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An Analysis of the Behavior of Soviet Machinery Prices, 1960-73

A Research Paper

ER 79-10631
December 1979

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Preface

This study analyzes the movement of machinery wholesale prices in the Soviet Union during the period 1960-73 in an attempt to shed some light on the extent of inflation in the machine-building sector. The approach taken is unique for two reasons. First, it uses detailed price data rather than information officially sanctioned by the Soviet Government—such as the published machinery price indexes or official statements appearing in the open press. Second, it employs econometric techniques to analyze the connection between quality improvements and price change in the machinery items.

Price indexes were constructed for eight types of machines in four machine-building branches using both an unweighted average of price relatives and a hedonic technique, which applies regression analysis to estimate the relationship between price and technical characteristics for successive generations of machines.

The paper is organized into five sections. The first summarizes the controversy over the presence and extent of inflation in Soviet machinery prices and the incentives and procedures governing price formation in the Soviet Union. In the second and third sections two different methods are used to construct price indexes for four MBMW branches, and the results of each are assessed. Then, the implications of the findings for other branches are considered, and a final section presents the overall conclusions of the study.

An Analysis of the Behavior of Soviet Machinery Prices, 1960-73

Key Judgments

Our analysis of the prices of individual machinery products indicates that substantial price inflation occurred in Soviet machine-building during the period 1960-73. This inflation resulted mainly from an upward revision of machinery prices in 1967 but also from pricing new or improved products at higher levels than warranted by technical improvements.

Although machinery prices did increase during this period, the extent of inflation was influenced by the share of new or improved products in machinery production. Prices, once established, tended to remain constant between years of major price adjustments for those products whose characteristics did not change.

According to indexes based on simple price relatives for the same models of machinery, prices changed little between 1960 and 1966, were revised upward in 1967, possibly fell in 1971, and declined again in 1973. The sharp rise in prices in 1967 casts doubt on the official claim that average machinery prices were unchanged by the 1967 price reform.

An investigation of hidden price inflation via the new-product pricing channel (simulated innovation) was carried out by constructing hedonic price indexes. The results show that the practice of pricing "new" products higher than warranted by the changes in their technical characteristics does exist in the Soviet Union. While our analysis does not permit us to identify hidden inflation year-by-year, in some of the samples it was substantial—averaging 4-5 percent a year from 1960 to 1973.

When the sample for each machine-building branch includes both products whose characteristics were unchanged over portions of the 1960-73 period and the "new" products, the price indexes were dominated by the 1967 price hikes. After 1967 the price adjustments imposed on established products in 1971 and 1973 outweighed the inflationary effects of new-product pricing, leaving the price level lower in 1973 than in 1967 in most of the machinery branches in the sample.

The branches of machine building included in our sample—construction and road machinery, machine tools, cranes, and trucks—are fairly typical of machine-building as a whole with respect to the characteristics affecting inflation. For example, the branches in the sample experienced increases in total wage and material costs close to the average for all machine building. A more restricted comparison of the sample branches with other machine-building branches indicates that changes in unit wage and material costs in the former were also not atypical. Nonetheless, our sample is too small to serve as the basis for estimating an average rate of inflation for machine building as a whole.

The results of the regression analysis confirm that the formation of wholesale prices on new models of machinery is carried out in a systematic way in the Soviet Union. That is, machinery prices appear to be set by price-setting authorities on the basis of certain key machine characteristics rather than on a random or ad hoc basis.

Finally, our findings support those of other Western and Soviet studies that the official Soviet machinery wholesale price indexes are unreliable. Our research indicates that the official indexes are clearly biased downward, most likely because of a failure to account for the disguised price inflation accompanying the introduction of new products.

The presence of inflation in Soviet machine building has a wide-ranging impact on the different sectors of the Soviet economy. Since inflation is not uniform across all branches of the machine-building and metalworking sector (MBMW), it will weigh more heavily on some users than it does on others.

As industrial enterprises accelerate investment in modernization and mechanization (for example, by replacing existing machinery and equipment with new and improved machines), the share of investment chewed up by inflation undoubtedly rises.

Inflation in machine building also raises the cost of consumer durables, both by increasing the cost of components to manufacturers and by raising prices on such items as refrigerators, radios, cameras, and the like.

The impact of inflation in machinery prices, however, may be most severe in the production of military hardware. As a result of Soviet efforts to compete militarily with the West, defense has become a high technology, innovative sector relative to the rest of Soviet industry and thus may be most susceptible to new-product pricing. On the other hand, it can be countered that the defense industries are subject to more effective quality control than are other sectors of industry. Military inspection teams are stationed at enterprises to ensure that quality standards are met, to monitor costs, and to oversee production. On balance, however, the more rapid pace of innovation, product obsolesence, and technological changes in the military sector probably means that the new-product pricing effect outweighs other considerations.

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An Analysis of the Behavior of Soviet Machinery Prices, 1960-73

Introduction

A prominent Soviet economist, Ia. A. Kronrod, proclaimed in 1960 that "... inflation in a socialist society has been eliminated."[1] A senior Soviet economist at Gosplan stated in 1974, "We haven't any process of inflation."[2] In 1978, Nikolay Glushkov, the Chairman of the State Committee for Prices, told journalists that, "There has been no inflation in the USSR since the early twenties, owing to the economic and monetary control made possible by socialism. . . ."[3] The official view from Moscow, unchanged over the past two decades, is that price inflation plays no role in the functioning of the Soviet economy.

There is, however, a growing amount of evidence refuting the claim of absolute price stability in the Soviet economy between the infrequent official adjustments in price schedules. This information ranges from complaints of Soviet citizens over rising prices appearing in the open press to scholarly studies by Western and Soviet analysts of the Soviet economy. As a result of this evidence, many Western economists now believe that the Soviet economic system is subject to a gradual, but persistent upward movement in the level of wholesale and retail prices.

Table 1 Index: 1960=100

Official Price Indexes for Machine Building[1]

	Enterprise Wholesale Prices	Industry Wholesale Prices		Enterprise Wholesale Prices	Industry Wholesale Prices
1960	100	100	1969	89	87
1961	NA[2]	NA[2]	1970	89	85
1962	100	96	1971	82	81
1963	98	96	1972	82	79
1964	95	94	1973	77	74
1965	92	91	1974	75	74
1966	91	89	1975	75	74
1967	91	89	1976	73	72
1968	91	89	1977	70	70

Source: *Narodnoye khozyaystvos SSSR*, various issues.

[1] There are two types of wholesale prices in the Soviet Union. The enterprise wholesale price (*optovaya tsena predpriyatiya*) is the price at which the producing enterprise sells its output. It consists of the enterprise production costs plus a profit markup. The industry wholesale price (*optovaya tsena promyshlennosti*) is the price paid by the enterprise buyer. Its value depends upon average branch production costs, a profit markup, the turnover tax (if any), a markup of the branch sales organization, and transportation charges if borne by the sales organization.

[2] NA indicates data are not available.

Background

Conflicting Claims Regarding Inflation in Machinery Prices

According to official Soviet price indexes, inflation in machinery prices is not a problem in the USSR. The published indexes of wholesale prices in the machine-building and metalworking sectors (table 1) show prices to have fallen steadily throughout the 1960-77 period. Even in 1967, the year of the major price reform, wholesale prices in MBMW did not increase according to the published statistics.

The validity of the published indexes of Soviet MBMW prices is questionable.[4] Descriptions of the methodology used by the Central Statistical Administration to construct these measures of price change are at best fragmentary and confusing. For example, the 1962 edition of *Narodnoye khozyaystvo*, the Soviet

[1] *Den'gi v sotsialisticheskom obshchestve*, (Moscow: Gosfinizdat,1960), p. 364.

[2] The outlook, *Wall Street Journal*, 18 August 1974.

[3] The British Broadcasting Corp., *Summary of World Broadcasts*, second series SU/W1005, 3 November 1978, p. 2.

[4] Perhaps the best critical analysis of these indexes is contained in Abraham S. Becker, "The Price Level of Soviet Machinery in the 1960s," *Soviet Studies*, XXVI (July 1974). See also Morris Bornstein, "Soviet Price Statistics," in *Soviet Economic Statistics*, ed. by Vladimir G. Treml and John P. Hardt (Durham, N. C.: Duke University Press, 1972), p. 361. Soviet economists have also openly criticized the published price indexes. See, for example, Ia. Kvasha and V. Krasovskiy, "Kapital'noe stroitel'stvo i problema vozmeshcheniya," *Voprosy ekonomiky* (1964), pp. 71-80.

statistical handbook that contains the indexes, says only that since 1961 the indexes are calculated on the basis of sample data. No additional details are given until the 1972 edition, which states that the wholesale price indexes for the separate sectors of industry are estimated by a chain method—that is, on the basis of estimates of goods production for each year in current prices and prices of the previous year.

Other information found in the Soviet literature provides a brief description of the product sample that is (or was) used to construct the price indexes. Specifically, it indicates that the sample was set in 1961, that it consists of 350 machinery products, and that it is weighted by the values of marketed output that existed in 1961.[5]

The sample and the weights evidently have not changed over time. D. M. Palterovich reports that there is no evidence that the sample and weights were changed even with the 1967 price reform.[6] But the information provided by the Soviets is just too sketchy and apparently inconsistent to draw any definite conclusions about the methodological foundations of the MBMW wholesale price indexes. Whatever method is used, it apparently did not change over the 1960-77 period. That is, the existing indexes have never been revised in any edition of the statistical handbook during this period nor do any apparent discontinuities appear in the overall data series. Even in the 1972 edition when the discussion of the chain method first appeared, there is no evidence of any change made to the price indexes.

One other possibility is that the Central Statistical Administration derives the published price indexes from value of output data; that is, by dividing an index of gross value of output (GVO) expressed in current prices by the index expressed in comparable prices. The relationship between just such an implicit price index and the officially published price index is shown in table 2.

[5] Becker, "The Price Level of Soviet Machinery in the 1960s," pp. 364-66.

[6] See Abraham S. Becker, "Ruble Price Levels and Dollar-Ruble Ratios of Soviet Machinery in the 1960s," Rand Corporation, R-1063-DDRE, January 1973, p. 9.

According to the implicit price index, machine-building prices fell throughout the 1960-75 period. But this derived index is almost certainly biased downward because the Soviet gross value of output indexes are biased upward. The methods used to price new and one-of-a-kind products and incorporate them into production indexes as well as the improper handling of quality change are the primary causes of this bias.[7] Since the GVO index for MBMW is biased upward—indeed, the bias may be most pronounced in MBMW because of the rapid product turnover—dividing a current price production index by an upward-biased comparable price production index results in an implicit price index that understates the real change in prices.

Most important, however, a comparison of the official and the derived implicit wholesale price indexes reveals that the two series are almost identical. Hence, not only must the official MBMW price index be biased downward but the fact that the movements of the two indexes are so close calls into question the independence of the official price indexes and the index of GVO.

While official Soviet price indexes show prices to be falling, evidence of hidden inflation in MBMW wholesale prices has been growing.[8] Complaints of large increases in machinery prices not justified by corresponding improvements in machine productivity have become commonplace in Soviet publications. Economist V. Krasovskiy cites a typical example in which a Kiev plant simply renamed a control-measurement instrument and increased its price five times.[9] Soviet economists occasionally even try to gauge the extent of inflation in machinery prices. Becker, in the article cited above, quotes D. M. Palterovich's estimate of the rate of inflation in MBMW in the 1960s of roughly 2 percent per year.[10]

[7] See, for example, Rush V. Greenslade, "Industrial Production Statistics in the USSR," in *Soviet Economic Statistics*, pp. 155-94.

[8] The term "hidden inflation" has been used by the Western economists Gertrude Schroeder, David H. Howard, and others to represent actual upward price movements hidden by the official price indexes.

[9] V. P. Krasovskiy, *Planirovaniye i analiz narodnokhozyaystvennoy struktury kapital'nykh vlozheniy* (Moscow: Izdatel'stvo "Ekonomika," 1970), p. 242.

[10] Becker, "The Price Level of Soviet Machinery in the 1960s," p. 373.

Table 2

Comparing the Implicit Price Index for Machine Building With the Official Price Indexes

	1960	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
	Billion rubles										
MBMW GVO in current prices [1]	30.9	58.7	66.2	74.5	81.2	89.8	95.4	104.2	108.8	119.7	131.0
	Index: 1970 = 100										
	34.4	65.4	73.7	83.0	90.4	100.0	106.2	116.0	121.2	133.3	145.9
Index of MBMW GVO in constant prices [2]	32.2	64.4	72.4	81.0	90.2	100.0	111.5	124.1	139.1	155.7	173.0
Implicit price index for MBMW [3]	107	102	102	102	100	100	95	94	87	86	84
Official price indexes for MBMW [4]											
Industry wholesale prices	118	105	105	105	102	100	95	93	87	87	87
Enterprise wholesale prices	112	102	102	102	100	100	92	92	87	84	84

[1] Producers' prices. Value for 1960 is from W. T. Lee, *The Estimation of Soviet Defense Expenditures, 1955-75* (New York: Praeger Publishers, 1977), p. 225. The remaining values are from a CIA unpublished series by R. J. Abbott. The Lee and Abbott series are roughly comparable. The major difference being an adjustment made by Abbott to account for wages paid out of the material incentive fund.

[2] *Narodnoye khozyaystvo SSSR*, 1970, p. 206, and 1975, p. 256. This index is estimated by the Soviets in enterprise wholesale prices as of 1 July 1967.

[3] Index of MBMW gross value of output in current prices divided by index of gross value of output in constant prices.

[4] *Narodnoye khozyaystvo SSSR*, various issues.

Krasovskiy has constructed his own price indexes for various types of machine-building output using data provided by branch institutes. His indexes—calculated using the Paasche price index formula (current year quantity weights)—are shown in table 3. Since Krasovskiy makes no adjustments for quality change, his indexes are probably biased upward. Nonetheless, a simple average of his indexes may provide some clue as to the actual movement of prices in MBMW between 1965 and 1970—an average annual rate of increase of 3.1 percent.

Another Soviet economist, N. M. Mitrofanova, recently published indexes of wholesale prices of machinery and equipment in the Soviet Union (see table 4). In a journal article, Mitrofanova presents a wholesale price index for machinery and equipment, and in a recent book, price indexes for seven separate categories of machinery and equipment.[11] As it turns out, her aggregate index in the journal article seems to be a simple unweighted average of the seven component indexes from her book.

[11] N. M. Mitrofanova, "Tendentsii dvizheniya kontraktnikh tsen v torgovlye stran SEV," *Voprosy ekonomiky*, no. 8, (August 1978) pp. 101-6; idem, *Tseny v mekhanizmye ekonomicheskovo sotrudnichestva stranchlenov SEV* (Moscow: Izdatel'stvo "Nauka," 1978), p. 74.

Table 3

Index: 1965 = 100

Krasovskiy's Estimated Indexes of Machine Building Prices for 1970

Machine-tool building	125
Power machine building	116
Diesel-locomotive building	144
Railroad-car building	144
Mining machine building	138
Metallurgical machine building	103
Equipment for the coal industry	111
Electrical-engineering industry	108
Equipment for chemical, petroleum, and gas industry	111
Road construction machine building and equipment for the building materials industry	122
Automobile industry	115
Tractors and engines	98

Source: V. P. Krasovskiy, *Planirovaniye i analiz narodnokhozyaystvennoy struktury kapital'nykh vlozheniy*, p. 234.

Table 4 Index: 1970 = 100

Mitrofanova Machinery and Equipment Wholesale Price Indexes

	1960	1966	1970	1971	1972	1973	1974	1975	1976
Machinery and equipment [1]	74	76	100	97	106	105	117	119	122
Metalcutting machine tools [2]	93	58	100	101	109	105	101	106	NA [1]
Trucks [2]	46	77	100	93	104	105	103	111	NA
Passenger cars [2]	66	83	100	114	115	113	109	108	NA
Excavators [2]	91	99	100	97	110	106	113	114	NA
Bulldozers [2]	89	66	100	69	90	90	90	90	NA
Tractors [2]	51	75	100	104	109	115	123	127	NA
Combines [2]	81	77	100	102	107	100	175	175	NA

Sources:
1. N. M. Mitrofanova, "Tendentsii dvizheniya kontraktnykh tsen v torgovlye stran SEV," *Voprosy ekonomiki*, no. 8 (August 1978), p. 103.
2. N. M. Mitrofanova, *Tseny v mekhanizmye ekonomicheskovo sotrudnichestva stran-chlenov SEV* (Moscow: Izdatel'stvo "Nauka," 1978), p. 74.
[1] NA indicates data are not available.

Mitrofanova's machinery and equipment index shows machinery prices to be rising over the 1961-76 period. The component indexes also generally increase over this period with a particularly large increase occurring between 1966 and 1970. Unfortunately, Mitrofanova does not include data for 1967 in any of her indexes, nor does she explain the methodology used to construct the seven component indexes. Presumably a large portion of that increase took place in 1967, the year of the major price reform.

In any event, Mitrofanova's machinery price index differs markedly from the official indexes. This can only be suggestive, however, because the official indexes encompass a wider spectrum of machine building branches while Mitrofanova's index is constructed using only seven machinery items. Moreover, it is not possible to judge the quality of her indexes since we know nothing of her methodology.

Two recent estimates of Soviet machinery price changes have appeared in the Western literature (table 5). Becker constructed an index of Soviet machinery prices for the period 1958-70.[12] He developed the index on the basis of official Soviet data together with other information contained in the Soviet literature.

Padma Desai has made the most recent attempt to construct a machinery sector price index.[13] Desai began by calculating a "true" index of machinery output on the assumption that it lies between the official Soviet published index and an index constructed according to market-economy methodology. To derive this index, therefore, she calculated the harmonic mean of the official output index of Soviet machine building and the corresponding market-economy Greenslade-CIA index. Finally, a "true" price index for MBMW was estimated by dividing an index of output in current (enterprise) prices—estimated from Soviet cost-distribution tables—by the corresponding "true" output index in constant prices.

[12] Becker, "The Price Level of Soviet Machinery in the 1960s," p. 378. Also, Moorsteen developed price indexes for all Soviet machinery for the period 1927-58; see Richard Moorsteen, *Prices and Production of Machinery in the Soviet Union, 1928-1958*, (Cambridge, Mass.: Harvard University Press, 1962).
[13] Padma Desai, "On Reconstructing Price, Output, and Value-Added Indexes in Postwar Soviet Industry and Its Branches," *Oxford Bulletin of Economics and Statistics*, vol. 40, no. 1 (February 1978), pp. 55-77.

Table 5

Becker and Desai Machinery Price Indexes

	Becker's Index [1] (1960 = 100)	Desai's Index [2] (1955 = 100)
1958	92	93
1959	98	89
1960	100	88
1961	102	111
1962	104	110
1963	106	116
1964	108	113
1965	110	114
1966	113	118
1967	113	122
1968	113	127
1969	114	126
1970	115	129
1971	NA [1]	125
1972	NA	125
1973	NA	116

Sources:
1. Abraham S. Becker, "The Price Level of Soviet Machinery in the 1960s," *Soviet Studies* XXVI (July 1974), p. 378.
2. Padma Desai, "On Reconstructing Price, Output and Value-Added Indexes in Postwar Soviet Industry and Its Branches," *Oxford Bulletin of Economics and Statistics*, vol. 40, no. 1 (February 1978), pp. 68, 69.
[1] NA indicates data are not available.

These unofficial machinery price indexes present a diversified picture of price change in the machine-building sector of Soviet industry.

Comparison of Unofficial Machinery Price Indexes

	Period Covered	Average Annual Rate of Growth (Percent)
Mitrofanova	1961-76	3.2
Becker	1959-70	1.9
Desai	1959-73	1.5

Price Formation in the Soviet Economy

The official Soviet policy since the start of the plan era regarding wholesale prices has been one of absolute price control. Wholesale prices of established products are determined under the direct supervision of government authorities on a cost-plus-profit basis and remain unchanged for extended periods of time. General price reforms and revisions have occurred infrequently since World War II—in 1949, 1950, 1952, 1955, and 1967. Partial price revisions have also occurred recently, for example, in the case of ferrous products (1 January 1972) and light industry and machine-building (1 January 1971 and 1 January 1973).

Given the institutional framework governing machinery wholesale prices and the Soviet policy of maintaining price stability, the question of interest is whether inflation can occur in the Soviet Union and, if so, by what process. The brief discussion presented here sets the stage for the analysis that follows.[14]

Two events have altered the process of price determination in the Soviet Union over the past 15 years. The first was the Economic Reform of 1965. A principle feature of a command economy is the need for an incentive system to induce economic participants to follow the dictates of the planners. The Economic Reform of 1965 emphasized "individual material incentive as a means of eliciting proper performance by all economic agents, from the humblest peasant to the general director of an 'association.' " [15] Specifically, the Reform abolished the basic bonus system existing at the time and replaced it with a new bonus fund. The size of the fund, used to finance various supplements to worker and managerial wages and salaries, was made to depend upon certain measures of enterprise performance—sales revenue, the profit rate, and labor productivity. Profit became an important entity as both a principal determinant of the size of the bonus fund and as the source of financing it.

