the sample. Spare parts for automobiles, tractors, and agricultural machinery and equipment are recorded in rubles as published in Soviet sources in constant 1975 prices, and repair of producer durables, consumer appliances, and passenger cars is recorded in 1981 prices. The share of products measured in constant prices in 1981 was 11.3 percent.

SOURCES OF DATA

Output series in physical units for 1965–1986 were collected from standard *Narkhoz* annual volumes (MBMW and consumer durables and appliances sections), statistical appendixes in technical journals, *Vestnik statistiki*, *United Nations Industrial Statistics Yearbooks*, and Council for Mutual Economic Assistance (CMEA) annual statistical handbooks² (industrial output sections). Selected listings published in annual *Narkhoz* volumes of the Soviet republics were used to estimate trends in cases where *USSR Narkhoz* coverage had gaps or the sum of outputs for republics was close to USSR totals. More than 97 percent of the machinery output data for 1965–1986 was taken directly from these sources, and only in some instances was linear interpolation used (mainly in cases of consumer appliances produced between 1965 and 1970).

The 1981 prices were obtained from the RSFSR Central Statistical Administration (1981), *Kommercheskii vestnik*, lottery listings³ in various Soviet newspapers, and other Soviet sources on machinery prices. In some instances Soviet sources reported what was

²CMEA annual statistical handbooks were used in preference to *Narkhoz* compendia, because they usually report outputs to three additional digits. In instances of discrepancies between CMEA and *Narkhoz* data, the latter were used.

³Soviet lotteries offer money and goods as prizes. Results of lottery drawings published periodically in newspapers include retail prices and descriptions of prizes won. In the absence of reliable average prices of consumer durables in standard Soviet statistical sources, these lottery lists provide Western analysts with data.

clearly an average weighted price for a large group of machines (e.g., forging presses). In cases when Soviet sources offered series of different prices for various models and types, the mean price (weighted whenever possible) was calculated. Retail prices of consumer durables and appliances collected from these sources were adjusted downward to exclude turnover taxes and trade and transportation margins to transform them into enterprise prices. In a few instances, average prices were estimated on the basis of published 1981 retail trade sales in rubles and in physical units and adjusted for taxes and distribution costs. Turnover tax, radio and TV users' fees, transportation, and trade and distribution cost data were obtained from four studies in which Soviet input-output tables were converted from purchasers' to producers' prices (Trembl et al., 1973; Gallik et al., 1975; Gallik, Kostinsky, and Trembl, 1983, 1984).

THE PROBLEM OF QUALITY CHANGE AND THE USE OF ALTERNATIVE MEASURES OF OUTPUT

Changes in technical characteristics and parameters of machines over time pose a serious problem for the accuracy of all machinery price indexes. Inclusion of a given machine in a price index covering years 0 to t implies that the machine produced in year 0 is identical to the one produced in year t. In most cases this is not true, as most machines undergo minor and major modifications over time, and their productivity changes. Technical changes in machinery also pose a problem for the interpretation of price indexes. Thus, an increase in the price of a given machine over a span of t years may not reflect the overall inflationary trend, but instead the fact that the machine produced in year t has a higher power rating, is more durable or versatile, or uses less energy. Abstracting from the issue of the learning curve, in this case the higher price of the machine in year t is explained by higher production costs that were necessary to make the quality modifications.

The ideal solution for products undergoing rapid technical changes or performance modifications is the construction of so-called hedonic price indexes, which are adjusted to reflect these changes. However, even under the best of circumstances, hedonic price indexes are difficult to construct and interpret because they involve assignment of arbitrary or approximate statistical weights to different technical characteristics of machines.

Some Soviet statisticians have experimented with hedonic price indexes for small machinery samples, but no detailed results or documentation have been published. Hedonic price indexes, of course, require much additional data on characteristics and performance. In the absence of such detailed data, construction of such indexes for the whole MBMW industry by Western analysts does not appear feasible.

A partial solution to the problem of machinery quality changes in the preparation of the 1965-1986 price index was the use of alternative measures of output. Soviet statistical sources regularly report the output of certain machines in terms of the number of units produced and also in various alternative measures such as horsepower ratings or kilowatts. For instance, the number of trucks produced increased from 379,600 units in 1965 to 787,000 units in 1981, a factor of 2.1; however, the total carrying capacity of these trucks increased from 1,377,000 tons to 4,129,000 tons, or by a factor of 3.0. The increase in the average carrying capacity from 3.6 to 5.2 tons per truck is, of course, not necessarily a qualitative improvement. Nevertheless, heavier trucks cost more to produce, and this should be reflected in their prices.

The following ten machinery groups included in the sample have their output series expressed in both standard units and alternative measures:

<u>Machinery Group</u>	<u>Alternative Measure</u>
Steam boilers	tons of steam
Turbines	kilowatts
Generators	kilowatts
Large electrical motors	kilowatts
Small electrical motors	kilowatts
Power transformers	kilowatt-amperes
Electrical locomotives	horsepower rating
Diesel locomotives	horsepower rating
Trucks	tons of carrying capacity
Tractors	horsepower rating

Alternative measures of output were not simply substituted for standard units in the output series of these ten machinery groups. Nevertheless, output series in terms of the number of units produced and a price index based on these series are not completely useless. For instance, it appears that all Soviet price indexes are based on such measures and we would need a similar price index for comparison purposes.

Under the circumstances, two different price indexes have been constructed—one using standard units of output for the entire sample and one utilizing alternative measures of output for the ten machinery groups.⁴

⁴Tables A.1 and A.2 in the Appendix list both measures of output. Whenever alternative measures of output such as horsepower rating or KWH are available, the machine is listed twice. The number 1 following the description of the machine refers to standard units of output, and the number 2 designates alternative measures.

The total value of the ten product groups in 1981 for which alternative measures of output were available was 10,431.4 million rubles in 1981 prices, or 19.3 percent of the sample GVO in that year.

The 1965-1985 price index based on output series using standard units of measurement was calculated at 2.111. The price index based on output series using alternative measures of output was lower, as expected, at 2.011.⁵

WEIGHTS USED IN AGGREGATING SECTORAL INDEXES

Because of the nature of the sample, the GVOs of individual sample sectors measured in constant 1981 prices are not proportional to the GVOs of similar sectors in the actual machinery industry. Therefore, the rates of growth of individual sample sectors had to be weighted to obtain the aggregate index of growth. Selection of these weights presented a problem. For example, large blocks of disaggregated MBMW data from which such weights could have been obtained are available only in reconstructed Soviet input-output tables. Thus we had the following choices:

- A set of 1966 GVOs for all needed sectors in 1966 producers' prices (Treml et al., 1977, pp. 1-67).
- A set of 1966 GVOs for all needed sectors in 1970 producers' prices (Treml and Guill, 1977, pp. 197-281).
- A set of 1972 GVOs for all needed sectors in 1972 producers' prices (Gallik, Kostinsky, and Treml, 1983).

All of these sets have advantages and disadvantages. The 1966 GVOs in 1966 prices are closest to our base year of 1965, but 1966 prices were revised during the major 1967 price reform and adjusted several times thereafter. Thus, 1966 prices probably differ most significantly from 1981 prices, which would have been a better choice. The 1966 GVOs measured in 1970 prices would be preferable in this respect, but the 1966-1970 conversion was based on a number of simplifying assumptions and approximations, particularly in some key sectors such as repair, and are therefore not as reliable as the GVOs for other years.

It must also be emphasized that all three sets are derived not directly from Soviet statistics but from Soviet input-output tables which were first reconstructed in terms of purchasers' prices and then converted to producers' prices.⁶ By and large, the original 1972

⁵For this example, the 1985 index was used rather than the 1986 index, because the 1986 production of trucks, which constitutes a significant share of output in alternative measures, is not available.

⁶Complete—that is, full three-quadrant—ex post input-output tables have never been released in the USSR. In most cases, Soviet sources publish large blocks of transaction matrixes and some

Soviet table was better than the original 1966 table, and the 1972 reconstruction and conversion were also more accurate than the 1966 one.

Under the circumstances, the 1972 shares of MBMW GVO in producers' prices were selected as best for reweighting of sectoral growth rates (See Table A.3 in the Appendix).

SELECTION CRITERIA

The sample of machinery prepared in this study cannot be viewed as representative in the usual statistical sense of the term. At the first stage of preparation of the sample, the overriding criterion was "the larger the better," and, accordingly, an effort was made to collect the data for all Soviet machinery for which 1981 prices were available and 1965-1986 output statistics could be found in Soviet sources. This universe of statistical data had numerous gaps. Standard Soviet sources carry little output information for small parts and components (e.g., reducers, transistors, carburetors, and the like), small hand tools and dies, instruments and gauges, and other intermediate machinery products. Also absent are data on the production of purely military products (arms, weapons) or civilian machinery produced by the Soviet defense industry complex, such as ships and aircraft.

Beyond this stage, the process of selection was, in some sense, open. Soviet technical books and journals publish plentiful information on a large number of other machines and equipment, but the data have gaps or are poorly defined, requiring estimation and interpretation. A complete and comprehensive collection of all output and price data, which would have required an effort to close the existing gaps by estimation, would have been prohibitively costly. Thus, a selective search was made, guided by the following criteria for inclusion:

- The relative importance of the sector in total machinery GVO measured in terms of shares of the sector in 1972 producers' prices.
- The relative importance of the machine within the sector.
- Rates of growth of output of the given machine as measured either by official Soviet output indexes or in physical unit series.
- Extent of price changes.
- Extent of mix changes within sectors over time.

additional data on direct and full input coefficients. Western specialists have reconstructed complete and fully integrated input-output tables on the basis of these truncated matrixes and selected non-input-output Soviet statistics. In the process of reconstruction some sectors have had to be aggregated, and the reconstructed tables therefore include somewhat fewer sectors.

Thus, the higher the relative share and the rate of growth and the greater the extent of price and product-mix changes, the more importance was attached to the inclusion of a given machine in the sample and the more effort was made to find the needed data. For example, we have a relatively large set of 1981 prices for machinery and equipment used in the industry producing construction materials, but virtually no output statistics for the USSR or by republics. The sector itself is relatively small—in 1972, its GVO accounted for only 0.4 percent of MBMW GVO, and official Soviet output indexes indicated relatively slow growth. A preliminary search of the literature yielded an average 1967 price for 34 types of crushing machines of 4,700 rubles (Fal'tsman, 1975, p. 105); the 1981 price was 10,474 rubles, and the implied average annual rate of increase in the price was about 5.9 percent. It is conceivable that a more thorough search of Soviet technical journals would have yielded more data on production time series and more prices, but the data would probably have required interpretation and extensive estimation of missing statistics. However, because of the relatively small size and slow growth of the sector relative to total machine-building and the evidence that prices were rising more or less at the same rate as in the whole machine-building industry, the search was not continued, and the category of construction materials machinery was excluded from the sample.

The cable and wire sector was another special case. In 1972, in terms of GVO, the sector was 4 to 5 times larger than construction materials machinery and accounted for 1.8 percent of output of the whole MBMW industry. Although no total USSR GVO data for the cable sector were found in standard sources, republic statistical handbooks yielded several time series for some 10 different types of cable and wire for most of the years in the 1965–1986 period. Scattered evidence also indicated that the cable sector was characterized by a high degree of price instability and major product-mix changes. Under the circumstances, omission of the cable sector from the sample would have been regrettable. Accordingly, an extensive search was made, and the data on ten types of cable, wire, and electrical cord products found in the literature were included. The coverage of this group is not comprehensive, as it omits such important products as aviation and automobile wire. The estimated 1981 GVO of these ten products is only 243 million rubles, or some 9 to 10 percent of a roughly estimated total 1981 GVO of 2,500 million to 2,750 million rubles.⁷ But the importance of the sector, in contrast to construction materials machinery, made this effort worthwhile.

⁷The numbers are based on rates of growth in current prices estimated on the basis of 1966 and 1972 GVOs in producers' prices and applied for 1972–1981 prices.

INCOMPLETE QUANTITY DATA FOR 1983-1986

Output statistics for a number of important machinery groups began to disappear from official statistical compendia in the early 1980s. Some data were restored in compendia published later, but a number of serious gaps still remains. The most notable case is the deletion of data on trucks, which had been published in Soviet sources without interruption since the late 1950s but was dropped from *Narkhoz* in 1983. Some, but not all, the missing data were found in technical journals and other sources. As a result, the output series for 1983-1986 are not as complete for 1965-1982, as can be seen from the following tabulation:

	1983	1984	1985	1986
Number of missing machinery types in the output series in physical units (out of total 188 types)	13	16	20	53
Value of missing machinery as percent of the value of the total sample in 1981	6.1	6.9	7.3	20.5

The gaps are obviously numerically important, and price indexes for 1983-1985, particularly the 1986 index, are not as accurate as those for earlier years.

The absence of some items from the sample for the 1983-1986 period required an additional step in the construction of the index. It will be recalled that an interim step in price index construction is the calculation of the ratio of the GVO of the given machinery group in a given year measured in 1981 prices to the GVO of this group in 1981. For the years in which some machinery groups had missing output entries, the numerator of this ratio was adjusted downward by deletion of the same missing entry.

THE SPECIAL CASE OF MACHINERY REPAIR

The machinery repair sector is one of the largest in Soviet MBMW. In the early 1980s, the total value of repair services was about 60 billion rubles (Popov and Vasil'ev, 1983, p. 32) of which capital repair accounted for 27.8 billion rubles (Pavliuchenko, 1982, p. 16). We do not know the exact classification of various repair services, but if we were to assume that all repair services are aggregated under the repair category in MBMW statistics, the latter would constitute around 30 percent of GVO in the early 1980s.⁸

Standard Soviet statistical sources offer no data on capital repair and the omission of such an important sector from the sample used in the construction of the 1965-1986 price index would have led to serious distortions, particularly since there is evidence that prices of

⁸In the 1972 Soviet input-output table converted to producers' prices, repair accounted for 14 percent of MBMW GVO. In input-output statistics, the repair sector is defined as current and maintenance repair performed in specialized enterprises and all capital repair regardless of where done. Thus, in input-output classification, current repair performed "in-house" in nonspecialized enterprises is excluded. The figure of 60 billion rubles probably covers all repair services.

current and capital repair services of trucks, tractors, grain combines, engines, and road-building machinery were growing at annual rates of between 4 and 8 percent from the mid-1960s through the early 1980s. Thus the inclusion of repair services in the sample was mandatory even though it would involve extensive estimates.

Repair services in the sample include capital repairs of trucks, truck engines, tractors, grain combines, excavators, bulldozers, scrapers and mobile cranes. Output of repair services was estimated as follows: The average annual stocks of tractors, trucks, and grain combines were estimated for the entire economy on the basis of available production, export and import data, and attrition rates for each, estimated on the basis of average annual stock data reported for agriculture. Shares of total machinery in stock annually undergoing capital repair were estimated on the basis of scattered Soviet data, and average 1981 RSFSR prices were used.

Repair services for the four types of road-building and construction machinery were estimated on the basis of published Soviet statistics on the annual stock of these machines in the construction industry. The percentage of machines undergoing capital repair every year and prices were roughly estimated on the basis of depreciation rates and by analogy with trucks and tractors.

