APPROVED FOR RELEASE 1994
CIA HISTORICAL REVIEW PROGRAM
18 SEPT 95

TITLE: Rubles Versus Dollars

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VOLUME: 6 ISSUE: Winter YEAR: 1962

STUDIES IN INTELLIGENCE

A collection of articles on the historical, operational, doctrinal, and theoretical aspects of intelligence.

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Nonsense and significance behind the international GNP numbers game.

RUBLES VERSUS DOLLARS *

Rush V. Greenslade **

In the hearings on the Soviet economy before the Congressional Joint Economic Committee in 1959, Morris Bornstein of the University of Michigan presented three comparisons of the U.S. and Soviet gross national products.** One of these priced both countries' goods and services in dollars, the second priced them both in rubles, and the third was the square root of the product (the geometric mean) of the other two. They showed, respectively, that in 1955 the Soviet GNP was 53% of ours when figured in dollars, 27% when figured in rubles, or 38% when these two were averaged geometrically. The procedure Bornstein used was identical with that used by intelligence analysts, and the data and results were essentially the same. Bornstein's paper was the first public revelation of any figure except the geometric mean.

The calculation comparing total Soviet and American production is done in response to the perennial question asked of intelligence, where does the Soviet economy stand in relation to ours? Comparing quantities of individual products—steel, coal, oil, electric power, cement, grain, tanks, aircraft—is necessary and more useful, but people still want an overall comparison, one that is comprehensive. Such comparisons of gross national products in dollar and in ruble prices have therefore been carried out as completely as possible. The geometric mean has been used as a "best" single-value answer.

When, however, two alternative calculations of what supposedly is the same thing differ so widely as by a factor of 2, the meaning and usefulness of the figures or their average are open to question. Since the Joint Economic Committee hearings the use of the geometric mean as a meaningful comparison has been challenged by both American and Soviet

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** *Comparisons of the U.S. and Soviet Economies*, Joint Economic Committee of Congress, USGPO, 1959, Part II, p. 377–395.

* Studies in Intelligence, Vol. [illegible]

** Mr. Greenslade is an area chief in [illegible]

economists for quite different reasons. The object of this article is to set forth the main outlines of the very complex calculations underlying the comparisons, to make clear their conceptual basis, and to show what interpretations of the comparative ratios are consequently justifiable. It will explain why the dollar and ruble comparisons are not so good, and the geometric mean not nearly so bad, as critics have alleged.

Unit-of-Measure Bias

Comparison of two heterogeneous baskets of goods and services in aggregate requires that their contents be measured in a common unit. Standard economic procedure is to use money values as the unit of measure and to convert each basket of goods into a monetary equivalent by a set of prices. Each good or service in physical units (e.g., tons of coal) is multiplied by its price per unit (e.g., $25) and the resulting values are added together. But what prices should be used—in an international comparison which country's prices, and analogously in computing growth of output from one period of time to another, which period's prices? The choice, as Mr. Bornstein's figures show, can be of major quantitative significance.

This now familiar impasse is referred to by economists as the index number problem. It is conceptually insoluble. It is also universal. It occurs unfailingly in any aggregative comparison between two economic complexes separated in time or space. Until a few years ago there were no international comparisons based on a detailed valuation of one country's product in another country's prices. Most international comparisons were derived simply by converting the total value of one country's product in its own prices into the currency of another country by the international exchange rate between the two. In 1954 the pioneering study of Gilbert and Kravis* presented detailed comparisons of U.S. production with that of the UK, West Germany, France, and Italy. The results showed that the foreign exchange rate conversions were quite misleading. They also showed that the index number problem was significant for all the countries studied.

**An International Comparison of National Products and the Purchasing Power of Currencies,* Milton Gilbert and Irving B. Kravis, OEEC, Paris, 1954.

The ratio of UK to U.S. GNP is significantly higher in U.S. prices than it is in UK prices. Here the difference is less than in the USSR/U.S. comparison; but in comparing U.S. production with that of Italy the difference between the two ratios is about as large as with the Soviet. So the difference between the ruble-valued comparison and the dollar-valued one cannot be attributed solely to the artificiality of Soviet prices.

