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REPORT TO THE SUBCOMMITTEE  
ON RESEARCH AND DEVELOPMENT  
COMMITTEE ON ARMED SERVICES  
UNITED STATES SENATE

72-0251



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Comparison Of Military Research  
And Development Expenditures Of  
The United States And  
The Soviet Union

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B-172553

Department of Defense

BY THE COMPTROLLER GENERAL  
OF THE UNITED STATES

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JULY 23, 1971



COMPTROLLER GENERAL OF THE UNITED STATES

WASHINGTON, D.C. 20548

B-172553

Dear Mr. Chairman:

As requested in your letter of April 1, 1971, the General Accounting Office has evaluated the data and the methodology on which the Department of Defense (DOD) based its conclusion that Soviet Union expenditures for military research and development (R&D) are about \$10 billion annually compared with United States expenditures of about \$7 billion.

As you have recognized, this is a very complex matter involving many abstract issues. Furthermore the data available for such a study are very limited. According to DOD officials, their conclusion regarding increased Soviet Union R&D funding was based primarily on intelligence reports. With one exception, these reports were not available to us.

Although our study was necessarily restricted in scope, we have covered the two areas mentioned on page 5 of your request; namely (1) identification of the rough magnitude of overall U.S. expenditures for defense-related R&D and (2) determination of the data and methodology used by DOD in calculating comparable Soviet Union expenditures.

Although we did not have time to obtain DOD's formal comments, we did discuss the report informally with DOD officials.

PROBLEM OF COMPARABILITY

Our limited study indicates that any comparison of United States and Soviet Union R&D efforts is complicated by such factors as:

- The sparseness of published information on the Soviet Union budget.
- The inability to accept the limited published Soviet Union budget data at face value.
- The inclusion in the Soviet Union budget of outlays for activities financed in the United States largely by the private sector and State and local governments.

- The uncertainties in converting rubles to dollars.
- The differences in methods of performance, especially in the use of manpower and equipment.
- The differences in innovative approach between a centrally planned economy and a competitive market economy.
- The reportedly inferior facilities and equipment of Soviet Union scientists (with the likely exception of some space and military research facilities), especially the lack of computers for R&D.

#### U.S. DEFENSE-RELATED R&D EXPENDITURES

In the past several years, DOD officials most often have mentioned defense-sponsored R&D as being in the area of \$7 billion. As long as the figure is not more precise, it can represent (1) the RDT&E (research, development, test, and evaluation) appropriation in DOD's budget request, (2) DOD's part of the R&D program contained in the Special Analyses section of the Budget of the United States, or (3) DOD's R&D program as published in National Science Foundation reports, which includes RDT&E appropriations plus some support received by R&D activities from other appropriations.

The expenditure figure of \$7 billion used by DOD in its recent statement included, in addition to DOD's RDT&E expenditures, costs for military atomic energy. The amount in current dollars was close to \$8 billion but was converted to 1968 dollars for comparison with Soviet Union expenditures.

We found in our study that expenditures for defense-related R&D in the United States were higher than any of the figures recorded in the above-named sources. Although we were unable to determine the exact amount, we believe that the additional effort exceeds \$1 billion. There are two principal areas in which these defense-related R&D costs are incurred: (1) expenditures are made by DOD that are not recorded as part of its RDT&E appropriations or its R&D program and (2) private

industry finances R&D (\$10 billion to \$11 billion annually), some of which is related to defense. These two areas are discussed in further detail subsequently.

Because of the nature of R&D there is no generally accepted definition of the activities which constitute R&D, especially when it comes to defining the point at which development ends and production begins. DOD believes that many of the so-called unrecorded R&D costs fall within the "gray areas" which border on the line between development and production and that there is a further definition problem involved in determining the part of industry's R&D efforts that is defense related.

DOD believes also that designation of these two types of costs as defense-related R&D costs would increase the amount recorded as U.S. defense-related R&D expenditures by about 15 percent--20 percent at the most--and that these add-on costs become important only if the Soviet Union is handling its similar expenditures in a different manner. DOD states that its comparisons were intended to make the Soviet Union RDT&E estimates functionally comparable to those of the United States and that such costs in the Soviet Union were outside the budget for its RDT&E. In our study we were unable to determine the handling of such expenditures in the Soviet Union budget.

Some DOD R&D-related expenditures  
not recorded as R&D

DOD's accounting system discloses some costs of RDT&E activities funded from appropriations for military personnel and military construction and from other appropriations. These costs are included in National Science Foundation reports on R&D. Other amounts relating to R&D however, are not funded with RDT&E appropriations or otherwise recorded as R&D.