INCLUSION OF SPARE PARTS IN THE SAMPLE

Spare parts constitute a significant share of gross output of a number of MBMW sectors, particularly in automobiles, tractors, agricultural machinery, road-building machinery, and railroad rolling stock, and for this reason alone every effort had to be made to include them in the sample. There are two additional and equally important reasons. Final machinery and equipment constitute a disproportionately large share of our total sample, compared with semifabricates, parts, components, and other intermediate machinery products. The inclusion of spare parts would significantly correct this imbalance. And in cases where the data are available, production of spare parts for automobiles, tractors and agricultural machinery was growing faster than the final machinery included in our sample, as can be seen from the following:

	<u>1965-1982 Output Index</u>
Automobiles and other final products of the automobile industry, 1981 prices	2.56
Spare parts for automobiles, 1975 prices	3.22
Tractors and agricultural machinery and equipment, 1981 prices	1.46
Spare parts for tractors and agricultural machinery	2.10

Thus, the exclusion of parts from the sample would unduly lower the average rate of growth and would ultimately contribute to an upward bias of the derived price index.

Soviet standard statistical sources regularly publish enough information to prepare time series of the production of spare parts for automobiles and tractors and agricultural machinery in constant 1975 prices.⁹ Soviet machinery statistics in so-called "constant prices" have a strong upward bias, and therefore none were used in the sample of general machines. In the case of spare parts, however, this bias is, in all probability, not particularly significant. For most machines, the upward bias is generated by the introduction of new or modified machinery at higher temporary prices. However, spare parts are produced not only for machinery produced in the same year, but also, or possibly mainly, to service the existing stock of machinery of earlier vintages. By definition, the share of spare parts produced for new machines is smaller than the share of spare parts for older machines. Thus, the built-in upward bias generated by introduction of new products should be smaller.

The moderate upward movement in the prices of spare parts can also be deduced from the officially decreed price changes summarized below:

	Price Indexes for Spare Parts ¹⁰		
	Automobiles	Tractors	Agricultural Machinery
1955-1967	1.032	1.087	0.997
1967-1975	0.989	0.997	0.991
1975-1982	1.102	1.134	1.183

Accurate conclusions are difficult to make, but, generally speaking, these price indexes suggest that prices of spare parts were increasing slowly before 1967, somewhat faster between 1967 and 1975, and slower again between 1975 and 1982. The advantages of the inclusion of spare parts in the sample outlined above thus probably outweigh the defects of constant prices.

⁹Production of spare parts has been reported for some selected years for the entire USSR and for most years for the RSFSR, the Ukraine, Belorussia, Kazakhstan, Azerbaidzhan, Lithuania and Tadzhikistan. Time series were thus estimated on the basis of USSR totals in years for which data were available, and trends were established on the basis of republican data. Data in 1955 and 1967 prices were converted to 1975 prices on the basis of estimated price indexes.

¹⁰Based on output data published in alternative prices for the same years in seven republic statistical compendia.

3. MBMW PRICE INDEXES FOR 1965-1986

SUMMARY

The price indexes for Soviet MBMW constructed in this study are shown in Table 1, and the same three indexes are graphed in Fig. 1. Columns 1 and 2 of Table 1 present the first and the principal version of the price index, based on the method described in Sec. 1. Columns 3 and 4 present the same index as the first two columns, but with one modification. The index in columns 1 and 2 is based on a sample of machinery products measured in standard units of output, i.e., on the number of machines produced. In columns 3 and 4, about 20 percent of the machines are measured not in standard units of production but in alternative measures of output, such as tons of carrying capacity of trucks, horsepower rating of tractors, and kilowatt ratings of electrical machines. This version of the

Table 1
MBMW Price Index, 1965-1986

Year	Units as Measures of Output, Unadjusted for Faster Intraindustry Growth of GVO		Alternative Measures of Output, Unadjusted for Faster Intraindustry Growth of GVO		Alternative Measures of Output, Adjusted for Faster Intraindustry Growth of GVO	
	Year by Year Index (1)	1965 = 1.00 Index (2)	Year by Year Index (3)	1965 = 1.00 Index (4)	Year by Year Index (5)	1965 = 1.00 Index (6)
1965	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1966	1.0655	1.0655	1.0633	1.0633	1.0556	1.0556
1967	1.0795	1.1502	1.0730	1.1409	1.0656	1.1248
1968	1.0723	1.2333	1.0553	1.2041	1.0485	1.1793
1969	1.0333	1.2744	1.0406	1.2529	1.0342	1.2197
1970	1.0391	1.3242	1.0358	1.2978	1.0297	1.2559
1971	1.0039	1.3293	1.0021	1.3006	0.9965	1.2515
1972	1.0324	1.3725	1.0304	1.3402	1.0248	1.2825
1973	0.9925	1.3622	0.9910	1.3282	0.9858	1.2643
1974	1.0424	1.4200	1.0403	1.3817	1.0350	1.3086
1975	1.0562	1.4998	1.0541	1.4565	1.0489	1.3725
1976	1.0004	1.5004	1.0003	1.4568	0.9954	1.3662
1977	1.0290	1.5440	1.0269	1.4960	1.0221	1.3964
1978	1.0659	1.6458	1.0638	1.5915	1.0590	1.4787
1979	1.0622	1.7480	1.0539	1.6773	1.0492	1.5515
1980	1.0419	1.8214	1.0400	1.7445	1.0355	1.6066
1981	1.0311	1.8780	1.0324	1.8009	1.0280	1.6515
1982	1.0274	1.9294	1.0250	1.8460	1.0207	1.6857
1983	1.0250	1.9777	1.0263	1.8946	1.0221	1.7230
1984	1.0339	2.0448	1.0264	1.9445	1.0222	1.7612
1985	1.0477	2.1422	1.0490	2.0399	1.0449	1.8402
1986	1.0532	2.2561	1.0434	2.1285	1.0394	1.9127

price index therefore should better reflect the changing quality and productivity of machines over time. The justification for this modification, the method used in the preparation of the index, and the underlying data are summarized in Sec. 2.

Columns 5-6 present the same price index, corrected for the probable upward bias generated by the faster growth of intraindustry output of the whole machine-building industry measured in current prices. The magnitude of the bias and one possible method for the correction of this bias are discussed later in this section. It should be noted that while this bias is definitely present in Soviet machinery GVO statistics, the correction of the bias is rough and must be considered a first approximation only.

As noted above, the price indexes presented here are derived on the basis of MBMW GVOs measured in current prices and sample GVO data measured in constant 1981 prices. Output indexes (based on standard units of production and on alternative measures of output) computed from the constant price series are shown in Table A.6 in the Appendix.

The main conclusion reached in this study is that prices of Soviet machinery rose steadily throughout the 1965-1986 period. The average annual price change was about 4 percent,¹ with actual changes varying from a high of +8 percent in 1967 to a low of -1 percent in 1973. As Fig. 1 shows, except for short periods in the early and late 1970s, the steady rise in machinery prices continued without interruption, indicating that the declared government policy of controlling and containing inflation in machinery was a failure.

An examination of changing Soviet rules for setting and controlling wholesale prices as well as the complex reasons for inflation in machinery prices is beyond the scope of this study (see Bornstein, 1987, pp. 96-109). But it would be instructive at this point to look at official² indexes, which, despite all of the evidence to the contrary, have been recording declining machinery prices for most of the postwar period, but which are virtually useless. One of the main shortcomings of the official index is that it primarily records officially posted price cuts and disregards upward movements of the so-called "temporary prices" and new products price supplements; thus it has a strong built-in downward bias. The divergent movements of the official index and the sample-based price index prepared in this study are shown in Fig. 2.

In the past several years, a number of prominent Soviet economists have criticized official Soviet statistics, singling out national income and price indexes as particularly defective. In general, while admitting certain shortcomings, *Goskomstat* officials have been

¹Calculated as a compound rate. A simple average rate was calculated as $(225.6 - 100)/21 = 6$ percent.

²Statistics released in TsSU (now *Goskomstat*) publications such as the annual *Narkhoz* compendia and *Vestnik statistiki* are referred to in this study as official.

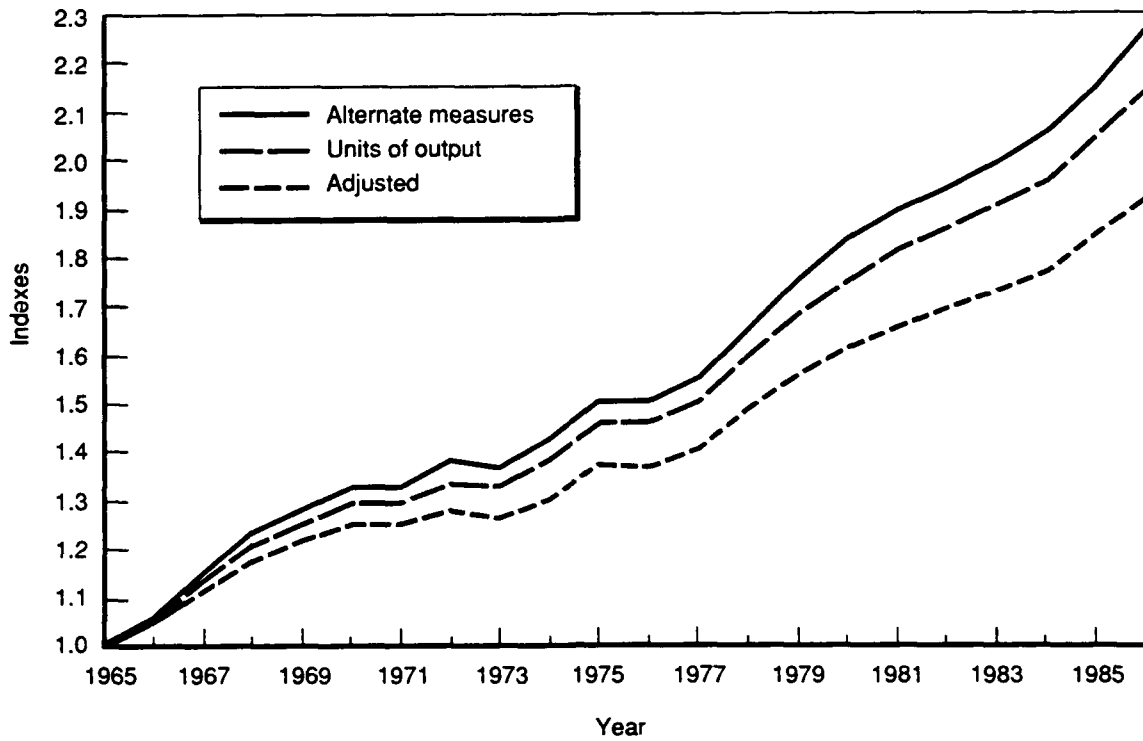


Fig. 1—Three Price Indexes

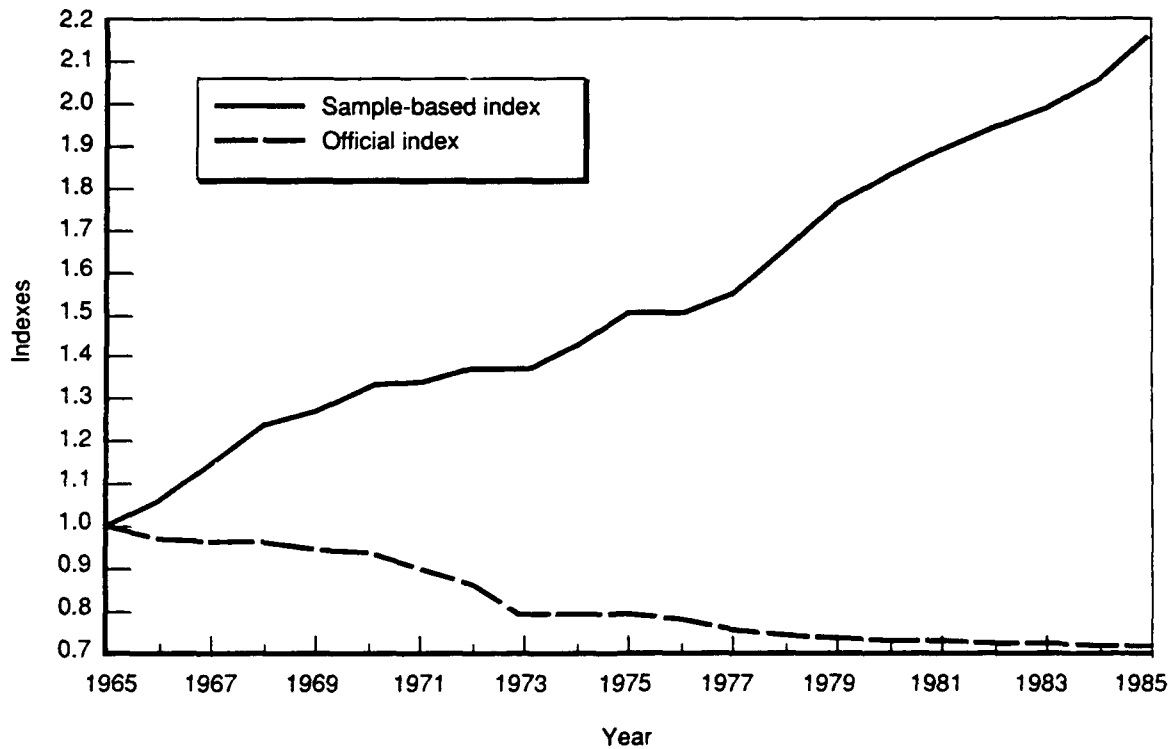


Fig. 2—Comparing Price Indexes

defending their record. It is worth noting, however, that starting in 1986, the publication of wholesale industry price indexes has ceased. In the past few years, *Goskomstat* has published a large number of long-suppressed statistical series, so the disappearance of price indexes from official publications can be interpreted as an admission of their defects. The fact that wholesale industry price indexes have disappeared from print does not mean that *Goskomstat* stopped computing them. Industrial GVO, labor productivity, and capital investment series derived on the basis of these indexes are still being published.³

Some Soviet authors have published their own versions of machinery price indexes for selected years, which are different from official indexes. But there is no documentation or clear definitions of the methods employed in their construction; furthermore, most of them cover only a subset of the total machinery output and thus are of limited utility for this study. We should note, however, that while the official index shows an almost continuous decline in prices, the indexes prepared by individual authors record relatively rapid price growth. Kornev (1988, pp. 43–50) studied 37 groups of machines that accounted for some 40 percent of investment in machinery and equipment and found that, contrary to the official price index, prices of these machines doubled between 1970 and 1985.

Several Western scholars have investigated price formation in Soviet machine-building and have constructed price indexes for different periods for the entire industry or for different groups of machines (e.g., investment machinery or road-building equipment). Virtually without exception, these indexes also show moderate to high rates of price increase.⁴ A careful examination of these indexes and comparisons with the indexes constructed in this study would be needed to insure comparability of coverage, definitions, and time periods; such an examination has not been undertaken here.

ASSESSMENT OF THE MACHINERY PRICE INDEX

It is not possible to directly test the accuracy and validity of the 1965–1986 price index prepared in this study, because of the absence of reliable Soviet data. The assessment of the validity of the price indexes is therefore limited. This section reviews several possible biases that could be present in our price index because of its special nature and compares the index prepared in this study with the official Soviet machinery price, output, and cost indexes.

