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**A Comparison of
Soviet and US
Gross National Products,
1960-83**

A Research Paper

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A Comparison of Soviet and US Gross National Products, 1960-83

A Research Paper

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SOV 84-10114
August 1984

A Comparison of Soviet and US Gross National Products, 1960-83

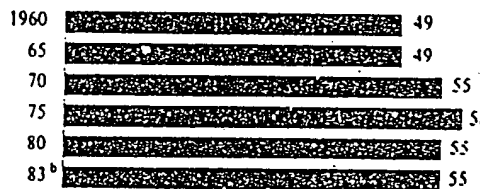
Summary

Information available
as of 1 March 1984
was used in this report.

Economic strength is a major determinant of international power. The Soviets have clearly recognized this relationship in numerous public statements over the years. The most famous of these were made by Khrushchev, who boasted that the Soviet Union would outproduce the United States by 1970 and that his country would have a higher standard of living than any capitalist country by 1981.

Figure 1
Soviet GNP as a Percentage of US GNP,
Selected Years^a

Percent



^a Measured by calculating the geometric mean of the percentages expressed in 1970 rubles and 1976 dollars.

^b Preliminary.

These forecasts have not come true, although the Soviets have made some progress. A comparison of the annual outputs (gross national products) of the two countries shows that the Soviets gained on the growing US economy between 1960 and 1975, as their GNP rose from 49 to 58 percent of the US total. After 1975, however, they lost ground, dropping to 55 percent of US GNP in 1981 and remaining at that level through 1983.

The elements of GNP leading the shift since 1975 were defense and investment. Average annual Soviet growth rates in these areas were markedly lower in the 10th Five-Year Plan than in earlier plan periods and were lower than corresponding American rates. The level of the Soviet defense effort, however, has remained substantially above that of the United States since the early 1970s. The relatively slower Soviet growth in defense and investment outweighed a small relative gain by the Soviets in consumption, even though consumption was by far the largest share of GNP in both countries. While the Soviets gained in both per capita and total consumption, their per capita consumption was still only slightly more than one-third that of the United States in 1983.

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We believe the gap between the two economies that began to widen after 1975 will continue to increase in the near term. We expect Soviet GNP growth for the rest of the decade to average below the 3 to 4 percent predicted for the US economy by US forecasters. If these projections are accurate, Soviet GNP in 1990 will be back down to less than half the US figure.

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Contents

	<i>Page</i>
Summary	iii
Background and Approach	1
GNP Comparisons	3
Trends in Aggregate Comparisons	3
Trends in GNP Components	4
Defense	4
Investment	5
Consumption	7
Implications of the Comparisons	8
Appesdixes	
A. General Methodology of Soviet-US Economic Comparisons	11
B. Differences Between Civilian PPP Ratios and Military Ruble-Dollar Ratios	19
C. Measuring Comparative Soviet and US Defense Burdens	21
D. Comparisons of Real Soviet and US GNPs: Tables	23

A Comparison of Soviet and US Gross National Products, 1960-83

Background and Approach

Gross national product (GNP) is the total market value of all final goods and services produced by a nation's resources in a year. It is frequently used to compare the size of a country's economy with that of another.¹ Comparisons of this type are particularly important to foreign policy formulation because the relative size of a country's GNP represents the relative availability of national goods and services for pursuing given policy options. Economic strength compared with that of any other country or combination of countries is thus a primary determinant of international power. As the first US Government study comparing Soviet and US GNPs stated in 1955:

In the struggle between the Communist Bloc and the Free World, the factor of relative economic strength is fundamental. Neither morale nor political stability nor a firm military posture can long be sustained in its absence. . . . A continued, dynamic economic growth, matching or surpassing that of the Communist Bloc, would seem to be indispensable for the maintenance of world stability and as a force for world peace.²

Periodic comparisons of Soviet and US GNPs therefore serve as yardsticks with which US policymakers can gauge the relative economic strength of the world's other superpower.

¹ Communist countries do not measure their economy's final output in GNP terms. Rather, they use a Marxist concept of national income that excludes "nonproductive" uses of resources (most services and some depreciation). CIA analysts and other Western economists find it more useful to analyze Soviet economic data in GNP terms than according to national income. The procedure by which the conversion is accomplished is spelled out in NFAC Research Paper ER 78-10505 (Unclassified), October 1978, *USSR: Toward a Reconciliation of Marxist and Western Measures of National Income*, and NFAC Research Aid A (ER) 75-76 (November 1975, *USSR: Gross National Product Accounts*).

² *Trends in Economic Growth: A Comparison of the Western Powers and the Soviet Bloc*, Joint Economic Committee (JEC), Washington, D.C., 1955, pp. iii-iv (letter of transmittal from Grover Ensley, Staff Director of the JEC introducing the study by the Legislature Reference Service).

The Soviet leadership has long been keenly aware of the USSR's secondary status as an economic power. Stalin and Molotov both exhorted Soviet workers to overtake the West. But Khrushchev transformed the long-held Soviet objective of "catching up" with America into a pressing national goal. In the late 1950s he promised that the Soviet Union would surpass the United States in total and per capita output within the decade. In October 1961 he boasted at the 22nd Party Congress that the Soviet Union would have a higher living standard than any capitalist country by 1981. In addition, he stated that the USSR's industrial output would be twice the 1961 level of the entire nonsocialist world in 20 years.

Khrushchev's dreams did not materialize, but the Soviets have made considerable progress since 1960. Industrial production has shown substantial gains, and increased production of consumer durables and food indicates a generally higher standard of living for the present Soviet consumer than his counterpart two decades ago. By no means, however, did the Soviets "bury the enemies of the Revolution" as Khrushchev claimed they would.³

The development of the Soviet economy relative to that of the United States since 1960 may be traced by comparing trends in aggregate GNP and changes in the major GNP categories (consumption, investment, and defense). Consistent comparisons of these two dissimilar economies are made by expressing their national outputs in the monetary unit of one country or the other. The generally preferred procedure for

³ Crankshaw, Edward (ed.), *Khrushchev Remembers*, Bantam Books, New York, N.Y., 1971, p. 563. In his memoirs, Khrushchev claims that his statement about "burying" the United States was misrepresented by the Western media. He said his intended meaning was that the US "working class" would bury the American "bourgeois class." Nevertheless, the American public at the time perceived the statement as an open economic challenge.

making international economic comparisons is to convert each country's GNP into the currency of the other country (Soviet Union in dollars and United States in rubles). Two GNP comparisons can then be made, one in rubles and one in dollars.

The two comparisons will yield different results. This phenomenon is commonly known as the index number problem, and it results from differences in the relative prices and quantities of goods and services found in each country. Goods produced in relatively large quantities in either country tend to sell at relatively low prices in that country, and vice versa. Soviet GNP is, therefore, a larger percentage of US GNP when comparisons are made in dollars, since dollars place greater weight than ruble prices do on investment and defense goods, which account for larger shares of output in the Soviet Union than in the United States.

The important point about index numbers is that valuations in rubles and those in dollars are equally correct. When a single figure is needed, economists by convention often resort to the "geometric mean" of the two as a reasonable point estimate that falls between the ruble and dollar comparisons. This paper will follow the geometric mean convention, although the reader is cautioned that it is used for its presentational convenience and does not, strictly speaking, represent a more valid result than that calculated in either currency.⁴ The actual ruble and dollar comparisons can be found in appendix D, but the geometric mean estimate will be given in the body of the paper for simplicity.

Converting Soviet and US GNPs in national currencies to the other's currency involves the use of specially constructed price ratios, called purchasing power parities (PPPs).⁵ These ratios measure the relative values of comparable goods and services found in both countries at the same time. Price ratios for individual goods and services can be aggregated into collective

⁴ Appendix A contains a more detailed discussion of index numbers, as well as descriptions of the concepts, assumptions, and methods used in the comparison.

⁵ The concept behind military ruble-dollar ratios used in comparing defense activities is somewhat different from that employed in constructing civilian PPP ratios. Differences in the ratios are explained in appendix B. Even though both types of ratios are generically called "ruble-dollar ratios," this paper for clarity will arbitrarily reserve that nomenclature exclusively for the military ratios.

PPPs by using either Soviet or US expenditure weights derived from respective national spending patterns. The resulting weighted ratios measure the relative values of items in groups, such as consumer durables, and eventually in categories, such as consumption. "Established prices," administratively set Soviet prices, are used in the ratios because they represent what Soviet consumers would see. "Factor cost prices," prices that would be charged if they represented the actual costs of resource inputs, are not used in the ratios because they are not available in sufficient detail. The comparisons in this paper, then, are closer to measures of real income differentials than to measures of relative production potential.⁶

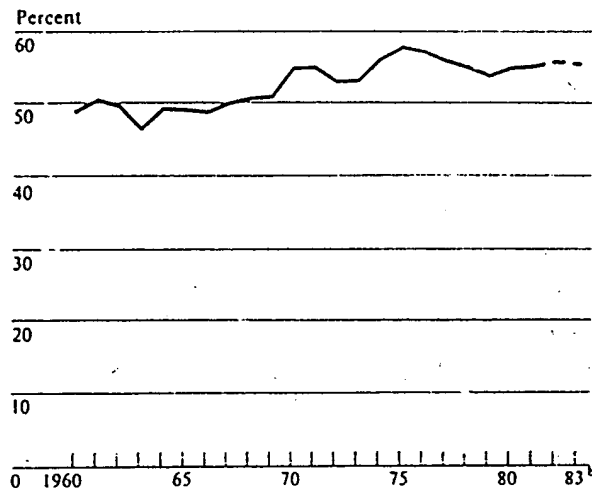
Over time, prices in one country change relative to those in another. Consequently, a comparison using the PPP ratio methodology, such as the one made by the CIA, requires periodic updating to remain valid. This paper presents the results of an updated comparison using recently completed and revised PPP ratio studies.⁷ PPP ratios in 1955-56 prices formed the basis of US-Soviet GNP comparisons developed by the CIA until 1979. In the comparisons published that year, the older ratios were replaced by the preliminary results of new consumption and investment PPP ratio studies in 1976 prices.⁸ The final results of these studies have been incorporated into this paper.