[14] A great deal has been written on this subject by Western students of the Soviet economy. For a more detailed discussion of the question, see, for example, Joseph S. Berliner, *The Innovation Decision in Soviet Industry* (Cambridge, Mass.: The MIT Press, 1976); Gregory Grossman, "Price Control, Incentives, and Innovation in the Soviet Economy" in *The Socialist Price Mechanisms*, ed. by Alan Abouchar (Durham, N. C.: Duke University Press, 1977), pp. 129-69; and Morris Bornstein, "The Administration of the Soviet Price System," *Soviet Studies*, XXX (October 1978), pp. 466-90.
[15] Grossman, "Price Control, Incentives, and Innovations in the Soviet Economy," p. 165.

The Reform also elevated the role that prices play in the individual enterprise's decisionmaking process. Under the new system, higher prices improve both the seller's success indicators and the amount of profit available for financing worker bonuses. In fact, Gregory Grossman makes the important point that since the Reform the Soviet firm is often less sensitive to cost than to product prices.[16]

The second noteworthy event was the establishment of the State Price Board (SPB) and an administrative bureaucracy responsible for the establishment, administration, revision, and application of prices.[17] The SPB, which is directly responsible to the USSR Council of Ministers, has mounted a concerted effort to improve price discipline, that is, enforcing regulations pertaining to the setting and use of prices.

Wholesale prices had to be revised after the 1965 Economic Reform to give enterprises sufficient profits to finance bonuses and to pay the 6-percent capital charge established as part of the Reform. The price reform of 1966-67, in fact, eliminated most of the disparities in relative prices and profit rates existing at that time.[18] Yet, it did very little to revamp the procedures by which prices were determined. Wholesale prices continued to be calculated on a cost-plus-profit basis under the supervision of central authorities, and no attempt was made to bring the fixed prices to equilibrium levels.[19]

A directive promulgated by the State Price Board on 23 June 1969 entitled, "Methodology for Determining Wholesale Prices for New Producer Goods and Equipment," however, did change methods of calculating wholesale prices. This directive classifies new products into three categories: group I—those items that are intended to replace equipment already in production, group II—items that are similar to existing equipment but differ in some technical parameters, and group III—items that are different from any equipment already in production.[20] Procedures were also specified for calculating prices for the three categories—analogue pricing for group I, parametric pricing for group II, and the traditional cost-plus-profit method for group III.[21]

By these measures, Soviet authorities have attempted to make wholesale prices more rational, to stimulate technological progress in the overall economy, and to encourage innovation on the part of industrial enterprises. Soviet enterprises have been reluctant generally to undertake the risk accompanying the introduction of new products under the cost-plus-profit pricing system. Since prices of established products remain constant over long periods of time while at the same time production costs fall, the production of such commodities becomes quite profitable. The production of new products, on the other hand, entail high and uncertain startup costs and a less favorable profit picture, especially during the first several years of production.

The Soviets first attemped to spur innovation by using temporary prices to boost profits during the early years of production.[22] Also, a new-products fund was created to subsidize startup costs. This fund, however, has had little affect on product development because of restric-

[16] Ibid., p. 148.

[17] For a full discussion of the administration of prices, see Bornstein, "The Administration of the Soviet Price System," pp. 466-90.

[18] Wholesale prices in light industries were revised in two parts, one effective 1 October 1966 and the second effective 1 January 1967. Heavy industry wholesale prices were revised effective 1 July 1967. For a discussion of the 1966-67 reform, see Gertrude E. Schroeder, "The 1966-67 Soviet Industrial Price Reform: A Study in Complications," Soviet Studies, XX (April 1969), pp. 462-77.

[19] The only significant structural change made was in the use of temporary prices. A 1966 decree limited the use of temporary prices to machinery, equipment, and instrument industry products introduced for the first time in the USSR. This decree also limited the duration of temporary prices to nine to 15 months, and a maximum 10-percent profit markup over average cost was imposed.

[20] Grossman, "Price Control, Incentives, and Innovation in the Soviet Economy," p. 159.

[21] Analogue pricing is the officially sanctioned method of setting prices on new products that are partial substitutes for older established products. Under this method, two limiting prices are calculated—a lower limit price roughly similar to the old cost-plus-profit price and an upper limit price based on "value in use" or product productivity. The actual price is supposed to be set somewhere between these two limits by Soviet authorities on the basis of a market-clearing rule. That is, the relationship between demand and supply is to be used to determine the exact price. Parametric pricing is a method used to set prices of products that are similar to existing items but differ from them in regard to some technical parameters. The most often used method of calculating such prices is to use regression analysis similar to the construction of the hedonic indexes in this paper. See Berliner, *The Innovation Decision in Soviet Industry*, pp. 301-38.

[22] Temporary (*vremennye*) prices, assigned at the inception of production, are set high enough to cover all startup costs plus a normal rate of profit. As average costs approach a more normal level after a period of time and initial startup costs disappear, the price is supposed to be replaced by a lower permanent price.

tions on its use and administrative problems. Temporary prices have had a more significant impact, although the benefits may have been outweighed by the abuses it allowed.[23] As a result, the use of temporary prices was more restricted under the 1965 Reform. The recently instituted analogue and parametric pricing methods promote higher prices and above-normal profits on new products. These methods are supposed to take product productivity, customer demand, and production costs into account in the price formation process.

Several other methods are being employed to reduce the rigidity of the old cost-plus-profit pricing system. For example, product improvement has been made more lucrative through the use of price surcharges tacked onto existing price schedules. The introduction of new products is also being promoted by more frequent partial price revisions. These revisions make old products less profitable (thus, promoting new products) by reducing their prices when production costs have fallen over time. A more radical measure along this line is the introduction of "stepwise" pricing (*stupenchatye tseny*). Although not yet employed extensively, it is intended to assure that prices of older products fall relative to those of new products.[24]

Potential for Hidden Inflation

The incentive for firms to push up prices has been increased by the Economic Reform of 1965, which reasserted the role of individual material rewards in the incentive system. Higher prices improve a seller enterprise's success indicators, which means greater bonuses for management and workers. At the same time, under the Soviet price system, machine users have little incentive to resist higher prices. That is, they must function in the environment of a seller's market in which they have to be primarily concerned with maintaining their sources of supply. In addition, funds for investment in new equipment are often provided to them by the state. Thus, cost considerations are only of secondary importance to the Soviet firm. Although price discipline has been strengthened by the reorganization of the price administration system, the potential for price evasion still remains high. The setting and monitoring of prices in the Soviet economy is a task of huge proportions. "Soviet sources declare that there are at least 10 million separate state prices. In the industrial wholesale price "reform" *(reforma)* of 1966-67, "several million" new prices were established and new price books totaling 38,000 pages were published." [25]

Enterprises are able, through a variety of ways, to evade price rules—euphemistically termed evasion of "price discipline" by the Soviets—and to raise prices. Evasion of the regulations may be overt, such as the outright disregard of established prices or price-setting regulations. For example, enterprises may sell at prices that are higher than those published in the official price catalogues. They either ignore catalogue prices altogether or misuse them and the surcharge-discount schedule that is sometimes attached. Sellers may also continue to use high, temporary prices beyond the authorized period. Or enterprises may set prices themselves rather than follow SPB regulations that require them to submit new prices to higher authority for approval.

Soviet firms may also implicitly evade "price discipline" by misapplying the regulations governing prices for new products. The new-product pricing regulations were written for the purpose of introducing more rationality into wholesale prices and to encourage genuine innovation. But the loopholes that remain allow firms to evade the intent of the rules. Specifically, enterprises may attempt to engage in what

[23] Enterprises took advantage of temporary prices to claim products as new when they were not, in order to get an increase in their price. This allowed firms to escape the bonds of fixed prices if they thought their profits were too low.

[24] "Stepwise" pricing automatically adjusts prices over time in anticipation of falling production costs. Hence, prices are set high enough initially to cover startup costs and an above-normal profit. Prices are automatically lowered during the normal lifetime of the product enough to allow only normal profits to be earned. Finally, product obsolescence is anticipated and allowed for by automatically lowering the price in later years still further so that below-normal profits are made or even losses incurred. See Berliner, *The Innovation Decision in Soviet Industry*, p. 293.

[25] Bornstein, "The Administration of the Soviet Price System," p. 467.

Berliner calls, "simulated innovation" and Grossman calls "pretended innovation." That is, they may spuriously classify products as genuinely new, when, in fact, they are not new. For example, a product can be changed slightly or even just packaged differently. By merely "changing labels" firms can attempt to have products classified as "new" with a corresponding higher price.[26] In addition, in the case of new group I or group II products, firms can cheat by falsifying data on production costs and machine productivity when applying to the State Price Board for a permanent price.

Many Western economists believe that the "new-product pricing" phenomena is so widespread that it may be the primary cause of an upward drift in Soviet wholesale prices. If that is true, then those particular industrial sectors with the highest product turnover rate should have the highest rate of price inflation. Since the machine-building sector has the most rapidly changing product mix, it is often cited as being most susceptible to inflation.

Study Plan

This study tests the proposition that significant hidden inflation exists in the machine-building sector. To do this, price indexes are constructed for four categories of machine-building equipment—construction and road machinery, machine tools, cranes, and trucks. Construction and road machinery equipment is further broken down into five components—bulldozers, scrapers, graders, excavators, and rollers. Thus, in all, eight industries of the machine-building sector are analyzed.

For each of the eight industries studied, wholesale prices and technical specifications were collected for as many machine models as possible over the period 1960 through 1973. The source of this information was a large volume of Soviet technical-economic textbooks, magazines, and other monographs. The data are presented, by sector, in appendix A.

[26] Berliner estimates that about one-half of all new products are still priced on a cost-plus-profit basis (group III.) This suggests that the potential for "simulated innovation" may be quite high. See Berliner, *The Innovation Decision in Soviet Industry*, p. 333.

Indexes Based on an Average of Price Relatives

Method of Construction

Ideally, a price index should be based on a statistically representative sample of product prices, properly weighted and adjusted for change in product quality over time. Despite the considerable effort invested in data collection for this study, machinery price indexes could not be formulated on this basis. Alternative procedures had to be devised.

In the first approach a simple, unweighted average of price-relatives was calculated over time. For each of the eight types of equipment, links were established for as many models of machines as possible. A link is simply observations of prices for a particular machine model in two or more different years. The number of links established and the link years are shown in table 6.

For each link, a price-relative was determined by dividing the most recent year price by the earlier year price. All price-relatives for the same pair of years (and the same category of equipment) were then summed and averaged.

In mathematical terms:

$$I_t = \frac{\Sigma P_{it_1}/P_{it_0}}{N}$$

where

P_{it_1} and P_{it_0} are the wholesale price of machine model i in periods t_1 and t_0 ($i = 1 \ldots n$)

N is the number of machine models for which prices are reported in both periods.

Finally, a chain index was constructed for each type of equipment by linking these results over the 1960-73 period. In addition, an overall construction and road machinery index was obtained by weighting the individual indexes constructed for scrapers, rollers, excavators, and bulldozers—using value of output produced in each sector as weights. (A price index for graders could not be constructed because of insufficient data.)

Table 6

Summary of Data Used for the Price-Relative Index Calculations

	Number of Links
Construction and road machinery	
Scrapers	
1961/66	6
1966/67	5
1967/70	9
1970/73	7
Bulldozers	
1961/65	5
1965/66	5
1966/67	4
1967/70	11
1970/73	12
Rollers	
1961/63	13
1963/65	6
1965/73	9
Graders	NA [1]
Excavators	
1960/61	9
1961/66	8
1966/67	4
1967/69	17
1969/70	14
1970/73	10
Trucks	
1960/61	11
1961/66	10
1966/67	10
1967/70	26
1970/73	20
1973/75	17
Cranes	
1961/63	12
1963/67	21
1967/68	37
1968/71	34
1971/72	28
1972/73	21
Machine Tools	
1960/70	54

[1] NA indicates data are not available.

Using price-relatives in the manner described above measures only changes in the prices of existing machine models. In other words, to establish a link, a machine had to already have been in production in an earlier year. What the indexes based on price relatives do not measure is the hidden inflation that may be caused by the introduction of a slightly different or unchanged version of an old machine model classified as "new" with a higher price tag.

Principal Findings

The price indexes developed on the basis of an unweighted average of price-relatives are recorded in table 7. According to these indexes: [27]

- Wholesale prices of established machinery products tended to remain unchanged in 1960-73 except when major or partial price revisions were implemented.

- Machinery prices were revised upward in 1967, possibly downward in 1971, and downward again in 1973.[28]

- The price increases in 1967 ranged from a low of about 7 percent to a high of just under 58 percent. The average increase for the eight sectors was about 25 percent.

- Prices of several types of machinery increased in 1966 as well as in 1967. Most noteworthy is the 15-percent increase in truck prices in 1966, followed by a 16-percent increase in 1967.

- The machinery price changes instituted in 1973 were mostly downward; the revisions ranged from less than a 1-percent drop to more than an 8-percent decrease. The only exception was truck prices, which rose slightly.

[27] The index developed for machine tools does not lend itself to analysis because data were available only for 1960 and 1970.

[28] There was a major reform of wholesale prices in the Soviet Union in 1966-67 subsequent to the Economic Reform of 1965. According to the Soviets, wholesale prices in light industry were revised in two parts, one effective 1 October 1966 and the second effective 1 January 1967. Heavy industry wholesale prices were revised effective 1 July 1967. Soviet sources also state that machinery prices were cut by 5 percent as of 1 Janaury 1971 and again by 8 percent in 1973. See, for example, V. K. Sitnin, "Price—An Important Economic Lever," *Den'gi i kredit*, March 1977, pp. 30-9; "The Economy and Prices" in *Pravda*, 8 February 1977; *Voprosy ekonomiky*, 1973, no. 7, p. 3; and V. G. Treml, *Price Indexes for Soviet 18-Sector Input-Output Tables for 1959-75* (Arlington, Va: SRI International June 1978, p. 35.)

Table 7

Index 1960 = 100

Wholesale Price Indexes, By Branch Based on Price Relatives [1]

	Construction and Road Machinery						Trucks	Machine Tools	Cranes
	Scrapers	Bulldozers	Rollers	Graders	Excavators	Weighted Average [2]			
1960	100.0	100.0	100.0	NA [3]	100.0	100.0	100.0	100.0	100.0
1961	100.0	100.0	100.0	NA	100.0	100.0	103.0	100.0	100.0
1962	100.0	100.0	100.0	NA	100.0	100.0	103.3	100.0	100.0
1963	100.0	100.0	100.9	NA	100.0	100.0	103.3	100.0	91.4
1964	100.0	100.0	100.9	NA	100.0	100.0	103.3	100.0	91.4
1965	100.0	105.1	107.5	NA	100.0	102.0	103.3	100.0	91.4
1966	98.9	108.8	107.5	NA	97.6	102.0	118.9	100.0	91.4
1967	119.5	135.8	169.7 [4]	NA	104.2	119.8	137.7	130.9 [4]	109.8
1968	119.5	135.8	169.7	NA	104.2	119.8	137.7	130.9	110.6
1969	119.5	135.8	169.7	NA	104.2	119.8	137.7	130.9	110.6
1970	119.1	136.3	169.7	NA	103.3	119.5	137.7	130.9	110.6
1971	119.1	136.3	169.7	NA	103.3	119.5	137.7	NA	106.6
1972	119.1	136.3	169.7	NA	103.3	119.5	137.7	NA	103.9
1973	116.8	135.2	169.7	NA	94.8	114.7	138.8	NA	97.1

[1] Prices assumed to have remained constant between estimated data points.
[2] Sectors are weighted on the basis of the value of output in 1970.
[3] NA indicates data are not available.
[4] Prices are assumed to have increased in 1967; post-1967 sample data were available only for rollers in 1973 and for machine tools in 1970.

Discussion of Findings

The results of the analysis bolster our confidence in the data collected and in the methodology used. For example, our analysis indicates a drop in machinery prices in 1973 ranging from 1 percent to 8 percent. Soviet sources confirm that price-setting authorities cut machinery prices in 1973—by 8 percent (see footnote 28 above). These same sources report a cut in machinery prices of 5 percent in 1971.[29] Because of insufficient data, only one of the indexes constructed—that for cranes—could have revealed a price change in that year; in fact, the price index for cranes fell by approximately 4 percent in 1971.

[29] The Soviets have greatly restricted the distribution of official price lists (*preiskuranty*) since the 1967 price reform. As a result, information on price changes must be collected in bits and pieces from Soviet journals and newspapers.

Our indexes do differ significantly from the official indexes of Soviet machinery prices, however. For example, the published indexes show no change in 1967, while our indexes rise considerably.[30] This disparity could be accounted for by the fact that this study analyzes the prices of only eight machinery categories (four MBMW branches), while the official data encompass all of Soviet MBMW. The machinery sectors included in the sample represent, at most, about 16 percent of the value of total machinery output, so it is risky to generalize the experience reported in table 7 to the whole machine-building sector.[31]

[30] Information compiled from the Soviet literature also indicates the MBMW prices remained unchanged in 1967. See Barbara S. Minnich, "Materials on the Soviet Price Reform of July 1967," *ASTE Bulletin* X (Fall 1968), pp. 12-19.
[31] Share calculated on the basis of data for gross value of output contained in the reconstructed 1972 Soviet input-output table in producers' prices. See U.S. Department of Commerce "The Reconstructed 1972 Soviet Input-Output Tables—Producers' Prices." (Unpublished report, February 1978).

Indeed, the direction and magnitude of the 1967 price change differed substantially among the various MBMW branches, ranging from a 19-percent decrease in prices of radio and electronics products to an almost 12-percent increase in prices for tractors and agricultural machinery and equipment (figure 1). It has been suggested that the largest price increases in 1967 were imposed on products that were bulky and required a great deal of metal in their manufacture because a sharp rise in metal prices occurred in 1967. (The price of rolled ferrous metals went up by 43 percent, and the price of ordinary steel increased by 54 percent.) [32] The share of ferrous metals purchases in total outlays of the four branches in 1966 was only 8 percent, however, while the share for all machine-building branches was 9 percent. Thus the findings should be both a fairly accurate reflection of the behavior of prices of established products in the four branches and generally indicative of revisions in prices of established products in other machine-building products.

The official industry wholesale price indexes do fall in 1971 (by almost 5 percent) and in 1973 (by more than 6 percent), and our price-relative indexes show a drop in prices in 1971 and in 1973. The official indexes, however, also fall in 1969, 1970, and 1972. The data are too meager to check the official indexes in these years, but the pattern of yearly price change revealed in the official indexes is hard to square with price-setting practices in the Soviet Union. Overall, a combination of the differences noted in 1967 and the unusual nature of the Soviet indexes in the late 1960s and early 1970s increases our skepticism regarding the official data.

Nonetheless, these findings must be considered in the light of the weaknesses inherent in the indexes constructed here—taken individually or as a measure of what happened in MBMW as a whole. First of all, the data do not permit the use of scientific sampling techniques. Nor is it possible to judge the representativeness of the samples by the proportion of output subsumed in the indexes for each sector; information on value and mix of output of each sector is not available. The sample's variability is evident in the wide disparity in the sample size of the different branches and the different link years used within branches. Finally, some of the minor fluctuations in the price indexes probably reflect inaccuracies in the data rather than price revisions. For example, some of the instability may be due to erroneous assumptions as to the effective date of some prices.

The most serious shortcoming of these indexes, however, is that they do not measure hidden inflation caused by enterprises which "simulate innovation." This phenomenon is often cited as the primary source of hidden inflation in the USSR, so we used a second method of formulating machinery price indexes in an attempt to measure this disguised inflation.

Hedonic Price Indexes

Method of Construction

Price increases may be caused by both quality improvement and inflationary pressures. The second approach to developing price indexes used in this study, the hedonic technique, attempts to identify and separate pure price change from increases due to quality change.[33]

The hedonic technique uses regression analysis to describe commodities in terms of a set of characteristics or qualities, and then estimates the implicit prices of each. According to Triplett, "quality is associated with a ranking of products (or services) according to grade, desirability, usefulness, or degree of excellence."[34] Using this methodology, price change can be measured over time net of product quality change—that is, as pure price change.

The hedonic method has been used to test US price indexes for an upward quality bias.[35] The best known

[32] Minnich, "Materials on the Soviet Price Reform of July 1967," p. 14.