³Based on the MBMW GVO time series in current prices prepared in this study and official MBMW rates of growth, the implicit MBMW annual price indexes for 1986 and 1987 are estimated to be approximately 0.99 and 0.98, respectively. Thus the decline in the official machinery price index persisted.

⁴Abraham S. Becker (1974, p. 378) has constructed an index for 1958–1970; Padma Desai (1978, pp. 68–69), for 1955–1973; Philip Hanson, Vladimir Kontorovich, and Boris Rumer (1989, pp. 149–152), for 1966–1987; CIA (1979, p. 23) and Robert Leggett (1981, pp. 169–184), for 1960–1973; James Steiner (1978), for 1960–1975; Vladimir Trembl and Gene Guill (1977, pp. 197–201), for 1966–1972.

BIAS GENERATED BY FASTER GROWTH OF INTRAININDUSTRY TURNOVER

The use of the concept of GVO in Soviet machinery statistics introduces a certain upward bias in output indexes regardless of the bias generated by the choice of constant prices, primarily because intraplant and interplant turnover in Soviet machine-building, i.e., the production of parts, semifabricates, components, and industrial services, grows faster than the production of final or end-use machines.⁵

One Soviet author reported the following ratios based on input-output tables which reflect this trend (Senchagov, ed., 1982, p. 68):

	Share of intraindustry turnover in total material cost of MBMW (%)
1959	31.8
1966	47.7
1972	54.7
1977	"Still higher"

The definition and measurement of the intraindustry and intersectoral turnover cannot be precise because they depend on the degree of vertical and horizontal integration of the industry and the statistical sector (commodity) classification employed. The ratios given by Senchagov refer to the total MBMW intraindustry turnover, i.e., deliveries of all products of all MBMW sectors in the industry to all MBMW sectors. For example, these deliveries cover tractor engines produced in the tractor sector and delivered to the sector producing road-building equipment, as well as components and semifabricates produced and consumed within the tractor sector. A similar trend is observed in intrasectoral turnover (i.e., products produced and used within the same sector) or, in terms of input-output tables, in diagonal cells of the machinery industry. The share of the sum of diagonal cells of the machinery block of Soviet input-output tables grew from 4.6 percent of MBMW GVO in 1959 to 11.9 percent in 1966, and to 14.3 percent in 1972 (Gallik et al., 1975; Trembl (ed.), 1977; and Gallik, Kostinsky, and Trembl, 1983).

It can be shown that the price index based on a sample will have an upward bias if
(1) production of intermediate products in the whole industry grows faster than production of

⁵The division of machinery into intermediate and final products follows the conventions used in Soviet input-output tables (Trembl et al., 1972, pp. 33-62). Intermediate products, that is, products used for productive purposes, are shown in the first quadrant of the table. Final machinery products, recorded in the second or final demand quadrant, comprise consumer appliances and durables, investment durables, capital repair of machinery, exports, and changes in stocks. The last two items pose problems, as they can include both final and intermediate goods, but we do not have the data to separate them.

end-use machinery, and (2) the share of intermediate products in the sample is lower than the share in the machinery industry as a whole. Conversely, the index will have a downward bias if the share of intermediate products in the sample is higher than the share in the industry as a whole. The magnitude of the bias in the index will depend, of course, on the relative importance (i.e., statistical weight) of the group or groups omitted from the sample and the degree of differentiation between rates of growth of different components of GVO.

It would thus be particularly important that the sample used in this study be representative of the entire machinery industry with respect to the mix of intermediate and final products. This was, however, virtually impossible to achieve because of the paucity of available Soviet intermediate output series.

Table 2 describes the composition of the sample used in this study.⁶ It should be noted, however, that it was difficult to accurately classify the machinery into intermediate and final, so the data should be viewed as rough approximations.

Intermediate products comprised about 19 percent of the sample in 1983, while their share was probably close to 50 percent in the entire MBMW industry.⁷ Combined final machinery in the sample (i.e., producer durables and consumer machinery products) grew somewhat faster (1.848) than the intermediate products (1.425), while in the entire machine industry the opposite was true.

We must thus conclude that the sample is *not truly representative* with respect to the intermediate versus final machinery mix, since the intermediate machinery is underrepresented. Because of this, the price index constructed in this study can be expected to have an upward bias.

Table 2
Composition of the Sample Used in this Study

	1965		1983		Growth (1965 = 1)
	Value (millions of 1981 rubles)	Percent	Value (millions of 1981 rubles)	Percent	
Intermediate products	6,524	22.8	9,298	18.6	1.425
Final consumer goods	4,600	16.1	12,853	25.7	2.794
Final producer durables	17,470	61.1	27,935	55.8	1.599
Total	28,594	100.0	50,086	100.0	1.752

⁶Data for 1983 are used in this tabulation instead of data for 1986, the last year of the study, because post-1983 data for some machines are not available and the sample thus became smaller.

⁷In the 1972 input-output table in producers' prices, intermediate machinery products comprised 41 percent of the total output (Gallik, Kostinsky, and Treml, 1983, p. 76), and the share must have risen since.

One possible way to adjust for the faster growth of intra-MBMW turnover was tried on an experimental basis. The sum of diagonal cells in the three Soviet input-output tables expressed as ratios of GVOs in producers' prices was as follows:

$$1959 = 0.0458$$

$$1966 = 0.1190$$

$$1972 = 0.1425.$$

An equation of a power curve fitted to these three points was calculated as

$$Y = 0.04615X^{0.43802}$$

where Y is the ratios of the sums of diagonal cells to GVO, and X is years. This equation was then used to estimate the ratios for all years between 1965 and 1986. As the last step, MBMW GVOs in current prices used in the construction of the price index in this study were all adjusted downward by the removal of estimated intrasectoral turnover. Ideally, we should have also removed intermediate machinery products, which were likely to have been found in the machinery sub-matrix in the first quadrant, but such an adjustment was impossible. Price indexes for the 1965-1982 period were then calculated as described above. As can be seen from Table 3, the overall price index dropped by some 4 percentage points as a result of this adjustment (see Table A.4 in the Appendix for the details of the adjustment).

The advantage of this procedure is obvious, as it removed the upward bias resulting from the tendency of intrasectoral turnover to grow faster than the GVO. It is, unfortunately, impossible to say how accurate an adjustment based on only three observations is.

We should also note that this adjustment affects only intrasectoral turnover, and it is possible that other elements of intraindustry use of MBMW intermediate products were also growing at rates different from the rate of growth of the entire industry.

BIAS GENERATED BY MAJOR GAPS IN THE SAMPLE

The price index constructed in this study is based on ratios derived from the total value of output of MBMW in current prices and a sample of machines in constant prices. The sample is not random, and several major product groups such as arms and weapons were not included because the necessary data were unavailable. If the main characteristics, such as price and output indexes, of omitted products are significantly different from those included in the sample, the final overall price index may be distorted. In this section we investigate

the nature of the possible bias generated by the omission of a large group of products, such as weapons, from the sample.

The true price index is calculated as the ratio of the output index in current and constant prices:

$$\frac{(R_t^m \cdot S^m + R_t^c \cdot S^c)}{(R_0^m \cdot S^m + R_0^c \cdot S^c)} = \text{Price index } \frac{P_t}{P_0}, \quad (8)$$

where

- R = output index or rate of growth
- m = military
- c = civilian
- t = current prices
- 0 = base-year or constant prices
- S = share of a specific group of products in the total

We rewrite Eq. (8) as

$$\frac{(R_t^m \cdot S^m + R_t^c \cdot S^c)}{S^m(R_0^m - R_0^c) + R_0^c} = \text{Price index } \frac{P_t}{P_0}. \quad (8a)$$

Suppose that we have the data on output indexes measured in current prices but do not have the constant price output index for the military component of the output. The price index will then be calculated on the basis of a sample which excludes military products:

$$\frac{(R_t^m \cdot S^m + R_t^c \cdot S^c)}{R_0^c} = \text{Price index } \frac{P_t}{P_0} \text{ based on a sample.} \quad (9)$$

The question we would like to explore is whether the omission of military products from a sample introduces a bias in the calculated price index. We will thus compare the two indexes, Eqs. (8a) and (9):

$$\frac{(R_t^m \cdot S^m + R_t^c \cdot S^c)}{S^m(R_0^m - R_0^c) + R_0^c} \geq \frac{(R_t^m \cdot S^m + R_t^c \cdot S^c)}{R_0^c}. \quad (10)$$

Cancelling the two common numerators we obtain the following relationship:

$$\frac{1}{S^m(R_0^m - R_0^c) + R_0^c} \gtrless \frac{1}{R_0^c} \quad (10a)$$

It should be clear from the above that if

$$R_0^m > R_0^c,$$

the right-hand term, which stands for a price index based on a sample omitting military products, will be greater than the left-hand term. Conversely, if

$$R_0^m < R_0^c,$$

the right-hand term will be smaller.

Accordingly, we can conclude that in the case of special price indexes derived by division of output indexes in current and constant prices, the following will hold true. If the output of a product group entirely omitted from the sample grows at a faster rate than the output of products included in the sample, the derived price index will overstate the true rate of change in prices. Conversely, if the output of a product group omitted from the sample grows at a slower rate than the output of products included in the sample, the derived price index will be understated. The degree of overstatement or understatement depends on the shares of omitted and included machinery groups and the difference between the output rates of growth of these groups.

As discussed above, the sample is reasonably large and representative as far as general-purpose machinery is concerned, but because of the absence of necessary data some machinery groups such as computers and precision instruments have been left out of the sample. The largest gap in the sample comprises weapons, arms, and ordnance, which accounted for about a third of MBMW GVO in 1972.⁸ The question of rates of growth of production of military machinery is, therefore, of paramount importance to the assessment of the validity of the price index prepared here.

No index of the production of military machinery is available in the Western literature. Using data on the growth of military procurement from unclassified CIA reports

⁸Estimated on the basis of the 1972 Soviet input-output table in producers' prices as the sum of shipbuilding and radio-electronic products and other machinery less final civilian radio products. This sum is believed to be close to the GVO of the Soviet defense industry.

and roughly estimated net exports of arms and weapons, we calculated the 1965-1982 output index for final military machinery products as falling between 1.6 and 1.8.⁹ This index, however, does not reflect the growth of output of intermediate machinery (parts, components, semifabricates) in the defense industry or the growth of production of final civilian machinery products such as ships and aircraft. In all probability, these two components of the defense industry were growing somewhat faster than the output of arms and weapons, and the overall output index for the defense industry was approximately equal to or slightly lower than the output index of 1.9 to 2.0 estimated for general-purpose machinery. We can therefore conclude that the omission of the defense industry from the sample did not significantly bias the price index.

Other groups of machinery that are underrepresented in the sample, such as precision instruments and computers, had high rates of growth relative to other machinery sectors. However, their share in total MBMW GVO is much smaller than that of defense products, and the bias introduced by their omission would be rather small. Furthermore, some machinery groups excluded from the sample had slower rates of growth than the whole machine-building industry.¹⁰ The effect of the omission of these machines would tend to cancel at least partially the bias introduced by the omission of precision instruments and computers.

Thus, in summary, we conclude that the incomplete coverage of the machinery sample prepared in this study probably did not introduce a significant bias in the price index.

COMPARISON OF THE PRICE INDEX WITH OFFICIAL SOVIET MBMW PRICE, OUTPUT, AND COST INDEXES

The validity of the price index constructed in this study can be tested indirectly by comparing it with the official MBMW price, output, and cost indexes regularly published in Soviet statistical compendia. These official measures, imperfect as they may be, have been

⁹These estimates are very rough. According to various CIA reports to Congressional committees, the procurement of arms and weapons measured in constant 1970 prices was growing at about 4 percent between 1965 and 1975, and at 0 percent thereafter. This gives us an index of procurement of about 1.48 for 1965-1982. However, we need an index not for procurement but for production, which we will define as procurement plus export minus import. Export and import of arms and weapons measured in current foreign trade prices can be approximately estimated by a residual method.

Deflating current values by price indexes derived from Sel'tsovskii (1982, pp. 32-37), and disregarding differences between foreign trade and domestic prices, we obtained an index for net exports of 4.524 for 1965-1982. As the last step, we combined the index for procurement (weight of 0.93) with an index of net exports (weight of 0.07) and calculated the index of the production of arms and weapons (1.693). This is, of course, the roughest possible estimate, and depending on assumptions and different weights, it could fall anywhere between 1.6 and 1.8.

¹⁰For example, production of casting equipment, paper industry machinery, leather and footwear equipment, and some agricultural machinery was growing much more slowly than the MBMW industry as a whole.

derived by the Central Statistical Administration of the USSR from a universe of extant machinery data. The sample of machinery price and output data used in the construction of the price index in this study draws on the same statistical universe. We have selected three of these official measures to investigate the possible relationships between the official measure and our price index: the overall MBMW price index, the set of output indexes for machinery sectors, and the data on the MBMW cost structure.

Comparison with the Official Price Index

Most Western and Soviet economists hold that the official, Laspeyres-type, chain-linked machinery price index has a strong downward bias. In 1965–1986, the official index shows a decline of about 30 percent, while the evidence frequently cited in Soviet literature suggests that in fact machinery prices were rising. The price index constructed in our study also shows a consistent upward movement of prices. Annual relative changes in the two price indexes are shown in Table 3.

There is a statistically significant degree of similarity between the official Soviet machinery price index and the price indexes constructed here, suggesting that the two indexes reflect price movements occurring in the same universe. The similarity is not particularly strong—the degree of correlation is measured by an R^2 of 0.505, significant at a 0.98 probability level—but it is clearly present. This correspondence between the two sets of indexes manifests itself in the following manner. In years when the official price index shows relatively strong price drops (e.g., in 1971, 1973, and 1976), our price index also shows a drop, albeit a smaller one (one exception is 1972, when the official price index records a drop of 4 percent and our index shows an increase of 3 percent). In years in which the official index shows little or no change (e.g., 1967, 1968, 1974, 1975, 1980, and 1981), our price index records the highest increase. This regularity does not hold in all years—the official price index for 1983 shows zero change, but our price index shows a moderate increase of 2.63 percent. The correspondence between the official and the sample-based index is even more evident in Fig. 3.