⁶ See appendix A for a fuller discussion of the differences between measures of income differentials and production potential. (U)

⁷ The PPP studies upon which the analysis in this paper is based provide a more detailed explanation of the classification and weighting schemes involved in deriving consumption and investment PPPs than is presented here. The interested reader is referred to *Consumption in the US and USSR, An International Comparison*, JEC, 1981; NFAC Research Paper ER 80-10410 (Unclassified), September 1980, *USSR and the United States: Price Ratios for Machinery, 1967 Rubles-1972 Dollars*, vols. 1 and 2; and NFAC Research Aid ER 76-10068 (Unclassified), February 1976, *Ruble-Dollar Ratios for Construction*. The article "The Real Gross National Product of the USSR, 1950-80," *USSR: Measures of Economic Growth and Development, 1950-80*, JEC, 1982, provided the Soviet GNP expenditure weights and indexes used to compare US and Soviet GNP over time. US expenditure weights and indexes were obtained from the Commerce Department's National Income and Product Accounts.

⁸ See Edwards, Imogene, et al., "US and USSR: Comparisons of GNP," *Soviet Economy in a Time of Change*, JEC, 1979. Some readers may be accustomed to seeing analysis in a more current price base. The dollar GNP comparisons could have been indexed to a more current base, but it was felt that the characteristicness of the price sample was better preserved if dollar prices were left in the price base of the study. Integration of defense, which is in 1970 rubles, was judged to be a compelling reason to index the ruble prices from 1976 to 1970.

Figure 2
Soviet GNP as a Percentage of US GNP,
1960-83^a



^a Measured by calculating the geometric mean of the percentages expressed in 1970 rubles and 1976 dollars.

^b Preliminary.

GNP Comparisons

Trends in Aggregate Comparisons

Between 1960 and 1983, Soviet GNP expressed as a proportion of US GNP increased 6 percentage points (geometric mean). It rose from 49 percent of US GNP in 1960 to a peak of 58 percent in 1975 and fell back to 55 percent by 1981 (figure 2).^{*} The Soviet Union gained on the United States from the mid-1960s to the mid-1970s because average annual Soviet growth

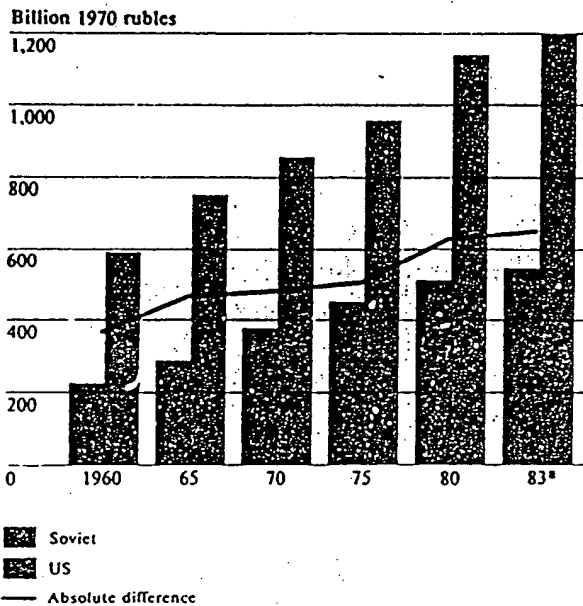
^{*} To give the reader a sense of the spread between the dollar and ruble comparisons encompassed by the geometric mean, Soviet GNP in 1983 was 67 percent of US GNP in dollars and 46 percent in rubles. The spread between the two comparisons has fairly steadily decreased since 1960, when Soviet GNP was 62 percent of US GNP in dollars and 38 percent in rubles. Ruble prices, where given, will be expressed as constant 1970 rubles; and dollar prices, as constant 1976 dollars.

rates during the Eighth and Ninth Five-Year Plans (FYPs) were higher than American rates during the same periods. Soviet growth, however, had been slowing since at least the mid-1960s, and the relationship between the two economies began to shift in America's favor in the 10th FYP (1976-80) as the decline in Soviet growth rates continued while US growth accelerated.

Short-term variations in US-USSR GNP comparisons generally reflected business cycle movements in the US economy. It is not surprising that a market economy experienced more pronounced fluctuations than a centrally planned economy. Planning tends to promote economic stability by controlling fluctuations in demand, although plan goals may not be met for a variety of reasons. Agricultural output, for example, is influenced by weather conditions, and swings in agriculture were the major cause of annual swings in Soviet GNP. As a rule, though, the Soviet GNP was less volatile than the US GNP. The GNP comparisons moved sharply in the Soviets' favor during the US recessions in 1970 and 1974-75, when US growth rates dropped well below Soviet rates. Similar shifts did not occur in the US recessions of 1980 and 1982 because Soviet economic growth had deteriorated to a point where it was only slightly better than that in the United States in those years.

Although the Soviet Union gained ground relative to the United States over the 20-year period as a whole, the absolute size of the gap between the two economies in goods and services produced annually increased, whether measured in rubles or dollars (figures 3 and 4). The US recessions of 1970, 1974-75, 1980, and 1982 caused the gap to lessen in those years, but the trend has been upward, and the gap widened noticeably after 1976. Between 1961 and 1983, US GNP grew \$300 billion or 285 billion rubles more than Soviet GNP.

Figure 3
Ruble Difference Between Soviet and US GNPs, 1960-83



* Preliminary.

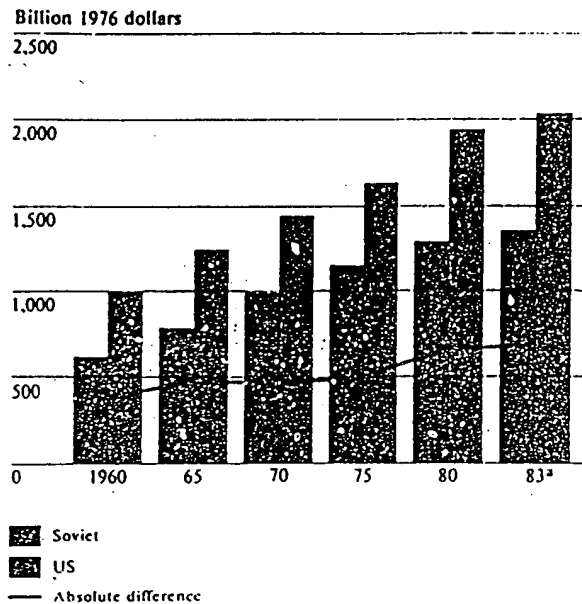
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Trends in GNP Components¹¹

Defense. The most striking difference in trends between the two countries since 1960 has been in defense. The Soviet defense effort passed that of the United States in the early 1970s. Real decreases in US defense spending occurred between 1969 and 1976 as the United States disengaged from Vietnam, while consistent growth pushed the Soviets over 40 percent higher than the United States by the mid-to-late 1970s (figure 5). Since reaching a post-Vietnam

¹¹ The estimates in this paper were prepared with data ending in 1981. Preliminary estimates for 1982 and 1983 were prepared using rough aggregate indexes. These could not be applied at the component level, but an update is under way that will extend the component comparisons to 1982 and 1983.

Figure 4
Dollar Difference Between Soviet and US GNPs, 1960-83



* Preliminary.

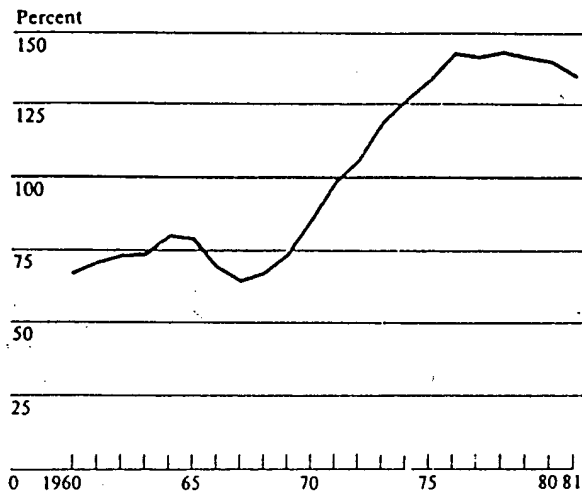
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low in 1976, real US defense costs have increased while the growth rate of Soviet defense has slowed, narrowing the defense gap to about one-third by 1981.¹¹

Defense has also been the category of GNP use where the greatest difference in GNP composition between the two economies exists. The United States halved the share of GNP going to defense following Vietnam—from 10 percent in the early 1960s to 5 percent

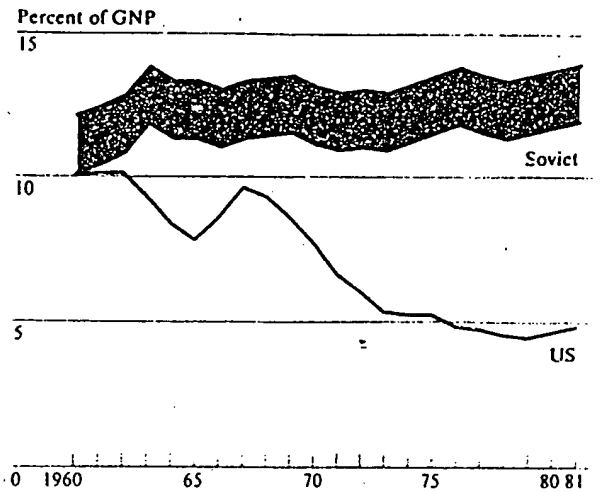
¹¹ See

Figure 5
Soviet Defense as a Percentage of US Defense, 1960-81^a



^a CIA defense comparisons have traditionally been made in dollars or rubles. This figure presents the geometric mean of the two comparisons for consistency with the rest of the figures in this paper.

