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Investment in the Soviet Economy: A Comparative Perspective

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Summary

The discussion of Soviet consumption had emphasized its low priority in resource allocation. By contrast, capital investment has enjoyed a high priority since central planning was first introduced a half century ago. While Soviet per-capita consumption levels have barely exceeded a third of US levels in recent years, Soviet per-capita investment levels have approached their US counterparts and have exceeded them in the aggregate. Soviet performance has been particularly favorable in the producer durables component of fixed investment.

In dynamic terms, too, the strenuous Soviet investment priority has been conspicuous. Since 1955 Soviet fixed investment has increased approximately three times as rapidly as the US rate, while at the same time prices of investment goods and services have risen much more gradually for the USSR.

If Soviet investment performance is evaluated in the perspective of a larger grouping of the principal industrial market economies and socialist Hungary, additional interesting features emerge. Both the USSR and Hungary devote a higher proportion of their national product to investment than their relative levels of per capita GNP would predict in terms of economic theory. If residential investment if excluded, their investment proportions appear even more abnormal.

While Soviet per capita investment levels have attained parity with those of the United States, they remain considerably below those for France, Germany, and Japan. They are glaringly low for housing investment and rank high only for producer durables. As for investment dynamics, Soviet investment growth rates are higher for all types of capital investment other than housing.

However, the more rapid Soviet investment growth rates and the high investment proportions mix have not yielded commensurately higher returns in terms of GNP growth. The increments to GNP obtained by cumulative non-residential investment in both the 1960s and 1970s for the USSR have been significantly below similar returns for France, Germany, Italy, and Japan, although higher than the yields for the United Kingdom and the United States. Furthermore, the rate of return has deteriorated markedly since 1970. The possible explanations for this unfavorable position and trend include (a) the heavy construction content of Soviet investment, (b) the relative neglect of replacement investment with its more rapid payoff, and (c) the structural composition of investment with its unusually large agricultural emphasis, favoring a sector beset by marginal weather conditions and chronic organizational problems.

The high investment priority with its connotation of relative production efficiency is also reflected in the relatively high purchasing power parity (PPP) of the ruble for this type of

expenditure. In 1976 the number of rubles per dollar required to purchase investment goods and services was .374 for the Soviet mix and .484 for the US mix. By contrast, the equivalent PPPs for consumption were .473 and .700. Within the investment grouping the PPP of the ruble was especially favorable for producer durables--.295 and .469, respectively; for the inefficient construction component the respective ratios were .450 and .495. The inefficiency of the Soviet construction sector is illustrated in the multilateral comparison by the lower PPP for construction than for producer durables. By contrast, for the five market economies and Hungary, construction has the higher PPP.

I. Introduction

The current study represents the second comprehensive estimation of comparative investment expenditures in the USSR and the US. Previous studies relied upon comprehensive comparisons of 1955 rubles and dollars. The present comparisons are based upon updated ruble-dollar ratios. These ratios, in turn, reflect the last comprehensive Soviet price reform in 1967, with modifications for producer durables in 1970. The US prices are those of 1972. Both Soviet and US base year prices have been updated to 1976 by appropriate price indexes.

The initial 1955 comparison was undertaken by the Office of

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1. CIA/RR ER 61-7, A Comparison of Capital Investment in the US and the USSR, 1950-59, February, 1961.

Economic Research of the Central Intelligence Agency, 1/ the producer durables portion of which was based upon research of Abraham Becker. 2/ As explained later in this study, the original 1955 comparisons was later revised by Rush Greenslade in an unpublished manuscript. Subsequently, another set of comparisons with similar results was prepared by Professor Abram Bergson as a major input into his estimates of Soviet and US levels of gross national product. 3/ Bergson based his estimates on Becker's study and a CIA study of construction ruble-dollar ratios. 4/

II. Price Ratios Used in the Comparisons

Although the objective of this analysis is an evaluation of the Soviet investment effort in a comparative perspective, it is first desirable to discuss the ruble-dollar price ratios which underlie the comparative measures of investment expenditures.

The general methodology for derivation of the ratios has been described in detail in the foregoing discussion of Soviet consumption and need not be duplicated here. Therefore, the discussion will be limited to specifics of derivation of the investment ratios.

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2. Rand Corporation, Prices of Producer Durables in the United States and the USSR in 1955 (RM-3432), August 15, 1959.

3. Abram Bergson, "The Comparative National Incomes of the Soviet Union and the US" in D. J. Daly (ed.), International Comparisons of Prices and Output, National Bureau of Economic Research, 1972.

4. CIA/RR ER 64-26, 1955 Ruble-Dollar Ratios for Construction, August 1964.

Ratios have been derived separately for the two basic components of capital investment--construction and producer durables. The detailed derivation of the construction ratios is described in Appendix A and the derivation of the producer durables ratios in Appendix B. The basic construction ratio study was prepared by Ray Converse and the producer durables study by John Keilty and Earl Rubenking of the Office of Economic Research, Central Intelligence Agency. For the interested reader the details of the derivation of the respective ratios are to be found in the basic studies referenced in the appendixes. Refinements of the basic findings are also described in the appendixes.

In 1976 the number of rubles per dollar required to purchase investment goods and services was .374 for Soviet-weighted and .484 for US-weighted ratios, while the equivalent required for purchase of consumer goods and services was .473 and .700, respectively. Within the investment grouping the ruble-dollar ratios were especially favorable for producer durables--.295 and .469, respectively. For the less efficient construction sector the respective ratios were .450 and .495.

The ruble-dollar ratios in 1976 for the full spectrum of investment expenditures are presented in table 1.

Although the same basic methodology has been used in the 1955 and 1976 comparisons, the information base was considerably larger and more representative for the later study, as noted in

TABLE 1

RUBLE-DOLLAR RATIOS FOR CATEGORIES OF FIXED INVESTMENT IN 1976

Category	Soviet-weighted ruble-dollar Ratios	US-weighted ruble-dollar Ratios
Producer durables a/	.295	.469
Transportation equipment	.351	.455
Tractors and agricultural machinery	.225	.277
Instruments	.361	.625
Energy and power equipment	.261	.264
Construction machinery	.195	.266
Mining, oil field and metallurgical machinery	.172	.246
Pumps, compressor, and materials handling equipment	.208	.250
Specialized industrial equipment and aircraft	.641	.637
Construction b/	.450	.495
Industry	.469	.495
Agriculture	.526	.527
Transportation and communication	.568	.595
Services	.382	.464
Construction sector	.526	---
Housing	.405	.486
Capital repair c/	.398	---
New fixed investment d/	.374	.484
Total fixed investment e/	.374	.484

a. See Appendix B for derivation of ratios.
b. See Appendix A for derivation of ratios.
c. See Appendix C for discussion of capital repairs estimates.
d. Producer durables plus construction.
e. Producer durables plus construction plus capital repair.

detail in the Appendices A and B. Therefore, any detailed comparisons of the 1955 and 1976 findings would have to be qualified for the foregoing reason to such an extent that the conclusions would have dubious validity. Nevertheless, in subsequent discussion the earlier ratio will be used to derive implicit price deflators for major investment categories.

A. Bias in the Computed Ratios

Any aggregate economic comparison between countries with considerably differing degree of economic development contains a built-in bias. While the lesser developed economy produces goods and services utilizing technologies which have been superseded by more advanced processes in the more developed economy, it is still possible to synthesize prices for these goods and services in the more developed country. When the more developed nation produces products beyond the technological capability of the lesser developed country, establishing price ratios is much more difficult. There is simply no reliable way to synthesize prices for goods in the less developed country that require technology beyond its current capability. Thus, the sample of goods and services is biased in favor of the less developed economy. The more advanced economy's production capability is understated, and there is a commensurate understatement of the PPP of its currency relative to that of the less developed country.

This general qualification applies to the Soviet-US binary comparison and, by indirection, to Soviet comparisons with the other market economies in the multilateral measures. In calculating producer durables ratios Keilty and Rubenking estimated that lower Soviet performance standards impart a downward bias of 4 percent to the ratios. 5/ They also selectively illustrate inferior durability of Soviet durables, but lack the data to suitably adjust the ratios. In the construction ratio calculations, the highest quality Soviet projects were compared against the lowest quality US examples, thus excluding higher quality US construction from the sample. A third element of downward bias is contributed by over-statement of the PPP of the ruble in capital repair expenditures (see Appendix C).

II. Comparison of Soviet and US Investment in 1976

While the United States has much higher consumption levels than the USSR, especially in per capita terms, the Soviet investment effort exceeded that of the United States in the aggregate in 1976 and approached parity in per capita terms. Such a result is not unexpected, given the high proportion of Soviet GNP that has been devoted to investment since central planning was introduced a half century ago (table 2).

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5. National Foreign Assessment Center, USSR and US Price Ratios for Machinery 1967, Rubles - 1972 Dollars, Volume I, pp. 44-48.