The main reason for the downward bias of the official price index is that it is calculated on the basis of a fixed sample of machines produced in the base year. As the industry continues to produce them, the average cost of production drops, and price authorities periodically post price cuts, thus producing the downward effect of the official price index. When we look not only at a fixed set of machinery in serial production covered by the official index, but at the whole machinery industry, we see new machinery or modifications of old machinery introduced each year at higher prices, driving average prices for the whole industry up. Thus, the official price index is not invalid; it simply measures

Table 3
Comparison of Official and Sample-Based MBMW Price Indexes,
1966-1985^a

Year	Official Index	Sample-Based Index
1966	-1.10	6.33
1967	0.10	7.30
1968	0.00	5.53
1969	-1.25	4.06
1970	-1.27	3.58
1971	-3.85	0.21
1972	-4.00	3.04
1973	-8.33	-0.90
1974	0.00	4.03
1975	0.00	5.41
1976	-3.75	0.03
1977	-1.30	2.69
1978	-1.32	6.38
1979	-1.33	5.39
1980	0.00	4.00
1981	0.00	3.24
1982	-1.18	2.50
1983	0.00	2.63
1984	-1.01	2.64
1985	-1.02	4.90

^aThe comparison ends with 1985 because the 1986 MBMW price index has not been published. The official price index presents some computational problems. There are, in fact, two indexes. The first, which was regularly published in *Narkhoz* annual volumes, uses 1949 as the base year and records year-end price indexes for the period 1949-1979. It appears that 1961 weights were probably used in these indexes. The publication of this price index in *Narkhoz* was discontinued in 1980, and a new price index using 1965 as the base year and recording price changes averaged for the year began to be published in *Vestnik statistiki*. Starting in 1984, the latter was replaced with a price index using 1980 as the base year. All three versions of the official MBMW price index are published in terms of only two-digit numbers which, needless to say, introduces a significant rounding error in the recomputation of indexes on a year-by-year basis or in the changing of the base year. For the purpose of comparison, the first version of the official price index was converted from an end-of-the-year to an average-for-the-year index and then chain-linked with the second and third versions. The new annual indexes were calculated mechanically to three decimal places.

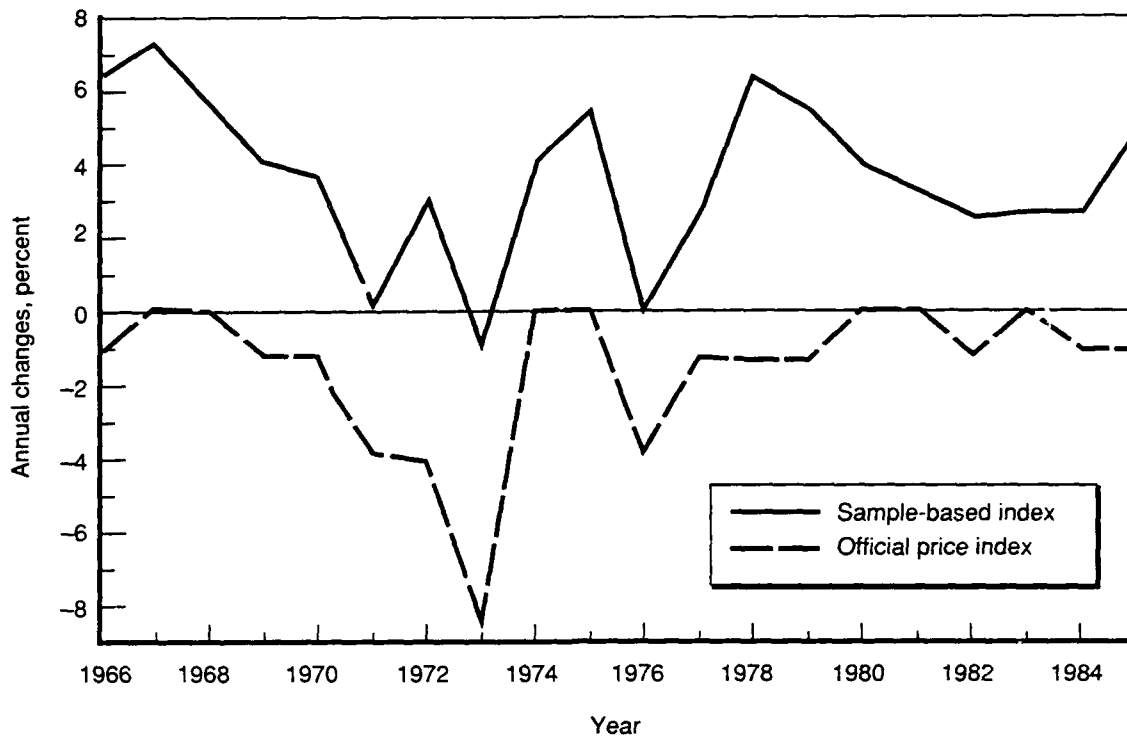


Fig. 3—Comparison of Annual Indexes

price changes in only a small part of the annual production. But the price cuts are real and are reflected in the level of overall changes recorded by the price index constructed in this study.

It must be stressed that the official price index was not used, directly or indirectly, in the construction of our price index, and the two are therefore completely independent. The similarity observed in the comparison of them can thus be taken as an indirect proof of the validity of our index.

Comparison of Official and Sample-Based Sectoral Output Indexes

Comparison of sectoral 1981 constant-price output indexes prepared in the process of construction of the MBMW price index with Soviet output indexes for the same sectors is also instructive. This comparison does not test the validity of our price index, but it tests the representativeness of the machinery sample prepared in this study. As in the price index comparison discussed above, we start with the basic assumption that Soviet official sectoral rates of growth and rates of sectoral growth recorded in our sample were derived from the

same universe of machinery production data. Thus, correlation between the two sets of growth rates would indicate that the sample is representative of the whole MBMW.

The two sets of output indexes, adjusted to insure comparability of coverage, are shown in Table 4. Official Soviet rates exceed rates of output growth of sectors included in the sample by factors of 2 to 6. Nevertheless, the two sets of indexes display some similarity. The correspondence between the two sets of growth rates is measured by an R^2 of 0.557, significant at the 0.98 level. The degree of correspondence is even more pronounced if, instead of analyzing the correlation between actual growth rates, we measure the correlation between ranks assigned to these rates (columns 3 and 4). The Spearman's rank coefficient measuring the degree of correlation is 0.78.

This moderate, but statistically significant, correlation between the official indexes and our output indexes suggests that our sample is indeed fairly representative of the whole Soviet machine industry.

Table 4
Comparison of Official and Sample-Based Sectoral Growth Rates, 1965-1985^a

Sector Number	Sector	Official Rates	Sample Rates	Official Rankings	Sample Rankings
12	Energy & power M&E	3.645	1.450	12	13
13-14	Electric-tech. M&E	4.086	1.963	9	6
15	Machine tools	4.782	1.698	5	8
16	Forging-pressing M&E	4.460	1.491	7	12
19	Precision instruments	17.252	3.075	1	1
20	Heavy metallurgical M&E	3.246	1.277	15	16
21	Pumps and compressors	4.955	2.374	3	4
23	Lights industry M&E	3.852	1.578	11	11
25	Printing industry M&E	3.475	1.337	13	14
26	Hoisting-transport M&E	3.300	1.592	14	10
27	Construction M&E	3.950	1.874	10	7
28	Railroad rolling stock	2.925	1.295	16	15
30, 32	Automobiles & bearings	6.192	2.672	2	2
31	Agricultural M&E	4.727	1.663	4	9
34-36	Metal prod. & structures	4.651	1.989	6	5
37	Repair of M&E	4.259	2.397	8	3

^aOfficial growth rates are taken from different issues of *Narkhoz*. Some regrouping of sectors was necessary. The official classification of the "electric-technical" industry covers both electro-technical machinery and electrical cables. Thus it was necessary to combine the two groups, which are shown separately in our study. Similarly, metal products and metal structures, shown separately in our study, were combined into a single sector to be comparable with the single "metal products and structures" sector recorded in *Narkhoz*. The grouping of heavy metallurgical machinery was done with official Soviet data, which are reported in terms of four separate sectors. Food machinery was omitted from the comparison because the only three machines included in the sample are milk-processing machines, while the *Narkhoz* food machinery sector encompasses a variety of other food equipment.

Relationship Between the Price and Cost Indexes

Standard statistical sources regularly publish data on the cost (*sebestoimost'*) structure of different Soviet industrial branches. These data show shares of such cost elements as basic material inputs, auxiliary material inputs, energy, fuel, labor, and depreciation expressed as a percentage of total cost of production. A large share of material inputs into machinery production consists of machinery, i.e., various subcontracted machinery components, parts, and semifabricates produced and used within MBMW. For example, according to the 1972 input-output table, machinery inputs into machinery production, i.e., the machinery block in the first quadrant, accounted for about 35 percent of the total cost of MBMW (Gallik, Kostinsky, and Treml, 1983, p. 104). If we assume that prices of intermediate and final machinery products change more or less in the same direction, it should follow that increases in the overall level of machinery prices will be reflected in an increase in the absolute ruble cost of production of machinery. The structure of cost would change depending on changes in prices and productivity of various inputs and changes in production techniques. In general terms, we note that wages in MBMW have been increasing more slowly than prices, and, combined with increases in labor productivity, the share of labor costs should be relatively stable. Shares of other cost elements such as energy, fuels, and depreciation should also be relatively stable. Thus, the share of basic material inputs can be expected to vary over time and to reflect, at least to some degree, changes in machinery prices.

This hypothesis was tested by comparing the MBMW price index constructed in this study with rates of change in the share of basic material inputs. The data are shown in Table 5. These data suggest that, as expected, changes in the overall level of machinery prices affect the share of material inputs in the total cost of MBMW production. Testing the relationship by means of linear regression yields an R^2 of 0.521, significant at a 0.99 probability level. This test, like the two tests described above, can thus be viewed as an independent verification of the validity of the price index constructed in this study.

Table 5
Comparison of Annual Changes in MBMW Price Index with Rates of
Change in Shares of Materials in Total MBMW Costs

Year	Share of Cost of Materials in Total MBMW Cost ^a	Percent Change in Cost ^b	MBMW Price Index ^c
1965	53.0	—	—
1966	54.8	3.40	6.33
1967	56.1	2.37	7.30
1968	57.3	2.14	5.53
1969	57.7	0.70	4.06
1970	58.4	1.21	3.58
1971	57.0	-2.40	0.21
1972	57.6	1.05	3.04
1973	57.5	-0.17	-0.90
1974	57.7	0.35	4.03
1975	58.1	0.69	5.41
1976	57.4	-1.20	0.03
1977	57.8	0.70	2.69
1978	58.0	0.35	6.38
1979	58.6	1.03	5.39
1980	58.8	0.34	4.00
1981	58.8	0.00	3.24
1982	57.8	-1.70	2.50
1983	58.6	1.38	2.63
1984	58.6	0.00	2.64
1985	59.0	0.68	4.90
1986	59.7	1.19	4.34

^aShare of basic materials in total MBMW cost of production as regularly published in Narkhoz compendia.

^bAnnual percent changes in values in column 1.

^cPrice index prepared in this study.

4. POSTSCRIPT

This study was essentially completed by the summer of 1989 and was based on Soviet sources available at that time. Since then, several new Soviet sources have been published, including a new industrial statistical compendium, *Promyshlennost' SSSR* (Moscow, *Finansy i statistika*, 1989). Machinery output series in new sources enabled us to improve the accuracy of the study and to extend it by two years.

As indicated in the text, output data for some machines were not available for 1985 and 1986, making the sample smaller and the derived price indexes for these two years less reliable than the indexes for earlier years. The new data made it possible to fill in most of the missing data, enhancing the accuracy of the 1985 and 1986 indexes. The new data also made it possible to extend the period of the study by two more years, i.e., to 1988. It should be noted, however, that the index for 1988 is less reliable because of some missing output series.

The corrected 1985 and 1986 indexes and the new indexes are summarized in Tables 6 and 7.

Table 6
MBMW Price Index, Unadjusted for Faster Intraindustry Growth
of GVO

	Year-by-Year Index	1965 = 1 Index
Units as Measures of Output		
1985	1.0396	2.1272
1986	1.0590	2.2528
1987	1.0749	2.4216
1988	1.0367	2.5104
Alternative Measures of Output		
1985	1.0406	2.0286
1986	1.0510	2.1320
1987	1.0749	2.2917
1988	1.0331	2.3675

Table 7
MBMW Price Index, Adjusted for Faster Intraindustry Growth
of GVO

(Alternative measures of output)

	Year-by Year-Index	1965=1 Index
1985	1.0365	1.8301
1986	1.0469	1.9159
1987	1.0704	2.0507
1988	1.0292	2.1106

Appendix

CALCULATIONS OF PRICE AND OUTPUT INDEXES

This appendix presents the data used to construct the weighted aggregate 1965–1986 price index for MBMW. Tables A.1 and A.2 list 177 types or groups of machines subdivided into 22 sectors. Sector classification, composition, and numbering are taken from the 1972 Soviet input-output table (Gallik, Kostinsky, and Trembl, 1983, pp. 95–99). Sectors 17, 18, 22, 28, and 38 are excluded from the sample because of the absence of necessary price and/or output data. Machinery within each sector is numbered consecutively. The outputs of 10 machinery types included in the sample are recorded both in numbers produced and in alternative measures. The number 1 following a type of machinery in the tables indicates that the value for production is given in units; a 2 indicates that the value is in an alternative measure. For example, the first two lines in Table A.1 are:

- 12.1 steam boilers 1
- 12.2 steam boilers 2 – tons of steam.

The number 12 is the standard input-output table number for the “energy and power machinery and equipment” sector; numbers after the decimal point are consecutive numbers assigned in this study to machines in the sector. The numbers 1 and 2 following “steam boilers” refer to the output measure used.

Table A.1 lists 1981 enterprise (producers’) prices, and Table A.2 records physical output series for 1965–1986. Soviet statistical sources do not publish time series on GVOs of various industries measured in current prices.¹ Accordingly, MBMW GVOs for 1965–1986 used in this study had to be estimated. The estimates were made on the basis of published Soviet data on profits, employment, wages, social security rates, and the shares of labor in the total cost of production for various years. The method is relatively reliable,² and the only uncertain element is the share of wages paid out of profits, which had to be estimated approximately.

¹The USSR has been reporting current price GVOs, employment, wages, and some other data for most industries to the United Nations Statistical Office (United Nations, 1979, p. 552; 1981, p. 523; 1985, p. 528; 1987, p. 552). The U.N.-published GVO data were, however, not used in this study, for several reasons. First, a comparison of U.N.-published Soviet data (such as employment and wages) with the data available in standard *Narkhoz* compendia reveals some discrepancies. These discrepancies are probably caused by differences in industrial classification and definitions, but we cannot adjust for them. Second, the U.N.-published GVO data are available only for 1972–1984. However, the differences between the U.N.-published GVO data and our estimates for the years for which the U.N. data are available are minor. The average error in annual rates of growth for the 12 years is only 0.25 percent.

²This method was tested on total industry GVO for 1965–1986. The resulting estimates differed from published official current price GVO series by less than 1 percent.