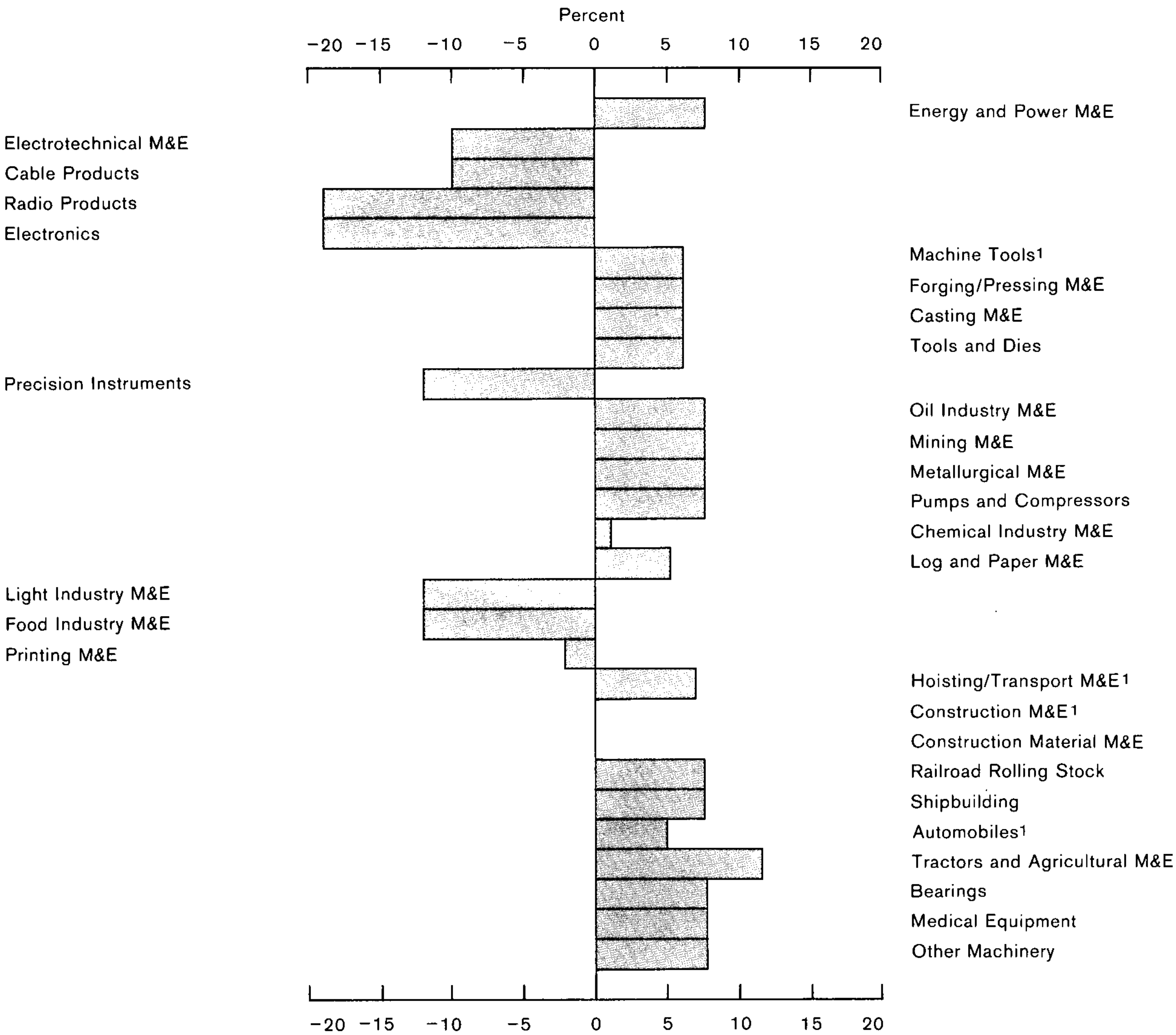
[33] A fair amount of literature has been published on this subject. See, for example, Zvi Griliches, ed., *Price Indexes and Quality Change* (Cambridge Mass.: Harvard University Press, 1977); and Jack E. Triplett, *The Theory of Hedonic Quality Measurement and Its Use in Price Indexes*, BLS Staff Paper 6, Bureau of Labor Statistics, U.S. Department of Labor (Washington, D.C., 1971).

[34] Triplett, *The Theory of Hedonic Quality Measurement and Its Use in Price Indexes*, p. 6.

[35] For a survey of existing studies see Triplett, "Determining the Effects of Quality Change in the CPI," *Monthly Labor Review*, May 1971, pp. 27-32, and "The Measurement of Inflation: A Survey of Research on the Accuracy of Price Indexes," in *Analysis of Inflation*, ed. by Paul H. Earl (Lexington, Mass.: D. C. Heath and Co.), pp. 19-82. Regression analysis has also been used to make international price comparisons for complex products that vary in quality. See Irving B. Karvis et al., *A System of International Comparisons of Gross Product and Purchasing Power*, (Baltimore: Johns Hopkins University, 1975), pp. 104-16.

Figure 1

USSR: Wholesale Price Change by Branch of Machine Building, 1967



M&E (Machinery and Equipment)

[1]Only these categories have been analyzed in the report.

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empirical work in this field is a study of the automobile component of the consumer price index by Zvi Griliches.[36] The development of Soviet hedonic price indexes in this paper parallels the work of Griliches. It is an especially attractive way of studying Soviet inflation because it offers a way of dealing with the new-product pricing phenomenon.

To repeat, the basic premise of the hedonic method is that various models of a given type of machine sell at different prices because they embody different characteristics or qualities. In mathematical language, the price (P_{it}) of a machine, model i at time t, can be expressed as a function of that set of characteristics. ($X_{1t}, X_{2t}, \ldots X_{nt}$). For a group of models within a particular machinery branches, this relationship may be expressed as follows:

$$P_{it} = f(X_{1it}, X_{2it} \ldots X_{nit}) \qquad (1)$$

where P_{it} is the price of model i at time t, (and $i=1 \ldots\ldots n$).

The first step in the analysis isolates the qualities or characteristics that influence the product price significantly. This is accomplished by regressing price on the relevant set of characteristics using ordinary least squares regression techniques and cross-sectional data. Those quality variables determined by Soviet machinery specialists to be the most important characteristics of each type of machine—subject to the availability of data—were used in the cross-sectional regressions. The final equation for each sector was selected on the basis of the statistics generated, as well as some analytical judgment.

The verification of the exact form of equation (1) is an empirical question. For purposes of this study, however, we adopted Griliches' semilogarithmic form, which relates the natural logarithm of price to the absolute values of the relevant set of qualities.[37] In other words, the dependent variable price (P_{it}), expressed in natural logarithm form, is specified as a linear function of the N independent quality variables. That is, in time period t:

$$\ln P_{it} = \alpha + \beta_1 X_{1it} + \beta_2 X_{2it} \ldots \beta_n X_{nit} + \mu_{it} \qquad (2)^{38}$$

The additive stochastic term μ_t is assumed to be normally distributed with mean zero and a finite variance σ_u^2.

The second step is to pool the data and estimate a new equation that separates pure price change from quality-induced price change. This is accomplished by respecifying equation (2) to include those quality variables that were found to have a significant influence on price and, in addition, binary (dummy) variables ($D_1 \ldots\ldots D_n$) for all the years between 1960 and 1975 for which data are available (except for 1960).

$$\ln P_{it} = \alpha + \beta_1 X_{1it} + \beta_2 X_{2it} \ldots \beta_n X_{nit} + \ldots \beta_{d_1} D_1 \ldots \beta_{d_n} D_n + \mu_{it} \qquad (3)$$

Specifying the model in this way, the regression coefficients of the quality variables should capture the change in average machine price due to quality improvements over the period tested. If the relationship between price and quality found by the cross-sectional regression analysis does not change over time, pure price increases—that is, price increases larger than justified on the basis of quality change—will cause the function to shift upward. The binary variable regression coefficients provide a measure of this shift. Furthermore, because of the way the binary variables are used and the equation is specified, they can be interpreted as measuring the approximate percentage change in the average machine price (if multiplied by

[36] Griliches, "Hedonic Price Indexes for Automobiles: An Econometric Analysis of Quality Change," in *Price Indexes and Quality Change*, pp. 55-87.

[37] Griliches, "Hedonic Price Indexes for Automobiles: An Econometric Analysis of Quality Change," p. 58.

[38] This specification assumes implicitly the following mathematical relationship between price and the independent variables:

$$P = e^{\alpha} \cdot e^{\beta_1 X_{1it}} \cdot e^{\beta_2 X_{2it}} \ldots\ldots e^{\beta_n X_{nit}}$$

It follows that

$$LnP_{it} = \alpha + \beta_1 x_{1it} + \beta_2 x_{2it} + \ldots\ldots \beta_n x_{nit}$$

100) between 1960 and the year the variable represents, holding quality constant.[39]

Finally, price indexes like those derived by the price-relative method can be constructed directly from the coefficients of the binary variables. Indexes were constructed for the same eight types of machines and an overall construction and road machinery index was calculated using value of output as weights. In using the hedonic method, the number of observations that could be used from the sample was much larger than in the price-relative method since each individual observation of model price and corresponding technical characteristics could be used. The price-relative method on the other hand required price links, which meant that a large number of individual observations had to be eliminated. Once again, however, data were not available for every year of the period studied. Therefore, the hedonic price indexes, like the price-relative indexes, were assumed to have remained constant during the years data were missing.

A bothersome problem in most hedonic studies is multicollinearity—interrelationships among the independent variables. The presence of multicollinearity in the data set used to estimate the coefficients of a single equation model by ordinary least squares can cause serious estimation problems. Where multicollinearity was a problem in this study, an estimating technique known as principal components regression analysis was used. (Principal components as an estimating technique in single equation models is discussed in appendix B.)

Principal Findings

A large number of regressions were computed, and no attempt is made here to reproduce all the equations estimated. Only the regression results used to construct the wholesale price indexes are shown in tables 8 and 9.

[39] The exact change between two periods can be calculated as follows:

$$\ln P_1 - \ln P_0 = \beta_{d_1}$$

$$P_1/P_0 = e^{\beta_{d_1}}$$

$$\frac{P_1 - P_0}{P_0} = e^{\beta_{d_1}} - 1$$

The regressions for each machinery category reflect these technical characteristics that proved to be statistically significant—determined by the value of the t statistic shown in parentheses below each independent variable—in the determination of the machine prices. The relative influence of the different characteristics can be judged by their respective regression coefficients. In the case of scrapers, for example, bowl capacity, bladewidth, and the machine control mechanism were the particular machine characteristics that proved to be statistically significant in explaining scraper prices. Furthermore, the average price of a scraper increased by 18.8 percent with each 1-cubic-meter increase in bowl capacity, by 52.8 percent with 1-meter increase in bladewidth, and by 38.3 percent when the control mechanism employed was hydraulic instead of cable.

Regression coefficients are also shown for the binary variables in those years that data were available. These coefficients can be used to calculate the average percentage change in the price of scrapers between 1960 and the year each binary variable represents. In the case of scrapers, the 1967, 1970, and 1973 binary variables proved significant. The data indicate that—abstracting from quality change—the average price of scrapers increased about 23.6 percent between 1960 and 1967, 28 percent between 1960 and 1970, and 22.4 percent between 1960 and 1973 (see footnote 39 above).

In other words, the binary variables measure pure price change between 1960 and the year represented by a particular binary variable in each regression equation. Price fluctuations between different years can be measured by comparing coefficients. For example, the analysis of scrapers shows that prices increased between 1960 and 1967 by about 24 percent. Between 1967 and 1970 prices went up another 3.5 percent, but over the 1970-73 period the average price fell by about 4.3 percent.

The results of the regression analysis appear reasonable, although they varied from sector to sector with respect to the goodness of fit attained. The portion of total variation explained by the different models $\bar{R}^2$ was generally good—ranging from 77 percent to 97

Table 8

Regression Results for Construction and Road Machinery (Pooled Data)

	Scrapers	Bull-dozers	Rollers	Graders	Excava-tors
Intercept Term (α)	6.175 (18.21)	7.062 (75.13)	7.053 (45.79)	6.437 (71.57)	8.359 (86.22)
Shovel (bowl) capacity *(SC)* [1]	0.188 (14.01)				0.429 (3.17)
Bladewidth *(BLW)* [1]	0.528 (3.37)	0.106 (2.15)			
Horsepower *(HP)* [1]		0.011 (9.27)			0.007 (4.32)
Weight *(WT)* [1]			0.128 (10.57)	0.151 (13.34)	
Control mechanism *(CONDUM)* [2]	0.383 (4.80)				
Propulsion method *(TYP)* [2]			0.762 (7.21)	0.980 (8.33)	
Type of base *(TIR)* [2]			−1.069 (9.14)		
Vibrating option *(VIB)* [2]			0.741 (4.81)		
Regression statistics: [4]					
$\bar{R}^2$	0.949	0.919	0.809	0.969	0.862
DF	48	75	56	25	102
F	148	153	39	192	87

	Scrapers	Bull-dozers	Rollers	Graders	Excava-tors
DUM61 [3]					0.010 (0.10)
DUM63 [3]			0.065 (0.50)	−0.011 (0.11)	
DUM65 [3]	0.020 (0.21)	0.053 (0.50)	0.078 (0.62)	−0.106 (1.04)	
DUM66 [3]					0.005 (0.05)
DUM67 [3]	0.212 (2.15)	0.213 (1.89)			0.333 (3.39)
DUM69 [3]					0.349 (3.39)
DUM70 [3]	0.246 (2.78)	0.301 (3.30)			0.301 (3.03)
DUM73 [3]	0.202 (2.14)	0.279 (2.83)	0.266 (1.95)	0.228 (2.13)	0.313 (2.98)

[1] Continuous quality variables.
[2] Binary quality variables:
CONDUM—equals 1 if hydraulically controlled; 0 if controlled by cable.
TYP—equals 1 if self-propelled; 0 if pulled.
TIR—equals 1 if on rubber tires; 0 if otherwise.
VIB—equals 1 if the roller has the capacity to vibrate; 0 otherwise.
[3] Binary time variables.

[4] The regression statistics shown in the table include the following:
t statistics are shown in parenthesis below each regression coefficient. They were used to test for the statistical significance of each independent variable and the intercept term.
$\bar{R}^2$ is the adjusted coefficient of determination. It measures the proportion of variation of the dependent variable explained by the independent variables.
DF, the number of degrees of freedom, is equal to the sample size less the number of variables on the right side of the equation.
The *F* statistic is used to test for the statistical significance of the $\bar{R}^2$ value.

97 percent. The number of quality variables found to affect price was quite small for some sectors, but data constraints were a problem.

The main difficulties encountered in the regression analysis were the small sample sizes available in several of the cross-sectional analyses, some statistical instability caused by multicollinearity, and some uncertainty in interpreting the sign of several of the quality variables. The physical dimensions of machine tools, for example, proved to be inversely related to price. This suggests that the compactness of the instrument is a consideration in machine tool design in the USSR.

Discussion of Findings

Based on the regression results shown in tables 8 and 9, hedonic price indexes were constructed for eight machine categories (table 10). The indexes have several interesting implications.

Table 9

Regression Results for Trucks, Machine Tools, and Cranes (Pooled Data)

	Trucks	Machine Tools	Cranes
Intercept term (α)	6.772	7.537	8.45
	(84.03)	(82.30)	(86.50)
Maximum lift capacity at minimum outreach *(CLM)* [1]			0.18
			(11.34)
Maximum lift capacity at maximum outreach *(CLMA)* [1]			0.71
			(5.17)
Boom size *(CBM)* [1]			0.056
			(7.82)
Weight *(WT)* [1]	0.044	0.133	−0.006
	(4.12)	(12.59)	(4.62)
Horsepower *(HP)* [1]	0.006		
	(7.50)		
Machine size *(DIM)* [1]		−0.014	
		(8.88)	
All-wheel drive *(DRIVE)* [2]	0.139		
	(2.56)		
Automation *(MECH)* [2]		0.565	
		(5.74)	
Type of precision *(PREC)* [2]		0.685	
		(3.51)	
DUM61 [3]	0.112		
	(1.03)		
DUM63 [3]			−0.046
			(0.48)
DUM66 [3]	0.219		
	(2.34)		
DUM67 [3]	0.399		0.334
	(3.69)		(3.81)
DUM68 [3]			0.394
			(4.61)
DUM70 [3]		0.252	
		(2.81)	
DUM71 [3]			0.279
			(3.08)
DUM72 [3]			0.302
			(3.00)
DUM73 [3]	0.341		0.157
	(3.23)		(1.38)
Regression statistics: [4]			
$\bar{R}^2$	0.881	0.802	0.768
DF	144	94	299
F	127	81	103

[1] Continuous quality variables.
[2] Binary quality variables:
DRIVE—equals 1 if the truck has an all-wheel drive; 0 otherwise.
MECH—equals 1 if semiautomatic; 0 otherwise.
PREC—equals 1 if a precision instrument; 0 otherwise.
[3] Binary time variables.

[4] The regression statistics shown in the table include the following:
t statistics are shown in parenthesis below each regression coefficient. They were used to test for the statistical significance of each independent variable and the intercept term.
$\bar{R}^2$ is the adjusted coefficient of determination. It measures the proportion of variation of the dependent variable explained by the independent variables.
DF, the number of degrees of freedom, is equal to the sample size less the number of variables on the right side of the equation.
The *F* statistic is used to test for the statistical significance of the $\bar{R}^2$ value.

First the hedonic indexes indicate that in the branches for which we have evidence, machinery price formation seems to have been carried out in a systematic way. In other words, within the Soviet price-setting bureaucracy individual enterprises or ministries either directly set prices themselves on the basis of certain key machine parameters, or they submit prices for approval to higher authority on the basis of these parameters. This conclusion follows from the fact that we were able to replicate reasonably well the Soviet price-setting process using regression analysis.

Second, like the price-relative indexes, the hedonic indexes show a substantial increase in machinery prices in 1967—the year of the major price reform—for all the machinery items analyzed. Because dummy variables could not be used for all years between 1960 and 1967, however, the timing has to be inferred. These pure price increases (not justified by changes in machine characteristics) ranged from a low of 24 percent to a high of almost 40 percent. The average increase for the eight categories studied was about 30

Table 10

Index: 1960 = 100

Wholesale Price Indexes, By Branch Hedonic Method [1]

	Construction and Road Machinery						Trucks	Machine Tools	Cranes
	Scrapers	Bulldozers	Rollers	Graders	Excavators	Weighted Average [2]			
1960	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1961	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1962	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1963	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1964	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1965	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1966	100.0	100.0	100.0	100.0	100.0	100.0	124.5	100.0	100.0
1967	123.6	123.7	130.5 [3]	125.6 [3]	139.5	130.9	149.0	128.7 [3]	139.7
1968	123.6	123.7	130.5	125.6	139.5	130.9	149.0	128.7	148.3
1969	123.6	123.7	130.5	125.6	141.8	131.9	149.0	128.7	148.3
1970	127.9	135.1	130.5	125.6	135.1	133.0	149.0	128.7	148.3
1971	127.9	135.1	130.5	125.6	135.1	133.0	149.0	NA [4]	132.2
1972	127.9	135.1	130.5	125.6	135.1	133.0	149.0	NA	135.3
1973	122.4	132.2	130.5	125.6	136.8	132.2	140.6	NA	135.3

[1] Indexes are depicted as having remained constant between the individual years estimated.
[2] Sectors are weighted on the basis of the value of output in 1970.
[3] Prices are assumed to have increased in 1967; post-1967 sample data were available only for rollers and graders in 1973, and for machine tools in 1970.
[4] NA indicates data are not available.

percent. The indexes also indicate that Soviet truck prices were increased in two steps, with the pure price increase amounting to approximately 25 percent in 1966 and 15 percent in 1967. Although based on only a sample of the machinery universe, the hedonic indexes, like the price-relative indexes, do not support the official Soviet declaration that machinery prices did not change on average during the 1967 price reform.

Since the hedonic indexes cover established machines as well as the relationship between price and quality of new products, a comparison of the hedonic indexes with the price-relative indexes provides some additional insights into price behavior during the reform period. For example, the hedonic indexes exceed the price-relative indexes for cranes, excavators, trucks, and scrapers in 1967. This suggests that in these sectors, prices for products with changing characteristics were increased more than quality improvements would justify in terms of the implied price-setting formulas.

An analysis of these indexes also indicates that price inflation due to new-product pricing was present between 1967 and 1973 in almost all the machinery categories for which the regression analysis was possible—that is, scrapers, bulldozers, excavators, trucks, and cranes.[40] All the indexes increased in some year during this period. For example, the bulldozer hedonic price index rose from 123.7 in 1967 to 135.1 in

[40] The analysis of rollers, graders, and machine tools was constrained by the fact that data were available for only two years—1960 and either 1970 or 1973. Hence it was impossible to separate out the price increases of the 1967 price reform or to develop a profile of pure price change over the time period studied.