TABLE 2
US AND USSR: COMPARISON OF FIXED INVESTMENT EXPENDITURES IN 1976 a/
(Billions of national currency units)

Category	Dollars			Rubles			Geometric Mean
	USSR	US	USSR/US Percent	USSR	US	USSR/US Percent	USSR/US Percent
New fixed investment	316.3	278.0	113.8	117.4	134.6	87.2	99.6
Construction	155.3	161.6	96.1	69.9	80.0	87.4	91.6
Producer durables	161.0	116.4	138.3	47.5	54.6	47.0	109.7
Capital repair	38.2	--	--	14.2	--	--	--
Total fixed investment	354.5	278.0	127.5	132.6	134.6	98.5	112.1

a. For derivation of US dollar and Soviet ruble estimates, see Appendix C.

The dollar comparison gives the Soviet economy a decided advantage, while the lower limit ruble comparison shows a somewhat lesser margin in favor of the United States. The compromise geometric mean comparison shows parity for new investment, but a decided Soviet advantage if capital repairs are included. The heavy reliance on capital repairs in the Soviet investment scheme contributes to the low productivity of Soviet investment, because this component of investment necessarily prolongs the lives of obsolescent assets.

If the investment comparison is recalculated in per capita terms, the Soviet margin is significantly eroded. For new investment the Soviet advantage disappears, irrespective of which country's prices are used. Even the inclusion of capital repairs yields a Soviet margin only if dollar measurements are used (table 3).

Of the two principal investment components, the Soviet margin is larger for producer durables than for construction. Only in the durables category is there a clear Soviet margin in total expenditures. Since construction comprises a larger proportion of investment expenditure in the USSR, the ruble-dollar relationship must be less favorable for this activity. The difference reflects the relative inefficiency of the Soviet construction sector, discussed below in connection with the multilateral investment comparisons.

TABLE 3
US AND USSR: COMPARISON OF PER CAPITA EXPENDITURES
ON FIXED INVESTMENT IN 1976
(national currency units)

Category	Dollars			Rubles			Geometric Mean
	USSR	US	USSR/US Percent	USSR	US	USSR/US Percent	USSR/US Percent
New fixed investment	1,232	1,292	95.4	475	626	73.0	83.5
Construction	605	751	80.5	272	372	73.1	76.7
Producer durables	627	541	115.9	185	254	72.8	91.9
Capital repair	148	--	--	55	--	--	--
Total fixed investment	1,380	1,292	106.8	516	626	82.4	93.8

TABLE 4
US AND USSR: COMPARISON OF CONSTRUCTION COMPONENTS
OF FIXED INVESTMENT EXPENDITURES IN 1976 a/
(Billions of national currency units)

Category	Dollars			Rubles			Geometric Mean
	USSR	US	USSR/US	USSR	US	USSR/US	USSR/US
All construction	155.3	161.6	96.1	69.9	80.0	87.3	91.6
Industry	37.9	27.7	136.8	17.5	13.7	129.9	133.3
Agriculture	24.0	2.6	923.1	12.6	1.4	900.0	911.5
Transportation and communication	9.5	18.6	51.1	5.4	11.1	48.6	49.8
Commerce, education, health, municipal	28.7	44.2	64.9	11.0	20.5	53.7	59.0
Construction industry	2.7	**	n.a.	1.4	b/	n.a.	n.a.
Housing	37.9	67.4	55.0	15.1	32.8	46.0	50.3
Undistributed c/	15.4	n.a.	n.a.	6.3	n.a.	n.a.	n.a.

a. See Appendix A for derivation of ruble-dollar ratios and expenditure weights.
b. Investment in this sector is not reported separately in US statistics.
c. Construction outlays listed under "other capital work and expenditures" in official statistics. They are not designated by sectors.

Although the comparisons in table 3 illustrate the high priority accorded to investment in the USSR, a finer perception of the differences between Soviet and US economic priorities may be obtained if both construction and producer durables investment are decomposed into their principal components.

The contrast of construction priorities between the two economies is striking (table 4). While the Soviet effort is directed toward increasing industrial and agricultural production capacity, the US emphasis is upon consumer-oriented activities like housing, personal services, and commerce. Even the heavier US transportation investment commitment is largely explained by highway construction with its heavy consumer orientation. The low Soviet priority for housing is especially conspicuous. In these comparisons the differences between the dollar and ruble measures are minimal.

If the capital repair of buildings and structures is included among Soviet construction components, total construction would rise by about 12 percent in both dollars and rubles. No conceivable distribution of this small increment among construction categories would alter the conclusion about sharply contrasting construction priorities.

A similar impression of sharply contrasting priorities is conveyed by comparison of the composition of capital investment in producer durables in the two economies (table 5).

TABLE 5
US AND USSR: COMPARISON OF PRODUCER DURABLES COMPONENTS OF NEW FIXED INVESTMENT IN 1976 a/
(Billions of national currency units)

Category	Dollars			Rubles			Geometric Mean
	USSR	US	USSR/US	USSR	US	USSR/US	USSR/US
Total producer durables	161.0	116.4	138.3	47.5	54.6	87.0	109.7
Transportation equipment	19.3	29.6	65.2	6.8	13.5	50.4	57.3
Tractors and agricultural machinery	22.6	9.1	248.4	5.1	2.5	204.0	225.1
Instruments	11.1	14.8	75.0	4.0	9.3	43.0	56.8
Energy and power equipment	21.0	11.4	184.2	5.5	3.0	183.3	183.7
Construction machinery	13.2	4.4	300.0	2.6	1.2	216.7	255.0
Mining, oil field, and metallurgical machinery	35.3	6.1	578.7	6.1	1.5	406.7	485.1
Pumps, compressors, materials handling equipment	16.8	6.4	262.5	3.5	1.6	218.8	239.7
Specialized industrial equipment and aircraft b/	21.9	34.7	63.1	14.1	22.1	63.8	63.4

a. See Appendix B for derivation of ruble-dollar values and expenditures weights.
b. Includes communication equipment and equipment for following industries: logging, textiles and apparel, food, printing, and services.

Soviet producer durables investment is focused on expansion of heavy industrial and agricultural production and on construction. By contrast, the US emphasis is on expansion of consumer goods production and services, and automation (purchase of instruments) of existing industrial and services technologies. The higher degree of sub-contracting in US industry and the widespread personal ownership of vehicles and electronic products probably explains the heavier emphasis on transportation and communication equipment in the United States.

As in the comparison of construction patterns, the currency chosen as the unit of measurement does not affect the impression of a marked contrast in priorities, nor would the inclusion of capital repairs of producer durables.

IV. Comparative Trends in Soviet and US Investment

There are two alternative approaches to estimating relative trends in Soviet and US investment expenditures. One approach compares indexes of investment in constant prices (table 6); the other compares levels of expenditures for the two countries in different benchmark years, as calculated with the help of ruble-dollar ratios derived for those years (tables 2 and 7).

Over the period 1956-77, Soviet investment expenditures increased three times as rapidly as those of the United States. The Soviet margin was greater for producer durables and somewhat less for construction. For total investment the compound growth

TABLE 6
US AND USSR: INDEXES OF FIXED INVESTMENT EXPENDITURES a/
(Constant prices, 1955=100)

Category	1965		1970		1975		1976		1977	
	USSR	US	USSR	US	USSR	US	USSR	US	USSR	US
New fixed investment	241.9	149.7	228.7	160.9	485.5	156.9	519.4	166.7	540.3	182.6
Constuction	204.7	143.9	280.1	143.2	365.1	130.2	375.0	139.5	383.7	151.7
Producer durables	326.3	162.7	483.4	164.3	757.9	217.6	824.2	228.8	894.7	252.9
Capital repairs	242.9	--	286.0	--	370.4	--	542.9	--	571.4	--
Total fixed investment	242.0	149.7	333.4	160.9	473.9	156.9	521.7	166.7	543.5	182.6

a. For Soviet indexes see John Pitzer "USSR: Gross National Product, 1950-80 Appendix B." For US indexes see Appendix C.

TABLE 7
US AND USSR: COMPARISON OF FIXED INVESTMENT IN 1955 a/
(Billions of national currency units)

Category	Dollars			Rubles			Geometric Mean
	USSR	US	USSR/US Percent	USSR	US	USSR/US Percent	USSR/US Percent
New fixed investment	29.9	46.6	42.9	19.6	57.0	34.4	38.4
Construction	17.0	46.6	36.5	14.2	39.7	35.8	36.1
Producer durables	12.9	23.1	55.8	5.4	17.3	31.2	41.7
Capital repairs	3.2	--		2.0	--		
Total fixed investment	33.1	69.7	47.5	21.6	57.0	37.9	42.4

a. Estimates in Central Intelligence Agency, A Comparison of Capital Investment in the US and USSR, 1950-59 (CIA/RR ER 61-7), February 1961, as revised by Rush Greenslade. Greenslade's revisions were subsequently used as the basis for Soviet-United States GNP comparisons appearing in annual CIA, Handbook of Economic Statistics publications.

rate for the Soviet Union was 8.0 percent and for the United States 2.8 percent. The respective growth rates for construction were 6.3 and 1.9 percent and for producer durables, 10.5 and 4.3 percent.

If the aggregate geometric mean investment comparisons for 1976 in table 2 were moved backward to 1955 by the indexes in table 6, the ratio of Soviet to US expenditures would be reduced to about a third and per capita expenditures to about a quarter. This simplified procedure assumes, however, that relative prices have remained constant in both economies, while in actuality rapid technological progress and changes in demand have led to significant price changes.