Table A.1
1981 Enterprise Prices of Machines and Equipment

Category		Price (in rubles)	
12 - Energy & Power M&E			
12.1	steam boilers 1	138,882.00	each
12.2	steam boilers 2 - tons of steam	1,922.40	per ton of steam
12.3	turbines 1	526,093.00	each
12.4	turbines 2 - kilowatts	18,016.88	per ths. kw
12.5	diesels - horsepower	19,033.00	per ths. hp
13 - Electric-tech. M&E			
13.1	generators 1	842,463.00	each
13.2	generators 2 - kilowatts	7,372.53	per ths. kw
13.3	large electric motors 1	1,509.00	each
13.4	large electric motors 2 - kw	7,501.68	per ths. kw
13.5	small electric motors 1	93.00	each
13.6	small electric motors 2 - kw	22,029.09	per ths. kw
13.7	power transformers 1	1,574.00	each
13.8	power transformers 2 - kva	2,119.71	per ths. kw
13.9	large electric machines	9,691.00	each
13.10	explosion-proof electric motors	279.00	each
13.11	motors for electric cranes	446.00	each
13.12	welding electrodes	753.00	ton
13.13	electric welding equipment	1,082.00	each
13.14	magnetic stations	263.00	each
13.15	light bulbs	165.00	per ths.
13.16	electric furnaces	13,368.00	each
13.17	washing machines, manual	49.35	each
13.18	washing machines, auto., semi-auto.	106.25	each
13.19	vacuum cleaners	28.38	each
13.20	floor polishers	21.35	each
13.21	electric irons	5.66	each
13.22	tea kettles	8.73	each
13.23	electric samovars	14.88	each
13.24	electric fans	6.47	each
13.25	electric razors	14.15	each
13.26	electric mixers	15.53	each
13.27	hot plates	16.58	each
13.28	electric meat grinders	22.50	each
13.29	electric fire places	7.83	each
14 - Cable Products			
14.1	shielded cable	2,115.00	per km
14.2	power cable	512.00	per km
14.3	lighting electric cord	47.00	per km
14.4	assembly wire	46.00	per km
14.5	cable, in copper weight	1,343.00	per km
14.6	black cable	59.00	per km
14.7	radio wire	137.00	per km
14.8	control cable	25.00	per km
14.9	tubular wire	132.00	per km
14.10	flexible cable	821.00	per km

Table A.1—Continued

Category		Price (in rubles)	
15 – Machine Tools M&E			
15.1	woodworking machine tools	2,689.00	each
15.2	programmed metal machine tools	51,715.00	each
15.3	automatic turning lathes	11,648.00	each
15.4	grinding & polishing machine tools	19,599.00	each
15.5	milling machine tools	7,805.00	each
15.6	other types	6,872.00	each
15.7	automatic machine lines	78,257.00	each
15.8	industrial robots	40,000.00	each
16 – Forging–Pressing M&E			
16.1	forging–pressing machines	8,843.00	each
19 – Precision Instruments			
19.1	watches	14.94	each
19.2	clocks	3.30	each
19.3	photo cameras	51.94	each
19.4	movie cameras	187.45	each
19.5	movie projectors	143.81	each
19.6	power meters	16.00	each
19.7	ind. programming & control units	14,731.00	each
19.8	personal computers	4,500.00	each
20 – Heavy Metal M&E			
20.1	blast furnace equipment	823.00	ton
20.2	steel smelting equipment	470.00	ton
20.3	rolling equipment	1,426.00	ton
20.4	ingot casting equipment	1,369.00	ton
20.5	mine cleaning combines	131,907.00	each
20.6	shaft sinking machines	41,769.00	each
20.7	cutting machines	8,733.00	each
20.8	mine loading machines	18,742.00	each
20.9	mechanized supports for coal mines	116,318.00	each
20.10	drills	16,457.00	each
20.11	petroleum equipment	1,130.00	ton
20.12	drills for prospecting	142,329.00	each
20.13	deep pumps	41.00	each
21 – Pumps and Compressors M&E			
21.1	pumps (except deep)	356.00	each
21.2	air and gas compressors	3,817.00	each
21.3	refrigeration units	801.00	each
21.4	oxygen equipment	196,695.00	each
21.5	household refrigerators	149.56	each
21.6	household freezers	186.00	each

Table A.1—Continued

Category		Price (in rubles)	
23 – Light Industry M&E			
23.1	carders for cotton	10,025.00	each
23.2	spinners	17,328.00	each
23.3	twisters and warpers	12,275.00	each
23.4	looms	5,342.00	each
23.5	automatic circlers, stackers, knitters	2,803.00	each
23.6	industrial sewing machines	297.00	each
23.7	household sewing machines	53.70	each
23.8	zigzag-type sewing machines	197.50	each
23.9	knitting tools	109.60	each
24 – Food Industry M&E			
24.1	lines for washing bottles	34,000.00	each
24.2	cream separators	203.75	each
24.3	automatic pasteurization equipment	6,000.00	each
25 – Printing M&E			
25.1	typesetting machines	6,259.00	each
25.2	printing machines	21,109.00	each
26 – Hoisting and Transport M&E			
26.1	elevators	4,820.00	each
26.2	cranes on tires	36,171.00	each
26.3	portal cranes	155,508.00	each
26.4	tower cranes	37,055.00	each
26.5	truck cranes	13,238.00	each
26.6	railroad cranes	16,903.00	each
26.7	bridge cranes	15,678.00	each
26.8	telfers, electric	474.00	each
26.9	electric carts	1,200.00	each
27 – Construction M&E			
27.1	multi-bucket excavators	30,064.00	each
27.2	single-bucket excavators	15,742.00	each
27.3	bulldozers	19,259.00	each
27.4	scrapers	18,675.00	each
27.5	auto graders	12,365.00	each
27.6	cement mixers	710.00	each
27.7	construction finishing machines	330.00	each
29 – Railroad Rolling Stock			
29.1	mainline electric loc. 1	330,900.00	each
29.2	mainline electric loc. 2 – hp	41,147.20	per ths. hp
29.3	mainline diesel loc. 1 – sections	247,306.00	per section
29.4	mainline diesel loc. 2 – hp	89,396.44	per ths. hp
29.5	mainline freight cars	10,200.00	each
29.6	mainline passenger cars	46,216.00	each
29.7	electric mine locomotives	10,491.00	each
29.8	subway cars	73,689.00	each
29.9	street cars	19,200.00	each

Table A.1—Continued

Category		Price (in rubles)	
30 – Automobiles			
30.1	trucks 1	5,682.00	each
30.2	trucks 2 – tons of capacity	1,083.01	per ton
30.3	passenger cars	2,472.00	each
30.4	buses	5,983.00	each
30.5	trolley buses	17,539.00	each
30.6	auto trailers	1,739.00	each
30.7	tractor trailers	2,352.00	each
30.8	motorcycles	488.34	each
30.9	bicycles	65.38	each
30.10	spare parts for autos	1.00	each
31 – Agricultural M&E			
31.1	tractors 1	6,661.00	each
31.2	tractors 2 – hp	77.67	per hp
31.3	tractor plows	386.00	each
31.4	tractor engines	1,179.00	each
31.5	surface plows	386.00	each
31.6	harrows	791.00	each
31.7	planters	1,031.00	each
31.8	potato planters	720.00	each
31.9	cultivators	531.00	each
31.10	grain combines	8,234.00	each
31.11	sugar beet combines	1,298.00	each
31.12	overhead irrigation combines	2,500.00	each
31.13	reapers	1,512.00	each
31.14	potato harvesters	4,840.00	each
31.15	mowers	950.00	each
31.16	rakes	430.00	each
31.17	fodder harvesting combines	3,251.00	each
31.18	fodder crushers	1,121.00	each
31.19	cattle watering units	3.00	each
31.20	milking units	1,616.00	each
31.21	multi-purpose loaders	880.00	each
31.22	press balers	1,794.00	each
31.23	fertilizer spreaders	1,164.00	each
31.24	spare parts for tractors	1.00	each
31.25	spare parts for agricultural m&e	1.00	each
32 – Ball Bearings			
32.1	ball bearings	875.00	per ths.
33 – Radio-Electronics and Other MB			
33.1	radios	47.72	each
33.2	television sets, black & white	130.57	each
33.3	television sets, color	388.32	each
33.4	tape recorders	54.65	each
33.5	record players	176.10	each
33.6	video recorders	1,526.00	each
33.7	telephone stations	86,018.00	each
33.8	telephones	22.65	each
33.9	loudspeakers	15.00	each
33.10	industrial fittings	10.65	each

Table A.1—Continued

Category		Price (in rubles)	
34 – Sanitary–Engineering M&E			
34.1	heating boilers	20.00	per m ²
34.2	radiators/convectors	5.00	per m ²
34.3	corrugated pipe	3.00	per m ²
34.4	cast–iron sewer pipe	173.00	per ton
34.5	bathtubs	29.00	each
34.6	hot water boilers	33.00	each
34.7	gas stoves	36.00	each
35 – Metal Products			
35.1	baby carriages	57.16	each
35.2	household utensils – tons	2,878.00	per ton
35.3	razor blades	25,000.00	per mil.
35.4	metal beds	11.69	each
36 – Metal Structures			
36.1	metal structures – tons	285.60	per ton
37 – Repair of M&E			
37.1	trucks (repair)	1 374.00	each
37.2	truck engines (repair)	267.00	each
37.3	tractors (repair)	3,409.00	each
37.4	grain combines (repair)	1,326.00	each
37.5	excavators (repair)	6,353.00	each
37.6	bulldozers (repair)	8,667.00	each
37.8	scrapers (repair)	8,404.00	each
37.9	cranes (repair)	7,178.00	each
37.10	appliances, radios, & cars (repair)	1.00	each

Table A.2

Production of Machinery and Equipment, 1965-1986, Physical Series

Category	Output Unit	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
12 - Energy & Power M&E												
12.1 steam boilers 1	ea.	338	458	464	478	523	497	489	519	591	653	696
12.2 steam boilers 2 - tons of steam	ths.	53.2	61.7	61.0	57.0	56.2	48.3	44.2	46.4	47.9	51.4	55.6
12.3 turbines 1	ea.	342	332	321	327	306	326	343	318	345	384	378
12.4 turbines 2 - kw	mil.	14.625	15.172	14.684	15.746	15.004	16.191	16.800	14.642	15.143	17.271	18.886
12.5 diesels - horsepower	mil.	13.6	14.1	14.3	14.8	15.6	16.5	17.1	17.9	17.8	18.2	18.6
13 - Electric-Tech. M&E												
13.1 generators 1	ea.	192	186	176	139	113	131	134	134	168	174	161
13.2 generators 2 - kw	mil.	14.4	13.4	14.6	14.5	12.7	10.6	12.6	13.7	16.5	16	17.1
13.3 large electric motors 1	ths.	25.2	25.2	27.3	27.2	26.4	28.0	28.9	30.7	31.6	33.5	35.5
13.4 large electric motors 2 - kw	mil.	5.295	5.500	5.800	5.400	5.200	5.486	5.647	5.993	6.031	6.522	6.970
13.5 small electric motors 1	ths.	4688	4908	5123	5289	5472	5837	6381	6866	7209	7578	8026
13.6 small electric motors 2 - kw	mil.	21.6	22.7	24.0	25.4	26.0	27.8	29.6	30.5	31.7	33.5	34.7
13.7 power transformers 1	ths.	132	131	134	137	153	146	150	157	167	180	179
13.8 power transformers 2 - kva	mil.	95.29	94.72	100.94	105.10	107.38	105.87	108.14	116.30	120.94	126.74	136.60
13.9 large electric machines	ths.	15.3	16.0	15.9	15.6	16.3	17.0	17.6	18.9	20.4	22.2	24.0
13.10 explosion-proof electric motors	ths.	157.3	180.1	190.3	191.7	197.0	217.2	232.2	244.8	270.1	283.6	308.0
13.11 motors for electric cranes	ths.	112.0	113.0	116.0	119.0	123.0	126.2	133.5	140.9	149.4	155.9	161.5
13.12 welding electrodes	ths.	442	458	480	503	517	543	562	566	587	615	629
13.13 electric welding equipment	ths.	198	205	205	229	229	253	274	290	287	289	303
13.14 magnetic stations	ths.	35.3	39.5	44.2	49.4	55.3	61.8	70.7	80.8	92.5	105.8	121.2
13.15 light bulbs	mil.	983	1053	1165	1269	1432	1627	1820	1957	1997	1985	2050
13.16 electric furnaces	ea.	8286	8618	8962	9321	9694	10100	10256	10413	10574	10737	10900
13.17 washing machines, manual	ths.	2847	3211	3589	3901	4277	4344	3161	2118	2111	2207	2425
13.18 washing machines, auto., semi-auto.	ths.	583	658	735	799	876	899	891	883	876	868	861
13.19 vacuum cleaners	ths.	800	899	1097	1230	1359	1509	1738	2168	2618	3319	2920
13.20 floor polishers	ths.	66	110	139	166	186	207	220	137	102	122	108
13.21 electric irons	ths.	3649	4691	5252	5974	7219	8600	10100	10800	12200	13500	14506
13.22 tea kettles	ths.	495	687	921	1063	1248	1522	1865	2203	2683	2982	3437
13.23 electric samovars	ths.	470	470	470	470	470	470	470	470	470	470	470
13.24 electric fans	ths.	491	390	309	245	194	154	199	258	333	431	557
13.25 electric razors	ths.	3809	4150	5008	5354	6020	6629	7184	7723	8171	8600	9236
13.26 electric mixers	ths.	16	21	26	34	44	56	72	92	118	152	195
13.27 hot plates	ths.	6054	6331	7237	7900	8761	9800	10900	10200	7800	5600	5200
13.28 electric meat grinders	ths.	0	0	0	0	0	10	17	29	49	84	142
13.29 electric fire places	ths.	405	450	500	556	618	687	764	849	943	1049	1166

Table A.2—Continued

Category	Output Unit	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
12 - Energy & Power M&E												
12.1 steam boilers 1	ea.	706	693	615	585	687	735	714	707	732	864	841
12.2 steam boilers 2 - tons of steam	ths.	53.2	52.2	55.8	54.9	51.0	53.1	43.1	50.8	46.5	43.7	51.7
12.3 turbines 1	ea.	456	500	500	500	500	500	500	500	500	500	500
12.4 turbines 2 - kw	mil.	19.6	19.0	18.3	20.0	19.6	14.6	17.3	15.5	21.3	21.6	20.9
12.5 diesels - hp	mil.	19.0	18.9	19.2	18.6	19.0	18.7	18.6	16.3	16.1	16.6	17.0
13 - Electric-Tech. M&E												
13.1 generators 1	ea.	168	164	163	148	121	122	120	101	85	81	90
13.2 generators 2 - kw	mil.	16.596	17.936	18.159	17.018	16.138	13.941	12.664	12.552	13.724	12.337	14.915
13.3 large electric motors 1	ths.	37.8	38.5	39.3	37.1	38.0	38.1	36.9	36.9	39.1	39.9	
13.4 large electric motors 2 - kw	mil.	7.452	7.547	7.729	7.542	7.700	7.664	7.719	7.647	8.007	8.223	8.472
13.5 small electric motors 1	ths.	8513	8864	9131	9215	9412	9617	9571	9637	9265	9279	9500
13.6 small electric motors 2 - kw	mil.	35.4	36.0	37.6	38.2	39.9	40.6	40.7	40.4	40.6	41.2	50.3
13.7 power transformers 1	ths.	198	216	210	202	209	217	221	220	210	211	227
13.8 power transformers 2 - kva	mil.	143.70	146.29	150.17	154.96	159.25	161.13	160.89	155.06	156.19	161.10	168.08
13.9 large electric machines	ths.	25.9	26.7	27.9	29.6	33.4	35.1	36.0	37.8	39.2	42.2	45.5
13.10 explosion-proof electric motors	ths.	341.9	369.5	370.5	370.6	371.9	374.0	374.7	384.6	391.8	402.2	
13.11 motors for electric cranes	ths.	167.3	170.4	175.7	151.2	146.7	144.3	148.1	128.7	134.0	131.8	129.7
13.12 welding electrodes	ths.	691	698	710	671	696	680	677	666	689	707	
13.13 electric welding equipment	ths.	305	303	317	305	303	309	315	314	320	327	
13.14 magnetic stations	ths.	136.4	153.2	167.0	169.0	168.5	182.6	171.3	117.5	111.9	119.3	
13.15 light bulbs	mil.	2032	2080	2097	2095	2172	2223	2269	2410	2462	2470	2490
13.16 electric furnaces	ea.	11292	11699	12120	12556	13000	15300	15300	25800	51200	87800	
13.17 washing machines, manual	ths.	2627	2742	2769	2710	2851	2925	2954	3157	3397	3830	4065
13.18 washing machines, auto., semi-auto.	ths.	883	905	928	951	975	1003	1041	1093	1137	1238	1318
13.19 vacuum cleaners	ths.	2661	2748	2925	3098	3222	3359	3492	3594	3813	4065	4269
13.20 floor polishers	ths.	93	86	111	60	72	79	62				
13.21 electric irons	ths.	14096	13696	13307	12928	12561	12993	13334	14080	14743	15442	15867
13.22 tea kettles	ths.	3526	3618	3712	3809	3905	3948	3916	3904	4222	4296	4073
13.23 electric samovars	ths.	1348	1433	1523	1620	1722	1815	1818	1877	1979	2144	2315
13.24 electric fans	ths.	605	656	712	773	836	926	1017	1313	1638	1898	2161
13.25 electric razors	ths.	9580	9537	8523	8540	8471	8832	9004				
13.26 electric mixers	ths.	219	247	278	313	352	379	416	489	727	830	1035
13.27 hot plates	ths.	5135	5076	5017	4959	4902	4845	4789	235	261	296	356
13.28 electric meat grinders	ths.	152	162	174	186	199	206	208	235	261	296	356
13.29 electric fire places	ths.	1258	1358	1465	1580	1705	2089	2234	2725	3045	3445	4067