Figure 6
Soviet and US Defense Burdens, 1960-81^a



^a Defense burdens are measured in national currencies (that is, rubles for the Soviet Union and dollars for the United States) and according to a US definition. The Soviet defense burden is presented as a range of ± 1 percentage point around a point estimate because of the uncertainty in the estimate. This range was not statistically derived. Similar ranges are not presented for the other elements of Soviet GNP because we have somewhat higher confidence in those data.

in the early 1970s. The Soviets, on the other hand, had a fairly steady defense burden estimated at 10 to 14 percent of GNP over the period (figure 6).¹²

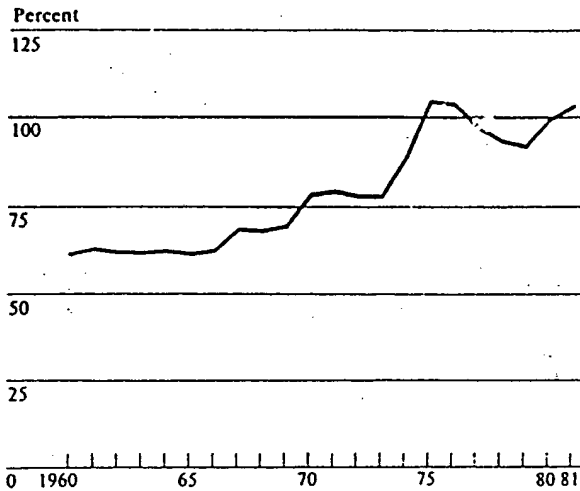
¹² These burden estimates use a US definition of defense. They could also be calculated using a Soviet definition, which we believe would include more activities (primarily civil defense and civil space activities that in the United States would be funded by NASA). The US defense burden remains nearly the same whether a US or Soviet definition of defense is used because the costs of US civil defense and civil space activities are small relative to the defense budget. The Soviet defense burden would increase by 1 to 2 percentage points if a Soviet definition were used. The Soviet definition is appropriate in a noncomparative context when defense resource costs as the Soviets might see them are analyzed and is used in DI Intelligence Assessment SOV.83-10135CX.

July 1983, *Soviet Defense Spending: Recent Trends and Future Prospects*. In all cases, however, the only appropriate burden calculation is that in which both defense and GNP are measured in the currency of the given country. See appendix C for more detail.

Investment. Trends in total investment growth were also very different. Total Soviet investment grew almost twice as fast as US investment over the 1960-81 period; it averaged 6 percent annually, while US investment averaged about 3 percent a year. The absolute level of Soviet investment stayed about 60 percent of the US level through the mid-1960s, rose to 80 percent in the early 1970s, and exceeded US investment in 1975, 1976, and 1981 by a small margin (figure 7).

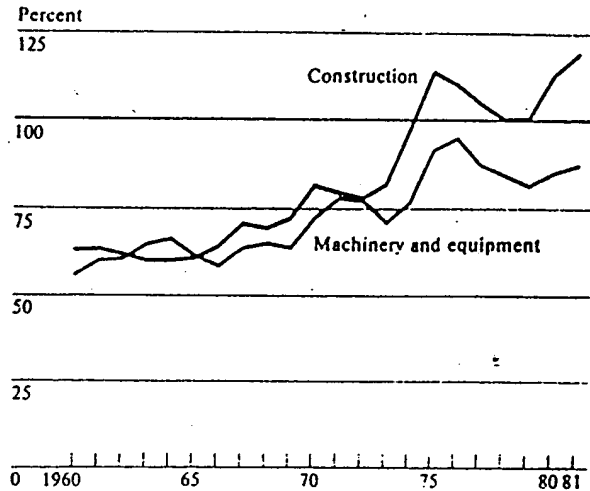
Even so, the growth rate of Soviet investment has been declining since the early 1960s, and investment's markedly lower growth rates during the 10th FYP

Figure 7
Soviet Investment as a Percentage of
US Investment, 1960-81*



* Geometric mean of the dollar and ruble comparisons.

Figure 8
Soviet Investment as a Percentage of
US Investment, by Component, 1960-81*



* Geometric mean of the dollar and ruble comparisons.

were a major factor behind the United States' ability to considerably widen the GNP gap by 1981. US investment, on the other hand, experienced the wide fluctuations common to a market economy's business cycles over the 1960-81 period but grew faster than Soviet investment on average during 1976-80.

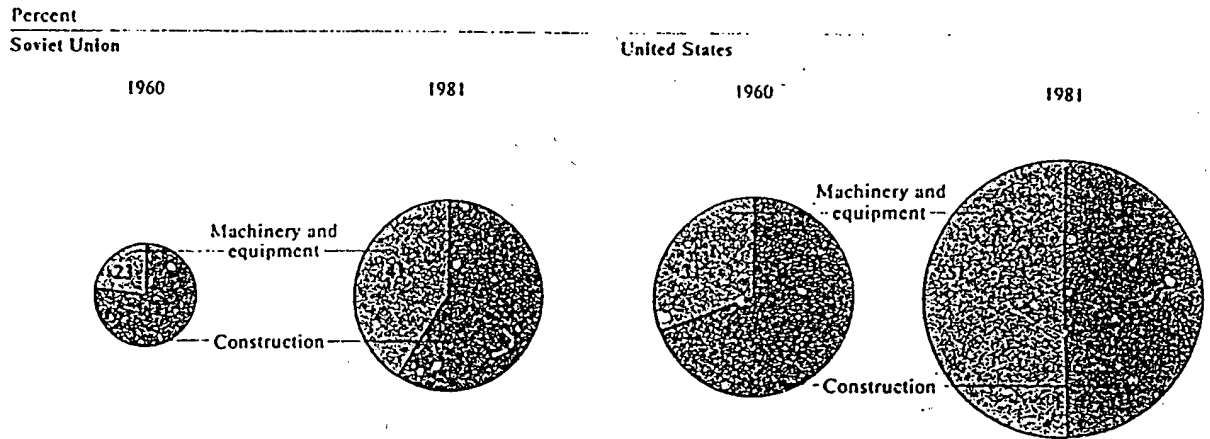
Soviet gains in comparative levels of investment were most pronounced in the area of construction because of the relatively greater facilities expansion in the USSR. Soviet construction investment rose from 63 percent of the US level in 1960 to 119 percent by 1981 (figure 8). The value of the machinery and equipment component of Soviet investment also increased relative to that of the United States over the entire period but stayed below the US figure. Underlying these trends is the general tendency in the United States to devote more investment resources to reequipping older facilities and to design more extensive use of mechanical and electronic equipment into new facilities.

The USSR has devoted a greater share of its economic resources to investment than has the United States since 1960. Soviet investment steadily increased from a low of 21 percent of Soviet GNP to a high of 30 percent by 1981, while US investment fluctuated between 17 and 20 percent of US GNP over the 1960-81 period (figure 9).¹³ Soviet investment for machinery and equipment (including comparably estimated capital repair)¹⁴ steadily increased from 5 percent of Soviet

¹³ US national income accounts may include some government expenditures that could be considered investment, such as hydroelectric plant and dam construction, in categories of government purchases of goods and services. An adjustment for this possible accounting anomaly has not been made because US national accounts were accepted as given by the Commerce Department. Should an adjustment be made, US investment would take a higher share of US GNP.

¹⁴ This paper uses the standard definition of capital repair as the sum of outlays on noncurrent repair of fixed assets. Unlike current maintenance outlays, capital repair outlays are not written off as current costs but are capitalized. The book value of the asset is raised to reflect this type of repair, which is supposed to extend the service life of the asset.

Figure 9
Composition of Soviet and US Investment,
1960 and 1981*



* Measured in national currencies.

GNP in 1960 to 13 percent by 1981, while Soviet construction plus comparable capital repair remained between 16 and 18 percent of GNP. In the United States, machinery investment increased from 5 to only 9 percent of GNP in those years, while US construction's share steadily decreased from 13 to 9 percent.

Consumption. The Soviets have gained slightly on the United States in total consumption since 1960. Soviet consumption over the period fluctuated between a low of 37 percent in the mid-1960s and a high of 42 percent of US consumption in 1981 (figure 10).

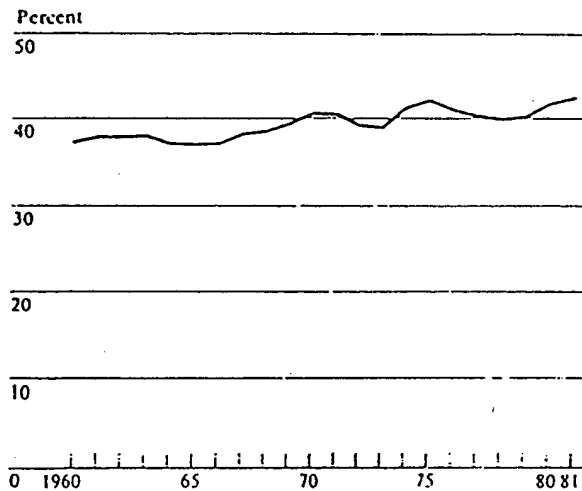
Within the consumption category, Soviet health expenditures showed the most dramatic change by steadily dropping from 67 percent of US health expenditures in 1960 to 38 percent by 1981 (figure 11). This was a consequence of US health costs rising much more rapidly than those in the Soviet Union.

Education costs in the Soviet Union began the period at or above the US level, dropped to 86 percent as US expenditures accelerated in the late 1960s and early 1970s, but returned to comparable levels by 1981. In the other consumption categories of food, soft goods, durables, and household services, the Soviets showed small but consistent relative gains.