Therefore, the second approach, which takes relative price changes into account, is more appropriate. In a 1955 comparison based on ruble-dollar ratios computed for 1955 the ratio of Soviet to US fixed investment is between 38 and 48 percent in the aggregate and between a third and two-fifths in per capita terms depending on whether the comparison are in rubles or in dollars (tables 7 and 8).

If the findings in the 1976 ruble-dollar ratio calculations (tables 2 and 3) are compared with those in the 1955 ruble-dollar ratio calculations (tables 7 and 8), over the more than two decades since 1955 Soviet investment has risen dramatically in comparison with that of the United States. From an aggregate proportion of two-fifths of the US effort (geometric mean

TABLE 8
US AND USSR: COMPARISON OF PER CAPITA FIXED INVESTMENT IN 1955
(National currency units)

Category	Dollars			Rubles			Geometric Mean
	USSR	US	USSR/US Percent	USSR	US	USSR/US Percent	USSR/US Percent
New fixed investment	153	420	36.4	100	343	29.2	32.6
Construction	87	281	31.0	72	239	30.1	30.5
Producer durables	66	139	47.5	28	104	26.9	35.7
Capital repairs	16	--		10	--		
Total fixed investment	169	420	40.2	110	343	32.1	35.9

comparison), by 1976 it was higher. In per capita terms it has risen to near parity from a proportion only a bit more than a third as large.

V. The Soviet Investment Effort in a Multilateral Perspective

Although the bilateral comparison of Soviet and US investment patterns provides perspective on Soviet policies, an even more informative impression may be obtained if the comparison is expanded to include the other major market economies, as well as Hungary, a smaller socialist economy. A principal reason for introducing this broader comparison is the marked differences between the investment efforts of the United States and some other market economies.

Before comparing the 1976 investment structures of the eight countries, it would be worthwhile to compare the countries in terms of relative per capita GNP levels (table 9).

If international prices are used as the standard, 6/ the economies fall into three groups: France and Germany have around 80 percent of US per capita GNP, Japan about 2/3 and the United Kingdom about 3/5, and Italy, Hungary, and the USSR slightly below half.

This comparison of relative income levels should be juxtaposed against the proportions of GNP devoted to capital investment and its principal components to gain impressions of

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6. See Appendix D for a discussion of the "international prices" methodology.

TABLE 9
PER CAPITAL LEVELS OF GNP - 1976 a/
(International prices) (US=100)

Country	US Prices
France	81.9
Germany	79.6
Japan	66.6
United Kingdom	60.3
Italy	48.7
USSR	58.0
Hungary	48.0
United States	100.0

a. See contribution by Margaret Hughes for derivation of estimates.

each country's relative investment efforts (table 10).

Basic economic theory, whether neo-classical or Keynesian, states that investment and savings are rising functions of per capita income. The precept assumes that consumer sovereignty prevails and that state decision making affects a comparatively small share of available resources. According to this principle the investment ratio should be lower for the less developed economies in the sample.

Both the USSR and Hungary invest a higher proportion of GNP than the theory would predict (table 10). Of course, the ability of the state to directly control the rate of investment and savings explains this apparent aberration. However, the theory cannot explain why the US investment ratio is below that of France, Germany, and Japan, let alone that of Italy. Whatever the shortcomings of the theory, one may conclude that Soviet and Hungarian investment efforts are large.

What characterizes the Soviet investment effort is not only its aggregate ratio, but its composition. Residential construction comprises a much lower share of GNP and non-residential construction an unusually high share. (The differences in the attention paid to housing in the Soviet Union and Hungary compared with other countries is striking and can only be explained by further research on Soviet and East European investment policies.) If only non-residential performance is analyzed, the "abnormal" Soviet and Hungarian efforts are even more conspicuous.

TABLE 10
MULTILATERAL COMPARISON OF FIXED INVESTMENT RATIOS IN 1976 a/
(Percent of GNP)

Country	Residential construction	Other construction	Producer durables	Total fixed investment	Total non-residential investment
United States	3.9	5.6	6.9	16.4	12.5
France	7.1	6.7	9.5	23.3	16.2
Germany	5.8	6.7	8.2	20.7	14.9
Japan	7.7	12.3	10.9	30.9	22.3
United Kingdom	3.8	6.9	8.7	19.4	15.6
Italy	5.6	5.8	8.6	20.0	14.4
USSR - I b/	2.8	10.4	9.0	22.2	19.4
USSR - II b/	3.1	11.4	10.5	25.0	21.9
Hungary (1973) c/	5.4	12.5	11.7	29.6	24.2

a. OECD, National Accounts, 1960-1977, except for USSR and Hungary.
b. See Appendix C. USSR - I excludes and USSR- II includes capital repairs.
c. ICP, Phase II.

If the results of the Soviet investment effort are to be compared with those of other major industrialized countries, investment efforts of each economy must be recalculated into a common currency. Ideally, the procedure would be that followed in the bilateral comparisons presented above; investment expenditures of each country in the sample would be valued in the country's own currency and in rubles with expenditure weights similarly computed. This ideal is not practical for the multilateral comparison, so an expedient has been adopted which draws upon the research of Professor Irving Kravis and his team, prepared for the United Nations.

Kravis has computed bilateral comparisons between the United States and other countries, except for the USSR, in the sample used in this study. 7/ Comparisons between pairs of countries other than the United States, in effect, are calculated through the common medium of dollar denominated international prices. Of the three possible weighting schemes used in the Kravis calculation, that of international prices is the only valid method for comparing outputs of more than two countries simultaneously.

The bias introduced by using international prices is to overstate the expenditures of less developed economies and relatively understate those of the most developed. Since the sample of countries is confined to industrialized economies, the

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7. See Appendix D for a discussion of the Kravis team's methodology.

degree of bias is probably not large. It is certainly less than would result from using US prices.

For the US-USSR comparison geometric means were used to compare investment expenditures by category. This procedure closely resembles international prices in its results, as shown by such close identity in the Kravis study.

For total fixed investment the effect of using the other countries own prices rather than US prices is on the ratio of investment in the given country to investment in the United States. The difference is 28 percent for the Soviet Union and only between 3 and 12 percent for the other market economies and Hungary. For construction alone, the difference in using own country prices rather than US prices differs little among the countries--9 percent for the USSR compared with a range of 2 to 11 percent for the other six countries. For producer durables investment, however, the spread in comparisons in different prices is much wider for the USSR--59 percent compared to a range of 5 to 32 percent for the other market economies and Hungary. 8/ It must, therefore, be concluded that the bias introduced by using US prices particularly overstates the relative size of the Soviet investment effort.

In a multilateral comparison Soviet per capita total fixed investment expenditures straddle those of the United States, (table 11). They are considerably below those for France,

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8. See Appendix D for the derivation of these estimates.

Germany, and Japan and far above those of Italy, the United Kingdom, and Hungary. Soviet housing investment is far below housing investment in other countries in the comparison, including socialist Hungary, tending to confirm the general impression of neglect of housing by Soviet planners.

For non-residential construction Soviet results are more respectable, but still far below those for the three market economies with the most concerted investment efforts. Again, Soviet inefficiency in construction is particularly marked, when one considers that the French and Germans devote half the Soviet proportion of GNP to this purpose.

In per capita investment in transport equipment the Soviets rank far behind the United States, but at about the same level as the United Kingdom and Japan. Even in investment in other durables the Soviets fall below France, Germany, and Japan. Relative Soviet production efficiency in this area is evident from comparisons with France and Germany. While Soviet per-capita GNP is only 70 percent of these two economies, the Soviet per capita investment ratio for other producer durables is just below parity.

Soviet investment performance is best conveyed in the comparison of non-residential investment. Here it straddles the United States, but is considerably below France, Germany, and Japan. Thus, Soviet allocation priorities not only induce an investment effort higher than that which would probably prevail

TABLE 11

MULTILATERAL COMPARISONS OF PER CAPITA FIXED INVESTMENT AND ITS PRINCIPAL COMPONENTS IN US DOLLARS IN 1976 (INTERNATIONAL PRICES) (US = 100)a/

Country	Residential construction	Other construction	Total construction
France	146.8	145.6	145.9
Germany	120.7	176.1	149.9
Japan	132.0	131.6	131.3
United Kingdom	83.0	61.9	70.4
Italy	74.9	69.6	71.8
USSR - I	42.2	101.1	76.6
USSR - II	49.2	117.0	89.1
Hungary	72.7	109.9	96.1

Country	Transport equipment	Other durables	Total durables	Total non-residential investment	Total fixed investment
France	60.0	122.8	102.6	117.0	123.5
Germany	80.8	118.6	105.9	129.0	126.0
Japan	45.7	122.5	96.9	108.7	113.7
United Kingdom	49.0	78.6	68.9	66.8	70.2
Italy	33.2	50.4	46.3	54.2	58.2
USSR - I	48.0	106.5	91.9	96.1	83.4
USSR - II	51.8	115.1	99.4	105.7	93.8
Hungary	n.a.	n.a.	54.5	74.2	74.1

a. See Appendix D. In the comparisons involving the USSR, Variant I excludes capital repair and Variant II includes capital repair.

under consumer sovereignty, but further magnify this effort by restraining the investment claim of the housing sector.