1970 and then dropped to 132.2 in 1973. Three factors must be considered in analyzing these data. First, the timing of the changing price levels must be implied because data were not available for each individual year. Hence the rise and fall of the average price level was probably more gradual. Second, the downward price revisions by price-setting authorities of established machine products in 1971 and 1973 worked opposite to and apparently outweighed the new-product pricing trends in those years. Third, the sample includes items whose characteristics do not change. Therefore, the measurement of the importance of hidden inflation in a given sector will be accurate only to the extent that the sample includes the proper mix of established and changing models. The patterns are similar in the other four indexes, which leads us to conclude that the new-product pricing phenomenon does exist and it does contribute to inflation in machinery prices. Its exact extent is difficult to quantify although it does not appear to have been strong enough during this period to outweigh the downward revisions of established prices.

In an effort to gauge the effect of new-product pricing more clearly we reran the regressions for the five machinery categories discussed above. The sample was modified to include individual model prices only once, the first year they appeared in the data base. Thus, the sample was purged of all models whose characteristics remained unchanged. The results are presented in tables 11 and 12.

The results of the partial sample regressions were, in general, good and consistent with the previous findings. That is, the $\bar{R}^2$ values were acceptable and the new equations compared very well with the original equations in terms of the technical characteristic coefficients. In the case of scrapers, and partially for cranes, however, the sample size became too small to obtain meaningful results.

Overall, the regressions verify that new-product pricing exists and that its effect is larger than apparent from the original indexes, which account for both new and established products. The dummy coefficients are generally larger and, in some instances, substantially larger than the coefficients obtained when both established and new products were included in the sample.

Table 11

**Regression Results—
Partial Sample Variant
for Bulldozers and Excavators [1]**

	Bulldozers		Excavators	
	(Full Sample)	(Partial Sample)	(Full Sample)	(Partial Sample)
Intercept term (α)	7.062 (75.13)	7.04 (57)	8.359 (86)	8.359 (90)
Shovel capacity (SC) [2]			0.429 (3.17)	0.531 (3.45)
Bladewidth (BLW) [2]	0.106 (2.15)	0.147 (2.10)		
Horsepower (HP) [2]	0.001 (9.27)	0.009 (6.19)	0.007 (4.32)	0.006 (3.42)
DUM61 [3]			0.010 (0.10)	−0.007 (0.07)
DUM65 [3]	0.053 (0.50)	0.164 (1.22)		
DUM66 [3]			0.005 (0.05)	0.026 (0.19)
DUM67 [3]	0.213 (1.90)	0.082 (0.41)	0.333 (3.39)	0.404 (4.92)
DUM69 [3]			.349 (3.39)	
DUM70 [3]	0.301 (3.30)	0.368 (2.97)	0.301 (3.03)	0.154 (1.13)
DUM73 [3]	0.27 (2.83)	0.393 (2.47)	0.313 (2.98)	0.663 (3.81)
Regression statistics [4]				
$\bar{R}^2$	0.919	0.919	0.862	0.913
DF	75	35	87	66

[1] Sample sizes for scrapers were not large enough to obtain meaningful results.
[2] Continuous quality variable.
[3] Binary time variable.
[4] The regression statistics shown in the table include the following:
t statistics are shown in parenthesis below each regression coefficient. They were used to test for the statistical significance of each independent variable and the intercept term.
$\bar{R}^2$ is the adjusted coefficient of determination. It measures the proportion of variation of the dependent variable explained by the independent variables.
DF, the number of degrees of freedom, is equal to the sample size less the number of variables on the right side of the equation.

Table 12

**Regression Results—
Partial Sample Variant
for Trucks and Cranes**

	Trucks		Cranes	
	(Full Sample)	(Partial Sample)	(Full Sample)	(Partial Sample) [1]
Intercept term (α)	6.792 (84)	6.71 (70)	8.45 (86.5)	8.48 (63)
Maximum lift capacity at minimum outreach (CLM) [2]			0.18 (11.34)	0.027 (9.73)
Maximum lift capacity at maximum outreach (CLMA) [2]			0.71 (5.17)	0.013 (1.22)
Boom size (CBM) [2]			0.056 (7.82)	0.055 (4.80)
Weight (WT) [2]	0.044 (4.12)	0.009 (1.62)	−0.006 (4.62)	−0.004 (2.11)
Horsepower (HP) [2]	0.006 (7.50)	0.008 (11.97)		
Machine size (DIM) [2]				
All-wheel drive (DRIVE) [3]	0.139 (2.56)	0.142 (1.50)		
DUM61 [4]	0.112 (1.03)	0.086 (0.53)		
DUM63 [4]			−0.046 (0.48)	−0.018 (0.16)
DUM66 [4]	0.219 (2.34)	0.176 (1.60)		
DUM67 [4]	0.399 (3.69)	0.391 (2.64)	0.334 (3.81)	0.343 (3.17)
DUM68 [4]			0.394 (4.61)	0.457 (4.06)
DUM71 [4]			0.279 (3.08)	
DUM72 [4]			0.302 (3.00)	
DUM73 [4]	0.341 (3.23)	0.482 (3.34)	0.157 (1.38)	
Regression statistics: [5]				
$\bar{R}^2$	.881	0.890	0.768	0.739
DF	144	56	299	123

[1] Sample sizes for cranes were not large enough to obtain meaningful results in some years.
[2] Continuous quality variable.
[3] Binary quality variable.
[4] Binary time variable.
[5] The regression statistics shown in the table include the following: *t* statistics are shown in parenthesis below each regression coefficient. They were used to test for the statistical significance of each independent variable and the intercept term.
$\bar{R}^2$ is the adjusted coefficient of determination. It measures the proportion of variation of the dependent variable explained by the indepenent variables.
DF, the number of degrees of freedom, is equal to the sample size less the number of variables on the right side of the equation.

In summary, our results show that the practice of pricing "new" products excessively high does exist in the Soviet Union and does contribute to inflation in machinery prices. Our analysis does not, however, enable us to say much about the timing of such price increases or their exact magnitude, although in some industries it appears to be substantial—perhaps as high as 4-5 percent a year if averaged out over the 1961-73 period. More importantly, however, when the overall level of prices is considered—that is, prices of both new and established products—the rate of inflation is very slight. In fact, the hedonic indexes presented in table 10 show the level of prices lower in 1973 than in 1967 for most of the machinery industries analyzed.

Nonetheless, the hedonic indexes can only be suggestive or indicative. First of all they have a fundamental ambiguity in a Soviet-type setting. The basis for separating pure price change from price change associated with quality change of producers' goods derives theoretically from production and consumer theory. Briefly put, the ratio of the price of a new model of a productive service to the price of an old model should equal the ratio of their respective marginal physical products. In an economy where prices of outputs and inputs determine enterprise behavior, a new model will not be bought if it is priced too high relative to an old model. Therefore, when hedonic indexes are calculated for US automobiles, for example, the prices represent products that have met a market test.

In the Soviet context, however, the incentive to economize on the cost of productive services is much weaker than it is in the West. Most machinery and equipment is paid for by the state rather than the enterprise, charges on fixed capital are low, and the enterprise does not have firm prior knowledge of what share of its profit it will be able to keep or how it will be able to spend the profits that are left to it. Moreover, if an enterprise is determined to find a least-cost production arrangement, it must maneuver within relatively narrow limits. It usually cannot shop around for equipment but instead must take what it can get. Clearly, then, the pricing formulas implicit in the hedonic indexes constructed from Soviet prices are different from those that can be estimated from Western prices. In the West, the coefficient on a given quality variable represents a decision on how much producers will be willing to pay for more of that particular quality. In the Soviet Union, the same coefficient probably—at best—represents an engineering calculation on the part of the producing enterprise. The calculation may be based on comparisons of producing the particular machine or even on some estimate of how the productivity of the machine is changed by variations in the given quality.[41] But the calculations are in no sense confirmed by a market test.

Moreover, the testimony of Soviet officials, academicians, and machine purchasers as to the nature of new machinery supports the findings of this study regarding hidden price inflation. Certainly, an impressive amount of testimony can be collected to the effect that machinery price increases are not justified on the basis of product quality improvements. As mentioned earlier, consumer complaints of unjustified price increases are frequent and often vociferous. A typical example is a report of a recent check by the Soviet State Price Inspectorate of the GAZ (Gor'kiy Motor Vehicle Plant) Production Association. It found that in 1977:

> The sale of below-standard products at hiked-up prices alone brought in 850,000 rubles of unlawful additional profit. Sales at prices which had not been approved, and which were, of course, excessively high, brought in 164,000 rubles of additional profit.[42]

Soviet economist V. P. Krasovskiy has written extensively on unjustified price increases:

> For machine tool building it is typical to have an increase in prices that is greater than the increase in capacity of the machine tools and their productivity. Thus from 1950 through 1962 the average price of one machine tool increased 2.1 times but the average capacity increased by only 27 percent.[43]
>
> The increase of approximately 10 percent in the average passenger capacity of motor buses is accompanied by a price increase of approximately 17 percent during the same period.[44]

Many more examples of consumer complaints about alleged unjustified price increases could be cited. Yet it is impossible to determine how typical these complaints are, whether within a given machinery sector or in MBMW as a whole. Nor is it possible to say whether the problem has become more or less severe over time.

The economic meaning of the complaints is also often far from clear. Take, for example, the seemingly persuasive Krasovskiy citation given above which reports that in 1951-62 the average price of a machine tool increased 2.1 times while the average capacity

[41] Analogue prices theoretically approach market-clearing prices since, in addition to costs, machine productivity and market demand are considered in their formation. It is likely, however, that few, if any, of the prices used here to construct the hedonic indexes are analogue prices. The analogue pricing methodology still is not used extensively in the Soviet Union and then only for products that are partial substitutes for older established goods.

[42] S. Davkin, "Bad Side of Price Juggling," *Khozyaystvo i pravo,* August 1978.

[43] V. P. Krasovskiy, *Planirovaniye i analiz narodnokhozyaystvennoy struktury kapital'nykh vlozheniy*, p. 235.

[44] Ibid., p. 237.

increased by only 27 percent. The precept that the prices of machine tool services should be proportional to their marginal productivities assumes that all else is equal. A new machine tool may work to closer tolerances, waste less metal, require fewer operators per machine-hours, need less maintenance, last longer, or occupy less space. A simple comparison of percentage changes in "capacity" and prices cannot reflect all of the relevant differences. In this connection, Soviet economists are not much better placed than Western observers to measure inflation resulting from new-product pricing. Without a market test, they must estimate (guess) the "unjustified" component of every price increase on each product in their sample.

One way of assessing the meaning of the hedonic indexes is to check the coefficients of the underlying regression equations against the experience and judgment of experts in industries using the kinds of machinery included in the indexes. Does a unit change in a given characteristic warrant a price increase of a given percentage? Knowledgeable people probably can give rough answers to such questions, but this analysis has not been carried out as yet.

Generalizing From the Findings for Four Sectors

Whether the findings for the narrow range of machine-building products considered in this study are representative of machine building as a whole depends on several considerations: if they are serially produced or not, their cost, and their composition.

Serially Produced Versus Special Orders

First, machine-building enterprises manufacture industrial products ranging from serially produced, homogeneous products at one end of the spectrum to special order products at the other extreme. All the products included in this study fall into the serially produced category, although the portion of total machinery produced by nonseries manufacturing processes may be as high as 50-55 percent.[45]

[45] Stanley H. Cohn, "National Income Growth Statistics," in *Soviet Economic Statistics*, ed. by V. G. Treml and J. P. Hardt (Durham, N. C.: Duke University Press, 1972), p. 145.

The exclusion from our sample of nonseries production clearly would bias our results because nonserially produced machine products are more susceptible to price inflation in the USSR. Special orders, such as a power plant or a specialized machine tool or an automated assembly line, are particularly suspect because of the relative ease with which pricing regulations can be evaded. Profit rates are higher, prices are negotiated directly between buyer and seller, and a great deal of latitude exists for cheating in the estimation of production costs. Since most of the machinery products analyzed in this study would be categorized as standard equipment, the rate of inflation may be higher in the other machine-building industries that deal to a large degree in nonserial output—for example, light industry machinery and equipment, food industry machinery and equipment and the like.

Cost Profiles

The sample branches might also be atypical with respect to their cost structures. Since the various elements of cost—labor, metals, and the like—behaved differently over the period, the inflationary pressures might, therefore, also be quite different. To judge the importance of such considerations, we tried two approaches. First, we looked at the change in total production costs—wages and materials—between 1966 and 1970, the period of greatest price rise. (The methodology used for this exercise is explained in appendix C.)

Comparing the total increase in cost of inputs (table 13) by branch suggests that the four branches in our study experienced above-average increases in total costs between 1966 and 1970. Three of the four branches fell into the second highest grouping of branches categorized by the degree of change of input costs. In the fourth branch—machine tools—costs increased by more than the average. Thus, prices in the four branches would be expected to go up at least as fast as prices in machine building generally—but not much faster.

While the analysis of total costs is crude at best, it has the advantage of comparing cost changes for all machinery branches. Its major drawback is that it does

Table 13

Estimates of the Change in the Total Cost of Inputs, By Branch of Machine Building, 1970 over 1966 [1]

	Percent
Group 1 (10 to 14 percent)	
Cable products	10.5
Printing M&E	12.9
Mining and Metallurgy M&E	13.4
Light industry M&E	13.8
Group 2 (15 to 19 percent)	
Electrotechnical M&E	15.0
Forging and pressing M&E	15.7
Casting M&E	16.4
Precision instruments	15.6
Pumps and chemical equipment	16.3
Food industry M&E	17.4
Construction material M&E	18.4
Machine tools [2]	18.8
Logging and paper M&E	19.8
Group 3 (20 to 24 percent)	
Automobiles [2]	20.0
Transportation M&E	20.4
Construction M&E [2]	20.1
Hoisting and transporting M&E [2]	20.2
Radio and other MB	20.7
Energy and power M&E	21.0
Bearings	21.7
Tractors and agricultural M&E	22.5
Group 4 (25 to 29 percent)	
Tools and dies	25.8
Mean	*18*
Median	*18.4*

[1] Calculations are based on data presented in table C-1, appendix C.
[2] This branch was analyzed in this paper.

not take changes in later productivity into account.[46] We therefore tried to determine the change in production costs—labor and material—per unit of real output. (The period analyzed was 1966-72 and the methodology, data sources, and calculations are described in appendix D.) Because of the dubious reliability of reported or estimated real output in some sectors, only seven machinery branches could be analyzed, of which three are included in our sample. The results of this exercise are shown in table 14.

Total costs per unit of real output increased by an estimated average of 17 percent in the seven branches between 1966 and 1972. The three branches of MBMW analyzed in our sample experienced increases of roughly 10 percent on average. Of these three, two experienced increases below and one above the average of all seven. Thus, whereas the comparison of changes in total costs (table 13) would have led one to expect rates of inflation slightly above average in the sample sectors, a comparison of changes in unit costs suggests the opposite. The analysis of unit costs is not the last word, however. Only a small number of machinery industries were analyzed and rising unit costs in a particular industry does not guarantee price increases in that industry. Rather profits may be squeezed or—as in the coal industry—subsidies may be introduced or

[46] Unit total cost (*UTC*) of real output produced equals the sum of unit material costs (*UMC*) and unit labor costs (*ULC*), abstracting from depreciation.

$$UTC = UMC + ULC$$

Unit material costs equal the sum of nominal material purchases (*M*) divided by real output produced (*Y*).

$$UMC = M/Y$$

Unit labor costs equal nominal wage rates (*W*) times man-years divided by real output produced.

$$ULC = \frac{W \times \text{man-years}}{Y}$$

Labor Productivity (LP) equals real output divided by man-years.

$$LP = Y/\text{man-years}$$

It follows that

$$ULC = W/LP$$

and,

$$UTC = M/Y + W/LP$$

Hence, an analysis of the change in unit costs implicitly accounts for changes in labor productivity.

Table 14 — Percent

Estimates of the Change in Unit Costs, By Branch of Machine Building, 1972 over 1966[1]

	Unit Labor Costs	Unit Material Costs	Total Unit Costs
Energy and power M&E	20.9	31.8	28.8
Electrotechnical M&E	32.4	33.0	32.8
Mining and metallurgy M&E	−5.9	56.6	31.8
Hoisting and transporting M&E[2]	−2.9	14.3	11.0
Construction M&E[2]	6.4	30.1	25.6
Transportation M&E	−2.2	−8.2	−7.1
Automobiles[2]	−16.8	−3.5	−6.2
Mean	4.6	22.0	16.7

[1] Calculations are based on data presented in table D-1, appendix D.
[2] This branch was analyzed in this paper.

increased. Nevertheless, a comparison of change in unit costs may reveal those industries where pressures to escape the yoke of fixed prices by engaging in new-product pricing are the greatest. On balance, we judge that the machinery branches analyzed in this study are fairly typical of the rest of the machine-building branches with regard to cost pressures.

Product Composition

The representativeness of our sample with regard to product composition (that is, new versus established products) is far less clear. We simply cannot judge from the available evidence which branches of machinery have the largest share of new or improved products in their output. Since this is a key issue in assessing the extent of inflation, any aggregate index of price inflation in MBMW based on our results can only be considered suggestive. Such an index, presented in table 15 and based on price behavior in the sample branches, indicates a rate of inflation of about 2.6 percent per year if averaged over the whole period. Most of the rise probably occurred, however, in 1966 and 1967, with the overall price level falling in 1971 and 1973.

Table 15 — Index: 1960 = 100

Estimated Wholesale Price Index for the Sample Machine Building Branches

1960	100
1961	NA[1]
1962	NA
1963	NA
1964	NA
1965	NA
1966	117
1967	145
1968	146
1969	146
1970	146
1971	144
1972	145
1973	139

Source: Derived by weighting the hedonic indexes for construction and road machinery, trucks, and cranes shown in table 10. The weights used were the gross value of output of the construction M&E, automobiles, and hoisting and transporting M&E sectors shown in Barry C. Kostinsky, *The Reconstructed 1966 Soviet Input-Output Table: Revised Purchasers' and Producers' Price Tables*, Foreign Economic Report no. 13, U.S. Department of Commerce, (September 1976).
[1] NA indicates data are not available.

Conclusions

Extent of Price Inflation

Price inflation did occur in the machine-building sector during the period 1960-73, according to our analysis. Furthermore, this inflation was the result of the setting of prices for new or improved products at higher levels than warranted by the improvement in the technical characteristics of the new products, as well as of the upward revision of machinery prices in 1967. Other studies by Western and Soviet scholars also report an inflationary trend in machinery wholesale prices in the 1960s and early 1970s.

The extent of inflation was found to depend partly on the share of "new or improved" products in total machinery production. Our analysis indicates that prices, once established, remained constant for those products whose parameters did not change over the period studied, except when major price reforms or revisions were carried out. For products in our sample that did change, however, the average rate of price inflation was found to be about 4 percent per year during 1961-73. Among the several industries of machinery examined, this rate varied from a low of 3 percent per year for bulldozers to a high of over 5 percent per year for excavators. When the prices of both new and established products were considered together for the machinery industries included in this study, however, the overall level of prices changed little after 1967, reflecting the high proportion of established products in our product sample. We judge that over brief periods the share of long-established products in the machinery sector as a whole still exceeds that of "new or improved" products, thus attenuating the impact of inflation on the overall price level of machinery.

It should be pointed out that none of the methods used in this paper to construct machinery price indexes can uncover hidden inflation due to outright cheating on the part of Soviet enterprises. The analysis rests on list or published prices rather than transaction prices. We simply cannot assess the degree to which Soviet enterprises explicitly violate price regulations by ignoring or misapplying catalogue prices. Chances are equally remote that we can tell whether the extent of such violations has varied over time, leading to a bias in price indexes compiled on the basis of list prices.

The officially published index of wholesale prices in Soviet machine building remains somewhat of a mystery. The profile of price change presented by the official index is not supported by any Soviet or Western study of machinery prices. We still do not have a clear explanation as to how the Soviets derive their indexes, although we have gone to some length in this paper to uncover the basis of their construction. The indexes presented above represent our effort to provide a better assessment of price change in the Soviet MBMW sector.

Which branches of machine building have the most inflation also remains unclear. The findings of this study are less than clearcut because, as noted earlier, the eight kinds of machines in our sample account for, at most, 16 percent of the gross output of MBMW. Although our analyses suggest that price movements in these branches may be fairly typical of price behavior of machinery products, the evidence is not overwhelming; our sample is far too small to serve as a basis for estimating an "average" rate of inflation in machine building as a whole.