The index number bias is also uniform in direction. In every case the ratio of country A's GNP to country B's GNP is larger when the products are valued at B's prices than when A's prices are used. This holds for the Western European countries as well as for the USSR. In each bilateral comparison with the United States, the ratio of the other country's GNP to ours is larger in dollars than in its own prices. The same systematic bias holds in comparisons over time. In 1954 prices U.S. GNP in 1955 is 216% of that in 1929; in 1929 prices it is 222%. A spectacular index number spread for time comparisons is found in measuring the growth of Soviet GNP: in 1926/27 prices the 1937 Soviet national product, as measured by Jazny and Grossman, was 198% of the 1928; in 1937 prices it was 150%.*

The economic explanation for the index number problem is fairly straightforward. The price of one kind of goods relative to that of other kinds varies from time to time and place to place. Given transport costs and barriers to trade, relative prices may differ greatly between countries. Everyone is familiar with differences like the following: wine is relatively cheap in France, while beer is relatively cheap in Germany; domestic servants are relatively cheaper in most foreign countries than in the United States; fuels, oil, coal, and natural gas are relatively much cheaper here than in Western Europe; meat is relatively very expensive in the Soviet Union but standard machine tools are relatively cheap. Relative prices differ between countries because of differences in taste, culture, and habits and also because of differences in natural resources, capital/labor ratios, stage of development, and other factors that affect the cost of production.

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* *Soviet Economic Growth*, Abram Bergson, ed., Row, Peterson & Co., 1953, p. 7.

Patterns of output also vary between countries, and their variation is related to the price patterns. Specifically, each country tends to use and therefore to produce relatively more of the goods which are relatively cheap. This tendency accounts for the systematic direction of the index number bias. To clarify this point a numerical example may be helpful. Suppose two countries, F and G, produce only two commodities, wine and beer. The quantities produced and the prices in each country are shown below.

	Country F		Country G	
	Price per liter (Francs)	Output (million liters)	Price per liter (Marks)	Output (million liters)
Wine	2	10	2	5
Beer	3	3	1	10

Then the total value of output in the two countries can be computed in either country's prices:

	Value of output			
	In million Francs		In million Marks	
	Country F	Country G	Country F	Country G
Wine	20	10	20	10
Beer	9	30	3	10
Total	29	40	23	20
Ratio F/G	72½%		115%	

In country F wine is cheap relative to beer and the population consumes relatively more wine, perhaps because the price is cheap; and the price is cheap because resources for producing wine are abundant. It is also possible that wine is cheap because the population likes wine and has concentrated on the technique of its production. In country G the wine-beer situation is reversed. Because of these inverse price and output patterns, country G's total output is greater than F's when measured in francs but smaller than F's when measured in its own currency.

If in this example one substitutes the United States and the USSR for F and G and consumer goods and investment/defense production for wine and beer respectively, it is easy to visualize how the U.S./Soviet index number discrepancy arises. In the United States consumer goods are relatively cheap and investment/defense goods relatively expensive, and our pattern of output favors consumer goods. In the USSR

the situation is reversed. The ratio of Soviet to U.S. output is larger in dollars because U.S. prices are relatively higher for the goods the USSR produces in relatively large quantities. The pattern of output by major end uses is shown in market prices below.

COMPARISON OF SOVIET AND U.S. GNP FOR 1960 AT MARKET PRICES IN 1955 DOLLARS AND RUBLES

END USE	RUBLE COMPARISON			DOLLAR COMPARISON			GEOMETRIC AVERAGE
	USSR (billion rubles)	U.S. (billion rubles)	USSR as percent of U.S.	USSR (billion dollars)	U.S. (billion dollars)	USSR as percent of U.S.	USSR as percent of U.S.
Consumption	1,172	4,700	24.9	143	315	45.4	33.6
Investment	447	514	87.0	102	78	130.8	106.7
Defense	156	162	96.3	39	38	103.0	99.6
Government administration	22	30	73.0	10	14	71.0	72.0
Gross national product	1,797	5,406	33.2	294	445	66.1	46.8

The index number problem derives from differences in patterns of output which in turn derive from differences in resources and in national preferences. The wider the divergence in patterns of output, the wider the index spread. Comparisons of developed with underdeveloped countries yield extremely large spreads between the two valuations simply because the patterns of output are so different.

Partisan Positions

As indicated earlier, this problem is insoluble. There is no ground for choosing between the two alternative valuations. A time-honored expedient has been followed in using their geometric average in public pronouncements.* The compari-

*The geometric mean is used in preference to the arithmetic because economic growth and other changes in general proceed geometrically; that is, constant percentage increases describe the changes better than constant absolute increases. The geometric average of two numbers exceeds the smaller of the two by the same percentage as the larger exceeds the average.

son the President made in his press conference of July 1961—that the Soviet GNP was 47% of ours in 1959—was the geometric average. This usage has been challenged by both Soviet and American economists. The Soviet economists have come out flatly for the dollar comparison, in which, of course, Soviet GNP is higher relative to ours. Interestingly enough, their justification is that in a planned socialist economy price does not have to correspond to value, i.e., real costs, and in fact does not in the Soviet Union. And therefore, they argue, the ruble valuation is meaningless.