VI. Investment Trends in a Multilateral Perspective

The more rapid growth in capital investment expenditures in the USSR, as compared with the United States, can be extended to comparisons with the other major market economies in somewhat lesser degree. In both the 1960s and the 1970s the Soviet economy has been a laggard in residential investment, but has increased non-residential construction and producer durables investment considerably more rapidly than most of the major market economies. The Soviet growth in total capital investment was conspicuously high, especially during the 1970s (table 12).

Nonetheless, Soviet investment growth rates were matched and even exceeded by Hungary and other Eastern European economies. 9/ The economies with particularly high rates of growth in investment, such as Poland and Hungary, have also been faced with serious balance of payments disequilibria resulting from large purchases of investment goods from Western Europe, Japan, and the United States.

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9. Unlike the Soviet investment indexes in which the construction component is independently derived from construction materials inputs, estimates for Eastern Europe countries are based on official statistics. Although there are grounds for believing these official estimates to be inflated, the degree of overstatement would not be large enough to negate the conclusions stated in the text.

TABLE 12

MULTILATERAL COMPARISONS OF TRENDS IN PER CAPITA NEW FIXED INVESTMENT, 1960-70 AND 1970-77
(Average annual percentage rate of growth)

Country	Residential Construction		Non-residential Construction		Producer Durables		Total Fixed Investment	
	1960-70	1970-77	1960-70	1970-77	1960-70	1970-77	1960-70	1970-77
France	6.0	2.5	7.0	0.3	6.8	3.8	6.6	3.7
Germany	0.9	2.9	3.9	-0.5	6.2	1.2	3.7	0.4
Italy	5.1	-4.0	2.7	N.A.	4.8	1.3	4.3	-1.2
Japan	N.A.	3.7	12.9	1.3	15.2	2.0	13.4	2.1
United Kingdom	2.8	-1.2	3.2	-1.5	3.8	1.4	4.4	-0.3
United States	0.5	4.1	0.5	-3.0	2.0	7.5	2.7	1.3
Hungary	7.3	6.6	10.2	5.0	5.7	8.1	8.2	6.3
Bulgaria	5.0	8.5	8.0	4.7	12.2	10.2	9.4	7.6
Czechoslovakia	5.5	2.5	2.5	6.4	6.1	7.1	4.2	5.9
East Germany	0.2	10.2	8.1	5.9	8.3	4.2	7.4	5.4
Poland	3.1	10.5	6.1	11.7	8.6	15.0	6.4	12.8
Romania	4.6	7.3	10.6	8.3	12.1	13.2	10.1	10.6
USSR	2.0	2.6	5.5	4.1	10.2	9.3	5.6	5.2

Sources: Market economies--OECD, National Accounts, 1960-1977 USSR--See Table 6. Eastern European economies--Soviet Ekonomicheskii Vzaimopomoshchi, Statisticheskii ezhegodnikh stran-chlenov soveta ekonomicheskoi vzaimopomoshchi.

VII. Effectiveness of Investment

The high Soviet investment/GNP ratios have meant that a relatively low proportion of national product has been available to the consumer, as highlighted by the consumption section of this study. The greater burden levied on the consumer to sustain an unusually high ratio of investment might be justified if there was a commensurate payoff in higher growth rates. At least the consumer could be comforted by the claim that he or she were enduring austerity today so as to insure a larger production capability tomorrow.

But during the past two decades this resource allocation strategy has failed to meet its promise. The strenuous Soviet investment effort has not yielded visably higher growth rates. During the 1960s per capita GNP increased at a slower rate in the USSR than in Japan, France, Italy, and Germany. In the first eight years of the seventies the Soviet growth rate has been exceeded by Japan and France and nearly equaled by Germany and the US.

Since economic growth is a function of increases in employment, as well as capital stock (investment in its dynamic dimension), any analysis which purports to relate growth to investment should abstract from the contribution to growth of increases in employment, especially for the Soviet Union, whose rates of increase in employment have considerably exceeded those of the Western European economies and Japan. In addition,

residential investment should be deducted from the total, as it contributes little to increased output. Therefore, in the following analysis of investment effectiveness comparative returns on investment are measured by the ratio of growth of GNP per employed person to cumulative non-residential investment for the periods 1961-69 and 1970-77.

By this test (table 13) the return on investment in the USSR in terms of the per unit increase in GNP per worker obtained from a unit of non-residential investment was higher than for the United States and the United Kingdom, but considerably lower than for France, Germany, Japan, and Italy. 10/ Furthermore, the rate of return fell significantly in the 1970s. Therefore, the strenuous Soviet investment effort has not yielded commensurately higher returns.

There may be some clues in the structure of investment which, at least in part, explain the relatively low return on Soviet investment. As noted earlier (table 10) the Soviet construction investment ratio was particularly high in 1976. This propensity was also evident in earlier years. Construction assets are longer lived than durables assets, hence the return per ruble invested over a given time period will be lower. Thus, the asset structure of Soviet investment has been biased toward lower rates

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10. The low return in the United States is reflected in average GNP growth and unusually rapid growth in employment, and that in the United Kingdom in sluggish GNP growth. France and Germany enjoyed substantial GNP growth, but employment growth was slow.

TABLE 13

COMPARATIVE RETURN ON NON-RESIDENTIAL INVESTMENT a/

Country	1960-1969	1970-1977
United States	.135	.083
France	.269	.179
Germany	.225	.168
Italy	.372	.139
Japan	.299	.137
United Kingdom	.151	.099
USSR	.146	.109

a. Increase in GNP per employed person over the given period divided by cumulative non-residential investment during the period.

Source: Market economies - see Table 12; USSR - Table 12 sources and GNP estimates of John Pitzer in this compendium.

of return. The same conclusion applies to the propensity of Soviet planners to devote a smaller proportion of investment to replacement of obsolescent capital stock than the market economies.

Another explanation lies in the sectoral structure of Soviet investment (table 14). The outstanding feature of Soviet investment policy has been the unusually heavy allocation to agriculture. This sector has been beset by unfavorable weather and inefficient organization. Moreover, much of investment in agriculture has been labor-substituting rather than output-increasing. Any belated attempt to rectify investment starvation in transportation, trade, and services will have unfavorable consequences for rates of return on investment in future years. Transportation has the highest capital requirements per unit of output of all the sectors in the analysis. Both the trade and services sectors tend to be construction-heavy with similar portents for return on investment.

VIII. Price Relationships for Construction and Producer Durables Revealed in Multilateral PPP Comparisons

An interesting feature of the multilateral investment comparisons is the apparent inefficiency of the Soviet construction sector. While the Soviet share of GNP devoted to this purpose (table 10) is higher than for the market economies

TABLE 14

COMPOSITION OF NON-RESIDENTIAL CAPITAL INVESTMENT
(Percentage of total)

Country	Industry	Agriculture	Transportation	Trade and Services	Construction	Total
A. 1960-1969						
United States	48.3	6.2	12.0	33.0	--	100.0
Germany	54.9	7.8	14.3	18.2	4.8	100.0
United Kingdom	59.2	5.1	15.2	18.8	2.7	100.0
USSR	44.0	19.6	11.4	21.3	3.6	100.0
B. 1970-1977						
United States	45.3	6.0	13.4	--	35.3	100.0
France	41.8	7.9	--	45.6	4.5	100.0
Germany	49.6	5.2	17.1	24.1	4.0	100.0
Italy	48.9	11.6	18.5	19.5	1.9	100.0
United Kingdom	47.4	5.3	18.2	26.3	2.8	100.0
USSR	41.5	23.5	12.2	18.3	4.4	100.0

Sources: Market economies: OECD: National Accounts, 1960-1977. Soivet Union: Narkhoz 1970 and 1978.

its effective construction effort is far below those for France, Germany, and Japan (table 11).

This finding can be supported by a multilateral comparison of foreign currency/dollar price ratios for construction and producer durables. What stands out so clearly in such a comparison is the lower purchasing power of the ruble in construction compared with producer durables investment, as compared with other economies (table 15).

The relatively high purchasing power (relatively low domestic currency/dollar ratios) for foreign currencies in construction reflects the relatively high labor intensity of that expenditure, as compared with producer durables. Given the US real wage levels, it would be expected that the goods and services with high labor intensity would be produced at a comparative disadvantage in the United States. The US relative advantage, as the purchasing power ratios confirm, lies in the production of capital-intensive durables.