Impact of Inflation

Since inflation in Soviet machinery prices is not uniform across all branches, inflation may weigh more heavily on some end users than on others. As industrial enterprises accelerate investment in modernization and mechanization—for example, replacing existing machinery and equipment with new and improved machines—the share of investment chewed up by inflation undoubtedly rises. Inflation in machinery also raises the cost of consumer durables, both by increasing the cost of components to consumer durables manufacturers, and by higher prices charged to consumers for such items as refrigerators, radios, cameras, and the like.

The impact of inflation in machinery prices, however, might be thought to be most severe in the production of military hardware. As a result of Soviet efforts to compete militarily with the West, defense has become a high technology, innovative sector relative to the rest of Soviet industry and thus may be most susceptible to new-product pricing. On the other hand, it can be countered that the defense industries are subject to more effective quality control than other sectors of industry. Military inspection teams are stationed at enterprises to ensure that quality standards are met, to monitor costs, and to oversee production. On balance, however, the more rapid pace of innovation, product obsolescence, and technological change in the military sector probably means that the new-product pricing effect outweighs other considerations.

Appendix A

The Sample Data

Section A.1

Cranes

Table A.1.1

Boom Cranes on Rubber Tires

Model	Price (rubles)	Maximum Lift Capacity		Length of Boom (meters)	Horsepower	Weight (metric tons)	Maximum Speed of Raising the Hook (meters/minute)	Outriggers
		At Minimum Outreach (metric tons)	At Maximum Outreach (metric tons)					
1961								
E-302	9,590	5	1.7	7.5	37	10.9	17.4	No
E-656	20,780	10	3.5	10	90	23.7	31.2	Yes
K-102	14,730	10	3	10	90	25	17.5	No
K-123	17,630	12	3	10	54	23	53.4	Yes
MKP-20	32,150	20	4.6	12.5	109	30	6.2	Yes
K-252	42,050	25	5	15	150	44.5	23	Yes
SKP-30/10	42,050	30	10	5	100	50	6	Yes
K-255	36,460	25	4	15	110	31.9	7.5	Yes
K-401	52,440	40	7	15	100	50	5	Yes
1962								
E-320	7,500	5	1.7	7.5	38	11.3	17.4	No
K-106	25,080	10	2	10	54	22	10	No
K-124	12,900	12	3	10	55	22	45	Yes
K-161	18,700	16	3.75	10	75	23.3	10	Yes
K-255	33,000	25	4	15	110	33	7.5	Yes
K-401	39,000	40	7	15	108	50	5	Yes
1967								
E-302A	9,865	5	1.7	7.5	45	10.6	25.8	No
K-106	12,840	10	2	10	54	22	10	No
K-124	16,820	12	3	10	55	22	45	Yes
K-161	20,100	16	3.75	10	75	23.3	10	Yes
K-255	30,244	25	4	15	110	33	7.5	Yes
MKP-25	33,630	25	5	12.5	100	39	6	Yes
MKP-40	69,470	40	4.5	15	180	48	4.4	Yes
K-401	40,452	40	7	15	108	50	5	Yes
K-631	83,400	63	7.5	15	180	69	5	Yes
K-1001	128,770	100	12	15	180	92	3	Yes
MKP-16	31,500	16	4	10	75	24	11	Yes

Table A.1.1

Boom Cranes on Rubber Tires (continued)

Model	Price (rubles)	Maximum Lift Capacity		Length of Boom (meters)	Horsepower	Weight (metric tons)	Maximum Speed of Raising the Hook (meters/minute)	Outriggers
		At Minimum Outreach (metric tons)	At Maximum Outreach (metric tons)					
1968								
K-161	20,100	16	3.75	10	75	23.7	10	Yes
K-255	30,240	25	4	15	110	33	7.5	Yes
MKP-40	69,470	40	4.5	15	180	48	4.4	Yes
K-631	83,400	63	7.5	15	180	69	5	Yes
K-1001	128,770	100	12	15	180	92	3	Yes
MKP-16	31,500	16	4	10	75	24	11	Yes
K-302B	9,870	5	1.7	7.5	50	11.93	31	No
K-166	26,000	16	3.5	12.5	75	23	6	Yes
K-255A	43,000	25	3	15	90	33	9	Yes
K-406	59,000	40	6.4	15	90	48	6	Yes
1971								
E-302A	9,865	5	1.7	7.5	45	10.6	25.8	No
K-106	12,840	10	2	10	54	22	10	No
K-124	16,820	12	3	10	55	22	45	Yes
K-161	20,100	16	3.75	10	75	23.7	10	Yes
K-255	30,244	25	4	15	110	33	7.5	Yes
MKP-25	32,600	25	5	12.5	100	29	6	Yes
MKP-40	57,000	40	4.8	15	180	45.2	4.4	Yes
K-401	40,416	40	7	15	109	50	5	Yes
K-631	83,400	63	7.5	15	180	69	5	Yes
K-1001	128,770	100	12	15	180	92	3	Yes
MKP-16	31,500	16	4	10	75	24	11	Yes
1972								
E-302A	9,120	5	1.7	7.5	38	10.6	25.8	No
K-161	18,985	16	3.75	10	75	23.7	10	Yes
K-255	29,120	25	4	15	110	33	7.5	Yes
MKP-25	32,600	25	5	12.5	100	39	6	Yes
K-401	38,980	40	7	15	108	50	5	Yes
K-631	83,400	63	7.5	15	180	69	5	Yes
MKP-16	31,500	10	4	10	75	24	11	Yes
K-166	23,900	16	3	12.5	75	23.7	6	Yes
K-255A	29,120	25	3.5	15	120	33	9	Yes

Table A.1.1

Boom Cranes on Rubber Tires (continued)

Model	Price (rubles)	Maximum Lift Capacity		Length of Boom (meters)	Horsepower	Weight (metric tons)	Maximum Speed of Raising the Hook (meters/minute)	Outriggers
		At Minimum Outreach (metric tons)	At Maximum Outreach (metric tons)					
1973								
K-161	18,990	16	3.75	10	75	23.7	12	Yes
K-255	27,225	25	4	15	110	31.9	7.5	Yes
MKP-25	31,085	25	5	12.5	100	39	6	Yes
MKP-40	49,500	40	4.8	15	180	45.2	4.4	Yes
K-401	36,410	40	7	15	108	50	5	Yes
K-631	75,000	63	7.5	15	180	70	5	Yes
K-1001	115,870	100	12	15	180	92	3	Yes

Table A.1.2

Boom Cranes on Tracks

Model	Price (rubles)	Maximum Lift Capacity		Length of Boom (meters)	Horsepower	Weight (metric tons)	Maximum Speed of Raising the Hook (meters/minute)	Outriggers
		At Minimum Outreach (metric tons)	At Maximum Outreach (metric tons)					
1961								
E-257	6,900	3	1.3	6.5	37	9.6	18	No
E-505	9,570	10	2.6	10	80	9.6	14.4	No
E-652	10,160	10	2.2	10	90	20.5	15.6	No
E-801	15,060	15	3.9	11	93	28.9	12.1	No
E-1004A	16,685	20	2.9	12.5	120	38.29	15.5	No
E-2006	39,700	50	8.2	15	250	77.2	12.1	No
EKG-4	88,790	75	15.5	20	119	190	7.6	No
E-1252	16,685	20	4	12.5	150	40.2	16	No
SKG-25	30,866	25	7.2	15	80	59.8	10.6	No
SKG-30/10	36,300	30	8	15	90	65	6	No
SKG-50	45,950	50	14.8	15	150	89.6	18	No
1963								
E-652	7,000	10	2	10	100	20.5	15.6	No
E-2006	39,700	50	8.2	15	300	76.2	8.5	No
EKG-4	72,125	75	15.5	20	419	190	7.6	No
E-1252	15,450	20	4	12.5	120	40.2	16	No
E-1258	25,300	20	3.9	12.5	120	40.8	14.4	No
DEK-25G	19,000	25	3.1	14	100	43.6	8.8	No
E-2508	39,700	80	13.8	14	300	77.7	13.8	No
E-156	5,500	15	.5	7.5	16	4.3	6.42	No
E-1251	13,300	20	4	12.5	116	37.5	16	No
E-1254	16,000	20	3.9	12.5	120	40.8	24	No
E-2006	36,000	50	8.2	15	250	77.2	12.1	No
1967								
MKE-6.3	19,160	6.3	1.5	10	75	15.9	19.4	No
E-252A	11,540	10	2.2	10	90	20.6	23.4	No
E-10011A	12,790	15	3.5	12.5	109	34.5	17.1	No
MKG-16	21,290	16	3.1	11	60	27.5	6.85	No
E-1252	20,540	20	4	12.5	130	38.4	16	No
E-1258	22,500	20	3.9	12.5	120	40.8	14.4	No
DEK-25G	23,740	25	3.1	14	109	41.3	8.8	No
SKG-40	40,370	40	8.3	15	120	57.6	6	No
DEK-50	68,960	50	14.8	15	150	89.1	5.1	No
E-2508	47,480	60	13.8	15	300	79	12.3	No
SKG-63	71,110	63	12.2	15	150	87.2	5	No

Table A.1.2

Boom Cranes on Tracks (continued)

Model	Price (rubles)	Maximum Lift Capacity		Length of Boom (meters)	Horsepower	Weight (metric tons)	Maximum Speed of Raising the Hook (meters/minute)	Outriggers
		At Minimum Outreach (metric tons)	At Maximum Outreach (metric tons)					
MKG-100	103,645	100	9	21	180	131.5	3	No
SKG-160	15,299	100	15.5	30	300	206	2.96	No
MKG-25	28,520	25	5.3	12.5	109	33	5.5	No
SKG-100	105,600	100	16.5	20	300	130.5	13	No
1968								
E-2503	63,200	60	13.8	15	160	NA	12	No
MKG-6.3	19,160	6.3	1.5	10	75	84.5	19.4	No
E-10011A	17,290	15	3.5	12.5	109	15.9	17.1	No
MKG-16	21,290	16	3.1	11	60	34.5	33	No
DEK-25G	23,740	25	3.1	14	108	27.2	8.8	No
SKG-40	40,370	40	8.1	15	120	38.8	6	No
DEK-50	68,970	50	14.8	15	150	57.8	5.1	No
E-2508	47,480	60	13.8	15	300	90.8	12.3	No
MKG-100	104,370	100	9	21	180	80.5	3	No
E-303B	8,745	5	1.5	7.5	50	131.5	24.4	No
MKG-10A	26,400	10	2.5	10	75	10.37	34	No
MKG-16M	31,000	16	4	10	75	20	33	No
E-1252B	20,540	20	3.9	12.5	130	25.3	15.5	No
E-1258B	22,500	20	4	12.5	130	37.1	21.6	No
MKG-25	28,500	25	5.2	12.5	108	39	6	No
ROK-25	39,600	25	47	12.5	108	42.6	7	No
E-2505	87,400	60	10	15	160	8.4	12	No
SKG-63A	71,110	63	12.2	15	150	87.2	5	No
SKG-100	105,600	100	16.7	20	300	132.5	13	No
1971								
MKG-6.3	19,160	6.3	1.5	10	75	15.9	19.4	No
E-652A	11,540	10	2.2	10	90	20.6	23.4	No
E-10011A	17,290	15	3.5	12.5	108	35	17.1	No
MKG-16	21,290	16	3.1	11	60	27.2	33	No
E-1258	22,500	20	3.9	12.5	130	41.2	14.4	No
DEK-25G	21,100	25	3.1	14	108	39	8.8	No

Table A.1.2

Boom Cranes on Tracks (continued)

Model	Price (rubles)	Maximum Lift Capacity		Length of Boom (meters)	Horsepower	Weight (metric tons)	Maximum Speed of Raising the Hook (meters/minute)	Outriggers
		At Minimum Outreach (metric tons)	At Maximum Outreach (metric tons)					
SKG-40	40,370	40	8	15	120	57.8	6	No
DEK-50	59,000	50	14.8	15	150	90.8	5.1	No
E-2508	42,570	60	13.8	15	300	79	12.3	No
DEK-161	18,700	16	2.8	14	60	31.7	11.7	No
SKG-63	71,110	63	12.2	15	150	87.2	5	No
MKG-100	104,365	100	9	21	180	131.5	3	No
SKG-160	200,000	160	15.5	30	300	206	2.96	No
MKG-25	28,520	25	5.2	12.5	108	39	6	No
SKG-100	105,600	100	16.7	20	300	132.5	3.3	No
1972								
MKG-6.3	19,160	6.3	1.5	10	75	15.9	19.4	No
E-652A	12,000	10	2.2	10	82	20.6	23.4	No
MKG-16	21,900	16	3.1	11.5	60	27.2	33	No
E-1258	22,500	20	3.9	12.5	130	41.2	14.4	No
EEK-25G	21,100	25	3.1	14	108	39	8.8	No
SKG-40	40,370	40	8	15	120	57.8	6	No
DEK-50	59,000	50	14.8	15	150	90.8	5.1	No
E-2508	42,570	60	13.8	15	300	79	12.3	No
DEK-161	18,700	16	2.8	14	60	31.7	10.7	No
SKG-63	71,110	63	12.2	15	150	88.7	5	No
MKG-25	28,520	25	5.2	12.5	108	39	6	No
1973								
SKG-40	36,000	40	8.1	15	120	57.8	6	No
DEK-50	56,400	50	14.8	15	150	90.8	5.1	No
E-2508	40,400	60	13.8	15	300	79	12.3	No
DEK-161	18,700	16	2.8	14	60	33	11.7	No
SKG-63	62,364	73	12.2	15	150	88.7	5	No
SKG-100	123,600	100	16.7	20	300	132.5	3.3	No
MKG-100	104,370	100	9	21	180	131.5	3	No
SKG-160	134,170	160	15.5	30	300	206	2.96	No

Table A.1.3

Truck Cranes

Model	Price (rubles)	Maximum Lift Capacity		Length of Boom (meters)	Horsepower	Weight (metric tons)	Maximum Speed Raising the Hook (meters/minute)	Outriggers
		At Minimum Outreach (metric tons)	At Maximum Outreach (metric tons)					
1961								
K-32	2,800	3	0.75	6.2	90	7.48	13	Yes
K-51	6,730	4	2	7.35	110	12.8	18	Yes
K-52	8,130	4	2	7.5	110	13	12	Yes
K-2.5-1EA	2,820	2.5	0.75	5.75	170	5.4	8.25	Yes
K-31	2,805	3	0.75	6.2	150	6.5	13.4	Yes
K-104	16,340	10	2.2	10	165	22.8	9	Yes
1963								
K-51	6,600	5	2	7.35	110	12.5	18	Yes
AK-5G	5,225	5	1	6.2	97	10	14.5	Yes
K-104	16,000	10	2.2	10	165	22.8	9	Yes
SMK-7	9,400	7.5	2	8.5	110	13.6	7.6	Yes
LAZ-690	2,800	3	0.75	6.2	90	6.8	12	Yes
KTS-3G	6,800	3	1.2	8.5	100	8.77	17.9	Yes
DEK-51	8,000	5	2	7.35	110	12.16	7	Yes
K-61	7,300	6	2	7.35	110	11.72	18	Yes
1967								
K-2.5-1EA	4,330	2.5	0.75	5.75	70	5.4	8.25	Yes
K-46	6,230	4	0.75	6.2	148	7.3	15.45	Yes
AK-75V	6,660	7.5	1.65	7.34	150	8.7	7.4	Yes
MKA-10M	19,570	10	1.4	10	180	14.6	18.3	Yes
K-162	28,365	16	4	10	180	23.6	12.7	Yes
AK-5G	21,695	16	2.8	10	180	21.8	16.2	Yes
KS-2561D	6,600	5	1	6.2	150	8.3	14.5	Yes
K-67	6,800	6.3	1.5	8	150	8.9	10.5	Yes
K-104	13,700	6.3	2	8.4	180	11.6	6.5	Yes
	19,000	10	2.2	10	165	22.8	10	Yes
1968								
K-25-1EA	4,330	2.5	0.75	5.75	70	5.4	18.25	Yes
K-46	6,230	4	0.75	6.2	150	7.3	18.45	Yes
AK-75V	6,600	7.5	1.65	7.34	150	8.7	18.4	Yes
MKA- 10M	19,570	10	2.4	10	180	14.6	18.3	Yes
MKA-16	25,820	16	4	10	180	23.6	18.7	Yes
K-162	20,170	16	2.8	10	180	21.8	16.2	Yes
KS-1562	7,430	4	1.2	6	115	7.1	13	Yes
K-64	11,970	6.3	2	7.35	180	12.2	16.5	Yes
K-67	14,390	6.3	2	8.4	180	11.9	6.5	Yes
K-69	11,970	6.3	2	7.35	110	11.8	16.5	Yes

Table A.1.3

Truck Cranes (continued)

Model	Price (rubles)	Maximum Lift Capacity		Length of Boom (meters)	Horsepower	Weight (metric tons)	Maximum Speed Raising the Hook (meters/minute)	Outriggers
		At Minimum Outreach (metric tons)	At Maximum Outreach (metric tons)					
SMK-7	15,000	7.5	2	8.5	110	13.9	7.6	Yes
K-104M	16,000	10	2.2	10	165	22.5	9	Yes
K-1014 (KS-3561)	16,000	10	1.0	10	180	13.8	12.5	Yes
1971								
K-2.5-1EA	4,330	2.5	0.75	5.75	70	5.06	8.25	Yes
K-46	6,230	4	4	6.2	148	7.3	9.95	Yes
AK-75V	7,790	7.5	7.5	7.5	150	8.7	7.4	Yes
MKA-16	25,820	16	16	10	180	22.5	12.7	Yes
K-162	19,775	16	16	10	180	21.8	8	Yes
KS-1562	7,430	4	4	6	115	7.3	13	Yes
AK-5G	6,420	5	5	6.2	150	8.3	14.5	Yes
KS-2561	6,988	6.3	6.3	8	150	8.9	10.5	Yes
K-64	11,403	6.3	6.3	7.35	180	12.2	16.5	Yes
MKA-10M (KS-1014)	19,000	10	10	10	180	14.6	18.3	Yes
1972								
K-46	6,230	4	0.75	6.2	148	7.3	9.95	Yes
AK-75V	6,500	7.5	1.65	7.5	150	8.7	7.4	Yes
MKA-10M	14,900	10	2.4	10	180	14.6	22.2	Yes
MKA-16	25,820	16	4	10	180	22.5	12.7	Yes
K-162	17,910	16	2.8	10	180	21.8	8	Yes
KS-1562	7,430	4	1.2	6	115	7.3	13	Yes
AK-5G	6,420	5	1	6.2	150	8.3	14.5	Yes
KS-2561D	6,800	6.3	1.3	8	150	8.9	10.5	Yes
K-64	11,300	6.3	2	7.35	180	12.2	16.5	Yes
K-67	13,700	6.3	2	8.4	180	11.9	6.5	Yes
AK-75	6,500	7.5	1.65	7.5	97	8.85	7.8	Yes
MKA-100	11,720	10	2.2	10	110	15.2	22.2	Yes
1973								
K-2.5-1EA	3,900	2.5	0.75	5.75	70	5.06	8.25	Yes
K-46	5,610	4	0.75	6.2	148	7.3	9.95	Yes
MKA-16	22,300	16	4	10	180	23.6	12.7	Yes
K-162	17,500	16	2.8	10	180	21.8	8	Yes
KS-1562	6,250	4	1	6	115	7.5	13	Yes
KS-2561D	6,805	6.3	1.5	8	150	8.8	10.5	Yes
K-67	13,000	6.3	2	8.4	180	11.9	6.5	Yes
K-104	15,105	10	2.2	10	165	22.8	10	Yes