Table A.2—Continued

Category	Output Unit	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
14 - Cable Products												
14.1 shielded cable	ths.	19.0	18.0	20.0	18.0	18.5	19.6	18.6	17.3	18.3	20.1	
14.2 power cable	km.	7800	7000	7700	7600	6000	7100	6900	7800	7600	7700	
14.3 lighting electric cord	km.	137200	124300	113000	118150	120600	123100	132100	142200	188700	172100	
14.4 assembly wire	ths.	144.4	143.5	139.7	136.4	129.8	131.4	130.1	135.4	155.1	146.8	
14.5 cable, in copper weight	tons	89159	91760	94942	97227	97113	94824	92758	100959	107076	110137	
14.6 black cable	km.	363100	371700	382000	378100	387100	385800	351300	383400	426800	428800	
14.7 radio wire	ths.	101.6	105.6	108.4	106.6	112.2	113.2	98.9	118.5	121.5	127.8	
14.8 control cable	ths.	20.0	18.0	19.0	17.0	18.6	19.5	16.9	16.3	17.3	18.6	
14.9 tubular wire	km.	27133	23814	29039	27770	27200	29800	31500	33400	34700	42100	
14.10 flexible cable	km.	18062	19682	18714	19457	20200	19800	18500	19300	22300	23300	
15 - Machine Tools M&E												
15.1 woodworking machine tools	ea.	49280	47822	46406	45033	43700	43200	42500	42400	42400	42800	
15.2 programmed metal machine tools	ea.	6131	6552	7365	7969	8865	10055	10605	11400	13300	17800	20300
15.3 automatic turning lathes	ea.	5671	5848	5696	5660	5334	5073	4839	4797	4518	4123	4505
15.4 grinding & polishing machine tools	ea.	13905	13969	13461	12452	11567	11435	10858	10293	10291	9775	9354
15.5 milling machine tools	ea.	23002	23196	22829	22111	20850	18888	18303	18588	18112	15909	14692
15.6 other types	ea.	184085	187996	188534	181990	169384	159549	150395	144922	141922	134593	115149
15.7 automatic machine lines	ea.	739	833	838	801	814	832	792	956	1068	1084	1089
15.8 industrial robots	ths.	0.2	0.3	0.5	0.8	1.4	2.5	4.5	8.7	11.1	17.4	15.4
16 - Forging-Pressing M&E												
16.1 forging-pressing machines	ths.	51.944	54.425	55.533	56.266	57.153	57.079	57.329	57.361	55.345	52.674	51.632
19 - Precision Instruments												
19.1 watches	mil.	33.341	35.349	36.950	38.503	39.584	40.848	40.626	37.609	33.524	33.017	34.344
19.2 clocks	mil.	24.562	25.469	26.390	26.372	27.095	27.734	28.473	31.539	33.533	34.183	35.556
19.3 photo cameras	ths.	3245	3567	3852	4055	4255	4376	4058	2986	2212	2085	2172
19.4 movie cameras	ths.	104	102	104	98	105	105	106	97	45	37	40
19.5 movie projectors	ths.	151.4	151.8	152.2	152.6	153.0	154.0	143.0	110.0	64.7	67.7	80.0
19.6 power meters	ths.	3224	3309	3411	3316	3221	3230	3254	3291	3306	3332	3359
19.7 ind. programming & control units	ths.	5.0	5.8	6.8	8.0	9.3	10.9	12.7	14.9	17.4	20.4	24.1
19.8 personal computers	ths.	0	0	0	0	0.4	0.7	1.3	2.5	4.7	8.8	16.6

Table A.2—Continued

Category	Output Unit	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
20 - Heavy Metal M&E												
20.1 blast furnace equipment	ths.	84	84	90	101	115	111	111	120	119	124	124
20.2 steel smelting equipment	ths.	37.2	37.5	46.2	58.0	52.4	50.7	54.5	45.8	57.3	63.3	63.4
20.3 rolling equipment	ths.	114.1	122.7	145.2	143.4	129.7	140.0	143.5	143.4	147.7	131.5	109.8
23.4 ingot casting equipment	ths.	6.9	7.8	8.7	9.8	11.0	12.4	13.9	15.7	17.6	19.8	22.1
20.5 mine cleaning combines	ea.	998	1043	1135	1195	1165	1130	1218	1121	1057	1148	1119
20.6 shaft sinking machines	ea.	141	167	197	234	276	327	363	424	451	487	510
20.7 cutting machines	ea.	202	218	165	153	150	115	110	110	85	90	90
20.8 mine loading machines	ea.	2802	2330	2285	2156	2157	2459	2553	2443	2674	2811	2807
20.9 mechanized supports for coal mines	ea.	121	144	171	203	241	287	321	359	402	450	504
20.10 drills	ea.	8439	8487	8322	6728	6315	6562	7384	7694	8103	9328	9780
20.11 petroleum equipment	ea.	118	148	140	125	123	127	139	157	159	172	135
20.12 drills for prospecting	ea.	520	522	496	420	355	480	497	512	516	483	544
20.13 deep pumps	ths.	93	89	87	83	74	77	81	81	82	85	85
21 - Pumps and Compressors M&E												
21.1 pumps (except deep)	ths.	763	936	936	985	1094	1087	1125	1164	1205	1247	1291
21.2 air and gas compressors	ths.	68	74	82	87	89	92	94	96	100	107	112
21.3 refrigeration units	ths.	142	161	174	189	208	238	268	291	308	338	360
21.4 oxygen equipment	ea.	459	427	355	239	262	259	246	275	300	327	344
21.5 household refrigerators	ths.	1675	2205	2697	3155	3701	4140	4557	5030	5423	5426	5579
21.6 household freezers	ths.	0	0	0	0	0	0	0	0	0	0	0
23 - Light Industry M&E												
23.1 carders for cotton	ths.	3.8	4.1	4.6	4.4	4.7	5.2	5.9	4.2	3.6	3.3	2.5
23.2 spinners	ths.	3.2	3.9	3.9	3.8	4.1	4.0	3.9	4.4	4.8	5.1	5.4
23.3 twistors and warpers	ea.	566	588	541	344	396	352	354	560	570	518	617
23.4 looms	ths.	24.3	23.9	21.3	17.6	17.3	19.8	18.6	19.5	25.0	28.8	31.3
23.5 automatic circlers, stackers, knitters	ths.	3.2	4.3	4.7	3.5	3.8	3.1	2.7	2.7	2.8	2.8	2.9
23.6 industrial sewing machines	ths.	105	120	126	130	138	129	157	165	180	170	148
23.7 household sewing machines	ths.	778	996	1160	1247	1257	1312	1291	1284	1195	1095	1001
23.8 zigzag-type sewing machines	ths.	22	29	38	50	67	88.	117	155	205	271	359
23.9 knitting tools	ths.	36	39	41	44	47	50	53	57	61	64	69
24 - Food Industry M&E												
24.1 lines for washing bottles	ea.	89	148	174	291	323	329	140	216	234	194	79
24.2 cream separators	ths.	17.6	18.1	18.7	19.3	19.9	20.5	19.3	18.3	17.3	13.6	14.4
24.3 automatic pasteurization equipment	ea.	871	1327	1306	1692	2040	2187	1034	1531	1916	2319	2661

Table A.2—Continued

Category	Output Unit	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
20 - Heavy Metal M&E												
20.1 blast furnace equipment	ths.	124	127	131	127	124	119	111	128	123	131	128
20.2 steel smelting equipment	ths.	67.2	71.7	70.7	76.9	73.1	70.1	66.1	64.2	62.2	66.0	66.2
20.3 rolling equipment	ths.	129.8	150.9	142.9	138.8	132.8	126.1	146.0	145.0	141.0	122.0	123.0
23.4 ingot casting equipment	ths.	22.1	22.1	22.1	22.2	22.2	27.9	120.6	118.9	115.7	29.8	27.2
20.5 mine cleaning combines	ea.	1197	1162	1209	1189	1266	1246	1187	1145	1059	1039	
20.6 shaft sinking machines	ea.	517	526	544	582	587	613	626	635	656	642	636
20.7 cutting machines	ea.	61	75	61	63	60	60	60				
20.8 mine loading machines	ea.	3064	3118	3113	3152	3032	3301	3268	3461	3344	3335	3233
20.9 mechanized supports for coal mines	ea.	549	559	578	587	594	514	500	484	492	481	458
20.10 drills	ea.	9354	9700	9016	8976	9270	9459	9291	12486	14500	16000	16400
20.11 petroleum equipment	ea.	164	171	180	188	184	182	176	174	166	168	176
20.12 drills for prospecting	ea.	511	503	505	473	521	541	558	577	561	570	546
20.13 deep pumps	ths.	86	83	95	95	92	95	96	96	95	94	95
21 - Pumps and Compressors M&E												
21.1 pumps (except deep)	ths.	1339	1386	1365	1350	1343	1370	1389	1426	1462	1463	1481
21.2 air and gas compressors	ths.	120	126	129	113	115	118	118	117	119	123	129
21.3 refrigeration units	ths.	382	400	395	403	402	405	397	403	413	422	422
21.4 oxygen equipment	ea.	366	378	396	406	415	402	408	412	426	420	422
21.5 household refrigerators	ths.	5827	5798	6069	5953	5925	5933	5800	5675	5627	5704	5752
21.6 household freezers	ths.	0	0	0	0	7	11	16	25	40	156	196
23 - Light Industry M&E												
23.1 carders for cotton	ths.	2.3	2.0	1.7	2.0	2.2	2.6	2.8	3.1	3.1	3.2	2.7
23.2 spinners	ths.	5.0	5.2	5.0	4.9	4.4	4.8	4.3	3.3	3.9	3.9	4.1
23.3 twistors and warpers	ea.	680	700	722	727	659	650	680	650	652	654	680
23.4 looms	ths.	30.9	25.4	21.2	22.2	21.8	22.6	22.2	21.4	21.7	21.3	21.0
23.5 automatic circlers, stackers, knitters	ths.	3.2	3.8	3.5	3.6	3.3	3.4	3.5	3.5	3.7	4.0	4.0
23.6 industrial sewing machines	ths.	154	157	158	157	154	157	156	155	153	151	146
23.7 household sewing machines	ths.	963	926	878	791	745	736	722	686	678	665	611
23.8 zigzag-type sewing machines	ths.	395	434	477	526	578	617	641	706	742	839	919
23.9 knitting tools	ths.	72	76	80	84	89	88	103	117	126	138	167
24 - Food Industry M&E												
24.1 lines for washing bottles	ea.	115	160	200	217	245	253	261	249	294	323	
24.2 cream separators	ths.	12.8	15.5	16.1	15.5	14.2	14.0	12.9	12.1	11.0	12.3	
24.3 automatic pasteurization equipment	ea.	2452	3367	3411	3715	3972	4039	3528	4644	4786	5541	5317

Table A.2—Continued

Category	Output Unit	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
25 - Printing M&E												
25.1 typesetting machines	ea.	1314	1227	1306	1422	1586	1626	1683	1841	1814	1493	1019
25.2 printing machines	ea.	1512	2650	2748	2418	2168	2293	2319	2363	2107	2394	2017
26 - Hoisting and Transport M&E												
26.1 elevators	ea.	8639	10229	11883	13712	15779	18107	20746	22804	24259	25323	25218
26.2 cranes on tires	ea.	1236	1273	1452	1505	1577	1963	2180	2235	2272	2459	2442
26.3 portal cranes	ea.	77	83	84	107	113	106	124	122	110	108	101
26.4 tower cranes	ea.	3455	3506	3720	3653	3798	3925	4161	4393	4593	4589	4641
26.5 truck cranes	ea.	11141	12324	12978	13805	13730	15397	16231	16369	17186	18989	19681
26.6 railroad cranes	ea.	463	467	487	486	503	493	496	509	482	474	499
26.7 bridge cranes	ea.	6764	6738	6572	6118	5929	5740	5772	5750	5928	6359	6523
26.8 telfhers, electric	ea.	90739	97666	99300	107842	110054	111761	114400	114963	108347	108396	106292
26.9 electric carts	ea.	10210	10868	10514	10991	10049	10444	10313	10202	10201	10615	9859
27 - Construction M&E												
27.1 multi-bucket excavators	ths.	1.7	1.9	2.3	2.6	2.9	2.8	3.1	3.2	3.2	3.4	3.5
27.2 single-bucket excavators	ths.	19.9	21.5	23.6	24.4	26.5	28.0	30.1	31.7	32.6	33.7	35.5
27.3 bulldozers	ths.	20.1	22.2	26.8	29.8	33.2	33.5	38.0	40.2	45.6	47.1	51.1
27.4 scrapers	ths.	7.3	7.4	7.9	8.8	9.7	9.8	10.8	11.7	12.6	13.5	14.5
27.5 auto graders	ths.	4.2	4.4	3.8	4.0	4.4	4.6	5.6	6.0	5.9	6.3	6.5
27.6 cement mixers	ths.	17.424	18.446	19.529	20.675	21.889	23.174	24.534	25.974	27.499	29.113	30.800
27.7 construction finishing machines	ths.	193	206	223	252	292	316	190	217	428	259	278
29 - Railroad Rolling Stock												
29.1 mainline electric loc. 1	ea.	641	600	388	305	296	323	341	351	354	358	395
29.2 mainline electric loc. 2 - hp	ths.	3902	3437	2834	2476	2346	2428	2571	2594	2594	2712	2972
29.3 mainline diesel loc. 1 - sections	ea.	1485	1529	1497	1500	1464	1485	1485	1488	1415	1434	1375
29.4 mainline diesel loc. 2 - hp	ths.	3287	3450	3539	3710	3669	3794	3803	3866	3820	4007	3867
29.5 mainline freight cars	ths.	39.576	40.190	43.833	48.056	50.240	58.282	63.672	68.872	71.786	72.364	69.922
29.6 mainline passenger cars	ea.	1991	1981	1928	1712	1754	1791	1871	2001	2001	2051	2090
29.7 electric mine locomotives	ea.	2411	2548	2721	2701	2569	2548	2492	2585	2621	2554	2605
29.8 subway cars	ea.	140	155	134	162	205	250	265	281	295	290	300
29.9 street cars	ea.	1245	1333	1311	1369	1087	783	775	818	873	1030	1065