Since Soviet wage levels lie at or near the bottom of those for the countries in the sample, the ruble construction PPP ratio should reflect this condition. Instead, the Soviet construction PPP ratio is below that for producer durables. The most plausible explanation is the striking inefficiency of the Soviet construction sector. This hypothesis is consistent with other observations, both by Soviet and foreign analysis. Construction is an activity which is particularly dependent upon efficient

TABLE 15

MULTILATERAL COMPARISONS OF PPP RATIOS FOR CONSTRUCTION AND PRODUCER DURABLES a/

Country	Own Currency Units per Dollar		Relative Purchasing power parity ratios b/ (Construction/Durables)
	Construction	Producer durables	
France	3.55	4.94	1.39
Germany	2.13	3.57	1.68
Italy	367	617	1.68
Japan	276	301	1.09
United Kingdom	.340	.423	1.24
Hungary	14.2	31.2	2.20
USSR	.450	.295	.66

a. Ratios for USSR are derived in Appendixes A and B and for other countries in the Kravis volume source indicated in Table 10.

b. Purchasing power values in durables column divided by values in construction column.

organization for its proper functioning. The Soviet system functions poorly in sectors like agriculture and construction in which organization of the work force is crucial.

By contrast the USSR appears to be relatively efficient in manufacturing producer durables. Here its effective effort (table 11) somewhat exceeds its relative investment share (table 10). However, this conclusion must be qualified somewhat. The disequilibrium nature of Soviet pricing and the deficiencies inherent in Marxian price theory tend to understate the opportunity costs of manufacturing producer durables. The long omission of interest as an ingredient in cost and its continuing undercosting particularly underprices durables, given the high capital intensity characteristic of their production. 11/ Therefore, the atypical Soviet PPP relationship may reflect understatement of durables prices as well as inefficient construction organization.

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11. In the 1965 reform, an interest rate was introduced under the euphemism, "capital charge." However, the rate is set below equilibrium at 6 percent on the average and is differentiated perversely, with lower rates for heavy industry.

APPENDIX A

DERIVATION OF RUBLE-DOLLAR RATIOS FOR CONSTRUCTION

The derivation of ruble-dollar ratios for construction has proceeded in three stages: 1) derivation of ratios in 1970 rubles and dollars; 2) movement of the foregoing derivation to one expressed in 1976 rubles and dollars, and 3) regrouping of 1976 estimates into classifications providing consistency between Soviet and US construction classifications and derivations of aggregate ratios.

The basic calculation of the ratios in detail compared a construction sample in 1970 rubles and dollars. 12/ The choice of 1970 was determined by the availability of Soviet data prepared for the capital stock revaluation of 1972 and 1973 and specifically denominated in 1970 prices. Expenditure weights were also prepared for that year in the Soviet National Accounts study of the Central Intelligence Agency. 13/

Derivation of Ruble-Dollar Ratios in 1976 Prices

In 1979 the ruble-dollar ratios were updated to 1976 both by revisions in the expenditure weights and by appropriate ruble and dollar price indexes. Before doing that it was decided to reconsider the original 1970 ratios to see whether they could be improved in light of additional evidence gathered since 1976. We

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12. Central Intelligence Agency, Research Aid: Ruble-Dollar Ratios for Construction, (ER 76-10068), February 1976.

13. Central Intelligence Agency, GNP 1970.

have decided that the original ratios can be improved in two ways described below.

Revision of 1970 Ratios

The first revision involves refining the comparison of multi-story US and Soviet buildings. Based on further investigation of Soviet buildings and designs, we have decided that the comparisons of buildings with elevators could be improved over the original study. While elevators are usually a relatively small share--about four percent--of total construction costs in the US, Soviet elevators are expensive and frequently constitute more than seven percent of construction costs. In addition, the Soviet elevators purchased at proportionately greater expense are smaller, less numerous, and less reliable. Structures like those in the USSR simply would not be built in the US because they would not meet building codes. Thus, the comparisons of some US and Soviet buildings in the study result in downward biased ruble-dollar ratios.

The ideal approach to correct this deficiency is not feasible due to data limitations. It would involve costing Soviet buildings with US-style elevators and US buildings with Soviet-style elevators. Then two comparisons could be performed, i.e., one for buildings with US-style elevators and one for buildings with Soviet-style elevators. Since the data preclude this kind of adjustment, the comparisons are improved by

increasing the costs of Soviet buildings with more than four stories to allow for improved elevators. The Soviet construction handbooks report the share of total construction costs incurred due to elevators. The average share of cost attributable to elevators is computed for each type of building and number of stories. Then we assume that the cost implied by this share would be double that amount to construct elevators comparable to US practices. While this assumption is highly subjective, it probably errs by being too conservative. By re-estimating the ruble costs of buildings with elevators, the ratios for office buildings, schools, and housing increase slightly. The revised ratios for 1970 resulting from this procedure appear in table A-1 with a twenty percent allowance for the average cost overrun of Soviet builders in excess of the estimates.

A second refinement of the original study is the method by which the aggregate ratios are computed. There were some categories of construction lacking computed ratios that previously were omitted in the determination of the aggregate ratios for construction. This is not important if the ratios for the omitted categories approximately equal the average ratio for the types of construction that are already incorporated in the sample of ratios. In retrospect, this view seems unwarranted; rather the ratios for the omitted categories probably fall towards the high end of the spectrum of ratios observed in the construction sample. Fortunately the construction

Table A-1

Revised Ruble-Dollar Rates by Type of Construction, 1970

	US-Weighted	Soviet-Weighted	Geometric Mean
Hospitals a/	.689	.595	.640
Housing	.751	.610	.677
Office Buildings	.623	.575	.599
Schools	.700	.601	.649
Industry	NA	NA	.721
Roads	NA	NA	.948
Airfields	NA	NA	.834
Railroads	NA	NA	1.003

a/ The hospital ratio is the geometric mean of the housing, office building, and school ratios. The computed ratio for hospitals was rejected in the original study. See page 13 of Ruble-Dollar Ratios for Construction.

characteristics of some of these omitted categories are sufficiently close to some computed ratios to be included in the determination of the aggregate ratio for construction.

The two deleted categories in the Soviet case are construction for agriculture and the construction industry itself. In 1970 these combined categories received an estimated 18.8 percent of construction and installation work. By 1976 this share had grown to 22.8 percent, so their omission has gained added importance. The construction activity in the omitted categories involves a substantial amount of work that is analogous to industrial construction, roads, and airfields, especially earthmoving and excavation. Therefore, the geometric mean of these three ratios is selected arbitrarily to represent construction for agriculture and construction. This change raises the aggregate ratio with Soviet weights because the three types of construction have a high earthwork component, work at which the Soviets operate at a relative disadvantage. The revised Soviet-weighted ratios are shown in table A-2.

Similar changes have been made in the US-weighted ratio. First, the basis of the weights has been changed from the series for "new construction put into place" to the "purchase of structures" in order to make the data parallel to the national income accounts. Second, the original study also ignored certain types of construction on the US side. The coverage of the

Table A-2

Derivation of Soviet-Weighted Construction Ruble-Dollar Ratio, 1970

	Weights b/	Ruble-Dollar Ratio c/	Dollar-Ruble Ratio d/	Weighted Dollar-Ruble Ratio e/
Industry	.294	.721	1.387	.408
Agriculture a/	.169	.829	1.206	.204
Transportation and communications except railroad	.049	.889	1.125	.055
Railroad transport	.021	1.003	.997	.021
Construction industry a/	.019	.829	1.206	.023
Housing construction	.219	.610	1.639	.359
Trade and communcal enterprises, forestry and enterprises, and institutions of science, culture, art, education, and health	.229	.588	1.701	.390
Soviet-weighted ratio		.685 g/		1.460 d/

a. Geometric mean of airfield, road, and industry ratios.
b. Ruble-Dollar Ratios for Construction, ER 76-10068, February 1976, p. 12.
c. Table A-1.
d. The reciprocal of the ruble-dollar ratio.
e. The product of each weight and its corresponding dollar-ruble ratio.
f. The sum of the products.
g. The reciprocal of the dollar-ruble ratio.

weights could be improved significantly by the inclusion of construction for public utilities less railroads, sewer, water, and other municipal work. Based on the composition of these two categories, it is assumed that "public utilities less railroads" could be approximated by the geometric mean of the ratios for industry, streets, and airfields. Moreover, sewer, water, and other municipal work could be represented by the geometric mean of industry, street, airfields, and railroads. Both of these inclusions raise the US-weighted ruble-dollar ratio. The derivation of the new 1970 US-weighted ratio--is displayed in table A-3.