The Soviet Union is unusual among developing countries in that its economy has not become increasingly service oriented. The Soviet service sector remained relatively steady at 19 to 21 percent of Soviet GNP between 1960 and 1981, while the US service sector increased from 33 to 39 percent of US GNP by 1975 before falling slightly to 37 percent by 1981 (figure 12). In both countries, the share of GNP devoted to durables increased, soft goods consumption remained

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Figure 10
Soviet Consumption as a Percentage of
US Consumption, 1960-81*



* Geometric mean of the dollar and ruble comparisons.

about the same, and the share going to food decreased. Food consumption as a share of GNP dropped by as much as 7 percentage points in the Soviet Union and by 4 percentage points in the United States over the period.

Because consumption is by far the largest component of GNP in both countries, changes in relative consumption have a major impact on comparisons of overall GNP. By themselves, these changes for 1960-81 tended to raise slightly Soviet GNP relative to US GNP during this period, but they were partially offset by the changes in defense and investment discussed earlier. Average annual growth rates of Soviet consumption in the 10th FYP (3.2 percent in rubles and 2.9 percent in dollars) were *higher* than those of the Soviet economy as a whole. At the same time, average annual growth rates for US consumption after 1975 were *lower* than those for the US economy as a whole for that period. These shifts consequently raised the share of consumption in Soviet GNP, lowered it in US

GNP, and slightly improved Soviet consumption relative to the United States over the period 1975-81 (figure 13).

Relative standards of living are usually measured in terms of consumption per capita. The Soviet consumer was less well off compared to his American counterpart when consumption is measured on a per capita basis than is indicated by the aggregate consumption comparison. This is because the Soviet population was 15 to 20 percent larger than the American population over the 1960-81 period. The trends over time of the per capita and aggregate consumption comparisons, however, are essentially the same because the populations of both countries grew at the same average rate—about 1 percent a year. Soviet per capita consumption rose slightly over the 1960-81 period, from 31 percent of US per capita consumption in 1960 to 36 percent in 1981. As in the aggregate consumption comparison, Soviet health expenditures showed the most change, dropping from 57 percent of US per capita health expenditures in 1960 to 33 percent in 1981. The other categories of education, food, soft goods, durables, and household services showed slight overall relative gains for the Soviets.

Implications of the Comparisons

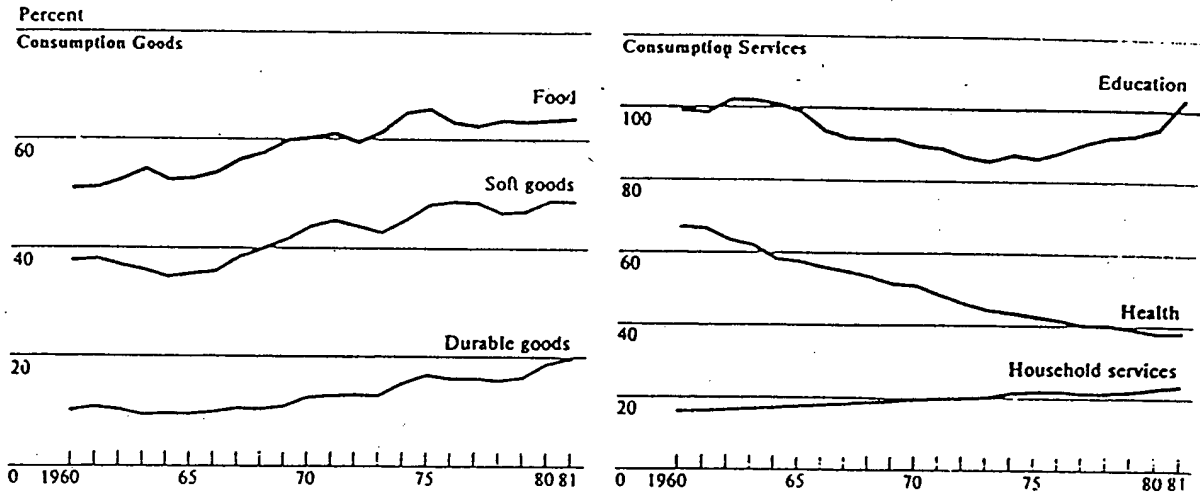
Quite obviously, the Soviet Union did not achieve Khrushchev's goal of outperforming the American economy by 1981. It was, however, slowly gaining ground until the mid-1970s. Why did it fail to continue catching up during this period, and what are the implications of this failure for future economic competition?

Soviet GNP growth has been on a downward trend since the late 1960s, but this trend worsened in the late 1970s for a number of reasons. Some were beyond the Soviets' control, such as bad weather, unfavorable international economic conditions, and a decline in the growth rate of the working population. Others included aging of the capital stock—which requires increasingly larger investments to keep it

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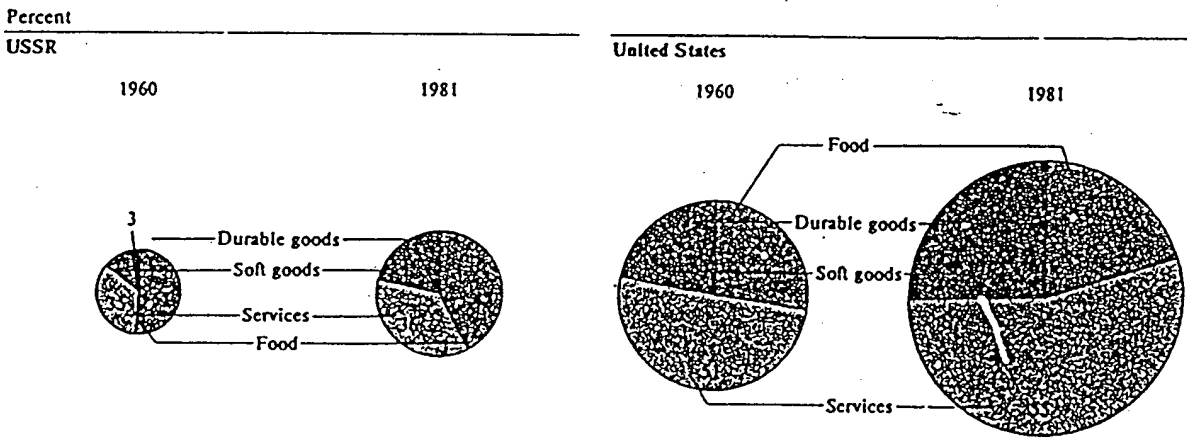
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Figure 11
Soviet Consumption as a Percentage of
US Consumption, by Component, 1960-81*



* Geometric mean of the dollar and ruble comparisons.

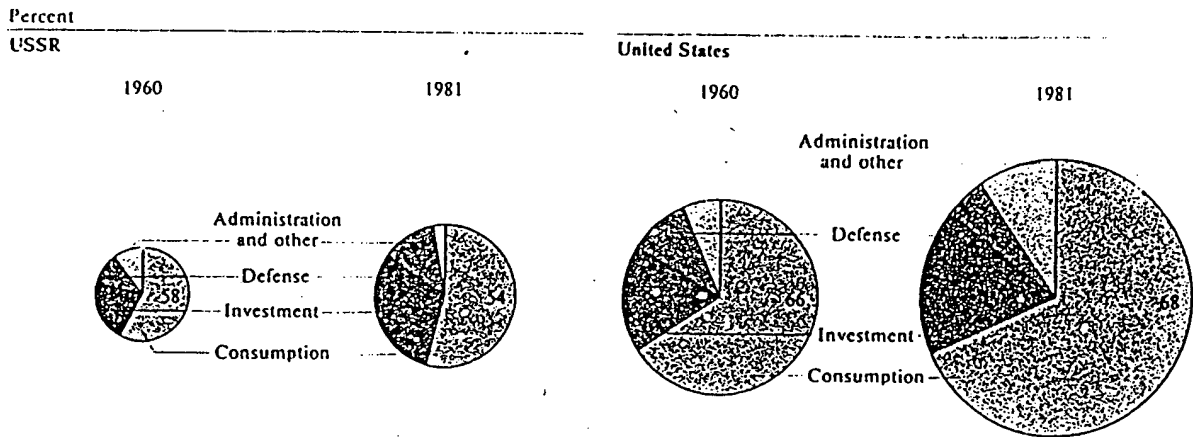
Figure 12
Composition of Soviet and US Consumption,
1960 and 1981*



* Measured in national currencies.

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Figure 13
Composition of Soviet and US GNP,
1960 and 1981*



* Measured in national currencies.

productive—and mounting shortages of key raw materials and energy sources. Still others were the results of planning decisions, particularly the decision implemented in 1976 to switch from an “extensive” investment policy that expanded production through large increases in capital and labor to an “intensive” policy of growth achieved by more efficient use of resources.¹⁵ Bad investment decisions also led to insufficient resources being devoted to transportation, which created shortages of rolling stock and massive bottlenecks. Finally, some of the causes of the downturn in growth rates may be endemic to the Soviet system of central planning. The planning process, with its emphasis on meeting production quotas, seems to have stifled innovation and creativity, which are vital to improving productivity. Lack of wage incentives and limited availability of consumer goods also have been drags on productivity growth.

If the US economy continues to perform as well as it has over the last year, the gap between the US and the

Soviet economies is likely to widen considerably in the next decade. Opinion is certainly not unanimous on whether the United States can sustain this growth, but the consensus of estimates developed by leading private forecasting groups shows average annual growth rates of 3 percent or more through the mid-to-late 1980s.¹⁶ Soviet growth, on the other hand, is projected by the CIA to be below this rate for the rest of the decade.¹⁷ If these projections prove accurate, Soviet GNP in 1990 will be back down to less than half the US figure. There is little reason to expect Soviet growth to exceed that of the United States on average during the rest of the decade. At best, Soviet GNP in 1990 is unlikely to be more than the 55 percent of US GNP estimated for 1983, and it probably will be less.

¹⁵ Based on 1983-90 projections of average annual growth rates from Wharton Econometric Forecasting of 3.1 percent and Data Resources of 3.3 percent. Chase Econometrics predicts 3.7-percent average annual growth between 1983 and 1985, and Evans Economics predicts 3.1 percent for the same period.