The Soviet argument is specious. As the studies of Gilbert and Kravis show, the index number problem always occurs, and in general the more divergent the pattern of output the wider the spread between the two figures. The patterns of U.S. and Soviet production are very divergent indeed. We can estimate how much difference the irrationality of Soviet pricing does make in the ruble comparison. We can eliminate a considerable part (but by no means all) of the distortions in Soviet prices by converting market prices to the Western accounting concept of factor costs. Factor costs are calculated by subtracting from market prices any direct taxes included in them, like the Soviet turnover tax, and adding subsidies granted to the industries. The adjustment of Soviet prices to factor costs cannot be carried out in detail because detailed data on turnover tax rates by commodity are not available. Preliminary calculations, however, indicate that the use of factor costs would raise the Soviet GNP as a percentage of the U.S. in rubles by a few points but would not eliminate the bulk of the index number spread.*

Objections by American economists are more serious. Abraham Becker of Rand** has argued that the average is meaningless and should be abandoned, that the ruble and dollar comparisons are equally correct measures of relative output and should be equally and impartially cited. The basis of his contention is that while the ruble and dollar comparisons are precisely defined by the two real price systems used

*The ratio of 47% in 1959 used by the President incorporated an upward adjustment from market price ratio to allow for the effect of factor costs.

**World Politics, p. 99, October 1960.

in the calculations, the geometric average of the two does not correspond to any existent price system. Another position is taken by Francis Hoeber of the Stanford Research Institute, who votes for the dollar comparison.* His argument, as nearly as I can tell, is simply that American prices are more familiar to Americans, who will therefore understand the dollar comparison better.

Both these positions impute more meaning to the comparisons than they can have. The GNP ratios have a broad, general, far from precise meaning, one which tends to disappear if you try to pin it down. Like a faintly fragrant flower, it can be apprehended by gentle inhalations, but an attempt to extract the scented oil and subject it to chemical analysis will ruin it altogether.**

Unknowns in the Equation

As background for a better appreciation of what the GNP index numbers mean let me outline some of the difficulties inherent in the data used to calculate them.

Procedurally, the conversion of Soviet product values to dollars and U.S. product values to rubles is carried out with ruble/dollar price ratios for individual goods and services. The ratios used, numbering a few hundred, are only a small sample of all prices in either economy. Each price ratio is applied to those sections of consumption, investment, defense, and government administration for which it is deemed to be representative: thus a man's suit, shirt, and pair of overalls are taken to be representative of the whole men's clothing category.

The small size of the price sample introduces a margin of uncertainty. Worse than that, it is limited to prices the USSR publishes, and it is therefore weakest in military hardware, construction, and custom-built equipment. And of course there can be no price ratios for the considerable number of both consumer and producer goods produced in the United States but not in the USSR. For many services, such

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**Soviet Economic Potential, 1960–1970*, Francis P. Hoeber and Robert W. Campbell, Stanford Research Institute, 1961.

**But we must reject on technical grounds any suggestion that the ratios be described as faintly fragrant numbers.

as health, education, and government administration, the product itself, let alone the price, is indefinable. Here we use wage and salary ruble/dollar ratios, thus implicitly assuming that the services of one Russian doctor equal those of one American doctor, and similarly in the other service professions.

The measurements are inherently quantitative. The quality and specifications of each product in the price ratio sample are checked as carefully as possible: an average Russian men's suit is paired not with an average American suit but with one that appears comparable in quality, well below the American average. But this product-by-product comparability, even if it could be achieved with accuracy, would not take into account the vast difference in diversity and assortment in the two countries. There is no way to quantify these factors, but we know from observation and from Soviet statements that supplies of consumer goods of all kinds are badly balanced, some types being in very short supply and others in surplus and unsalable. Diversity and assortment problems are evident in the investment field as well; for example, the range and mix of agricultural equipment is poor by the Soviets' own admission. Nevertheless, if 100,000 agricultural tractors of a certain type are produced they are included in the measure of output, regardless whether there is a demand and economic use for that number of these tractors.

Another deficiency in the statistical procedure concerns the value of retail trade services, which is included in the value of the consumer goods compared. The goods themselves are kept comparable by matching the physical qualities of individual products, but there is no practical way of measuring the quantity or quality of retail service that goes along with the product. Thus a pound of ground beef is counted the same in the two countries even if in one it is accompanied by air conditioning, soft music, and quick service, in the other by clouds of flies, pungent odors, and interminable queuing.

It is hard to believe that these data deficiencies do not favor the USSR, making the dollar valuation of the Soviet product too large by some few percentage points. On the other hand, as we saw above, the use of ruble market prices rather than

factor cost overstates the U.S. product in rubles. To what extent these two overstatements offset each other is impossible to say. For all these reasons, over and above the index number problem, the total GNP comparisons should be regarded as order of magnitude indicators and not as precise measures.