Derivation of 1976 Ratios

Price indexes for both the Soviet and US sides are needed to update the ratios to 1976 prices. While fairly decent price indexes may be derived from US data, the indexes for the Soviet side must be determined indirectly. Implicit GNP deflators for purchases of structures as computed by the Department of Commerce are used to adjust the US prices. The wealth of detail in the implicit deflators allowed applying unique price indexes to different types of construction. In some cases it is necessary to combine price deflators for private and public construction of a certain type, e.g., hospitals. For these cases, the data for the value of purchases in 1970 and 1976 in both current prices and 1972 dollars are used to estimate an implicit price deflator

Table A-3

Derivation of the US-Weighted Construction Ruble-Dollar Ration, 1970

	(1) Purchases of Structures (million dollars) a/	(2) US Weights b/	(3) Ruble-Dollar Ratio c/	(4) Weighted Ruble-Dollar Ratio d/
Industrial	7038	.0801	.721	.058
Commercial	9902	.1126	.623	.070
Educational	6483	.0738	.700	.052
Hospital	3366	.0383	.689	.026
Residential	35696	.4061	.751	.305
Railroad	306	.0035	1.003	.004
Public utilities ex railroad	10291	.1171	.829	.097
Highways and Streets	9981	.1135	.948	.108
Sewer, water, and other municipal	4832	.0550	.870	.048
Total	87895	1.0000		.768 e/

a. The National Income and Product Accounts of the United States, 1929-74, pp. 166-167.
b. Column (1)/87895
c. Table A-1.
d. The product of each weight and its corresponding ratio.
e. The sum of the products.

for the private and public sectors combined. The correspondence between categories is as follows:

Category of Ruble-Dollar Ratio	Category of GNP Deflator
Hospitals	Private Hospitals and Institutions and Government Hospitals
Housing	Private and Government Residential
Office Buildings	Commercial
Schools	Private and Government Educational
Industry	Private and Government Industrial
Roads	Highways and Streets
Airfields	Highways and Streets
Railroad	Railroad

The derivation of the ruble price change from 1970 to 1976 is presented elsewhere in this volume in the article by John Pitzer. In brief he compares a synthetic index of construction activity based on estimated material inputs in constant prices with an official Soviet measure that reports construction activity in current prices. By dividing the current price series by the constant price series, an implicit price deflator drops out. The

resulting deflator implies that Soviet construction costs in 1976 have risen 2.6 percent above those in 1970. 14/ Since Pitzer's methodology cannot discern between relative prices indexes for different types of construction, the 2.6 percent is applied uniformly to all construction.

The ruble-dollar ratios computed for 1976 allow for the Soviet propensity to incur cost overruns above estimate of approximately 20 percent. The ratios by type of construction are:

1976 Adjusted Ruble-Dollar Ratio

	US-Weighted	USSR-Weighted	Geometric Mean
Hospitals	0.458	0.395	0.425
Housing	0.486	0.395	0.438
Office Buildings	0.407	0.375	0.391
Schools	0.456	0.392	0.423
Industry	NA	NA	0.470
Roads	NA	NA	0.595
Airfields	NA	NA	0.524
Railroads	NA	NA	0.600

14. This estimate may be conservative. An article in Stroitel'naya Gazeta (January 21, 1979) asserts the prices of construction and installation increased 18-20 percent since 1969. Assuming the growth of prices was smooth throughout the period, this would imply construction costs in 1976 are 12.3 percent above 1970.

The aggregate construction ratios for 1976 are computed in the same way as for 1970. The 1976 Soviet weights are derived in table A-4 and the Soviet-weighted construction ratio based on each category's price-adjusted ratio is given in table A-5. The 1976 US weights are derived as they were for 1970. The US-weighted constructed ratio (table A-6) uses the 1970 ratios for the US categories, adjusted by the implicit price deflators for each country.

The ruble-dollar ratios for 1970 and 1976 in current prices are summarized below:

Ruble-Dollar Ratios for Construction

	1970	1976
US-weighted	.768	.495
USSR-weighted	.685	.450
Geometric mean	.725	.471

Finally, a few of the limitations in this update exercise should be mentioned. First, the overall increase in Soviet construction costs is uncertain. While the results of John Pitzer's approach seem plausible, they are simply crude estimates. A more serious limitation is that the Soviet price adjustment is applied evenly across categories because the structure of the estimated cost changes is unknown. While this might have a minor impact on the aggregate ratio, it could have substantial impact on the ratios for functional categories. Second, the methodology to update these ratios ignores possible

Table A-4

Derivation of Soviet 1976 Construction Weights

(1)	(2) Capital Investment (million Rubles a/	(3) Share of Investment by Construction and Installation (percent b/	(4) Construction and Installation (million Rubles) c/	(5) Share of Construction and Installation by Function (Percent) d/
Total	117966	57	67000	100.0
Industry	41702	45	18766	28.01
Agriculture	24350	56	13636	20.35
Transportation and communications except railroads	9840	44	4330	6.46
Railroad transport	3090	44	1360	2.03
Construction industry	4731	34.37	1626	2.43
Housing construction	16449	78.07	12841	19.17
Construction of trade and communal enterprises, forestry enterprises, and institutions of science, culture, art, education and health	17804	81.11	14441	21.55

a. Narodnoye khozyaystvo SSSR za 60 let, 1972, p. 437.
b. Total, industry, agriculture, transport and communications: CMEA Statistical Annual 1978, pp. 148-62. Construction and trade and communal enterprises, etc.; distribution of capital stock in 1972 according to input-output table. Narodnoye khozyzystvo v 1974, pp. 62-81. Housing: computed as a residual after derivation of column (4).
c. Column (2) x column (3), except housing which is estimated as residual.
d. (Column (4) - 67000) x 100.

Table A-5

Derivation of Soviet-Weighted Construction Ruble-Dollar Ratio, 1976

(1)	(2)	(3)	(4)	(5)
	Weights b/	Ruble-Dollar Ratio	Dollar-Ruble Ratio	Weighted Dollar-Ruble Ratio c/
Industry	.2801	.470	2.128	.596
Agriculture a/	.2035	.527	1.897	.386
Transportation and communications except railroad	.0646	.558	1.792	.116
Railroad transport	.0203	.600	1.667	.034
Construction industry a/	.0243	.527	1.898	.046
Housing construction	.1917	.395	2.532	.485
Trade and communcal enterprises, forestry and enterprises, and institutions of science, culture, art, education, and health	.2155	.383	2.611	.563
Soviet-weighted ratio		.449 e/		2.226 d/

a. Geometric mean of airfield, road, and industry ratios.
b. Ruble-Dollar Ratios for Construction, ER 76-10068, February 1976, p. 12 and Table A-4.
c. The product of each weight and its corresponding dollar-ruble ratio.
d. The sum of the products.
e. The reciprocal of the dollar-ruble ratio.

Table A-6

Derivation of the US-Weighted Construction Ruble-Dollar Ratio, 1976

(1) Category	(2) Purchases of Structures (million dollars) a/	(3) US Weights b/	(4) Ruble-Dollar Ratio c/	(5) Weighted Ruble-Dollar Ratio d/
Industrial	8161	.0584	.470	.027
Commercial	12955	.0927	.407	.038
Educational	6926	.0496	.456	.023
Hospital	5188	.0371	458	.017
Residential	67587	.4837	.486	.235
Railroad	556	.0040	.600	.002
Public utilities ex railroad	18440	.1320	.527	.070
Highways and Streets	9788	.0700	.595	.042
Sewer, water and other municipal	10129	.0725	.545	.040
Total	139730	1.0000		.494 e/

a. Survey of Current Busines, Number 7, July 1978, p. 48.
b. Column (1)/139730
c. Text table on page 9.
d. The product of each weight and its corresponding ratio.
e. The sum of the product.

changes in the mix of construction within a given category. For example, the distribution of housing by number of stories is held constant at 1970 levels. While exact data are not available, it is apparent that Soviet buildings are now being built taller than previously. This means that buildings with elevators are more important, so that the ratios should be somewhat higher. Third, the update ignores changes in the locational pattern of construction in either country. The average construction location in either country probably has changed since 1970. Although these three failings represent potential problems with the ratios, some solace can be taken from the evidence that the ratios are not highly sensitive to these factors.

Regrouping of 1976 Estimates into Consistent Classifications

The derivation of ruble-dollar ratios for the principal categories of construction requires that there be consistency in definition between the two economies. In order to achieve this requirement some revisions have been introduced in the Soviet expenditure weights. These revisions and the revised category ratios are as follows:

Sector	USSR		United States	
	Expenditure Weight (percent) a/	Dollar-Ruble Ratio b/	Expenditure Weight (percent) c/	Ruble-Dollar Ratio d/
Industry	27.9	2.13	18.0	.495 f/
Agriculture	20.3	1.90	1.7	.527
Transportation & communications	8.5	1.76 g/	12.2	.595 h/
Construction	2.2	1.90	Not separately estimated	
Services	17.3	2.61 i/	28.8	.464 j/
Housing	23.8	2.45	39.4	.486
Aggregate ruble-dollar ratio	100.0	.450 e/	100.0	.494

a. The construction-installation proportions of the construction, housing and services sectors have been revised to 31.7, 97.3, and 65.4 percent, respectively, based upon the author's research for an ongoing study of Soviet investment policy. If these new proportions are multiplied by total respective sector investments and the resulting sector construction estimates are divided by total construction investment, the expenditure weights are derived.

b. These ratios are those derived in Table A-5.

c. Survey of Current Business, July 1979, Table 5.4.

d. Table A-6.

e. The aggregate ruble-dollar ratio derived as the reciprocal of the Soviet weighted dollar-ruble ratio, which is 2.22.

f. Table A-6 categories of industry and public utilities combined.

g. Table A-5 categories of transportation and communications, except railroads and that of railroads combined.

h. Table A-6 categories of railroads and highways and streets combined.

i. Table A-5 categories of trade and communal enterprises; forestry and enterprises; and institutions of science, culture, art, education, and health combined.

j. Table A-6 categories of commercial, educational, hospital, and sewer, water, and other municipal combined.