Table A.1.4

Tower Cranes

Model	Price (rubles)	Maximum Lift Capacity		Length of Boom (meters)	Horsepower	Weight (metric tons)	Maximum Speed of Raising the Hook (meters/minute)	Outriggers
		At Minimum Outreach (metric tons)	At Maximum Outreach (metric tons)					
1961								
BKSM-1M	3,278	1	0.5	13.3	11.6	12.5	21	No
SBK-1	6,240	3	1.5	20	40.4	42.4	30	No
SBK-IM	11,974	3	1.5	20	52	85	22.5	No
M-3-5-5	13,100	5	3	22	72.8	60.5	30	No
M-5-5-10	16,620	5	3	22	72.8	87.8	30	No
BKSM-5-5A	11,900	5	5	22	73	72	30	No
BKSM-5-10	16,525	5	5	22	75	89	30	No
S-391	2,492	1.5	0.5	7.55	12.6	6.8	20	No
KB-16	4,022	2	1	15.75	13.74	16	20	No
BK-215	6,110	3	1.5	18	36	24	32.5	No
MK-3-5-20	12,940	5	3	20	50	43	30	No
MK-5/20	15,020	5	5	20	44	53	30	No
1963								
KS-391	2,000	1.5	0.5	10	10.9	6.7	20	No
KB-16	4,500	2	1	16	19	16.65	35	No
MSK-5/20	16,500	5	5	20	44	53	30	No
BK-300	29,000	25	8	30	106	149	12	No
BK-1425	94,000	75	25	45	273	393	6.4	No
BKSM-14PM2	18,800	5	5	30	45	77	12	No
S-419	6,000	5	3	20	53	56.1	30	No
BK-406A	35,000	25	13	40	97	236	12	No
KBGS-101M	67,000	25	10	40	233	210.5	60	No
KP-10	21,000	10	5	18	77	49.5	16	No
S-464A	14,000	5	5	20	60.8	52.7	30	No
BKSM-5-5B	17,300	8	8	22	73	72	30	No
MSK-8-20	23,000	5	5	20	44	58	15	No
MK-20-14	38,000	20	5	30	102	114	9.2	No
BK-405	37,000	40	15	36	97	237	7	No
1966								
SBK-1	6,210	3	1.5	20	40.4	43.5	30	No
SBK-1M	11,990	3	1.5	20	52	85	30	No
M-3-5-5	13,100	5	3	22	72.8	60.5	30	No
M-3-5-10	16,620	5	3	22	72.8	87.8	30	No
BKSM-5-5A	11,920	5	5	22	73	72	30	No
BKSM-5-10	16,525	5	5	22	73	90	30	No

Table A.1.4

Tower Cranes (continued)

Model	Price (rubles)	Maximum Lift Capacity: At Minimum Outreach (metric tons)	Maximum Lift Capacity: At Maximum Outreach (metric tons)	Length of Boom (meters)	Horsepower	Weight (metric tons)	Maximum Speed Raising the Hook (meters/minute)	Outriggers
BK-215	6,110	3	1.5	18	36	24	32.3	No
MSK-3-5-20	12,880	5	3	20	50	45	30	No
MBTK-80	20,430	5	4	20	44.5	44	30	No
1967								
SBK-1	12,860	3	1.5	20	40.4	44	30	No
SBK-1M	29,640	3	1.5	20	52	85	30	No
M-3-5-5	17,120	5	3	22	72.8	60.7	30	No
M-3-5-10	33,460	5	3	22	72.8	87.8	30	No
BKSM-5-5A	24,150	5	5	22	73	72	30	No
BKSM-5-10	37,710	5	5	22	73	91	30	No
KB-16	5,695	2	1	16	20	16.65	35	No
BK-215	11,140	3	1.5	18	36	24	32.5	No
MSK-3-5-20	17,800	5	3	20	50	44	30	No
MSK-5/20	20,135	5	5	20	44	53	30	No
BK-300	46,600	25	8	30	106	149	12	No
BK-1000	104,225	50	16	45	262	294	10.7	No
BK-1425	149,635	75	25	45	273	393	6.4	No
MBTK-80	20,580	5	4	20	44.5	44	30	No
KB-60	17,070	5	3	20	44.5	38.2	30	No
KB-100.0	18,930	5	5	20	46	51.2	20	No
KB-100.1	19,730	5	5	20	46	52	20	No
KB-100.OM	21,930	5	5	20	46	70	20	No
MSK-5-20A	21,245	5	5	20	59	57	29	No
KB-160.1M	42,620	8	8	20	79	70	14.2	No
KB-160.2	38,765	8	5	25	79	78	15	No
KB-160.4	43,440	3	2	25	79	79.5	15	No
BKSM-14PM2	23,508	5	5	30	45	77.3	12	No
BKSM-14PM3	20,608	5	5	30	52	75.1	12	No
1968								
BKSM-5-5A	24,100	5	5	22	73	72	30	No
MSK-3-5-20	17,800	5	3	20	56	43	30	No
MSK-5/20	20,100	5	5	20	44	53	30	No
BK-300	45,300	25	8	30	106	149	12	No
BK-1000	103,600	50	16	45	262	294.5	10.7	No
BK-1425	149,600	75	25	45	273	393	6.4	No
KB-60	17,000	5	3	20	44.5	39.2	30	No

Table A.1.4

Tower Cranes (continued)

Model	Price (rubles)	Maximum Lift Capacity		Length of Boom (meters)	Horsepower	Weight (metric tons)	Maximum Speed Raising the Hook (meters/minute)	Outriggers
		At Minimum Outreach (metric tons)	At Maximum Outreach (metric tons)					
KB-100.0	18,700	5	5	20	46	52.6	20	No
KB-100.1	21,600	5	5	25	46	56	20	No
KB-100.0M	21,700	5	5	20	46	70	20	No
MSK-5-20A	21,200	5	5	20	65	57	29	No
KB-160.2	47,300	8	5	25	79	78	20	No
KB-160.4	59,500	3	2	25	79	79.5	15	No
BKSM-7-9	21,200	7	7	22	75	15	10	No
BKSM-7-5	17,300	7	7	22	68	88.7	16	No
KB-306	25,000	5	4	25	48	76.6	20	No
S-419	13,000	5	3	20	53	61.3	30	No
S-419M	16,800	5	3	20	60	74.6	30	No
T-266E	37,800	5	4	25	57	88	20	No
KB-100.2	30,000	5	4	25	51	65.3	20	No
BKSM-5-9	30,800	5	5	22	73	87.5	30	No
MSK-7.5-20	24,500	7.5	7.5	20	44	54	15	No
BK-406A	42,000	25	13	40	97	237	12	No
KBGS-101M	72,000	25	10	40	159	255	60	No
BK-404	41,200	40	18	30	97	236.5	7	No
1971								
MSK-5/20	19,720	5	5	20	44	53	30	No
BK-300	45,600	25	8	30	106	149	12	No
MBTK-80	20,430	5	4	20	44.5	44	30	No
KB-100.0	18,930	5	5	20	46	52	20	No
KB-100.0M	20,930	5	5	20	46	70	20	No
MSK-5.20A	20,720	5	5	20	65	57	29	No
KB-160.1M	42,620	8	8	20	79	80	20	No
KB-160.2	34,065	8	5	25	79	78	20	No
KB-160.4	37,940	3	2	25	79	79.5	40	No
BKSM-14PM2	20,660	5	5	30	71	77	30	No
BKSM-14PM3	20,610	5	5	30	52	75.1	12	No
BKSM-7-9	21,530	7	7	22	12	75	10	No
BKSM-7-5	17,600	7	7	22	75	88.7	16	No
KB-306	19,360	5	4	25	48	76.6	20	No

Section A.2

Trucks

Table A.2.1

Trucks

Model	Price (rubles)	Hauling Capacity (metric tons)	Weight (metric tons)	Maximum Speed (km/hr)	Fuel Consumption (liters/100 km)	Engine	
						Horsepower	Cylinders
1960							
GAZ-51	1,050	2.5	2.71	70	26.5	70	6
GAZ-51A	1,050	2.5	2.71	70	20	70	6
GAZ-51B	1,260	2.0	3.1	65	24	56	6
GAZ-63	1,330	2.0	3.2	95	29	70	6
GAZ-93	1,240	2.25	3.1	70	28	70	6
GAZ-93A	1,240	2.25	3.0	70	20	70	6
UAZ-450D	2,000	0.8	1.7	90	14	62	4
ZIS-150	1,370	4	3.9	75	37	90	6
ZIS-151	2,125	4.5	5.58	60	42	92	6
ZIL-164	1,370	4	4.1	75	27	97	6
ZIL-157	2,125	4.5	5.8	65	42	109	6
ZIL-585	1,520	3.5	4.21	65	40	90	6
MAZ-200	3,520	7	6.4	65	32	120	4
MAZ-200G	3,730	7	6.75	65	32	110	4
MAZ-205	3,520	6	6.6	52	35	120	4
MAZ-525	23,700	2.5	22.0	30	160	300	12
URAL-355M	1,800	3.5	3.4	75	24	95	6
KAZ-585V	1,520	3.5	4.4	65	40	90	6
1961							
GAZ-93	1,240	2.25	3.1	70	28	70	6
ZIS-150	1,370	4	3.9	75	37	90	6
ZIS-151	2,125	4.5	5.58	60	42	92	6
ZIL-164	1,540	4	4.1	75	27	97	6
ZIL-157	2,400	4.5	5.8	65	42	109	6
ZIL-130	1,700	4	4.27	94	27	150	8
ZIL-585	1,680	3.5	4.21	65	40	90	6
MAZ-200	3,520	7	6.4	65	32	120	4
MAZ-205	3,520	6	6.6	52	35	120	6
MAZ-500	3,520	7.5	6.5	75	25	180	6
MAZ-525	23,700	25	24.38	30	135	300	12
MAZ-530	50,000	40	38.4	43	200	450	12
KAZ-600	2,400	3.5	4.525	65	29	93	6
KRAZ-214	8,610	7	12.3	55	70	205	6
KRAZ-219	6,200	12	11.3	55	60	180	6
KRAZ-222	6,470	10	12.2	47	65	180	6

Table A.2.1

Trucks (continued)

Model	Price (rubles)	Hauling Capacity (metric tons)	Weight (metric tons)	Maximum Speed (km/hr)	Fuel Consumption (liters/100 km)	Engine	
						Horsepower	Cylinders
1966							
GAZ-51A	1,030	2.5	2.11	70	20	70	6
GAZ-51B	1,445	2	3.1	65	24	56	6
GAZ-63	1,330	2	3.3	95	30	70	6
GAZ-63A	1,440	2	3.44	65	25	70	6
GAZ-53	3,050	3	3.06	80	22	115	8
GAZ-53A	2,200	4	3.25	85	24	115	8
GAZ-93B	1,260	2.25	3.0	70	20	70	6
GAZ-66	3,550	2	3.47	95	24	115	8
GAZ-69	1,270	0.5	1.525	90	14	55	4
UAZ-450D	1,700	0.8	1.7	90	14	62	4
UAZ-451	1,690	0.8	1.52	90	14	70	4
UAZ-451D	1,650	0.8	1.50	95	12	70	4
UAZ-451DM	1,600	1	1.51	100	12	70	4
ZIL-157K	2,450	4.5	5.8	65	42	110	6
ZIL-130	2,800	5	4.3	70	28	150	8
ZIL-MMZ-555	2,900	4.5	3.69	80	27	150	8
MAZ-200	3,520	7	6.4	60	36	120	4
MAZ-200G	3,730	7	6.75	65	32	110	4
MAZ-502	4,450	4	7.7	50	32	135	6
MAZ-502A	4,800	4	7.8	50	32	135	6
MAZ-501	4,300	5	7.6	45	32	120	6
MAZ-503	6,560	7	6.75	70	24	180	6
MAZ-525	23,700	25	24.38	30	135	300	12
URAL-355M	1,700	3.5	3.4	75	24	95	6
KAZ-600V	2,200	3.5	4.525	65	29	93	6
GAZ-5AZ-53B	3,050	3.5	3.75	85	24	115	8
KRAZ-214	8,600	7	12.3	55	70	205	6
KRAZ-219	6,200	12	11.3	55	60	180	6
KRAZ-222	6,470	10	12.2	47	65	180	6
1967							
GAZ-63	1,600	2	3.2	95	12	70	6
GAZ-53A	2,660	4	3.25	85	24	115	8
GAZ-93B	1,475	2.5	3.0	70	20	70	6
GAZ-50-03	1,500	2.5	2.815	70	21	75	6
GAZ-66	3,550	2	3.47	95	24	115	8
ZIL-157K	3,085	4.5	5.8	65	42	110	6
ZIL-130	3,100	5	4.3	90	28	150	8
ZIL-MMZ-555	3,370	4.5	3.69	90	27	150	8
MAZ-500	5,810	7.5	6.5	75	25	180	6
MAZ-503B	6,000	7	6.75	75	24	180	6

Table A.2.1

Trucks (continued)

Model	Price (rubles)	Hauling Capacity (metric tons)	Weight (metric tons)	Maximum Speed (km/hr)	Fuel Consumption (liters/100 km)	Engine	
						Horsepower	Cylinders
URAL-3775	7,700	7.5	7.06	60	58	180	8
GAZ-5A2-53B	3,700	3.5	3.75	85	24	115	8
KRAZ-214B	9,800	7	12.1	55	50	205	6
KRAZ-219B	8,300	12	11.3	55	55	180	6
KRAZ-256B	8,420	11	11.4	65	38	240	8
KRAZ-256	8,070	10	11.4	62	45	240	8
BELAZ-540	24,500	27	20.925	55	100	375	12
1970							
GAZ-51A	1,200	2.5	2.71	70	20	70	6
GAZ-63	1,600	2	3.2	95	12	70	6
GAZ-53A	2,600	4	3.25	85	24	115	8
GAZ-93B	1,475	2.25	3.0	70	20	70	6
GAZ-52-03	1,500	2.5	2.815	70	21	75	6
GAZ-66	3,550	2	3.47	95	24	115	8
ZIL-157K	3,085	4.5	5.8	65	42	110	6
ZIL-130	3,100	5	4.3	90	28	150	8
ZIL-MMZ-555	3,370	4.5	4.5	80	27	150	8
MAZ-200	3,300	4.7	6.4	60	36	120	4
MAZ-205	3,300	6	6.6	52	35	120	4
MAZ-500	5,810	7.5	6.5	75	22	180	6
MAZ-503B	6,000	7	6.75	75	24	180	6
MAZ-525	17,500	25	24.38	30	135	300	12
MAZ-530	36,000	40	38.4	43	200	450	12
MAZ-537	44,000	50	22	55	125	525	12
URAL-377S	7,700	7.5	7.06	60	58	180	8
KAZ-600V	2,380	3.5	4.525	65	29	93	6
KAZ-608	4,450	10.5	4.0	75	40	150	8
GAZ-SAZ-53B	3,700	3.5	3.75	85	24	115	8
KRAZ-219B	8,300	12	11.3	55	55	180	6
KRAZ-255B	10,290	7.5	11.95	71	40	240	8
KRAZ-256B	8,420	11	11.4	65	38	240	8
KRAZ-256	8,070	10	11.4	62	45	240	8
KRAZ-540	24,500	27	20.925	55	100	375	12
BELAZ-548A	36,200	40	26.925	55	125	520	12
1973							
GAZ-51A	1,200	2.5	2.71	70	20	70	6
GAZ-53A	2,565	4	3.25	85	24	115	8
GAZ-93B	1,475	2.25	3.0	70	20	70	6
GAZ-52-03	1,500	2.5	2.815	70	21	75	6
GAZ-69	1,490	0.5	1.525	90	14	52	4

Table A.2.1

Trucks (continued)

Model	Price (rubles)	Hauling Capacity (metric tons)	Weight (metric tons)	Maximum Speed (km/hr)	Fuel Consumption (liters/100 km)	Engine	
						Horsepower	Cylinders
UAZ-451DM	1,600	1	1.51	100	12	70	4
ZIL-157K	3,085	4.5	5.8	65	42	110	6
ZIL-130	3,200	5	4.3	90	28	150	8
ZIL-130G	3,320	5	4.57	90	28	150	8
ZIL-131	5,800	5	6.46	80	40	150	8
ZIL-131V	5,800	10.5	4.0	75	40	150	8
ZIL-MMZ-555	3,470	4.5	3.69	80	27	150	8
MAZ-500A	6,050	8	6.6	85	22	180	6
MAZ-503A	6,200	8	7.1	75	22	180	6
MAZ-504A	5,900	17.75	6.4	85	32	180	6
URAL-3750	9,100	4.5	8.4	75	48	180	8
URAL-3775	7,700	7.5	7.06	60	58	180	8
KRAZ-255B	11,300	7.5	11.95	71	40	240	8
KRAZ-256B	8,420	11	11.4	65	38	240	8
KRAZ-257	8,270	12	11.13	55	55	215	8
BELAZ-540	24,500	27	20.725	55	100	375	12
BELAZ-548A	36,200	40	26.925	55	120	520	12
1975							
GAZ-51A	1,200	2.5	2.71	70	20	70	6
GAZ-53	2,565	3	3.06	80	22	115	8
GAZ-52-03	1,500	2.5	2.815	70	21	75	6
GAZ-66	3,720	2	3.47	95	24	115	8
UAZ-451DM	1,600	1	1.51	100	12	70	4
UAZ-451M	1,800	1	1.6	90	14	90	4
UAZ-452D	1,760	0.8	1.67	95	13	71	4
ZIL-130	3,290	5	4.3	90	28	150	8
ZIL-131	5,800	5	6.46	80	40	150	8
ZIL-MMZ-555	3,470	4.5	3.69	90	27	150	8
MAZ-500A	6,120	8	6.60	85	22	180	6
MAZ-503A	6,250	8	7.10	75	22	180	6
URAL-3750	9,100	4.5	8.40	75	48	180	8
URAL-377	7,900	7.5	7.27	75	48	175	8
GAZ-SAZ-53B	3,310	3.5	3.75	85	24	115	8
KRAZ-256B	8,420	11	11.4	65	38	240	8
KRAZ-256	8,270	10	11.5	62	45	240	8
KRAZ-257	8,000	12	11.5	62	36	240	8
BELAZ-540A	26,000	27	20.925	55	100	360	12
BELAZ-548A	36,200	40	26.925	55	120	520	12

Section A.3

Machine Tools

Table A.3.1

Lathes

Model	Price (rubles)	Maximum Diameter of Bar Stock (millimeters)	Power of Main Drive (kilowatts)	Weight (metric tons)	Machine Dimensions (cubic meters)	Manual (M) Automatic (A)	Precision Instrument
1960							
1B124	2,500	25	4.2	1.75	2.216	A	
1B125	5,200	25	4.5	2.15	2.537	A	
1B136	2,500	36	4.5	1.75	2.216	A	
1B140	5,200	40	7.0	2.2	2.537	A	
1341	2,300	40	4.5	2.2	5.76	M	
1A616	1,130	34	4.5	1.5	3.461	M	
1A616P	1,600	34	4.5	1.5	3.461	M	P
1K62 (710-mm)	1,405	36	10	2.161	3.944	M	
1K62 (1,400-mm)	1,470	36	10	2.401	5.022	M	
1A64	6,920	80	20	11.7	19.399	M	
165 (2,800-mm)	7,250	80	28.0	12.5	20.504	M	
165 (5,000-mm)	7,960	80	28.0	16.0	29.146	M	
1970							
1B124	4,120	25	4.5	1.75	2.216	A	
1B125	4,220	25	4.5	2.25	2.537	A	
1B136	4,290	36	4.5	1.75	2.260	A	
1B140	8,180	40	7.0	2.3	2.537	A	
1341	3,830	40	5.5	2.2	5.76	M	
1A616	1,610	34	4.0	1.5	3.191	M	
1A616P	1,910	34	4.0	1.5	3.191	M	P
1K62 (710-mm)	2,000	45	7.5	2.080	3.893	M	
1K62 (1,400-mm)	2,600	45	10	2.290	4.959	M	
1A64	7,870	80	17	11.7	19.399	M	
165 (2,800-mm)	8,580	80	22	12.5	20.504	M	
165 (5,000-mm)	9,700	80	22	15.650	29.146	M	

Table A.3.2

Drilling and Boring Machines

Model	Price (rubles)	Maximum Diameter of Hole Bored (millimeters)	Power of Main Drive (kilowatts)	Weight (metric tons)	Machine Dimensions (cubic meters)	Manual (M) Automatic (A)	Precision Instrument
1960							
2170	2,590	75	10.0	3.6	6.423	M	
2A430	6,700	60	2.0	1.93	4.070	M	P
2N57	5,700	75	7.0	9.5	21.743	M	
2B635	34,200	160	14	26.0	102.375	M	
278	1,750	165	1.7	2.25	7.452	M	
278L	1,630	165	1.7	1.65	2.457	M	
278N	1,680	165	1.7	1.85	2.808	M	
1970							
2170	3,280	75	10.0	3.75	6.851	M	
2A430	7,130	60	2.0	2.33	3.070	M	P
2N57	10,780	75	7.5	9.5	21.743	M	
2B635	31,530	160	14	27.9	103.605	M	
278	1,930	165	2.2	2.25	7.587	M	
278L	1,380	165	2.2	1.45	2.478	M	
278N	1,260	165	2.2	1.85	2.880	M	

Table A.3.3

Grinders

Model	Price (rubles)	Maximum Diameter of Bar Stock (millimeters)	Power of Main Drive (kilowatts)	Weight (metric tons)	Machine Dimensions (cubic meters)	Manual (M) Automatic (A)	Precision Instrument
1960							
3B151	4,020	200	7.0	3.8	9.765	M	
3A151	4,480	200	7.0	3.8	9.765	A	
3B161	4,260	280	7.0	4.5	13.104	M	
3G182	3,300	25	7.0	2.45	2.867	A	
3722	6,920	0.320 [1]	10	7.0	15.265	A	
3B722	5,500	0.320 [1]	10	6.2	15.774	A	
3B732	5,100	0.256 [1]	14	6.4	13.804	A	
1970							
3B151	5,500	200	7.5	4.2	9.765	M	
3A151	5,720	200	7.5	4.2	9.765	A	
3B161	5,530	280	7.5	4.5	13.432	M	
3G182	4,140	25	5	2.467	3.636	A	
3A227	6,500	400	3.0	3.1	6.146	M	
3722	9,350	0.320 [1]	10.0	7.3	15.774	A	
3B722	7,320	0.320 [1]	10	7.1	15.774	A	
3B732	6,990	0.256 [1]	14	6.5	14.308	A	

[1] Table area.