Table A.2—Continued

Category	Output Unit	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
25 - Printing M&E												
25.1 typesetting machines	ea.	1094	1023	1108	1042	1005	1050	1056	886	937	905	957
25.2 printing machines	ea.	1861	1951	1178	1121	1074	1047	812	745	705	1173	1139
26 - Hoisting and Transport M&E												
26.1 elevators	ea.	27353	28859	30946	33358	33788	34273	33400	30500	30600	31200	33700
26.2 cranes on tires	ea.	2504	2572	2575	2562	2366	2602	2616	2614	2649	2684	2795
26.3 portal cranes	ea.	108	118	109	116	115	121	106	95	96	99	99
26.4 tower cranes	ea.	4659	4117	4235	3918	3419	3014	2961	3041	2950	3110	3314
26.5 truck cranes	ea.	20162	21160	21402	21883	21685	21000	20800	19900	18000		
26.6 railroad cranes	ea.	515	514	520	530	525	500	495	505	523	508	470
26.7 bridge cranes	ea.	6865	6659	6670	6389	6248	6093	6208	6167	6307	6622	6752
26.8 telfers, electric	ea.	111311	113308	110526	105351	104481	102936	100280	101000	98000	98000	100164
26.9 electric carts	ea.	9540	9509	8960	9438	8547	8566	8218	8677	10200	10200	10063
27 - Construction M&E												
27.1 multi-bucket excavators	ths.	3.8	3.5	3.4	3.3	3.3	3.3	3.2	3.0	3.1	3.1	3.1
27.2 single-bucket excavators	ths.	36.6	38.0	37.7	38.4	38.7	39.0	39.5	38.8	38.8	39.5	39.8
27.3 bulldozers	ths.	49.1	52.3	45.3	44.9	45.5	46.1	43.0	42.6	41.6	41.3	43.5
27.4 scrapers	ths.	14.1	12.9	11.8	12.0	11.4	11.3	9.9	11.2	11.2	10.2	8.8
27.5 auto graders	ths.	6.8	6.9	6.6	5.8	6.2	6.0	6.3	6.1	5.1	5.0	5.3
27.6 cement mixers	ths.	30.5	30.1	29.8	29.4	29.6	29.1	28.7	28.1	21.3	21.9	
27.7 construction finishing machines	ths.	293	323	314	305	307	312	313	316	394	420	
29 - Railroad Rolling Stock												
29.1 mainline electric loc. 1	ea.	410	423	438	413	429	430	451	453			
29.2 mainline electric loc. 2 - hp	ths.	3163	3306	3475	3254	3395	3458	3731	3786	4100		
29.3 mainline diesel loc. 1 - sections	ea.	1455	1344	1392	1335	1378	1357	1298	1375			
29.4 mainline diesel loc. 2 - hp	ths.	4050	3705	3846	3704	3836	3754	3596	3802	3960		
29.5 mainline freight cars	ths.	71.884	71.170	68.270	64.589	62.964	61.044	58.597	58.400	59.300	57.097	
29.6 mainline passenger cars	ea.	2078	2110	2124	2060	1990	1915	1939	1916	2000	2048	
29.7 electric mine locomotives	ea.	2671	2694	2674	2471	2477	2562	2771	2817	2878	2875	2902
29.8 subway cars	ea.	308	286	297	308	309	312	326	365	360	365	375
29.9 street cars	ea.	1113	1057	1100	1006	1005	1014	1057	1070	1109	1147	1193

Table A.2—Continued

Category	Output Unit	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
30 - Automobiles												
30.1 trucks 1	ths.	379.63	407.63	437.35	478.15	504.53	524.51	564.25	596.80	629.48	666.29	695.80
30.2 trucks 2 - tons of capacity	ths.	1377	1513	1676	2175	2093	2266	2406	2526	2640	2770	2900
30.3 passenger cars	ths.	201.18	230.25	251.44	280.33	293.56	344.25	529.04	730.11	916.70	1194.70	1201.30
30.4 buses	ths.	35.507	37.327	39.960	42.357	46.099	47.363	49.316	51.926	56.023	60.564	66.994
30.5 trolley buses	ea.	1540	1628	1722	1820	1924	2238	2170	2103	2035	1968	1900
30.6 auto trailers	ths.	92.9	98.4	104.3	110.5	117.1	124.0	129.9	136.1	142.6	149.4	158.0
30.7 tractor trailers	ths.	132	155	182	214	252	296	295	294	292	291	290
30.8 motorcycles	ths.	721	753	784	802	827	833	872	898	932	960	1029
30.9 bicycles	ths.	3873	4048	4199	4303	4372	4443	4547	4631	4779	4831	5007
30.10 spare parts for autos	ths.	605	658	716	768	822	878	953	1002	1109	1183	1329
31 - Agricultural M&E												
31.1 tractors 1	ths.	354.53	382.50	405.10	423.40	441.70	458.53	472.01	477.82	496.58	531.09	550.43
31.2 tractors 2 - hp	ths.	21000	22800	24700	26200	28100	29400	31300	33400	36300	39800	41400
31.3 tractor plows	ths.	166	177.5	195.4	196.7	204.1	212	221	227	232	218	205
31.4 tractor engines	ths.	506.1	543.7	582.2	609.2	625.2	649.3	676.3	681.7	699.8	739.7	776.0
31.5 surface plows	ths.	44.0	39.0	43.8	49.4	46.8	38.3	25.1	28.2	26.4	31.2	32.6
31.6 harrows	ths.	18.4	21.3	18.5	21.5	21.5	22.8	26.4	26.6	28.7	30.1	32.1
31.7 planters	ths.	262	220	174	174	168	163	141	145	160	178	180
31.8 potato planters	ths.	16.1	18.1	20.8	21.0	22.0	18.0	13.0	6.9	2.3	7.2	9.1
31.9 cultivators	ths.	206	209	204	207	195	219	184	178	195	178	188
31.10 grain combines	ths.	85.8	92.0	101.2	101.3	94.5	99.2	102.0	95.7	84.8	88.4	97.5
31.11 sugar beet combines	ths.	17.5	10.5	10.2	11.0	10.8	9.1	10.1	11.4	14.1	15.9	17.1
31.12 overhead irrigation combines	ths.	14.3	27.7	28.5	29.3	30.4	12.3	13.8	13.2	22.4	25.0	27.1
31.13 reapers	ths.	97.8	88.6	63.3	41.2	41.3	47.7	51.8	60.4	63.7	83.5	92.1
31.14 potato harvesters	ths.	4.9	4.5	5.5	5.2	6.6	7.0	8.0	8.6	8.8	8.8	9.4
31.15 rowers	ths.	122.0	130.0	135.9	137.1	140.3	144.0	150.0	155.0	131.0	93.0	83.9
31.16 rakes	ths.	39.9	49.1	53.1	58.1	56.3	61.7	49.6	48.0	59.1	53.0	46.1
31.17 fodder harvesting combines	ths.	20.0	12.4	18.3	20.8	24.6	34.3	40.2	54.2	64.5	68.4	70.9
31.18 fodder crushers	ths.	17.6	13.0	11.4	12.2	12.7	14.2	16.2	20.2	28.0	32.0	33.2
31.19 cattle watering units	ths.	3831	4089	4364	4658	5305	5305	5560	5366	5301	5339	5169
31.20 milking units	ths.	6.7	9.5	13.6	19.3	27.5	39.2	56.1	57.1	55.3	54.0	53.3
31.21 multi-purpose loaders	ths.	68.7	61.8	67.7	71.6	75.8	78.2	82.0	87.4	85.8	85.9	90.1
31.22 press balers	ths.	7.0	11.0	12.2	9.9	13.9	15.8	18.1	20.8	23.0	25.5	28.1
31.23 fertilizer spreaders	ea.	2200	13630	23033	33698	43825	56429	59668	62010	64054	65901	66252
31.24 spare parts for tractors	bil.	709	726	763	766	776	791	826	876	958	1026	1083
31.25 spare parts for agricultural m&e	bil.	198	217	236	242	242	250	281	281	314	343	370
32 - Ball Bearings												
32.1 ball bearings	mil.	525	560	596	630	650	673	709	756	799	849	907

Table A.2—Continued

Category	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Output Unit											
30 - Automobiles											
30.1 trucks 1	716	734	762	780	787	787	780	790	795	815	
30.2 trucks 2 - tons of capacity	3056	3320	3429	3878	4001	4129	4180				
30.3 passenger cars	1239	1280	1312	1314	1327	1324	1307	1315	1327	1332	1326
30.4 buses	70	75	77	79	85	87	86	85	85	85	
30.5 trolley buses	1993	1960	2256	2008	2015	2219	2080	2180	2350	2416	2489
30.6 auto trailers	158	164	167	171	178	177	181	178	180	181	
30.7 tractor trailers	299	299	305	309	312	321	315	317	323	346	354
30.8 motorcycles	1060	1090	1099	1078	1090	1095	1110	1127	1151	1148	1130
30.9 bicycles	5072	5229	5414	5362	5452	5500	5605	5622	5803	5828	5904
30.10 spare parts for autos	1399	1505	1623	1673	1814	1919	1948				
31 - Agricultural M&E											
31.1 tractors 1	562.175	569.145	576.113	557.415	554.916	558.538	555.159	563.995	571.403	585.472	594.975
31.2 tractors 2 - hp	44000	45400	47000	46600	47000	47900	47900	49300	50700	52800	54500
31.3 tractor plows	202	185	216	211	202	203	208	202	207	207	220
31.4 tractor engines	792.3	807.2	812.5	795.6	801.8	798.3	791.0	815.0	819.9	829.5	839.8
31.5 surface plows	30.5	33.3	31.8	26.4	25.4	27.0	24.8	28.7	29.3	29.9	30.5
31.6 harrows	32.1	33.3	29.6	31.6	31.9	35.6	36.5	41.1	44.0	45.2	46.1
31.7 planters	191	197	199	202	201	213	205	209	215	230	229
31.8 potato planters	10.5	11.0	11.5	12.9	13.1	13.4	13.5	13.5	17.2	16.9	17.0
31.9 cultivators	190	187	193	202	204	218	218	223	251	267	279
31.10 grain combines	102	106	113	115	117	106	112	118	118	112	112
31.11 sugar beet combines	14.4	14.6	14.9	10.6	9.5	9.3	9.7	8.9	6.6	5.0	7.0
31.12 overhead irrigation combines	28.4	27.5	26.0	20.3	18.0	17.1	36.3	45.8	45.2	53.7	61.5
31.13 reapers	93.6	92.7	95.9	106.0	98.1	99.7	105.0	106.0	99.4	85.7	76.4
31.14 potato harvesters	9.9	9.9	9.9	10.0	10.0	10.2	10.6	8.3	6.6	7.4	7.7
31.15 mowers	89.4	97.2	109.0	102.0	86.2	84.2	87.7	90.4	99.7	79.1	82.5
31.16 rakes	42.5	46.7	48.3	50.9	53.1	48.9	56.1	59.3	65.1	69.9	75.1
31.17 fodder harvesting combines	56.0	56.7	48.0	45.6	46.7	40.8	42.0	47.5	27.7	38.0	40.4
31.18 fodder crushers	35.1	36.6	32.2	28.0	27.1	26.7	30.4	32.0	32.2	31.1	32.2
31.19 cattle watering units	4960	4869	4880	5037	5233	4943	4995	5000	5000	5000	5000
31.20 milking units	53.1	54.9	53.4	57.7	56.7	62.6	68.6	67.9	67.6	68.4	71.6
31.21 multi-purpose loaders	94.7	96.2	93.2	93.4	95.5	95.8	93.5	95.6	91.4	98.3	96.3
31.22 press balers	30.2	28.7	28.7	32.1	31.0	32.0	31.6	32.8	33.0	35.1	32.2
31.23 fertilizer spreaders	65707	64603	64497	54145	54139	49245	49323	45200	47900	47700	44200
31.24 spare parts for tractors	1173	1222	1266	1307	1335	1374	1427				
31.25 spare parts for agricultural m&e	401	417	448	453	467	487	475				
32 - Ball Bearings											
32.1 ball bearings	953	987	1015	1032	1050	1058	1081	1078	1088	1089	1089

Table A.2—Continued

Category	Output Unit	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
33 - Radio-Electronics and Other MB												
33.1 radios	ths.	5160	5842	6416	6981	7266	7815	8794	8842	8615	8753	8376
33.2 television sets, black & white	ths.	3655	4415	4955	5742	6595	6036	5758	5903	6105	6163	6155
33.3 television sets, color	ths.	0	0	0	0	0	46	59	77	166	406	589
33.4 tape recorders	ths.	453	648	792	928	1064	1192	1394	1636	1797	2112	2525
33.5 record players	ths.	176	215	262	319	389	474	565	672	801	954	1136
33.6 video recorders	ths.	0	0	0	0	0	0	0	0	0	0	0
33.7 telephone stations	ths.	1046	1056	1104	1087	1286	1322	1399	1338	1531	1573	1706
33.8 telephones	ths.	1461	1636	1829	2066	2225	2490	2630	2692	3007	3254	3446
33.9 loudspeakers	ths.	2850	3614	4444	4503	4964	5478	5759	6036	6628	6935	7351
33.10 industrial fittings	ths.	54100	56200	60600	63600	65400	68000	71000	68000	73000	78000	81000
34 - Sanitary-Engineering M&E												
34.1 heating boilers	ths. m ²	2800	3000	3200	3400	3500	3700	3700	3800	3900	4100	4300
34.2 radiators/convectors	ths. m ²	25500	26100	26000	25100	27400	29700	32200	34200	36600	40000	42100
34.3 corrugated pipe	ths. m ²	3100	3100	3100	3100	3100	3100	3000	2900	2900	2700	2800
34.4 cast-iron sewer pipe	tons	321000	323700	339500	362700	359600	367000	383000	386000	409000	425000	437000
34.5 bathtubs	ths.	1613	1767	1874	1958	1969	1886	1892	1944	2016	2226	2235
34.6 hot water boilers	ths.	659	704	786	796	806	890	957	995	970	763	765
34.7 gas stoves	ths.	1234	1340	1578	1705	1850	1871	1884	1905	1899	1908	1850
35 - Metal Products												
35.1 baby carriages	ths.	802	981	1116	1240	1347	1467	1592	1745	1944	2166	2436
35.2 household utensils - tons	ths.	344.7	357.5	368.6	385.3	395.3	414.0	451.5	477.3	503.8	510.1	530.0
35.3 razor blades	mil.	1652	1724	1851	1851	1895	1965	2001	1809	1859	1825	1800
35.4 metal beds	ths.	11700	11800	12900	13700	13300	12800	11900	11000	10000	9700	9500
36 - Metal Structures												
36.1 metal structures - tons	mil.	2.5	2.7	2.9	3.1	3.3	3.5	3.8	4.0	4.1	4.6	4.5
37 - Repair of M&E												
37.1 trucks (repair)	ths.	550.9	579.3	593.8	612.2	636.1	666.5	675.9	680.7	709.6	732.4	742.8
37.2 truck engines (repair)	ths.	918.2	965.5	989.6	1020.4	1060.2	1110.8	1126.5	1134.5	1182.7	1220.7	1238.0
37.3 tractors (repair)	ths.	587.8	607.3	623.1	634.6	656.7	676.9	699.1	713.6	730.0	747.7	744.9
37.4 grain combines (repair)	ths.	171.9	170.8	172.4	175.8	179.7	181.7	182.3	182.6	178.8	179.1	177.9
37.5 excavators (repair)	ths.	16.6	18.1	19.6	21.0	22.9	24.9	26.7	28.7	30.6	32.3	34.1
37.6 bulldozers (repair)	ths.	16.3	17.8	19.2	20.8	22.5	24.4	26.4	28.4	30.4	32.1	34.1
37.8 scrapers (repair)	ths.	4.9	5.2	5.5	5.9	6.3	6.9	7.6	8.1	8.7	9.3	10.0
37.9 cranes (repair)	ths.	20.1	21.7	23.3	25.0	26.8	28.7	30.7	32.8	34.7	36.3	39.4
37.10 appliances, radios, & cars (repair)	mil.	89	180	217	263	321	393	474	544	637	737	885