The successive adjustments in the ruble-dollar ratios are as follows:

Price Base	USSR Weights	United States Weights	Geometric Mean
1970 ruble/1970 dollars	.685	.768	.725
1976 rubles/1976 dollars	.450	.494	.471

APPENDIX B

DERIVATION OF RUBLE-DOLLAR RATIOS FOR PRODUCER DURABLES

Ruble-dollar ratios for machinery and equipment (producer durables) are derived in three stages. Since the most recent general Soviet price revisions for durables occurred in 1967 and the most recent information on the US investment shares of producer durables is found in the US input-output table for 1972, the detailed ruble-dollar comparison is in terms of 1967 rubles and 1972 dollars. The detailed ratios are derived in a publication of the National Foreign Assessment Center, Central Intelligence Agency. 15/

The next step requires that the comparisons be moved forward to 1976. In the absence of comprehensive price quotations and information on the final distribution of producer durables investment in 1976, it is necessary to resort to appropriate price indexes to shift the 1972 comparison forward to 1976. Since information on US price trends is much more extensive and direct than that available from Soviet sources, different producers have been followed for each economy. The updating of dollar prices was prepared by Margaret Hughes and the updating of ruble prices by Stanley Cohn.

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15. National Foreign Assessment Center, USSR and US: Price Ratios for Machinery, 1967 Rubles-1972 Dollars (ER 80-10410), September 1980, Vols I and II.

Derivation of Dollar Price Indexes for Producer Durables, 1972-1976

Dollar price indexes for producer durables are based on line item indexes calculated by the Bureau of Labor Statistics (BLS) and by the Bureau of Economic Analysis (BEA). 16/ The line item indexes are aggregated into the larger groupings, necessary to facilitate Soviet and US comparisons (table 1), by US expenditure weights for 1972. 17/

The price indexes for component aggregated groupings are as follows:

Transportation equipment	153.6
Tractor and agricultural machinery	150.1
Energy and power equipment	151.4
Construction machinery	154.8
Instruments	121.4
Mining, oil field, and machinery	148.3
Pumps, compressors, and materials handling equipment	151.3
Specialized industrial equipment and aircraft	153.2

16. The line items may be found in National Foreign Assessment Center, op. cit., Volume I, pp. 5-12.
The BLS price indexes are published in Wholesale Prices and Price Indexes, Supplement 1977 and the BEA indexes in annual issues of the Survey of Current Business.

17. US Department of Commerce, Bureau of Economic Analysis, The Input-Output Structure of the US Economy, 1972.

The aggregation of line items into component groupings is as follows:

Transportation Equipment -	Trucks, buses, and truck trailers Autos Ships and boats Railway equipment
Tractors and Agricultural Machinery -	same components
Instruments -	Office, computing, and accounting machinery instruments
Energy and Power Equipment -	Fabricated metal products Engines and turbines Electrical transmission and distribution equipment Electrical equipment, nec.
Construction Machinery -	Construction machinery
Mining, Oil field, and Metallurgical Machinery -	Mining machinery Oil field machinery Machine tools Forges and presses Casting machinery and equipment Tools and dies
Pumps, Compressors, and Materials Handling Equipment -	General industrial machinery Hoisting-transport equipment
Specialized Industrial Equipment and Aircraft -	Textile and apparel industry equipment Food industry equipment Printing industry equipment Construction materials industry equipment Service industry machinery Communications equipment Aircraft Other machinery and equipment

Derivation of Ruble Price Index for Producer Durables, 1973-76

While detailed group price indexes are available for moving the 1972 dollar prices to 1976, no reliable information is published regarding trends in Soviet producer durables prices between 1972 and 1976. If these ruble prices are not updated, the producer durables ruble-dollar ratios for 1976 would not reflect the inflationary trends which have characterized Soviet machinery prices over the past dozen years.

The methodology selected to estimate price changes for machinery parallels that used to estimate the movement of ruble construction prices in Appendix A. Since no information is provided on the current costs of investment in producer durables or the factor inputs used in this investment process, the proxy of machinery production in current and constant values is used as a reasonable approximation. The main conceptual flaw in this procedure is the assumption that price trends in total machinery production, which includes consumer durables, military durables, and net exports in addition to producer durables, do not differ significantly from such trends in producer durables output.

Machinery production in constant prices is approximated by the Soviet industrial production index constructed by the Office of Economic Research of the Central Intelligence Agency. 18/ The current value of machinery production has been estimated for the

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18. F. Douglas Whitehouse, Ray Converse, "Soviet Industry: Recent Performance and Future Prospects," in Joint Economic Committee, Soviet Economy in a Time of Change, p. 422.

1965-1975 period in unpublished estimates of Robert Abbott of the Office of Strategic Research, CIA, and for the 1955-1965 period by William Lee. 19/ Abbott's index has been moved forward to 1977 by the methodology followed in the estimation of the construction price index for the 1970-1976 period (Appendix A). When the constant and current price indexes are compared for the years 1967-1976, an implicit machinery price index is derived. This index number, 108.1, is presumed to apply across all machinery categories equally, again paralleling the construction price estimate procedure.

The successive adjustments in ruble-dollar ratios for the producer durables component at each of the three stages are as follows:

Price Base	Soviet Weights	US Weights	Geometric Mean
1967 rubles/1972 dollars	.404	.634	.506
1967 rubles/1976 dollars	.274	.434	.345
1976 rubles/1976 dollars	.295	.469	.372

Ruble-Dollar Ratios and Expenditure Weights for Producer Durables Component of Investment Expenditures in 1976

In addition to shifting the ruble-dollar price ratios forward to 1976, it is also necessary to shift the expenditure weights forward. The 1976 dollar-ruble and ruble-dollar ratios and

19. William Lee, The Estimation of Soviet Defense Expenditures, 1955-1975: An Unconventional Approach, 1977, p. 225.

expenditure weights for eight durables sectors are as follows:

	USSR		United States	
Component	Expenditure Weights (Percent)	Dollar-Ruble Ratio	Expenditure Weights (Percent)	Ruble-Dollar Ratio
Transportation equipment	14.3	2.85	25.4	.455
Tractors and agricultural machinery	10.7	4.44	7.8	.277
Instruments	8.4	2.77	12.7	.625
Energy and power equipment	11.5	3.83	9.8	.264
Construction machinery	5.4	5.13	3.8	.266
Mining, oil field, and metallurgical machinery	12.8	5.81	5.2	.246
Pumps, compressors and materials handling equipment	7.3	4.81	5.5	.250
Specialized industrial equipment and aircraft	29.6	1.56	29.8	.637
	100.0	3.39	100.0	
Aggregate ruble-dollar ratio		.295a/		.469

a. Reciprocal of dollar-ruble ratio, which is 3.39.

APPENDIX C

ESTIMATION OF VALUES FOR SOVIET AND US INVESTMENT IN 1976

Values for Soviet Investment

Soviet investment in producer durables is largely composed of direct investment by state institutions, as reported in the annual economic handbook. This amount is supplemented by outlays by budgetary organizations (for education, health, etc.) the net change in uninstalled machinery and equipment. 20/ Finally, the combined total, which is measured in adjusted 1969 prices, 21/ is recalculated to a 1976 price base by a deflator previously calculated in the estimation of the ruble-dollar ratio for durables (Appendix B).

Producer Durables Investment	Billion Rubles
State	40.7
Budgetary institutions	1.45
Net change in inventory of uninstalled equipment	.303
Total (adjusted 1969 prices)	42.453
Deflator (1970 = 100)	.987
Total producer durables investment (1976 prices)	41.901

The construction component of investment is composed of the officially reported value, supplemented by assumptions regarding construction expenditures included in the official investment classifications "design-geological work" and "other capital work

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20. CIA, GNP 1970, p. 55.

21. These are defined as estimate prices of 1969, adjusted for new equipment wholesale prices introduced on January 1, 1973.

and expenditures." Again the combined total, which is measured in adjusted 1969 prices, 22/ is adjusted to a 1976 price base by a price deflator originally constructed to calculate the construction ruble-dollar ratio (Appendix A).

Construction	Billion Rubles
Published expenditures	67.0 a/
1/2 of design-geological expenditures	1.2 b/
2/3 of other capital expenditures	5.3 c/
Total (1969 prices)	73.5
Deflator (1969 = 100)	1.027
Total construction investment (1976 prices)	75.5

a. Narkhoz 1977, p. 349.

b. Ibid. It is assumed that geological prospecting outlays are of capital investment type outlays, but that project design expenditures are an integral part of the investment process. Although some design expenditures relate to machinery and equipment, it is assumed that the bulk are devoted to preparation of plans for buildings and structures.

c. According to official instructions in Metodicheskie ukazaniia k razrabotke gosudarstvennykh planov razvitiia narodnogo khoziaistva SSSR, 1974, pages 275-276, the category of "other capital work and expenditures" includes outlays which would be classified as construction in United Nations and OECD accounts and other outlays which would not be considered of an investment nature. Included among the construction grouping are drilling costs, construction research and engineering costs connected with regional adaptations of techniques, drainage cost, land preparation expenditures, land protection costs, and permanent plantings. Excluded items include training costs for construction workers, administrative costs of construction control organizations, and additions of working livestock. It is assumed that two-thirds of total outlays in this miscellaneous grouping consist of construction type expenditures.