¹⁶ See DI Research Paper SOV 84-10017 [] February 1984, *USSR: Economic Projections Through 1990—A New Look*.

¹⁷ The effects of the switch in investment policies are more fully discussed in DI Research Paper SOV 83-10093 [] June 1983, *The Slowdown in Soviet Industry, 1976-82*.

Appendix A

General Methodology of Soviet-US Economic Comparisons

This appendix gives a general description of the methodology used in making the Soviet-US economic comparisons presented in this paper. The first section discusses some of the important basic concepts of international comparisons. Following sections outline the key assumptions upon which the Soviet-US comparisons are based and examine the composition of each GNP category. Finally, the comparisons are evaluated in terms of their validity, usefulness, and the confidence we have in them.

Basic Concepts

Comparisons of any two economies must value each country's assortment of goods and services in some common unit of measure. One of the two techniques most widely used today to convert data measured in one country's prices into another's price base uses international currency exchange rates; the other uses purchasing power parity ratios. This section discusses the reasons PPP ratios are preferred, what they measure, and how they are constructed. It also examines a way to handle the sometimes troublesome fact that a two-country GNP comparison can be made using either country's prices as a base.

Purchasing Power Parities and Weighting Schemes
Exchange rates are determined mainly by supply and demand for internationally traded goods and services and by international capital transactions. Consequently, they are not satisfactory for GNP comparisons because they do not reflect the relative purchasing power of different currencies over the whole range of goods and services produced and consumed. They are frequently used for comparisons, however, because they are easily available from open sources for most countries.

We rely instead on PPP ratios. These ratios measure the relative value of a comparable set of goods and services found in both countries at the same time when measured in each country's prices. The GNP comparisons in this paper in general are based on PPP

ratios that indicate the number of rubles required to purchase the same quantity of goods and services that could have been bought with a given amount of US dollars, and vice versa.¹⁴ The exception is defense comparisons, which involve a somewhat different concept.¹⁵

Exchange rates may differ greatly from PPP ratios, especially when comparisons involve economies with substantially different price structures. In fact, studies have shown that the purchasing power of the currency of low-income countries relative to that of very-high-income countries is often two to three times as great as the exchange rate would indicate.²⁰ In the case of the USSR, moreover, the value of the ruble relative to other currencies is artificially maintained by the Soviet Government and has no direct connection to relative purchasing power. Therefore, the ruble/dollar exchange rate cannot be used as even a rough measure of relative purchasing power.

Comparability of products and services is the key to useful PPP ratios. Comparability may be defined many different ways, but CIA PPP ratio studies for the United States and the USSR define it in terms of function and performance. For example, a three-phase Soviet AC electric motor with a 40-kilowatt capacity that operates at 1,500 rpms was judged to be representative of a type of Soviet general purpose electric motor used in a wide variety of industrial applications.

¹⁴ The purchasing power of a ruble and a dollar varies widely among individual commodities. For example, in 1976, 43 cents bought as much canned orange juice in the United States as 1 ruble bought in the USSR, but it took over \$5 in the United States to purchase the same amount of frozen cod sold in the USSR for 1 ruble. . .)

¹⁵ See appendix B for a discussion of the differences in civilian and military ruble-dollar ratios. . .)

²⁰ Kravis, Irving, et al., *World Product and Income, International Comparisons of Real Gross Product (Phase III)*, Johns Hopkins University Press, Baltimore, 1982, p. 3. . .)

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Figure 14
Construction and Use of Machinery and
Equipment PPP Ratio

Item PPPs	x Weights	- Product PPPs	x Weights	- Group PPPs	x Weights	- Subcategory PPPs
Type of motor	Value shares of electric motor output	Type of product	Value shares of electro-technical output	Type of machinery group	Value shares of machinery output	Investment subcategory
0.8 kw		Electric motors		Electro-technical		Construction
1.1 kw		Generators		Energy and power		Machinery and
4.5 kw		Transformers		Cable products		equipment
10 kw		High-voltage apparatus		Machine tools		
40 kw				Forge-press		
75 kw				Casting		
100 kw				Tools and dies		
200 kw				Precision instruments		
250 kw				Mining and metallurgical		
1,000 kw				Pumps and compressors		
4,000 kw				Logging and paper		
				Light industry		
				Food industry		
				Printing		
				Hoist-transport		
				Construction		
				Transportation		
				Automobiles		
				Tractors		
				Other		

Note: Highlights refer to example described in text of PPP weighting scheme for 40 kw motor.

A comparable US motor with similar specifications and functions was identified, and the ruble price of the Soviet motor was compared with the dollar price of the US motor to form a PPP ratio for this particular item.

The usefulness of a PPP ratio for a specific item is in its relation to a larger group. It is used to generate a PPP ratio applicable to an entire product line; that product PPP ratio is used to generate a ratio applicable to a still larger group, and so on. Individual PPP ratios are aggregated into more comprehensive PPP ratios by calculating weighted averages—the weights reflecting an item's importance in total value of production. Two sets of weighted ratios must be built up. Ratios required to move Soviet GNP from rubles to dollars are called Soviet weighted because they use as weights Soviet expenditures derived from official

Soviet statistics. US-weighted ratios use US expenditures compiled by the Department of Commerce as weights so that US GNP in dollars can be put into rubles.

A simplified schematic of the weighting process for machinery and equipment PPP ratios is shown in figure 14. The product PPP ratio for electric motors is calculated from individual motor PPPs weighted by their share of electric motor output. This and other product PPP ratios are then weighted by their share of electrotechnical group output to derive a group PPP ratio. Machinery group PPP ratios are then weighted with shares of machinery output to calculate a PPP ratio for the machinery and equipment subcategory.

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The Index Number Problem

In making Soviet-US comparisons, we encounter a phenomenon common to all international economic comparisons—the so-called index number problem. It arises because the comparison in rubles yields a result different from the comparison in dollars, yet both are equally legitimate.

The lack of a single quantifiable comparison can be presentationally awkward, so economists by convention often resort to the "geometric mean" as a basis for a single comparison. In the case of two countries, the geometric mean is the square root of the product of the two comparisons. However, the theoretical justification of the geometric mean as a valid *average* indicator in economic comparisons is disputed. Abraham Becker argues against its use in US and Soviet comparisons because "the average reflects neither the dollar nor the ruble price pattern and in principle, therefore, is simply wrong."²¹ Paul Samuelson, on the other hand, believes that use of the geometric mean "does seem more evenhanded."²² This paper adopts the geometric mean convention, but the reader should remember that a geometric mean represents neither the ruble nor dollar comparison and may therefore be inferior to the more general estimate defined by them.

Key Assumptions

For the comparisons in this paper to be useful, a number of analytical conditions must be met or at least reasonably approximated. First, the base year for the PPP ratios must be considered a reasonably typical year from an economic standpoint. The comparisons in this study are based on a sample of PPP ratios in 1976 prices. The comparisons, therefore, are only representative of other years to the degree that economic conditions in 1976 and, in particular, relative prices both within a given country and between countries can be assumed to be typical for those other years. Unusual supply or demand conditions in either country in 1976 would distort the relative prices and cause the comparisons to be biased.

The choice of 1976 as a base year has merit for several reasons. On the Soviet side, the 1976 decision to reduce the rate of investment growth took time to work its way through the economy. Its most dramatic effects on industrial production, consumer prices, and GNP seem to have been delayed until 1979-81, as shown in table 1. Thus, 1979-81 may have been atypical, but 1976 was more or less an "average" year by Soviet standards.

For the United States, 1976 was a year of strong economic growth following the severe recession of 1975. In this sense, it is typical of the growth rates in the 1962-66, 1972-73, and 1977-78 periods. It also was not marked by an unusual swing in industrial production, and inflation had not yet reached the high rates of the late 1970s.

Comparisons for years other than the 1976 base year involve greater uncertainty the more distant the comparisons are from the base year. Changes in relative prices from the base year relationships are more likely. In addition, US GNP in current prices must be deflated to 1976 dollars using price deflators that are subject to error. Soviet GNP must be estimated for years other than 1976 by moving 1976 weights with quantity indexes of output, and this process inevitably introduces some distortion. Comparisons of US and Soviet GNPs in 1960 and 1981, for example, are therefore less reliable than those for 1976.

In this paper we assume that valid comparisons of defense efforts can be made using ruble prices from a year other than the one on which the PPP ratio studies were based. This assumption is necessary because we make our estimates of Soviet defense spending in constant 1970 rubles, and we have no reliable basis for moving these data to an equivalent 1976 base. Ruble estimates of GNP in this paper, therefore, were also made in constant 1970 rubles rather than constant 1976 rubles to better facilitate the incorporation of our defense estimates. This required indexing the ruble prices in the PPP ratios to 1970 prices. The reindexing was carried out at the

²¹ "Comparisons of United States and USSR National Output: Some Rules of the Game," *World Politics*, vol. XVIII, No. 1, October 1960.

²² "Analytic Notes on International Real Income Measures," *Economic Journal*, September 1974, p. 608

Table 1
US and Soviet Economic Indicators

	1960	1965	1970	1975	1976	1977	1978	1979	1980	1981
Industrial production * (1970=100)										
USSR	54	74	100	133	138	144	149	153	158	161
United States	61	83	100	109	121	128	136	141	136	140
Consumer price index * (1970=100)										
USSR	90	97	100	110	111	112	114	116	120	122
United States	76	81	100	139	147	156	168	187	212	234
GNP Growth (percent change from preceding year)										
USSR	4.0	6.3	7.7	1.7	4.8	3.2	3.4	0.8	1.4	2.2
United States	2.2	6.0	-0.2	-1.1	5.4	5.5	5.0	2.8	-0.4	3.7

* Source: DI Reference Aid CPAS 83-10006, September 1983, *Handbook of Economic Statistics, 1983*.

lowest level of aggregation possible, usually the sub-category level but, down to the group level in some cases. We recognize that this process could introduce some distortions in the comparisons to the extent that 1970 ruble price relatives are different from those for 1976. We decided this would introduce less distortion, however, than arbitrarily choosing a rate of inflation for defense.