Table A.3.4

Gear Cutting Machines

Model	Price (rubles)	Maximum Wheel Diameter (millimeters)	Power of Main Drive (kilowatts)	Weight (metric tons)	Machine Dimensions (cubic meters)	Manual (M) Automatic (A)	Precision Instrument
1960							
5107	1,650	80	0.6	0.850	0.622	M	
5V12	1,850	208	1.7	1.85	2.275	M	
5P23A	6,320	125	1.7	1.60	2.080	A	
5A27S-4	14,100	500	4.5	8.0	5.545	A	
528S	19,340	800	10	12.2	11.915	A	
5A283	23,500	1,600	7	21.0	24.905	A	
5350	4,500	150	7	3.65	5.959	A	
5350B	5,000	150	7	4.150	7.877	A	
5350V	5,200	150	7	4.550	9.156	A	
5822	16,500	200	4.5	3.90	7.148	M	P
5831	8,670	320	0.75	4.5	15.078	A	
1970							
5107	2,400	80	0.6	0.850	0.622	M	
5V12	2,610	208	1.7	1.85	2.258	M	
5P23A	7,440	125	1.7	1.80	2.080	A	
5A27S-4	22,370	500	4.5	8.12	6.299	A	
528S	22,430	800	10	14.00	11.915	A	
5A283	25,470	1,600	7	19.0	26.159	A	
5350	5,350	150	7	3.65	5.997	A	
5350B	6,510	150	7	4.150	7.915	A	
5350V	7,160	150	7	4.550	9.194	A	
5822	11,450	200	4.5	3.85	7.522	M	P
5831	11,420	320	0.75	4.75	15.078	A	

Table A.3.5

Milling Machines

Model	Price (rubles)	Diameter of Work Sheet (square meters)	Power of Main Drive (kilowatts)	Weight (metric tons)	Machine Dimensions (cubic meters)	Manual (M) Automatic (A)	Precision Instrument
1960							
6M13K	5,600	6.4	7	4.7	13.221	M	
675	1,850	1.0	1.7	1.63	1.690	M	
676	2,165	0.151	2.8	1.10	2.673	M	
1970							
6M13K	5,490	6.4	7.5	4.7	13.271	M	
6610	34,850	4	52	39	186.376	(1)	
675	2,000	1.0	1.7	1.63	1.760	M	
676	2,370	0.158	2.2	1.385	2.584	M	

[1] Not applicable to this model.

Table A.3.6

Planers and Slotters

Model	Price (rubles)	Diameter of Work Sheet (square meters)	Power of Main Drive (kilowatts)	Weight (metric tons)	Machine Dimensions (cubic meters)	Manual (M) Automatic (A)	Precisión Instrument
1960							
7110	15,000	2.7	40	30.750	101.907	M	
7210	14,420	2.7	40	27.5	113.32	M	
7212	17,800	4.48	55	35	170.677	M	
7A256	46,900	10.8	118	65	412.322	M	
7A278	81,150	20	118	117	762.586	M	
7M36	2,300	0.315	7.0	3.2	8.675	M	
7M37	12,600	0.560	10	4.5	13.024	M	
745A	11,200	. . .[1]	28	19.0	72.950	M	
7B705V	3,800	. . .	10	3.4	8.788	M	
1970							
7110	20,000	2.7	40	27.500	102.165	M	
7210	20,690	2.7	40	27.5	106.419	M	
7212	24,000	4.48	55	35	165.608	M	
7A256	87,150	10.8	110	68.7	411.474	M	
7A278	147,850	20	110	122.8	909.703	M	
7M36	3,830	0.315	7.5	3.3	8.878	M	
7M37	4,100	0.560	10	4.5	13.024	M	
745A	16,410	. . .	28	17.0	72.950	M	
7B705V	5,470	. . .	10	3.93	9.646	M	

[1] . . . indicates data not applicable to this model.

Section A.4

Construction and Road Machinery

Table A.4.1

Bulldozers

Model	Price (rubles)	Blade Size [1] (square meters)	Horse-power	Weight (metric tons)	Control Mech-anism [2]
1961					
D-159	2,150	1.824	54	6.2	H
D-159b	2,070	1.801	54	6.18	H
D-259A	4,050	4.048	90	14.0	C
D-271	3,950	3.333	80	13.3	C
D-175	22,600	5.193	140	18.97	C
D-312	2,600	1.000	37	4.10	H
D-315	2,400	2.80	54	7.92	H
D-347	1,310	0.65	14	1.85	H
D-444	2,080	2.048	54	6.25	H
D-449	2,565	1.10	45	3.59	H
D-459	2,450	2.80	55	7.24	H
D-492	4,050	3.782	100	14.0	C
D-535	2,720	2.048	75	6.56	H
bu-55	2,540	2.00	54	7.203	H
1965					
D-159b	2,330	1.824	54	6.290	H
D-271A	4,350	3.333	100	13.33	C
D-275A	15,600	4.640	180	17.50	C
D-384	45,000	5.40	300	28.535	H
D-444	2,250	2.048	54	6.080	H
D-492A	4,600	3.861	100	14.00	C
D-493A	5,400	3.950	100	13.90	H
D-521	18,350	3.685	180	17.975	H
D-522	20,000	4.020	180	18.050	H
D-535	2,650	2.12	75	6.370	H
D-579	2,580	1.80	50	3.00	H
bu-55	2,470	2.00	54	6.850	H
D-494A	5,300	3.366	100	13.53	H
1967					
D-275A	20,350	4.640	180	17.5	C
D-444	3,070	2.048	54	6.25	H
D-492A	5,640	3.861	108	14.0	C

Table A.4.1

Bulldozers (continued)

Model	Price (rubles)	Blade Size [1] * (square meters)	Horse-power	Weight (metric tons)	Control Mech-anism [2]
D-522	24,800	5.316	180	17.85	H
D-535	3,160	2.048	75	6.560	H
D-579	3,210	1.20	50	3.00	H
D-686	6,250	3.84	108	14.1	C
D-687	7,200	3.84	108	14.0	H
bu-55	3,720	2.00	54	6.85	H
D-572	45,300	6.892	300	28.920	H
1970					
D-712	5,000	2.048	75	8.10	H
D-689	8,500	3.053	110	10.50	H
D-685	7,000	2.752	110	10.18	H
D-572c	48,600	7.037	300	31.38	H
D-159b	3,270	1.847	54	6.3	H
D-271	5,250	3.333	100	13.3	C
D-275A	20,350	3.685	140	18.1	C
D-444	3,070	2.048	54	6.25	H
D-449	3,210	1.10	48	3.59	H
D-492	5,640	3.861	100	6.25	H
D-493A	6,740	3.94	100	13.98	H
D-521	22,400	3.685	180	17.97	H
D-522	24,800	5.316	180	19.32	H
D-535	3,160	2.016	75	6.56	H
D-579	3,210	1.30	50	3.30	H
D-606	4,430	2.048	75	7.0	H
D-686	6,250	3.840	108	14.113	C
D-687	7,200	3.840	108	14.00	H
bu-55	3,720	2.150	54	6.85	H
D-572	45,300	7.037	300	31.38	H
D-575A	22,600	4.477	180	18.2	H
D-444A	3,070	2.016	54	6.410	H
D-492A	5,850	4.169	108	14.015	C
D-521A	20,800	5.387	180	18.255	C
D-607	4,850	2.80	75	8.90	H

* Footnotes appear at end of table.

Table A.4.1

Bulldozers (continued)

Model	Price (rubles)	Blade Size [1] (square meters)	Horse-power	Weight (metric tons)	Control Mech-anism [2]
D-687c	7,530	3.84	108	13.78	H
D-275b	20,254	4.623	180	18.865	C
1973					
D-384A	43,730	6.975	271	28.535	H
D-492A	5,740	4.334	108	14.0	C
D-493A	6,740	3.900	108	14.7	H
D-521	23,740	5.292	180	18.340	H
D-522	23,065	5.316	180	19.320	H
D-532c	19,900	4.160	140	13.350	H
D-535	3,050	2.048	74	6.37	H
D-579	3,370	1.300	50	3.50	H
D-606	3,980	2.016	75	6.925	H
D-607	5,300	2.80	75	8.484	H
D-686	5,960	3.84	108	14.113	C
D-687	7,250	3.84	108	13.956	H
D-687A	8,250	3.84	108	13.780	H
D-687c	7,250	3.84	108	13.710	H
D-535A	3,050	2.048	74	6.370	H
D-572	45,700	6.975	271	31.380	H
D-694A	10,440	4.368	108	17.100	H
D-444A	3,050	2.016	54	6.410	H

[1] Length times height.
[2] H = hydraulic, C = cable.

Table A.4.2

Rollers

Model	Price (rubles)	Speed While Working in First Gear (km/hr)	Weight w/o Ballast (metric tons)	Horsepower	Self-Propelled (S) Towed (T)	With/Without Vibrator	Smooth (S) Rough Roller (R)	Pneumatic Tires	Width of Rolled Strips (meters)
1961									
D-219	1,200	...[1] *	1.83	...	T	w/o	S	Yes	2.20
D-263	3,130	...	6.5	...	T	w/o	S	Yes	2.50
D-211	2,170	1.7	10.0	40	S	w/o	S	No	1.80
D-211B	2,600	1.8	10.0	40	S	w/o	S	No	1.8
D-220	2,100	...	13.3	...	T	w/o	R	No	2.73
D-326	7,100	...	13.2	...	T	w/o	S	Yes	3.30
D-399	4,100	2.5	8.6	40	S	w/o	S	No	1.30
D-399A	3,740	2.51	8.6	55	S	w/o	S	No	1.3
D-400	4,750	2.5	10.8	30	S	w/o	S	No	1.30
D-400A	4,340	2.8	10.8	55	S	w/o	S	No	1.3
D-455	2,900	1.35	1.4	8	S	w	S	No	0.85
D-469	2,800	2.13	6.9	28	S	w/o	S	No	1.8
D-126A	320	...	2.6	54	T	w/o	S	No	1.30
D-178B	4,750	3.5	13.9	40	S	w/o	S	No	1.30
D-260	1,520	2.05	6	30	S	w/o	S	No	1.70
D-338	1,100	2.3	0.88	6	S	w/o	S	No	0.70
D-3175	2,700	1.7	3.0	14	S	w	S	No	1.00
D-365	8,700	3.04	10.7	100	S	w/o	S	Yes	2.60
D-484	1,150	1.80	1.35	8	S	w	S	No	0.73
D-130B	460	...	3.3	...	T	w/o	R	No	1.51
1963									
D-219	1,200	...	1.8	...	T	w/o	S	Yes	2.20
D-263	3,130	...	5.25	...	T	w/o	S	Yes	2.50
D-211	2,170	1.8	10.0	40	S	w/o	S	No	1.80
D-220	2,100	...	13.3	...	T	w/o	R	No	2.73
D-326	7,100	...	13.25	...	T	w/o	S	Yes	3.3
D-399	4,350	2.51	8.6	55	S	w/o	S	No	1.3
D-400	5,000	2.5	10.8	55	S	w/o	S	No	1.3
D-480	2,150	...	3.0	...	T	w	S	No	1.4
D-130B	460	...	3.3	...	T	w/o	R	No	1.50
D-126A	320	...	2.6	...	T	w/o	S	No	1.30
D-1785	4,750	3.5	13.9	40	S	w/o	S	No	1.30
D-260	1,520	2.15	6.0	30	S	w/o	S	No.	1.70
D-130A	460	...	3.20	...	T	w/o	R	No	1.30
D-242	5,000	...	10.0	...	T	w/o	S	Yes	3.00
D-390	5,000	...	13.9	40	T	w/o	S	No	1.30

* Footnote appears at end of table.

Table A.4.2

Rollers (continued)

Model	Price (rubles)	Speed While Working in First Gear (km/hr)	Weight w/o Ballast (metric tons)	Horsepower	Self-Propelled (S) Towed (T)	With/Without Vibrator	Smooth (S) Rough Roller (R)	Pneumatic Tires	Width of Rolled Strips (meters)
1965									
D-219	1,170	...	1.9	...	T	w/o	S	Yes	2.20
D-263	2,700	...	5.65	...	T	w/o	S	Yes	2.50
D-211B	2,500	1.8	10.0	50	S	w/o	S	No	1.80
D-220	2,520	...	13.3	...	T	w/o	R	No	2.73
D-326	7,000	...	13.3	...	T	w/o	S	Yes	3.30
D-399A	3,450	2.8	8.6	55	S	w/o	S	No	1.30
D-400A	4,000	2.8	10.8	55	S	w/o	S	No	1.30
D-455	2,900	1.33	1.4	8	S	w	S	No	0.85
D-469A	2,250	2.43	6.4	40	S	w/o	S	No	1.80
D-480	2,200	...	3.0	...	T	w	S	No	1.40
D-614	820	...	5.0	...	T	w/o	R	No	1.80
D-627	9,500	7.54	9.0	110	S	w/o	S	Yes	1.7
D-630	1,480	...	9.0	...	T	w/o	R	No	2.60
D-1305	620	...	3.74	...	T	w/o	R	No	1.500
D-613	3,800	1.8	3.2	18	S	w	S	No	1.00
D-634	3,800	2.13	6.0	28	S	w	S	No	1.00
D-615	1,650	...	18.0	...	T	w/o	R	No	3.60
1973									
D-263	3,520	...	5.65	...	T	w/o	...	Yes	2.5
D-211B	3,750	1.85	10.0	50	S	w/o	S	No	1.8
D-220	3,800	...	13.3	...	T	w/o	R	No	2.8
D-399A	3,370	2.8	8.6	50	S	w/o	S	No	1.3
D-400A	4,000	2.8	11.3	50	S	w/o	S	No	1.3
D-469A	2,820	2.43	6.4	40	S	w/o	S	No	1.8
D-614	1,380	...	5.0	...	T	w/o	R	No	1.8
D-627	17,930	7.54	9.0	110	S	w/o	...	Yes	1.62
D-630	3,130	...	9.0	...	T	w/o	R	No	2.6
D-5515 *(tyagach)*	21,300	15	20.4	240	S	w/o	S	Yes	2.8
D-455A	1,850	1.8	1.5	8	S	w	S	No	0.85
D-613A	2,440	2.17	6.0	18	S	w	S	No	1.00

[1] ... indicates data not applicable to this model.

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Table A.4.3

Excavators, Single Bucket

Model	Price (rubles)	Shovel Capacity (cubic meters)	Horse-power	Weight (metric tons)	Type of Tracking [1] *
1960					
E-153	5,200	0.15	40	5.3	R
E-157A	4,953	0.15	18	4.8	C
E-257	6,500	0.25	37	9.32	C
E-302	9,100	0.3	48	11.0	R
E-652	10,200	0.65	80	20.5	C
E-752	10,650	0.75	93	33.3	C
E-754	10,650	0.75	93	29.7	C
E-1004A	17,100	1.0	120	39.5	C
E-1004	16,185	1.0	120	39.5	C
E-1252	17,300	1.25	150	40.2	C
E-2001	35,000	2.0	190	80	C
E-2002	39,000	2.0	250	79.2	C
1961					
E-153	5,200	0.15	37	5.3	R
E-156	4,950	0.15	16	4.27	C
E-155	4,950	0.15	16	4.3	R
E-221	5,490	0.22	40	5.3	R
E-257	6,500	0.25	37	9.32	C
E-302	9,100	0.3	38	11.0	R
E-504A	9,340	0.5	54	21.7	C
E-505A	9,540	0.5	80	20.5	C
E-652	10,200	0.65	90	20.5	C
E-1004A	17,100	1.0	120	39.3	C
E-1251	15,145	1.25	108	39.5	C
E-1252	17,300	1.25	120	40.2	C
E-2001	35,000	2.0	190	80	C
E-2002	39,000	2.0	250	79.2	C
E-1003A	14,945	1.0	150	39.5	C
1966					
E-153	5,200	0.15	37	5.3	R
E-157A	4,953	0.15	20	5.23	C
E-257	6,500	0.25	37	9.35	C
E-302	9,100	0.3	38	11.0	R
E-303	6,500	0.3	38	9.6	C
E-304	6,650	0.3	38	12.0	C
E-652	10,200	0.65	90	20.5	C
E-653	9,000	0.65	100	24.2	C

* Footnote appears at end of table.

Table A.4.3

Excavators, Single Bucket (continued)

Model	Price (rubles)	Shovel Capacity (cubic meters)	Horse-power	Weight (metric tons)	Type of Tracking [1]
E-752	10,650	0.75	80	33.3	C
E-754	10,650	0.75	80	33.3	C
E-1251	12,170	1.25	116	39.5	C
E-1252	17,300	1.25	120	40.2	C
E-2001	35,000	2.0	190	80	C
1967					
E-153	5,120	0.15	50	5.3	R
E-157A	5,000	0.15	18	5.0	C
E-3025	10,420	0.4	48	11.7	R
E-304A	8,050	0.4	48	12.0	C
E-302A	9,120	0.4	48	11.7	R
E-303A	8,000	0.4	49	10.8	C
E-303B	10,800	0.4	48	10.8	C
E-3045	9,350	0.4	48	12.0	C
E-304B	10,200	0.4	48	13.7	C
E-352A	7,900	0.4	48	13.0	C
E-652	10,200	0.65	100	20.5	C
E-652A	12,000	0.65	82	21.2	C
E-6525	13,505	0.65	82	21.2	C
E-1252	22,135	1.25	130	39.3	C
E-1252B	24,435	1.25	130	40	C
E-1602	68,345	1.6	185	56.4	C
E-2503	63,200	2.5	160	94.0	C
E-4010	23,794	0.4	75	18.4	C
E-5015	18,000	0.5	75	11.25	C
E-10011A	19,590	1.0	108	35	C
E-2505	84,205	2.5	218	89	C
1969					
E-153	5,120	0.15	50	5.3	R
E-157A	5,000	0.15	18	5.19	C
E-302B	10,420	0.4	48	11.7	R
E-304A	8,050	0.4	48	12.1	C
E-302A	9,120	0.4	48	11.6	R
E-303A	8,000	0.4	48	12.7	C
E-303B	10,800	0.4	48	10.8	C
E-304A	9,350	0.4	48	12.1	C
E-304B	10,200	0.4	48	13.7	C
E-652A	12,000	0.65	90	21.5	C

Table A.4.3

Excavators, Single Bucket

Model	Price (rubles)	Shovel Capacity (cubic meters)	Horse-power	Weight (metric tons)	Type of Tracking [1]
E-652B	13,505	0.65	82	21.25	C
E-1602	68,345	1.6	180	56.4	C
E-2503	63,200	2.5	218	94	C
E-4010	23,794	0.4	75	18.4	C
E-5015	18,000	0.5	75	11.2	C
E-2505	84,205	2.5	218	89	C
1970					
E-153	5,480	0.15	48	5.3	R
E-157A	5,390	0.15	18	5.24	C
E-302B	10,000	0.4	50	11.7	R
E-304A	8,050	0.4	50	12.07	C
E-302A	9,120	0.4	48	11.7	R
E-304B	8,350	0.4	50	12.07	C
E-304V	10,200	0.4	50	13.7	C
E-352A	7,900	0.4	48	13.0	C
E-652A	13,245	0.65	82	21.5	C
E-6525	14,745	0.65	82	21.25	C
E-1251B	24,105	1.25	116	40.6	C
E-1252B	23,705	1.25	130	40	C
E-1602	59,000	1.60	180	56.4	C
E-2503	57,000	2.5	218	94.0	C

Table A.4.3

Excavators, Single Bucket (continued)

Model	Price (rubles)	Shovel Capacity (cubic meters)	Horse-power	Weight (metric tons)	Type of Tracking [1]
E-2513	7,100	0.25	40	8	C
E-4010	21,600	0.4	75	18.4	R
E-2515	6,000	0.25	48	5.1	R
E-5015	18,000	0.5	75	11.2	C
E-10011A	19,790	1	108	36.5	C
1973					
E-153	5,480	0.15	48	5.3	R
E-302B	9,700	0.4	48	11.7	R
E-303B	10,200	0.4	48	11.6	C
E-304B	8,960	0.4	48	12.3	C
E-304V	10,200	0.4	48	13.5	C
E-652B	13,505	0.65	108	21.25	C
E-1251B	16,300	1.25	122	40.6	C
E-1252B	18,600	1.25	130	41	C
E-2503	45,690	2.5	218	94	C
E-4010	21,100	0.4	75	18.4	R
E-5015	18,000	0.5	75	11.25	C
TE-3M	10,500	0.5	48	20	C
E-1011AS	20,300	1	75	35	C
E-2505	54,500	2.5	218	94	C
EP-1	23,400	1	75	35.6	C

[1] R = rubber tires, C = tracks.