Table A.2—Continued

Category	Output Unit	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
33 - Radio-Electronics and Oth. MB												
33.1 radios	ths.	8456	8652	8728	8452	8478	8704	8906	9298	9391	8849	8924
33.2 television sets, black & white	ths.	6258	5951	5734	5457	5266	5480	5227	5170	5400	5347	5070
33.3 television sets, color	ths.	805	1122	1431	1814	2262	2710	3118	3408	3598	4024	4366
33.4 tape recorders	ths.	2601	2601	2623	2741	3045	3216	3446	3734	4084	4665	4765
33.5 record players	ths.	1193	1254	1317	1383	1455	1442	1425	1446	1497	1407	
33.6 video recorders	ths.	0	0	0	0	0	0	0	0	0	6.8	13.0
33.7 telephone stations	ths.	1700	1700	1700	1700	1700	1700	1700				
33.8 telephones	ths.	3766	3915	4165	4395	4625	4485	4845	5015	5395	4955	6135
33.9 loudspeakers	ths.	7573	7889	8126	8354	8682	8906	9127				
33.10 industrial fittings	ths.	80000	83000	83000	80000	79000	78000	80000	83000	84000	84000	86000
34 - Sanitary-Engineering M&E												
34.1 heating boilers	ths. m ²	4429	4554	4601	4730	4760	4713	4911	5004	5555	5383	
34.2 radiators/convectors	ths. m ²	45973	46352	44458	40837	39069	37722	35827	36042	35682	36645	
34.3 corrugated pipe	ths. m ²	2573	2318	2097	1915	1750	1576	1425				
34.4 cast-iron sewer pipe	tons	422100	406800	392400	379800	368000	355300	343500				
34.5 bathtubs	ths.	2253	2338	2345	2096	1848	1708	1558				
34.6 hot water boilers	ths.	793	727	724	720	718	712	603				
34.7 gas stoves	ths.	1965	2032	1787	1818	1901	1946	1992	2068	1980	2008	
35 - Metal Products												
35.1 baby carriages	ths.	2676	2832	2923	3167	3590	3941	4253	4636	5013	5180	5323
35.2 household utensils - tons	ths.	546.4	545.4	522.6	506.2	509.3	497.7	476.5				
35.3 razor blades	mil.	1907	1566	1610	1461	1497	1411	1487	1459			
35.4 metal beds	ths.	9100	9000	8900	8900	9000	9200	8300	7900	7400	6600	7000
36 - Metal Structures												
36.1 metal structures - tons	mil.	4.7	4.6	4.9	4.6	4.4	4.4	4.7	5.0	5.1	5.1	5.8
37 - Repair of M&E												
37.1 trucks (repair)	ths.	754.0	763.4	777.7	791.3	806.3	826.2	852.2	882.8	908.7	932.8	956.7
37.2 truck engines (repair)	ths.	1256.7	1272.4	1296.1	1318.9	1343.8	1377.1	1420.4	1471.3	1513.9	1554.6	1594.4
37.3 tractors (repair)	ths.	744.4	766.5	770.2	788.7	787.1	781.1	777.7	778.5	779.2	778.5	776.1
37.4 grain combines (repair)	ths.	175.4	172.9	170.6	168.0	166.4	166.8	168.6	170.5	172.1	171.6	168.0
37.5 excavators (repair)	ths.	35.8	37.4	38.8	39.7	40.6	41.1	41.3	41.5	41.9	42.4	42.7
37.6 bulldozers (repair)	ths.	37.0	39.1	39.9	40.3	40.3	40.4	40.4	40.5	40.3	39.3	39.0
37.8 scrapers (repair)	ths.	10.5	10.8	10.9	10.9	10.9	10.9	11.0	11.0	11.6	10.0	9.6
37.9 cranes (repair)	ths.	43.8	46.7	48.3	49.9	51.3	52.3	52.8	53.8	54.8	55.4	55.4
37.10 appliances, radios, & cars (repair)	mil.	1089	1272	1436	1614	1835	2054	2270	2542	2835	3145	3306

Table A.3 presents the calculation of sectoral weights for 1972. Table A.4 shows the adjustment in MBMW GVO for intraindustry turnover. Growth rates of the machinery sectors in the sample for 1965-1986 are given in Table A.5, and growth rates for the total value of machinery in the sample are given in Table A.6 in constant 1981 prices. Finally, Table A.7 estimates the 1965-1986 MBMW GVO in current rubles.

Table A.3
Calculation of 1972 Sectoral Weights^a

Sector Number	Sector	1972 GVO (millions of rubles)	Weights
12.	Energy & Power	1494.7	0.023
13.	Electrical-tech. M&E	6996.1	0.106
14.	Cable products	1934.0	0.029
15.	Machine tools	1477.6	0.022
16.	Forging-pressing M&E	339.7	0.005
19.	Precision instruments	1000.0	0.015
20.	Heavy metal M&E	2400.7	0.036
21.	Pumps and compressors	2341.1	0.035
23.	Light industry M&E	684.3	0.010
24.	Food industry M&E	635.2	0.010
25.	Printing M&E	58.9	0.001
26.	Hoisting and transport M&E	1318.5	0.020
27.	Construction M&E	1598.6	0.024
29.	Railroad rolling stock	1896.6	0.029
30.	Automobiles	8838.3	0.134
31.	Agricultural M&E	7128.4	0.108
32.	Ball bearings	767.4	0.012
33.	Radio-electronics and other MB	3000.0	0.045
34.	Sanitary-engineering M&E	1375.7	0.021
35.	Metal products	4113.7	0.062
36.	Metal structures	1754.0	0.027
37.	Repair of M&E	15001.2	0.227
	Sum	66154.7	1.000

^a1972 GVO data are in current producers' prices, i.e., prices net of turnover taxes and trade and transport charges, which are from the 1972 Soviet ex post input-output table. (See Gallik, Kostinsky, and Trembl, 1983, p. 76.) Two sectors, casting machinery and equipment and machinery for construction materials industry, were omitted from the GVO because they are absent from the sample. The GVO of the sector "radio-electronics and other machinery," which in the input-output table includes arms and weapons, was reduced to reflect only consumer radio-electronic products.

Table A.4
Adjusting MBMW GVO for Intraindustry Turnover

Year	MBMW GVO Current Prices ^a (millions of rubles)	Intraindustry Turnover ^b (% of GVO)	MBMW GVO Without Turnover ^c (millions of rubles)
1965	49435	0.108	44085
1966	56868	0.115	50342
1967	65025	0.121	57160
1968	73559	0.127	64252
1969	80115	0.132	69546
1970	87501	0.137	75509
1971	92359	0.142	79249
1972	100207	0.147	85514
1973	104860	0.151	89014
1974	115457	0.155	97509
1975	126476	0.160	106286
1976	131841	0.164	110260
1977	140307	0.168	116791
1978	152580	0.171	126425
1979	163200	0.175	134621
1980	173236	0.179	142275
1981	181408	0.182	148349
1982	188388	0.186	153411
1983	199315	0.189	161641
1984	211792	0.192	171067
1985	227200	0.195	182783
1986	241611	0.199	193619

^aSee Table A.7.

^bEstimated; see text, Sec. 2.

^cColumn 1 times (1 - column 3).

Table A.5
Growth Rates of Machinery Sectors Included in the Sample, 1965-1986^a
(In constant 1981 prices)

Sector Number	Sector	Physical Units Index	Alternative Measures Index
12.	Energy & power M&E	1.488	1.156
13.	Electric-tech. M&E	1.753	1.768
14.	Cable products	1.894	—
15.	Machine tools	1.435	—
16.	Forging-pressing M&E	1.648	—
19.	Precision instruments	2.927	—
20.	Heavy metallurgical M&E	1.354	—
21.	Pumps and compressors	2.266	—
23.	Lights industry M&E	1.451	—
24.	Food industry M&E	3.015	—
25.	Printing industry M&E	0.714	—
26.	Hoisting-transporting M&E	1.530	—
27.	Construction M&E	1.978	—
28.	Railroad rolling stock	1.109	1.456
30.	Automobiles	2.662	3.197
31.	Agricultural M&E	1.663	1.983
32.	Ball bearings	2.015	—
33.	Radio-electronics	3.167	—
34.	Sanitary-engineering	1.362	—
35.	Metal products	1.481	—
36.	Metal structures	1.760	—
37.	Repair of M&E	2.002	—

^aAlternative measures of output are available only for sectors 12, 13, 29, 30, and 31. In other sectors, the two versions are the same.

Table A.6
Rates of Growth of the Total Value of Machinery Included
in the Sample
(In constant 1981 prices)

Year	Standard Physical Units	Alternative Measures of Output
1965	1.000	1.000
1966	1.080	1.082
1967	1.144	1.153
1968	1.207	1.236
1969	1.272	1.293
1970	1.337	1.364
1971	1.405	1.436
1972	1.477	1.512
1973	1.557	1.597
1974	1.645	1.690
1975	1.706	1.757
1976	1.777	1.831
1977	1.838	1.897
1978	1.875	1.939
1979	1.889	1.968
1980	1.924	2.009
1981	1.954	2.038
1982	1.975	2.064
1983	2.039	2.128
1984	2.095	2.203
1985	2.145	2.253
1986	2.166	2.296

Table A.7
Estimating MBMW GVO in Current Rubles, 1965-1986

Year	Employment (thousands)	Wage Rate (rubles/mo.)	Total		Labor Pay from Profits (% of wage bill)	Labor Pay from Profits (millions of rubles)	Total Labor Cost (millions of rubles)	Share of Labor		Total Cost (millions of rubles)	Profits (millions of rubles)	MBMW GVO (millions of rubles)
			Total Wage Bill (millions of rubles)	Wage Bill Incl. Soc. Sec. (millions of rubles)				Cost in Total Cost	Cost in Total Cost			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)		
1965	9670	102.9	11941				0.302	42406	7029	49435		
1966	10154	106.5	12977	12807			0.289	48158	8710	56868		
1967	10600	111.9	14234	13918			0.276	55310	9715	65025		
1968	11275	122.2	16538	15266			0.270	62630	10929	73559		
1969	11702	129.3	18160	17737	0.050	826.9	0.266	68100	12015	80115		
1970	12017	134.4	19378	19477	0.075	1362.0	0.256	73614	13887	87501		
1971	12369	139.7	20735	20783	0.100	1937.8	0.251	79512	12847	92359		
1972	12718	144.5	22049	22238	0.110	2280.9	0.246	85373	14834	100207		
1973	13049	149.5	23414	23648	0.120	2645.9	0.243	91777	13083	104860		
1974	13424	157.5	25377	25112	0.120	2809.7	0.240	100715	14742	115457		
1975	13816	164.1	27209	27217	0.120	3045.2	0.236	109816	16660	126476		
1976	14156	171.4	29116	29182	0.120	3265.1	0.240	115555	16286	131841		
1977	14549	174.5	30466	31227	0.120	3493.9	0.237	122441	17866	140307		
1978	14987	178.6	32120	32674	0.120	3655.9	0.228	140728	22472	163200		
1979	15399	182.3	33686	34448	0.120	3854.4	0.225	148704	24532	173236		
1980	15612	187.5	35127	36128	0.120	4042.3	0.222	155644	25764	181408		
1981	15770	191.7	36276	37674	0.120	4215.2	0.229	168276	20112	188388		
1982	15868	198.4	37780	38906	0.120	4353.1	0.224	176649	22666	199315		
1983	16028	201.7	38794	43069	0.120	4533.6	0.221	186289	25503	211792		
1984	16194	207.7	40363	44225	0.120	4655.2	0.217	198089	29111	227200		
1985	16380	214.4	42142	46013	0.120	4843.5	0.212	208578	33033	241611		
1986	16496	219.0	43351	49421	0.120	5202.2	0.212	208578	33033	241611		

NOTES:

- Column 1. Employment—1965 to 1975, 1980, 1985 and 1986 from various issues of *Narkhoz*, *Vestnik statistiki*, and from *Trud* (1988). 1976 to 1979 and 1981 to 1984 estimated on the basis of labor productivity and GVO rates of growth (See Rapawy, 1987).
- Column 2. Monthly wages—various issues of *Narkhoz* and *Vestnik statistiki* as well as *Trud* (1988).
- Column 3. Total wage bill—Column 1 times column 2 times 12.
- Column 4. Total wage bill including social security payments—1965 through 1981, column 3 times 1.072 (Simonenko, ed., 1971, pp. 237-240), 1982 through 1986, column 3 times 1.14 (Verbov and Petrukhin, 1980, pp. 500-501).
- Column 5. The system of labor incentive payments out of profits was introduced in 1965 but was not extended to all industry for several years. We will notionally use 5% for 1968, 7.5% for 1969, 10% for 1970, and 11% for 1971. From 1972 on, the incentive payments were estimated at a constant 12% of the wage fund (Artemov, 1975, pp. 37-45; Artemov et al., 1983, pp. 20-31; Miliukov, 1973, pp. 107-109; Kunel'skii, 1975, pp. 196-201).
- Column 6. Incentive payments to labor in rubles—column 5 times column 3.
- Column 7. Total labor cost—column 4 minus column 6.
- Column 8. The share of labor in total cost of production—*Narkhoz* for different years.
- Column 9. Total cost of production—column 7 divided by column 8.
- Column 10. Total profits—*Narkhoz* for different years.
- Column 11. Total MBMW GVO in rubles—column 9 plus column 10.

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