Lastly, we assume that reasonable comparisons can be made for dissimilar economies. Comparisons are generally considered more reliable for countries with similar levels of development and social systems. For countries at different stages of development, such as the United States and the Soviet Union, comparisons in alternative prices tend to overstate the relative position of the less advanced country. The more advanced country could shift to a less complicated product mix more easily than the less advanced country could produce the more complicated assortment of goods and services of the advanced country. The United States turns out goods and services that the Soviet Union cannot produce at all because of the widely noted Soviet difficulty in manufacturing high-quality and technologically complex goods. Therefore,

the ruble comparison of Soviet and US GNPs probably overstates the relative ability of the USSR to produce the US output mix because it understates the ruble costs of US state-of-the-art technology. The dollar comparison understates the US ability to produce the Soviet output mix because it overstates the dollar costs of advanced Soviet goods.

Coverage of Product Samples and Comparison Categories

GNP in this paper has been divided into five end use categories: consumption, investment, defense, administration, and other. The composition of each of these major categories and their ratios will be briefly examined in this section.²¹

²¹ For more detailed descriptions of the work that provides the foundation for this paper, see NFAC Research Paper ER 80-10410, September 1980, *USSR and the United States: Price Ratios for Machinery, 1967 Rubles-1972 Dollars*, vols. 1 and 2; NFAC Research Aid ER 76-10068, February 1976, *Ruble-Dollar Ratios for Construction: Consumption in the US and USSR* (JEC 1981); and *USSR: Measures of Economic Growth and Development 1970-80* (JEC 1982).

Consumption

Consumption includes all household expenditures on goods and services plus government expenditures on health and education. In the USSR the state is responsible for practically all expenditures for education, while in the United States households provide a significant share. Consumption is divided into six subcategories: food, soft goods, durables, household services, health, and education.

The *food* estimate is based on a sample of prices for 108 items, such as milk, ground beef, white flour, eggs, coffee, and carrots. Ruble prices primarily represent weighted averages for food sold in Soviet state retail stores and on collective farm markets. Food produced and consumed on farms is also included, valued at average prices received by farmers for urban marketings. The dollar prices consist of comparably weighted average prices, including sales tax, for the same set of food items in the United States.

The price samples for *soft goods* (such as clothing) and *consumer durables* (such as color television sets) included 163 items. Retail established prices were used and no attempt was made to account for black-market sales, which are prevalent in the Soviet Union. A considerable effort was made to account for quality differences between Soviet and US goods, which frequently resulted in a determination that the price of the US good should be lowered.

Comparisons of *household services* were made for 64 items covering housing, utilities, public transportation, personal communications, personal care, repair, automobile services (gas, oil, and maintenance), recreation, and miscellaneous services.²⁴ PPPs for household services are based on national average prices for individual services such as monthly telephone service and charges for hotel rooms. Although in the USSR most of these services are provided through public organizations, prices of privately supplied services have been included in the PPP ratios where appropriate.

²⁴ For the United States, miscellaneous services cover mainly financial services that have no counterpart in the USSR. The miscellaneous category was converted using a PPP ratio based on that for personal care and repair services.

The weak link in the household services comparison is *housing*. There is no Soviet counterpart to single-family housing, which comprises the bulk of housing in the United States. The PPP ratio for housing used in this paper is the weighted sum of ratios for rental costs per square meter and for maintenance. The PPP ratio for housing is based on the price per square meter of average-size urban apartments in the USSR adjusted to exclude the large Soviet subsidies on housing.²⁵ The comparable US average rental rate is derived from the relationship between US rents and various housing characteristics presented in United Nations-sponsored international comparisons. Ratios for maintenance are based on prices of building materials such as plywood, Portland cement, and paint, along with an estimate of labor charges.

PPP ratios for *health and education* are based on inputs—wages and current material purchases.²⁶ No tangible measure of output of these services exists that can be priced in a comparison. The drawback of the input method is that it ignores capital inputs and implies that there is equal productivity in US and Soviet health and education or that a correction can be made for unequal productivity. The input method also assumes equal quality of service. Most observers agree that Soviet health and education are inferior both in productivity and quality to their US counterparts, but there is no objective way to correct for these differences. For these reasons, the health and education comparisons probably are biased in the Soviets' favor.

²⁵ Housing subsidies have been excluded because they are nonproductive transactions. GNP attempts to capture only transactions that contribute to current output. Including subsidies would thus overstate annual output.

²⁶ Charges for fixed capital services are excluded on both sides in this category. In the United States the soaring costs of increasingly sophisticated hospital equipment used for diagnosis and treatment have been a major cause of the rise in health expenditures. Present comparisons understate the US advantage in health care because PPP ratios for medical equipment are almost certain to be higher than those for wages or hospital supplies.

Investment

Comparisons are made for gross fixed investment in machinery and equipment (including capital repair) and construction. Investment comparisons exclude inventory change and net additions to livestock herds, which are included in "other" expenditures.

PPP ratios for *machinery and equipment* are taken from a study that compares US and Soviet machinery prices for a sample of 245 items. For many years, comprehensive data on prices and specifications for Soviet machinery items were not available from Soviet sources. Soviet publication during 1970-71 of a large number of price handbooks (*tsenniki*) containing prices for a wide spectrum of machinery and equipment made a systematic comparison of US and Soviet machinery possible. The classification system of the Soviet input-output table was used to provide the framework for the price sample. Products were selected from the 21 sectors that define Soviet civilian machinery production and matched under a contract with a US manufacturer with comparable US products. The *tsenniki* ruble price and the dollar price formed the item PPP ratio.

The PPP ratios for *construction* are based on a sample of 277 types of projects representing a broad cross section of construction. The individual ratios were grouped into eight construction categories to mesh with categories used in each country's published data on construction expenditures. Construction ratios rely on the USSR's 1972-73 capital census handbooks, which provided simplified formulas for cost per square meter of construction of various sizes and specifications. These ruble costs were adjusted upward by 20 percent to allow for Soviet cost overruns.

The quality of Soviet construction has often been observed to be inferior to American. Although many aspects of this inferiority relate only to appearance, others reflect the Soviet attitude toward maintenance. As an approach to handling the quality problems, we arranged the comparisons so that the highest quality Soviet construction for a given type of project was matched with average and poor quality US construction. This procedure is arbitrary and does not entirely eliminate the problem, although the correction moves in the proper direction.

Capital repair expenditures are the sum of Soviet spending on noncurrent repair of fixed assets. Unlike current maintenance expenditures, capital repair expenditures are not written off as current costs but are capitalized. The book value of the asset is raised to reflect this type of repair, which is supposed to extend the service life of the asset.

Half of Soviet expenditures on capital repair have been excluded in US-USSR comparisons of new fixed investment. This compromise is adopted because repair expenditures are rarely capitalized in the United States for tax reasons, while in the USSR capital repair is an accepted alternative to new investment and represents an increment in the value of fixed capital.

Soviet capital repair was allocated to machinery and construction according to CIA estimates of its proportional distribution. The machinery and construction ratios were then adjusted to reflect its inclusion.

Defense, Administration, and Other Expenditures

Defense expenditures in both countries include expenditures on military equipment, construction, personnel (excluding transfer payments in the form of pensions), operations, maintenance, military RDT&E, and defense-related atomic energy programs. Except where otherwise noted, defense will be defined according to US conventions. This is done to make the comparison of US and Soviet defense activities consistent, comparable, and familiar to US policymakers. There is some evidence that the Soviet definition of defense incorporated in Soviet statistics²⁷ is broader than the US definition. The cost differences between the Soviet "broad" and the US "narrow" definitions—mainly costs of civilian US space programs that would be funded by the Soviet military and civil defense activities—have been arbitrarily allocated to the Soviets' "other" category. Appendix C gives a fuller discussion of the reasons two different definitions of defense are needed.

²⁷ Comprehensive official Soviet data on defense spending have never been released. The official figure released annually obviously covers only a small part of the total effort.

Table 2 *Billions 1976 US \$*
Alternate Measures of US Defense
Spending in Selected Years

	1972	1975	1978	1980	1981
Budget data	93.2	84.3	85.2	92.7	97.3
GNP data	96.3	86.1	86.5	92.1	96.7

This study uses US defense expenditures and price deflators from US GNP accounts for consistency with other elements of US GNP. The figures in this paper for US defense expenditures in 1976 prices differ slightly from deflated defense expenditures derived from the US budget and the Five-Year Defense Program, which are used by the CIA in other studies for comparisons of US and Soviet military activities. Defense expenditures in US GNP accounts are the sum of actual disbursements in a calendar year as reported by the US Department of the Treasury. In contrast, the defense series used by the CIA is derived from annual outlays reported by DoD in the budget and deflated by specially constructed deflator indexes. Most of the small differences arise from differences between the price deflators associated with the two series. Both estimates of US defense spending are shown in table 2.

For the USSR, *administration* is the sum of estimated expenditures on general agricultural programs, the forest economy, state administrative bodies at all levels, and municipal and related services (including police). For the United States, this category is a residual of current government spending on goods and services not classified elsewhere. Some of the larger categories of administration expenditures are central administration and management, public safety, natural resources, and agriculture. The totals for the two countries may not be entirely comparable, and Soviet expenditures may be understated. The USSR is notoriously secretive about such matters as expenditures for police and fire protection, for example.

PPP ratios for administration are based on inputs of manpower and materials. Dollar wage data are based on the average salary of federal civilian employees

and state and local government employees not employed in education. Ruble wage data are the average annual salaries of employees in Soviet administration categories listed above.