Rationale of the Mean

Let us now return to the meaning of the dollar and ruble valuations and their geometric average. The valuation of one country's output in its own or in another country's prices has a precise *statistical* meaning given it by the calculation procedure, i.e., the multiplication of commodities by a specified list of prices. Further, these prices are taken from an actual operating price system. But this is still far from an *economic* meaning. The price systems of the two countries subject to bilateral comparison are not the only possible scales of valuation; consider the possibility and desirability of multilateral international comparisons. If we were comparing the U.S., Soviet, and West German output there would be three price systems and three sets of ratios for the U.S./Soviet GNP. Each country added would add another set of comparative ratios. In what sense then is the dollar or ruble valuation uniquely "correct"?

In a precise economic sense none of the valuations are correct. Two production aggregates can be unambiguously compared only if they are made up of identical proportions of the different kinds of goods and services. The comparison of two GNP's with different proportions can be given meaning only by an assumption about the transferability of resources, the assumption, for example, that the United States can shift resources from the present pattern of output to any other one at prevailing dollar costs and prices. The dollar ratio of Soviet to U.S. GNP, 66% in 1960, would be unambiguously the measure of comparative output *if the US were to shift resources until its output had the same proportional pattern as the USSR's* and *if the 1960 dollar value of this output were unchanged.* Similarly, if the USSR were to shift resources in the opposite direction, leaving its ruble total unchanged, the ruble ratio, 33%, would be unambiguously correct. The two provisos are, of course, highly dubious assumptions. They

imply that unit costs of production would remain constant at all levels of output for all products.

This argument leads to the main conclusions I wish to draw. First, the two comparisons could be described better as equally incorrect than as equally correct. Second, the geometric average of the two can be given a defined meaning by assumptions no more dubious, possibly much less so. The average ratio would be unambiguously correct if both countries could shift to an identical intermediate pattern of output, the value of each total output in the domestic currency remaining unchanged. The feasibility of such a shift is certainly not harder to conceive than a shift of either country entirely over to the other country's pattern. The geometric mean is a rough approximation to the comparison that would hold if the pattern of output in both countries were a mean between the present patterns. In this interpretation it is a far from precise but still useful figure indicative of the relative overall size of the two GNP's.

Elements of Challenge

The third conclusion is that the capability for shifting resources lies at the heart of these interpretations. The figures shed no light on this capability; they require, on the contrary, an arbitrary assumption about shifts in order to have meaning. Thus specific questions about capability cannot be answered. For example, how much could each country produce of a specified list of defense goods and services under full mobilization? One could not deduce an answer from either the ruble or dollar comparison, but only, if at all, from a detailed study of the mobilization potential of each economy, industry by industry. The output comparisons really tell us nothing about capabilities for producing alternative mixes and hence nothing very precise about relative output. When and if the USSR reaches a level of output measuring 103% of the U.S. in dollar prices and 57% in ruble prices, it will be impossible, and probably at that stage of the game irrelevant, to say whether these ratios mean that it has caught up with us.

If the aggregate GNP comparisons are so ambiguous, of what use are they? They have found a place in the propaganda battle between the Bloc and West, but their analytical

usefulness is limited. The useful quantitative comparison between the U.S. and Soviet economies is not of total GNP but of its separate segments. The table on page 5 shows that although there is an index number discrepancy in the individual consumption, investment, and defense components of GNP, it is a smaller one. This is because the difference between the two countries in pattern of output for each individual end use is less than in their production patterns as a whole. A breakdown (as detailed as possible) of the two GNP's in both sets of prices reveals precisely the divergence in pattern of output which causes the index number problem in the total GNP comparison and at the same time is obscured by the aggregation. The comparisons by end use show also the relative price differences which accompany the differences in output patterns.

The point to be emphasized in conclusion is that overall GNP comparisons—dollar, ruble, or average—do not measure in any significant sense the USSR's economic challenge to the United States. It is the uses to which productive capacity is put that are significant. Soviet GNP in 1960 may be 33, 47, or 66 percent of ours, but Soviet defense expenditures are approximately equal to ours and investment for growth is also equal or perhaps a little larger than ours. There is no policy question that need hinge on the overall GNP comparison. There is much more pertinent information available to U.S. policy makers and also to the general public regarding Soviet economic performance, the structure of the economy, the uses of production, and the USSR's objectives, plans, and potentialities. In speeches by the Director of Central Intelligence and in many other ways it has been publicly reiterated that the Soviet economy, though significantly smaller than the U.S. over all, is growing much faster, particularly in heavy industry; that its production is concentrated along ominous lines—investment for more growth, armaments, and the development of new military technology; that its efforts in these fields are already comparable in magnitude to our own; that it is devoting its resources with all the power of a determined dictatorship to a long-run aim declared in Khrushchev's promise, "We will bury you."

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