22. These are defined as estimate prices of 1969, adjusted for reduced construction coefficients introduced on January 1, 1976.

Reclassification of Installation Expenditures

Before the official Soviet estimates on construction and producer durables investment can be used in international comparisons they must be adjusted. In the investment statistics for market economies, installation outlays are classified as equipment expenditures; Soviet statistics combine them with construction. The reasons for this difference are largely institutional. In most market economies firms that manufacture machinery and equipment include installation in their services; in the Soviet Union construction organizations are responsible for installation of machinery and equipment. Installation expenditures must therefore be shifted into the machinery and equipment category, with offsetting reductions in construction estimates.

Two Soviet economists estimated that in 1975 installation costs comprised 5-6 percent of total productive investment. 23/ Inclusion of installation would raise the producer durables component of investment from 12 to 14.4 percent. Since nearly all producer durables are allocated to productive sectors, this adjustment is applicable to total investment as well. In this study a mid-range upward adjustment of 13.3 percent is assumed. There is an offsetting reduction in construction investment equal to the absolute annual upward adjustment in the other investment category.

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23. S. A. Efremov and P. D. Samokhin, Normirovanie truda i smety, 1976, p. 234.

In 1976 the official value for the producer durables component of investment estimate is raised from 41.9 to 47.5 billion rubles and the official value for construction is reduced from 75.5 to 69.9 billion rubles. The same procedure is followed for other years.

Values for US Investment

Estimates of the construction and producer durables component of US investment expenditures in 1976 are obtained from figures published for the Bureau of Economic Analysis of the Department of Commerce. 24/ Private sector investment consists of new private construction (table 5.4) and private purchases of durables (table 5.6). Government sector investment consists of government non-defense purchase of structures and government non-defense purchases of durables (table 3.9).

Construction	Billion Dollars
Private (new)	124.1
Government (new)	37.5
Total	161.6

Durables Investment	Billion Dollars
Private	108.9
Government	7.5
Total	116.4

24. Survey of Current Business, July 1979.

Capital Repair

Soviet accounting has a quasi-investment concept not found in US national accounting practice, that of capital repairs. They are defined as outlays involving major replacement or renovation of parts of existing assets. Current repairs, on the other hand, are defined as essentially preventive maintenance or routine servicing expenditures. In the United States minor repairs would be charged against production cost and major repairs would be classified as new investment.

The estimated total value of capital repairs before adjustment is derived as follows:

	Billion Rubles
Amortization fund	22.651 1/
Budgetary outlays	5.964 2/
Collective farm outlays	1.460 3/
Total	430.035

1. Narodnoe khoziaistvo SSSR, 1977, p. 558.

2. Union-republic budget outlays of 3.969 billion rubles (Gosudarstvennyi Biudzhet SSSR, 1976, p. 78) are increased by the average annual growth rate of 9.7 percent for 1971-1975. This union-republic budget total of 4.354 billion rubles is inflated to a national (state) budgetary total of 5.924 billion by assuming a union-republic to state budget ratio of 73.5 percent, which pertained to the combined total for education and culture, health, science and state administration outlays (Gosudarstvennyi Biudzhet SSSR, 1976, pp. 33-34, 60, 69 and 72).

3. The 1975 estimate of 1.351 is increased by the 1971-1975 annual average growth rate of 8.1 percent (L. S. Golimon, Finansy Sel'skoe Khoziaistvo, Finansy, 1976, p. 157).

To the extent that capital repairs prolong investment lives, they should be included as an investment component. The problem becomes one of determining what proportion of capital repairs to include and how to distribute that share between construction and producer durables. One Soviet economist cites a sample survey in which only a third of recorded capital repairs of durables were restorative in nature, with the other two-thirds consisting of routine maintenance. 25/ If this sample is assumed to be representative and if it further be assumed that most (two-thirds) of capital repairs of buildings and structures are genuine, given the nearly equal distribution of capital repairs between durables and plant and structures, 26/ then about half of recorded capital repairs fall within the definition of fixed investment expenditures. In this study half of capital repairs will be so included. Total investment will be measured both inclusive and exclusive of repairs.

Ruble-Dollar Ratio of Capital Repairs

Given the assumptions concerning the composition of genuine capital repairs between construction and producer durables assets, it will also be assumed that the Soviet-weighted ruble-dollar ratio for repairs is determined by assigning

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25. Iu. V. Kurenkov and D. M. Palterovich, Tekhnicheskii progress i optimal'noe obnovlenie proizvodstvennogo apparata, 1975, p. 191.

26. Unpublished manuscript of Scot Butler, The Growth of Capital Repair in the USSR, 1950-1977, March 1979,

construction double the weight of producer durables.

These assumptions probably lead to overstatement of the ruble PPP for capital repairs. Repair is a labor-intensive activity. Total labor cost comprise about 51 percent of total costs for repairs in 1972 compared with labor cost share of only 37 percent in the production of machinery and 45 percent for construction. 27/ No comparisons of repair activity in the USSR and United States are available, but qualitative impressions point to significant differences in technology. One major reason for the high labor input into repair in the USSR is that replacement spare parts often must be fabricated on the site while in the United Stated spares are produced in adequate quantities by firms which manufacture the complete units. The high labor intensity and low productivity of Soviet repair operations, compared with US counterparts, would imply a higher ruble-dollar ratio than those computed for new investment. Therefore, the assumed ruble-dollar ratio is likely overstated and becomes another source of downward bias in the ratios.

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27. Unpublished collation of the reconstructed 1972 Soviet input-output matrix, prepared by the Foreign Demographic Analysis Division, US Bureau of the Census.

APPENDIX D

DERIVATION OF MULTILATERAL COMPARISONS OF PER CAPITA INVESTMENT

Sources of Multilateral Investment Comparisons

The basic source for the 1976 multilateral comparisons of investment is the 1973 estimates calculated by Professor Irving Kravis and his team for the United Nations International Comparison Project. 28/ Kravis has calculated a series of bilateral comparisons between the United States and selected foreign economies of per capita expenditures of various components of GNP in dollars and in the other country's own currency. (His comparisons do not include the USSR; the US-USSR comparisons are based on the PPP ratios derived in Appendices A and B.) Each component is further comprised of several representative products or services weighted by respective US and other country expenditure weights. What emerges from his calculations are per capita expenditure ratios comparing outlays in the United States and other economies in both dollar and the prices of these other economies. 29/ Kravis terms the ratio in dollar prices as "US weight" and that in the other country's currency as that country's weight, for example, "France weight."

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28. ICP, Phase II.

29. Ibid., Summary binary tables starting on p. 196.

For multilateral comparisons the Kravis team uses the methodology of international prices. In this procedure dollar prices are established for each representative product or service. In order to overcome the quality comparison problem, prices are quality adjusted by linkage of countries with not widely differing levels of development rather than bilateral linkage between a particular country and the United States. These separate country prices are then quantity-weighted by each country's production in order to obtain an international prices for each category of products.

In order to measure per capita investment expenditure ratios for 1976 in the absence of a detailed survey, it was necessary to adopt an expedient used by Kravis, Milton Gilbert, and other scholars engaged in international comparisons research. In its national accounts publications the OECD presents time series in both current and constant prices. 30/ The bilateral comparisons (foreign country vs. United States) may be updated from 1973 to 1976 by multiplying the 1973 conversions for a given component of GNP by the ratio of the real growth in that component in 1973-76 in the foreign country to the real growth in the component in the United States in the same time interval. 31/

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30. OECD, National Accounts, 1960-1977.

31. For example, the index of per capita residential construction in 1976 (1973=100) for France is 101.4 and for the United States is 79.9. If the ratio of the French to the US index (101.4/79.9=126.9) is multiplied by the 1973 ratio of 123.1 (in US prices), a ratio of 156.2 for 1976 is obtained.

Differences in Ratios of Per Capita Investment Expenditures Arising from Differing National Price Structures

The ratio of investment expenditures of another country to those of the United States depend upon the prices selected. For reasons explained earlier, valuation in dollars almost always yield higher ratios than those in the country's currency. The greater the degree of similarity between relative prices in the various categories of investment, the closer will be the ratios yielded by the use of alternative prices. The differences resulting from using different prices have been termed the spreads in expenditure ratios. Other things being equal, the nearer two economies are in their stages of economic development the smaller will be the spreads.

Empirically the spreads are calculated by comparing expenditure ratios in dollars and in other currencies for each component of investment. In terms of the present study this procedure would be equivalent to comparing component expenditure ratios in both sets of prices. For 1976 the implicit valuation spreads are as follows:

Spreads Between Investment Expenditure Ratios a/

Country	Residential Construction	Other Construction	Durables	Total Fixed Investment
France	1.09	1.01	1.32	1.07
Germany	1.27	1.03	1.17	1.12
Italy	.98	.94	1.27	1.04
Japan	1.00	1.05	1.05	1.03
United Kingdom	1.13	1.04	1.21	1.07
Hungary	1.02	1.02	1.36	1.04
USSR	1.19	1.08	1.59	1.29

a. Comparisons in dollars divided by comparisons in prices of other country.