For the USSR, *other expenditures* include the difference between total GNP and the sum of consumption, investment, defense, and administration as well as several accounts that have been transferred from other categories for compatibility purposes. Other expenditures in Soviet GNP consist of net exports, inventory change, civilian space, civilian research and development, net change in livestock inventories, and any statistical discrepancy. Livestock inventories and civilian research and development funds have been transferred to other expenditures from investment, and civilian space has been transferred from defense. For the United States, other expenditures include net exports, inventory change, civilian space, foreign military assistance, and any statistical discrepancy.

Alternative Interpretations and Major Uncertainties

Because of the wide gulf separating the processes of price determination in the United States and the USSR, there are two general ways to view the comparisons: as measures of relative production potential and as measures of relative real income. The first requires some major assumptions given the nature of the available information, while the second is subject to strong qualification.

To measure production potential, prices in the two countries in the base year should satisfy the theoretical conditions governing producer equilibrium: they must be free to move so that relative prices can reflect the marginal rates of substitution. For the United States and especially for the USSR, the established prices used in the comparisons involve distortions of these conditions. In the USSR, indirect taxes, which fall almost entirely (although unevenly) on consumption, and an enormous bill for subsidies to agriculture and other sectors ensure that relative factor costs will

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be quite different from relative established prices. At the same time, investment goods are effectively rationed and distributed at prices that probably do not fully recover production costs. Until detailed adjustments of the established prices to factor costs can be made, GNP comparisons will not provide good measures of relative production potential.

The comparisons are more valid as measures of real income differentials. To reach this interpretation, we must assume, as in all such comparisons, that the results do not depend on the distribution of income within the countries, and that Soviet and American tastes are the same.²⁴ Once the proposition of common tastes is accepted, the comparison of real incomes requires that relative prices be proportional to the relative marginal utilities of the goods and services as judged by the representative consumer in each of the two countries. Even for the United States, where relatively free markets prevail, there are important distortions from these conditions. In the Soviet Union the prevalence of queues and black markets shows that at state prices the Soviet consumer would like to spend more than he or she is able to on some commodities. Thus, relative prices are not proportional to marginal utilities of goods and services over a substantial part of the Soviet market. Relative prices apparently also play only a small role in Soviet investment and defense decisions. But the assumption that the population adjusts its purchases so as to maximize its satisfaction with given incomes makes sense for both countries.

If the comparisons qualify as reasonable measures of the relative size of real incomes in the USSR and the United States, we believe they trace the upper bound of the ratios of Soviet-to-US GNP. The GNP ratios tend to overstate the Soviet relative position because:

- The PPP ratios for machinery, equipment, and construction were not adjusted to account for US quality advantages beyond those reflected in the original product matches.

²⁴ See Kravis, *op. cit.*, for a defense of the analogous assumptions for countries as different as Kenya and the United States

- The ratios of established prices in the two countries ignore the substantial advantage that the American consumer has in terms of convenience, variety, and availability. These "services" are covered in the US price but not in the Soviet counterpart. The dollar value of Soviet output, therefore, is overstated and the ruble value of US output is understated.
- The PPP ratios for services—especially health and education—probably are too high because they do not adjust adequately for the higher qualifications of American workers in health and education.

On balance, then, Soviet economic performance probably compares somewhat less favorably with that of the United States than our calculations suggest.

In the area of basic data quality, we have the most confidence in the US- and Soviet-weighted investment and consumption PPP ratios because of the extensive research underlying them. The US-weighted defense ratio (the one used to convert US defense from dollars to rubles) has the least confidence because of the difficult nature of pricing US weapons in rubles. We therefore realize our estimates of US defense in rubles are subject to considerable uncertainty. The uncertainty in the US ruble defense estimate, however, has a limited effect on the aggregate comparisons. The US-weighted ruble-dollar defense ratio would have to be in error by at least 50 percent to shift Soviet GNP as a percentage of US GNP by as much as 1 to 2 percentage points, and we believe it is unlikely to be off by this much. Errors in the US-weighted defense ratio would have no effect on the aggregate comparisons in dollars, since they are determined by Soviet-weighted ratios in which we have higher confidence.

Appendix B

Differences Between Civilian PPP Ratios and Military Ruble-Dollar Ratios

The incorporation of defense into Soviet-US economic comparisons requires combining defense comparisons using the military ruble-dollar ratio methodology and civilian comparisons using the FPP ratio methodology into a coherent structure. Consequently, the differences between the two methodologies take on greater significance than when civilian and military comparisons are estimated separately using their respective methods. This appendix examines these differences and addresses issues of compatibility.

The CIA's purpose in estimating dollar costs of procuring and maintaining Soviet military equipment is to determine what it would cost to manufacture and maintain the *Soviet* design (exclusive of RDT&E costs) in the United States using US manufacturing technology and practices. We do this, when possible, through detailed engineering studies.²⁷ Where we do not have enough information for an engineering study, the dollar costs of Soviet weapons derived using the military ruble-dollar ratio methodology often depend on mathematical models called cost-estimating relationships (CERs). These calculate costs based on performance parameters. For example, US aerospace industries have found from experience that factors like weight and speed are good predictors of aircraft costs. A CER used to derive dollar costs for Soviet aircraft, then, would be based on US manufacturing and design experience but would have Soviet aircraft performance characteristics as inputs. To avoid overstating the dollar cost of the Soviet item, a US CER with a level of technology appropriate to that of the Soviet system is selected. If no CER or direct information is available, a US analogue that matches the Soviet good as closely as possible is used as a last resort. Because of the problems in matching, this method is only used in a limited number of cases.

²⁷ The results of the military dollar cost comparisons are discussed in DI Intelligence Assessment SOV 83-10035, 2 February 1983. *A Comparison of Soviet and US Defense Activities, 1972-81.*

The PPP ratio concept differs from the military ruble-dollar ratio concept in that it estimates the cost of producing the performance of the Soviet good using *US* design as well as manufacturing technology and practices. In other words, a US good is selected that most closely matches the function and performance of the Soviet good, and its dollar price is compared to the ruble price of the Soviet good to form the individual product PPP ratio.

Until recently, there have not been strong analytic reasons to integrate the two methodological concepts; they have been developed separately to address different issues. Consistency, however, might argue for an estimate constructed with the same methodology. How different are the two types of ratios and what is the effect on the GNP estimate of mixing the two methodologies?

In theoretical terms, there should be no difference between military ruble-dollar ratios and military PPP ratios. The cost of a US analogue to a Soviet good should be the same as the cost to build the Soviet good in the United States provided that the analogue is a perfect match in all performance parameters. For example, a military ruble-dollar-ratio for the MIG-21 aircraft would be formed by obtaining the Soviet ruble price of the aircraft and the dollar cost of building it in the United States. A military PPP ratio for the same MIG-21 aircraft would be constructed by comparing the dollar price of a US plane that met the specified key performance criteria, such as pounds of thrust and airspeed, with the MIG-21's ruble price. Assume, for example, that the American F-4 met the specified criteria.

The military PPP ratio and the military ruble-dollar ratio for the MIG-21 would be identical if the dollar cost of the F-4 were identical to the dollar cost of

producing the MIG-21 in the United States. In reality, however, the two ratios probably would not be equal, because it is very difficult to find perfect US analogues. Selected parameters may be matched, but US military goods tend to be produced with expensive "state-of-the-art" technology that improves their performance in other areas relative to the Soviet good. The dollar cost of the US analogue would thus be higher than the dollar cost of the Soviet good derived from the military ruble-dollar ratio methodology, making the military PPP ratio lower than the military ruble-dollar ratio. This relationship may not be true in every case, but is probably true in the preponderance of cases because of the US lead in many key technological areas.

The differences between PPP ratios for military goods and services and actual military ruble-dollar ratios suggest that the use of the latter probably affects the GNP comparisons somewhat, but the effects are difficult to quantify.³⁹ Use of military ruble-dollar ratios in a GNP study primarily based on PPP ratios probably understates the size of the Soviet defense effort in dollars and overstates the size of the US defense effort in rubles relative to what would have been estimated had PPP ratios been used for military goods and services. This is the opposite direction of the bias introduced into Soviet-US comparisons by the index number effect. The Soviet comparative

³⁹ Empirical efforts to estimate these differences based on a limited sample, in fact, contradict the hypothesis that military ruble-dollar ratios should be higher than PPP ratios for the military, because the two types of ratios are fairly consistent for some goods. Certain durable goods, such as transport aircraft, tractors, trucks, construction equipment, electronics, and transport ships, are common to both the civilian and military samples of goods and services used in our defense and GNP comparisons. The PPP ratios and the military ruble-dollar ratios for these goods were derived independently, but the civilian PPP ratios may be viewed as "military" PPP ratios because they relate to goods in the military sample. When compared, the military ruble-dollar ratios of these goods fall within a comfortable range of the corresponding civilian (conjectural military PPP) ratios. When the means of the ratios in each category are ranked, the same pattern is found in both sets: the more technologically complex the category, the higher its mean ratio. This indicates that it is relatively more difficult (measured in terms of cost) for the Soviet Union to build complex goods than it is for the United States. This evidence is suggestive of a general trend but not conclusive because the number of items common to both sets of ratios and their impact on either the comparative GNP estimate or the estimate of comparative dollar costs of defense activities is small. Also, most of these goods are not as technologically complex as some military systems, and the practical differences between the ratio concepts may be larger for more complex items.

disadvantage in producing complex goods, reflected in high military ruble-dollar item ratios, is being accentuated as the Soviet weapon mix begins to include more of such weapons. These complex goods, however, would have somewhat lower ratios if the PPP concept were used for the military, which would result in a larger estimate of the Soviet defense effort in dollars and a smaller estimate of the US defense effort in rubles. Thus, the use of military ruble-dollar ratios tends to offset somewhat the uncertainty in the Soviet-US comparisons that comes from the index number problem in economic measurement.