Table A.4.4

Graders

Model	Price (rubles)	Size of the Blade [1] * (square meters)	Horsepower	Weight (metric tons)	With/ Without Elevator	Control Mechanism [2]	Self-Propelled (S) Towed (T)
1961							
D-205	1,050	1.869	... [3]	4.26	w/o	M	T
D-20BM	1,316	1.826	...	3.8	w/o	M	T
D-144	9,700	1.998	100	13.7	w/o	M	S
D-241	800	1.5	...	2.8	w/o	M	T
D-395	27,500	2.59	150	18.2	w/o	M	S
D-437	6,100	...	...	2.8	w	H	T
D-446B	5,016	1.52	65	7.8	w/o	H	S
D-192A	4,750	...	54	9.75	w	M	T
D-265	6,000	1.50	54	8.5	w/o	M	S
D-426	9,500	2.174	110	9.2	w/o	H	S
B-10	4,700	...	75	9.3	w	H	S
D-241M	1,075	1.529	...	2.76	w/o	M	T
1963							
D-20B	1,050	1.869	...	4.26	w/o	M	T
D-144	9,700	1.998	100	13.4	w/o	M	S
D-241	800	1.5	...	2.8	w/o	M	T
D-395	30,000	2.59	150	17.4	w/o	H	S
D-437	6,970	...	...	8.2	w	H	T
D-446	6,000	1.52	65	7.8	w/o	H	S
D-512	5,000	2.169	75	9.0	w/o	H	S
D-192A	4,750	...	...	9.75	w	M	T
D-265	6,100	1.50	54	8.5	w/o	M	S
D-426	9,700	2.174	110	9.2	w/o	H	S
B-10	5,000	...	54	10.1	w	H	S
D-473	34,000	3.825	300	20.0	w/o	H	S
1965							
D-20BM	1,150	1.85	...	4.0	w/o	M	T
D-144	7,000	1.998	100	12.935	w/o	M	S
D-241	950	1.5	...	3.075	w/o	M	T
D-395	25,500	2.597	150	17.6	w/o	H	S
D-437A	6,050	...	...	8.3	w	H	T
D-446B	5,050	1.52	75	7.8	w/o	H	S
D-512	5,700	2.181	75	9.25	w/o	H	S
D-598	5,400	1.52	75	7.8	w/o	H	S

* Footnotes appear at end of table.

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Table A.4.4

Graders (continued)

Model	Price (rubles)	Size of the Blade [1] (square meters)	Horsepower	Weight (metric tons)	With/ Without Elevator	Control Mechanism [2]	Self-Propelled (S) Towed (T)
1972							
D-20BM	1,190	1.826	108	4.26	w/o	M	T
D-144A	11,300	1.998	108	12.7	w/o	M	S
D-241	820	1.529	...	2.8	w/o	M	T
D-395A	35,000	2.59	165	18.27	w/o	H	S
D-395AS	35,300	2.59	165	18.27	w/o	M	S
D-437A	6,720	...	108	8.16	w	H	T
D-710A	7,950	1.520	90	8.7	w/o	H	S
D-598	6,073	1.520	75	7.7	w/o	H	S
D-598A	6,156	1.520	60	8.6	w/o	H	S
D-598B	6,150	1.520	75	8.25	w/o	H	S
D-557	13,500	2.091	110	12.34	w/o	H	S
D-557A	11,000	2.072	108	12.1	w/o	H	S
D-616	20,650	...	...	12.60	w	H	T
D-633	71,000	...	...	33.20	w	H	S
D-557S	14,800	2.072	110	12.34	w/o	H	S
1973							
D-20BM	1,520	1.826	...	3.86	w/o	M	T
D-241A	1,240	1.529	...	2.76	w/o	M	T
D-710A	9,000	1.52	90	8.7	w/o	H	S
D-598	6,180	1.52	75	7.7	w/o	H	S
D-598A	6,540	1.52	90	8.6	w/o	H	S
D-557-1	14,300	2.091	108	12.8	w/o	H	S

[1] Length times height.
[2] M = mechanical; H = hydraulic.
[3] . . . indicates data not applicable to this model.

Table A.4.5

Scrapers

Model	Price (rubles)	Shovel Capacity (cubic meters)	Horsepower	Weight (metric tons)	Width of the Blade (meters)	Control Mechanism [1] *	Self-Propelled (S) Towed (T)
1961							
D-213A	27,000	10	140	9.0	2.830	C	T
D-222	5,660	6.5	100	6.6	2.59	C	T
D-354	2,750	2.75	54	2.4	1.90	H	T
D-357G	18,810	9	165	8.6	2.78	H	S
D-374	5,900	8.0	100	6.5	2.59	C	T
D-392	35,615	15	375	14	2.85	H	S
D-458	2,750	2.75	54	2.2	1.90	H	T
D-498	8,400	6	100	7.3	2.765	H	T
D-511	46,200	15	300	16.28	2.90	H	T
D-541	3,580	3	75	2.28	1.90	H	T
D-373	3,505	2.75	54	10.50	1.90	H	T
D-188A	46,200	15	300	15.75	3.10	C	T
D-222	5,660	6.5	100	6.6	2.59	C	T
D-222A	5,960	6.0	100	6.6	2.59	C	T
D-183B	2,730	2.25	54	2.42	1.65	H	T
D-230	2,515	2.25	54	1.82	1.65	H	T
D-147	5,675	6.0	93	6.0	2.59	C	T
D-468	11,935	4.5	110	6.2	2.60	H	S
D-461	2,890	2.75	54	2.5	1.90	H	T
1965							
D-213A	18,800	10	100	9.5	2.82	C	T
D-357M	18,000	9	180	10	2.72	H	S
D-374	5,820	8	100	6.5	2.592	C	T
D-374A	6,500	8	100	6.6	2.672	C	T
D-458	2,800	2.75	54	2.3	1.90	H	T
D-511	59,800	15	300	16.28	2.85	H	T
D-541	3,520	3	75	2.29	1.90	H	T
D-569	3,500	3	75	2.78	2.10	H	T
D-523	23,000	10	140	8.0	2.80	H	T
1967							
D-213A	24,160	10	180	9.6	2.82	C	T
D-374B	8,620	8	108	6.7	2.67	C	T
D-392	66,900	15	375	14	2.85	H	S
D-458	4,010	2.75	54	2.38	1.90	H	T
D-498	10,490	7	108	7.3	2.65	H	T
D-511	62,400	15	300	16.5	2.85	H	T
D-541	4,510	3	75	2.29	1.90	H	T
D-541A	4,430	3	75	2.385	1.70	H	T

* Footnote appears at end of table.

Table A.4.5

Scrapers (continued)

Model	Price (rubles)	Shovel Capacity (cubic meters)	Horsepower	Weight (metric tons)	Width of the Blade (meters)	Control Mechanism [1]	Self-Propelled (S) Towed (T)
1970							
D-213A	24,160	10	180	9.6	2.82	C	T
D-357G	17,970	9	180	17.1	2.78	H	S
D-374	8,620	8	100	6.5	2.59	C	T
D-374B	8,620	8	108	6.5	2.59	C	T
D-392	66,900	15	360	14	2.15	H	S
D-458	4,010	2.75	54	2.38	1.90	H	T
D-498	10,490	6	108	7	2.60	H	T
D-511	62,400	15	300	16.5	2.85	H	T
D-541	4,510	3	75	2.28	1.90	H	T
D-541A	4,300	3	75	2.39	1.90	H	T
D-569	5,140	3	75	2.75	2.10	H	T
1973							
D-213A	22,440	10	140	9.5	2.82	C	T
D-354	4,300	2.75	54	2.4	1.90	H	T
D-374A	8,550	6	100	7.3	2.67	C	T
D-374B	8,550	8	108	6.7	2.65	C	T
D-392	57,000	15	375	16.55	2.85	H	S
D-498	9,900	7	108	7.0	2.65	H	T
D-511	58,040	15	271	16.5	2.85	H	T
D-541A	4,850	3	74	2.39	2.15	H	T
D-569	5,600	3	74	2.75	2.10	H	T

[1] H = hydraulic, C = cable.

Appendix B

Use of Principal Components

A high degree of correlation among independent variables in a regression equation—that is, multicollinearity—causes instability in the estimates of the standard errors of the regression coefficients.[1] In matrix terminology, the diagonal elements of the $(X'X)^{-1}$ matrix get very large. Since, the diagonal elements multiplied by a constant are, by definition, the estimates of the variances of the regression coefficients of the independent variables, it is precisely these variances which increase. Since the test of the significance of an explanatory variable in the model—the t test—is an inverse function of the square root of its variance,[2] multicollinearity may cause the model builder to drop a variable from the equation which should, in theory, be retained. In other words, multicollinearity may cause imprecision in the estimation process and lead to model misspecification.

In those instances in the study where multicollinearity was a problem, an estimating technique known as principal components regression analysis was used. The use of principal components in a single-equation model is a special form of factor analysis—a technique for examining relationships between variables in a set.

Factor analysis creates artificial variables, which are combinations of the original variables in the data set. Principal components factor analysis is one method of obtaining or creating these artificial variables. The variables are created by using the eigenvectors of the correlation matrix of the original variables as weights. The original linear model can then be rewritten in terms of the principal components and reestimated. Finally, estimates of the regression coefficients in terms of the original variables can be obtained through a retransformation of the coefficients obtained using principal components. Using matrix notation, this procedure can be expressed in mathematical terms as follows:[3]

$Y = XB + \mu$ (original model in matrix notation) (1)

$X =$ matrix of original independent variables

$W =$ matrix whose columns are the normalized eigenvectors

$Z = XW$ (principal components matrix) (2)

$Y = ZW'B + \mu$, where $X = ZW$ (from term 1) (3)

Set $A = W'B$

$Y = ZA + \mu$ (original model transformed using principal components to be estimated by ordinary least squares) (4)

$B = WA$ (transformation of A to ordinary least squares estimate of B) (5)

[1] According to Klein, "multicollinearity is not necessarily a problem unless it is high relative to the overall degree of multiple correlation." That is:

$r_{ij} > R_y$ $\quad r_{ij} =$ correlation between two independent variables.

$R_y =$ multiple correlations between dependent and independent variables.

See L. R. Klein, *An Introduction to Econometrics* (Englewood Cliffs, N. J.: Prentice-Hall, 1962), p. 101.

[2] $t = \beta_i / (VAR\, \beta_i)^{1/2}$.

[3] For a complete derivation of the principal components of a matrix X, see T. W. Anderson, *An Introduction to Multivariate Statistical Analysis* (New York: Wiley, 1958).

Appendix C

Estimating the Change in Wage and Material Costs, By Branch of Machine Building

An estimate of the change in wage and material costs by branch of the machine-building and metalworking sector was obtained using data contained in the reconstructed 1966 Soviet input-output table in producers prices. Very briefly, for each MBMW branch the major material inputs were identified in the I/O tables. Each input was expressed as a percentage of the total material purchases (less taxes on material purchases) of that sector. This weight was multiplied by the change in price of the corresponding input over the 1966-70 period. Estimates of price changes effected in the 1966-70 period were those decreed by the Price Office of GOSPLAN, found in *Studies in Soviet Input-Output Analysis.*[1]

Material inputs from other MBMW branches make up a significant portion of total material purchases. Hence, for the exercise to be meaningful, they had to be included. Therefore, intra-MBMW material purchases were aggregated into a single category and moved forward to 1970 using Mitrofanova's price index of machinery and equipment.[2] No change was assumed in the price of the remaining material purchases not accounted for—usually 20 percent or less. The total change in material costs over the 1966-70 period was calculated by summing the weighted individual input price changes. This estimate of the change in material costs for each sector was then multiplied by the weight of total material purchases (less taxes on material purchases) to total sector outlays (less tax on material purchases). These figures are shown in column 7 of table C-1.

[1] V. G. Treml and G. D. Guill, "Conversions of the 1966 Producers' Price Input-Output Table to a New Price Base," in *Studies in Soviet Input-Output Analysis* ed. by V. G. Treml (New York: Praeger Publishers, 1977), pp. 197-281.
[2] See the section "Conflicting Claims Regarding Inflation in Machinery Prices," pp. 1-5, above.

The change in wage costs were accounted for by assuming that the average wage in MBMW was applicable to each branch. In reality Soviet sources indicate that wage differentials between MBMW branches are as high as 19 percent. Unfortunately, wage data for individual MBMW branches are not available. Therefore, the change in the average wage for overall machine building was used and multiplied by each sector's total wage bill as a percent of total outlays. The results are shown in column 9 of table C-1.

Finally, the portion of total outlays other than material purchases and wages was calculated (column 10). It was assumed that such costs remained constant over the period since information on MBMW industry profits and on other cost items included in the other net income line of the I/O tables is not available. The total change in costs by industry of MBMW was obtained by summing the change in material, wage, and other costs (column 11).

Table C-1

Calculating the Change in Wage and Material Costs, By Branch of Machine Building

	1966 Total Material Purchases [1] (Less Tax on Purchases) (thousand rubles)	1966 Total Outlay [1] (Less Tax on Purchases) (thousand rubles)	Materials Weight (W_1) (1)÷(2)	1966 Wages [1] (thousand rubles)	Wages Weight (W_2) (4)÷(2)	1970 over 1966 Material Price Ratio [1]	Change in Material Costs (3)×(6)	1970 over 1966 Wage Rate Ratio [2]	Change in Wage Costs (5)×(8)	1-(W_1+W_2)	Total Cost Change (7)+(9)+(10)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Energy and power M&E	720,023	1,433,894	0.502	303,908	0.212	1.307	0.656	1.262	0.268	0.286	1.210
Electrotechnical M&E	2,598,344	4,914,031	0.529	843,224	0.172	1.198	0.634	1.262	0.217	0.299	1.150
Cable production	822,275	1,283,172	0.641	89,843	0.070	1.136	0.728	1.262	0.088	0.289	1.105
Machine tools [2]	378,032	881,198	0.429	250,871	0.285	1.264	0.542	1.262	0.360	0.286	1.188
Forging and pressing M&E	69,241	196,256	0.353	46,647	0.238	1.270	0.448	1.262	0.300	0.409	1.157
Casting M&E	13,207	36,534	0.361	11,246	0.308	1.229	0.444	1.262	0.389	0.331	1.164
Tools and dies	203,762	507,191	0.402	130,739	0.258	1.472	0.592	1.262	0.326	0.340	1.258
Precision instruments	811,267	2,251,847	0.360	642,706	0.285	1.224	0.441	1.262	0.360	0.355	1.156
Minerals and metallurgical M&E	761,201	2,552,930	0.298	498,292	0.195	1.277	0.381	1.262	0.246	0.507	1.134
Pumps and chemical equipment	705,715	1,555,026	0.454	259,562	0.167	1.263	0.573	1.262	0.211	0.379	1.163
Logging and paper M&E	61,040	122,567	0.498	25,432	0.207	1.289	0.642	1.262	0.261	0.295	1.198
Light industry M&E	195,525	511,624	0.382	135,212	0.264	1.181	0.451	1.262	0.333	0.354	1.138
Food industry M&E	176,206	387,918	0.454	73,996	0.191	1.274	0.578	1.262	0.241	0.355	1.174
Printing M&E	13,141	48,973	0.268	13,930	0.284	1.207	0.323	1.262	0.358	0.448	1.129
Hoisting and transporting M&E [2]	454,770	787,796	0.577	115,787	0.147	1.283	0.740	1.262	0.186	0.276	1.202
Construction M&E [2]	559,105	942,220	0.593	132,145	0.140	1.276	0.757	1.262	0.177	0.267	1.201
Construction material M&E	105,100	228,290	0.460	42,557	0.186	1.294	0.595	1.262	0.235	0.354	1.184
Transportation M&E	2,230,015	3,721,713	0.559	543,459	0.146	1.277	0.765	1.262	0.182	0.257	1.204
Automobiles [2]	2,801,303	4,348,467	0.644	691,142	0.159	1.245	0.802	1.262	0.201	0.197	1.200
Agriculture M&E	2,723,691	4,408,666	0.618	833,384	0.189	1.283	0.793	1.262	0.239	0.193	1.225
Bearings	183,107	457,684	0.400	145,692	0.318	1.335	0.534	1.262	0.401	0.282	1.217
Radio and other machine building	6,106,686	9,457,069	0.646	1,920,195	0.203	1.239	0.800	1.262	0.256	0.151	1.207

Sources:

1. Barry C. Kostinsky, *The Reconstructed 1966 Soviet Input-Output Table: Revised Purchasers' and Producers' Price Table,* Foreign Economic Report no. 13, U.S. Department of Commerce (September 1976).

2. The change in the average wage of the machine-building sector was calculated from data in *Trud v. SSSR* (Moscow: *Izdatel'stvo Statistika,* 1978) p. 141 and *Vestnik Statistiky,* no. 11 (1972) pp. 93, 94. The average wage in 1966 was 1,278 rubles and for 1970 was 1,613 rubles.

[1] These estimates can be obtained from the author. The methodology used to obtain them is explained above.

[2] This industry was analyzed in this paper.

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Appendix D

Estimating the Change in Production Costs Per Unit of Output Produced, By Branch of Machine Building

Appendix C presents the methodology, data sources, and calculations for estimating the change in total production costs by machinery branch. This appendix presents the same information for calculating production costs on a per unit of real output basis.

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Table D-1

Unit Cost Analysis of Seven Soviet Machine-Building Branches

	Wages [1] (thousand rubles)		Material Purchases [1] (thousand rubles)		Total Purchases (thousand rubles)		Value of Output [2] (thousand 1970 rubles)	
	1966 (1)	1972 (2)	1966 (3)	1972 (4)	1966 (5) (1)+(2)	1972 (6) (2)+(4)	1966 (7)	1972 (8)
Energy and Power M&E	303,908	322,000	726,973	840,945	1,030,881	1,162,945	1,512,886	1,325,894
Electrotechnical M&E	843,224	1,253,000	2,613,315	3,895,847	3,456,539	5,148,847	4,633,262	5,196,720
Mining and metallurgy M&E	498,292	540,000	770,062	1,384,660	1,268,354	1,924,660	2,669,386	3,072,201
Hoisting and Transporting M&E [1]	115,787	174,000	456,769	802,598	572,556	976,598	829,284	1,274,775
Construction M&E [1]	132,145	198,000	561,570	1,025,393	693,715	1,223,393	944,685	1,326,888
Transportation M&E	534,459	804,000	2,243,270	3,176,890	2,777,729	3,980,890	3,921,719	6,052,894
Automobiles [1]	691,142	1,248,000	2,819,462	5,904,519	3,510,604	7,152,519	4,283,113	9,305,564

Sources:
1. US Department of Commerce, *The Reconstructed 1966 Soviet Input-Output Table: Revised Purchasers' and Producers' Price Tables,* Foreign Economic Report no. 13, September 1967; and *The Reconstructed 1972 Soviet Input-Output Table in Producers' Prices,* May 1979, unpublished.
2. CIA, Office of Economic Research, Soviet industrial production data.

[1] This industry was analyzed in this paper.

Total Unit Costs		Unit Labor Costs		Unit Material Costs		Employment [1] (thousand man-years)		Labor Productivity Rubles per Man-Year	
1966 (9) (5)÷(7)	1972 (10) (6)÷(8)	1966 (11) (1)÷(7)	1972 (12) (2)÷(8)	1966 (13) (3)÷(7)	1972 (14) (4)÷(8)	1966 (15)	1972 (16)	1966 (17) (7)÷(15)	1972 (18) (8)÷(16)
0.681	0.877	0.201	0.243	0.481	0.634	237.8	176.3	6,372	7,521
0.746	0.991	0.182	0.241	0.564	0.750	659.8	755.8	7,022	6,876
0.475	0.626	0.187	0.176	0.288	0.451	389.9	249.6	6,846	12,308
0.690	0.766	0.140	0.136	0.551	0.630	90.6	100.3	9,153	12,710
0.734	0.922	0.140	0.149	0.594	0.773	103.4	114.9	9,136	11,548
0.708	0.658	0.136	0.133	0.572	0.525	418.2	442.0	9,378	13,694
0.820	0.769	0.161	0.134	0.658	0.635	540.8	722.1	7,920	12,887

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