Appendix C

Measuring Comparative US and Soviet Defense Burdens

Defense burden is conventionally expressed as the ratio of the value of military goods and services produced to the total value of goods and services produced by an economy when both defense and GNP are measured in indigenous currency terms. The burden ratio answers significant questions about a country's resource commitment to its military, but these answers differ depending upon the definition of defense used.¹¹

Alternative Definitions of Defense Costs

When we compare US and Soviet defense activities, we usually use a US definition of defense because it is more familiar to US policymakers. This definition includes:

- National security programs in both countries that in the United States would be funded by the Department of Defense.
- Defense-related nuclear programs in both countries that in the United States would be funded by the Department of Energy.
- US Selective Service activities and their Soviet counterparts.
- The defense-related activities of the Soviet Border Guards and the US Coast Guard. (U)

Soviet defense costs measured by this definition exceeded US costs by a considerable margin in 1981—by 25 percent in ruble terms and by 45 percent in dollars.

A comparison could, of course, also be made using a Soviet definition of defense. We believe a Soviet definition would be broader than the US definition

¹¹ The reader interested in burden analysis is referred to

Becker adds a political-institutional perspective to the comparative burden issue in "The Burden of Soviet Defense: A Political-Economic Essay," *World Military Expenditures and Arms Transfers, 1970-1979*, ACDA, 1982.

Table 3
Costs of US and Soviet Defense Activities in 1981

US definitions

Billions of 1970 Rubles			Billions of 1976 Dollars		
USSR	United States	USSR/US	USSR	United States	USSR/US
66	52 ^a	1.25	138 ^b	97	1.45

^a US defense costs in rubles show what it would cost using prevailing prices and wages and assuming the necessary production technology for the Soviets to procure the same new weapons and man a force of the same size and with the same weapons inventory as that of the United States and to operate that force as we do.

^b Soviet costs in dollars give the US cost to procure, man, and operate the Soviet force as the Soviets do.

because a greater range of activities are associated with the defense function in the USSR. The Soviet definition would probably add the following costs to the narrow US definition:

- Space activities that in the United States would be funded by the National Aeronautics and Space Administration.
- Civil defense.
- Soviet Internal Security, Railroad, and Construction Troops.

The estimate based on this broader definition provides an indication of the level and trend in the annual Soviet resource commitment to its military forces. It allows us to assess the full impact of defense on the Soviet economy and, conversely, the impact of economic factors on Soviet defense activities. The broad ruble defense estimate also provides somewhat better insights into the resource constraints confronting Soviet military planners as well as the priorities they assign to different elements of their defense effort

Table 4
 Ratios of Defense Costs to GNP for the
 USSR and the United States, 1981 Percent

	1970 Rubles		1976 Dollars	
	Narrow Definition	Broad Definition	Narrow Definition	Broad Definition
United States			4.9	5.1
USSR	12.9	13.9		

The Defense Burden Ratio

Narrow and broad definitions of defense, along with comparative GNP data, allow us to compute a number of different measures of defense in relation to national output. When comparing burden ratios for different countries a common definition of defense should be adopted so as not to distort the meaning of comparative differences. When one particular country's perception of its defense burden is of interest, however, that country's own definition of defense or an approximation of it should be used.

Regardless of the definition of defense activities used, any burden analysis should be calculated in indigenous currencies. Price and quantity relationships vary from country to country, and measuring burdens in indigenous currencies preserves the domestic price and quantity relationships that would be distorted if foreign prices were used.

Table 4 shows the estimated burden ratios based on both the narrow and broad definitions of defense. Of the eight ratios that can be calculated, only those based on dollars for the United States and rubles for the Soviet Union embody all of the necessary pricing conditions to serve as burden measures. If the Soviet burden of defense were being compared to the American, it would be over two and a half times as great (12.9 percent of Soviet GNP versus 4.9 percent of US GNP using the US definition of defense activities). The burden of defense in each country, however, would be 13.9 percent of Soviet GNP and 4.9 percent of US GNP, where each figure is based on a definition of activities most consistent with national circumstances.

Appendix D

Comparisons of Real Soviet and US GNPs: Tables

Table 6
Comparison of Soviet and US GNP's
in Billion 1976 US Dollars

	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	
GNP																						
USSR	415.4	449.3	475.2	660.4	731.9	779.9	818.5	854.5	897.7	927.5	951.2	1,018.2	1,036.1	1,096.6	1,137.4	1,149.9	1,201.3	1,240.0	1,240.1	1,282.7	1,291.6	1,311
United States	992.9	1,019.3	1,077.3	1,124.3	1,179.3	1,244.8	1,321.5	1,354.7	1,418.2	1,451.2	1,447.0	1,495.6	1,577.7	1,671.3	1,846.8	1,635.0	1,718.0	1,810.8	1,898.2	1,911.0	1,841.3	1,827
USSR/US	0.20	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Manufactures																						
USSR	317.1	324.5	342.5	339.7	373.0	394.3	415.1	437.4	462.3	486.6	508.4	575.3	536.8	523.3	571.7	594.8	613.0	639.5	649.0	666.3	646.4	657
United States	451.6	443.4	456.4	425.3	464.3	481.3	456.8	485.2	490.8	496.2	498.9	482.8	482.4	495.2	481.4	443.9	420.2	413.3	389.3	389.3	391.5	391.5
USSR/US	0.47	0.49	0.51	0.49	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
Food																						
USSR	100.2	102.0	106.1	110.0	110.7	115.7	120.9	128.0	135.2	138.0	143.2	147.2	151.2	155.2	159.2	163.2	167.2	171.2	175.2	179.2	183.2	187.2
United States	178.1	181.0	183.5	185.9	192.4	200.6	206.0	207.2	217.4	224.4	229.9	236.6	243.2	249.8	256.4	263.0	269.6	276.2	282.8	289.4	296.0	302.6
USSR/US	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Soft goods																						
USSR	34.7	35.9	37.2	37.3	37.7	41.4	45.2	49.4	53.9	57.1	62.3	65.4	67.3	69.8	72.5	76.6	80.3	83.7	86.0	87.9	89.1	91.1
United States	77.1	79.4	84.6	87.3	93.3	96.1	105.9	107.2	112.4	117.0	121.5	126.0	130.4	134.6	138.6	142.5	146.4	150.3	154.2	158.1	162.0	165.9
USSR/US	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Durables																						
USSR	9.7	9.9	10.4	10.4	11.4	12.7	14.0	15.0	16.4	17.3	18.3	21.7	24.7	26.5	28.4	30.7	34.1	37.2	38.2	39.5	42.3	44.2
United States	66.0	62.4	69.0	73.9	82.2	92.7	99.2	101.1	112.0	118.0	117.7	122.2	127.2	132.7	141.6	141.3	156.1	173.2	184.3	185.0	173.6	161.2
USSR/US	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Household services																						
USSR	29.4	31.5	34.3	34.7	34.6	34.6	34.4	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0
United States	232.4	240.2	249.8	257.1	276.6	283.6	294.7	310.5	323.3	336.6	346.5	374.3	374.3	388.5	391.7	403.6	420.8	440.4	461.7	474.8	479.6	481
USSR/US	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Nonhousing																						
USSR	14.1	14.9	15.6	15.3	15.0	15.6	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
United States	78.3	81.9	86.2	89.9	92.8	95.1	102.7	107.0	112.1	117.0	122.0	127.0	132.0	137.0	142.0	147.0	152.0	157.0	162.0	167.0	172.0	177.0
USSR/US	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Utilities																						
USSR	4.6	5.0	5.6	6.1	6.6	7.2	7.7	8.2	8.7	9.2	9.9	10.5	11.2	11.9	12.7	13.4	14.2	14.8	15.5	16.1	16.8	17.4
United States	29.3	29.8	31.2	32.8	34.3	36.2	37.6	38.9	39.8	40.0	41.8	42.3	43.1	43.2	45.2	46.8	48.6	50.2	52.0	53.6	55.0	57.0
USSR/US	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Public transportation																						
USSR	7.5	8.2	9.2	10.2	11.1	12.1	13.4	14.8	16.2	17.4	18.7	20.0	21.3	22.7	24.5	26.4	27.9	27.8	27.9	28.2	28.2	28.2
United States	7.9	7.7	7.3	7.3	7.4	7.9	8.2	8.7	9.3	9.9	9.7	9.9	10.5	11.0	11.6	11.4	11.9	12.6	13.2	14.0	14.9	15.9
USSR/US	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Personal communication																						
USSR	1.6	1.7	1.8	1.9	2.1	2.3	2.5	2.8	3.0	3.2	3.5	3.7	4.0	4.3	4.6	5.0	5.3	5.6	5.9	6.2	6.6	6.8
United States	2.7	3.1	3.7	4.1	4.8	5.6	6.4	7.2	8.0	8.8	9.7	10.6	11.5	12.4	13.3	14.2	15.1	16.0	16.9	17.8	18.7	19.6
USSR/US	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Repair and auto																						
USSR	7.8	7.3	7.2	7.5	8.2	9.2	10.2	11.2	12.3	13.3	14.4	15.3	16.4	17.6	18.7	19.8	21.0	22.0	23.6	23.2	27.0	27.0
United States	63.0	61.7	65.8	67.3	69.0	72.4	75.8	78.0	81.5	84.3	87.5	89.6	91.0	94.2	96.1	97.5	95.2	99.7	102.2	101.2	97.2	97.2
USSR/US	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Resale																						
USSR	7.4	6.9	6.4	7.1	7.4	8.2	9.4	10.6	11.7	12.4	13.2	14.6	15.6	16.7	17.8	18.9	20.0	21.0	22.6	24.1	25.8	27.0
United States	101.4	114.3	127.9	139.7	146.1	153.3	163.2	170.0	174.2	174.9	182.7	192.2	202.7	205.2	206.6	211.6	212.3	213.8	211.3	216.2	215.6	215.6
USSR/US	0.07	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

* The estimates of defense presented in this appendix are given as range estimates because the composition of Soviet and US GNP reports is. They should, however, be considered as indications of a range of substantial uncertainty. Because they use a US definition of defense, they are not commensurate with estimates of Soviet defense spending presented in other CIA publications that use Soviet definitions of defense.