1. As explained in our report to the Congress ("Allowances for Independent Research and Development Costs in Negotiated Contracts--Issues and Alternatives," B-164912, February 16, 1970), DOD's share of contractors' costs for independent research and development (IR&D)

(including other independent technical effort, such as bid and proposal) is generally absorbed as overhead on contracts. Such contracts are funded from appropriations for procurement, RDT&E, and to some extent operations and maintenance. On the basis of our knowledge of the funding of defense contracts, we estimate that 20 percent of such IR&D costs were funded from RDT&E appropriations. Therefore, using Defense Contract Audit Agency reports for 1970, we calculate that about 80 percent of such costs--more than \$550 million--represents additional defense R&D costs not included in RDT&E or otherwise recorded as R&D.

DOD informed us that it had included about \$300 million for IR&D in computing the \$7 billion of United States defense-related R&D costs for comparison with the Soviet Union R&D expenditures.

2. Certain expenditures, related to development of weapons systems and components, are funded from other than RDT&E appropriations and are not recorded by DOD as R&D costs. These include such areas as "product improvement" or "component improvement," "major modification," and "advanced production engineering."

DOD does not maintain separate records of product improvement or component improvement costs financed by the procurement or operations and maintenance appropriations. At our request DOD estimated that R&D costs for programs in this gray area amounted roughly to \$100 million in procurement appropriations for fiscal year 1972. We believe that the amount may be higher, because DOD has planned to approve \$113 million in calendar year 1971 and \$126 million in calendar year 1972 for aircraft engines, a single-component improvement program.

DOD informed us that Soviet Union expenditures for product improvement were made by Soviet Union production enterprises and were not included in estimates of the Soviet Union RDT&E budget. We were unable to corroborate this information and therefore are unable to comment on the statement.

DOD had not made a study of the engineering and testing costs funded from procurement appropriations for major modifications of

weapons systems and consequently did not provide us with an estimate of such amount. Our limited review indicated that modification programs involved substantial costs and, when implemented as modifications to production contracts, were not funded from RDT&E appropriations. The extent to which such modifications involve R&D efforts is not known.

DOD considered advanced production engineering as another gray area and estimated that such R&D effort involved \$50 million financed from 1972 procurement appropriations.

3. Expenses of R&D management and administrative organizations at DOD departmental headquarters levels were not financed from RDT&E appropriations and were not recorded by DOD as R&D program costs. DOD estimated these costs at \$42.3 million for fiscal year 1972.

#### R&D financed by private industry

Inasmuch as all activities in the Soviet Union are funded and controlled by the Soviet Union Government, we believe that it is necessary to recognize that a part of all United States R&D expenditures, private as well as governmental, must be considered in comparing defense-related R&D expenditures of the two countries. DOD contends that industry R&D performed in the civilian sector of the Soviet Union does not appreciably benefit the Soviet Union defense R&D effort. Nevertheless the Director of Defense Research and Engineering informed the House Committee on Armed Services on May 25, 1971, that, in making funding comparisons between the United States and the Soviet Union:

"\*\*\* an attempt was made to estimate the equivalent RDT&E value to the U.S. military RDT&E budget of U.S. non-defense, non-space R&D items which the Soviets might have to include in their military and space budget in the interest of secrecy. Computer manufacturing technology was a major item. The estimate for such civilian-furnished RDT&E to Defense was between \$500 million and \$1 billion per year in 1970 \*\*\*."

The National Science Foundation, which has the statutory responsibility for collection and analysis of data on R&D in the United States, does not attempt to determine how much R&D financed by industrial companies is defense-related. This could be because of the inherent problem in trying to arbitrarily distinguish between ultimate uses for defense as opposed to civil applications. However, we have identified two areas involving R&D in the private sector where it appears that the defense-related R&D is significant. These areas are:

1. Contractors' unreimbursed IR&D

According to Defense Contract Audit Agency reports, major defense and space contractors incurred \$1,294 million of IR&D costs in 1970. Of this amount, \$1,087 million was accepted by the Government for allocation to all the contractors' work. To be acceptable for allocation, such work generally must be related to product lines for which the Government has contracts. Consequently it seems reasonable to assume that the difference between the amount accepted for allocation (\$1,087 million) and the DOD-National Aeronautics and Space Administration share (\$791 million), or approximately \$300 million, represented unreimbursed costs incurred for defense-related research.

We believe that the IR&D costs incurred in excess of the amount accepted for allocation also represented--to an undetermined degree--costs incurred for defense-related research. Such costs, amounting to \$207 million in 1970, were incurred by major defense and space contractors as a means of meeting anticipated customer needs, and consequently it appears that such unreimbursed cost would represent a substantial amount of defense-related research financed by private industry.

2. Computer technology

The importance of considering computers when assessing the relative R&D positions of the United States and the Soviet Union is evidenced by reports that there is a serious lack of computing power for scientific and other purposes in the Soviet Union. Since computers have a high potential for military application, it is reasonable to assume that much of industry R&D in the computer field has a definite relationship to defense.

The National Science Foundation reported that in 1968 the office-, computing-, and accounting-machine industry performed \$658 million of applied R&D. About 90 percent of this effort, largely related to computers, was attributed to industry financing. DOD believes that these figures do not reflect indirect Government financing. DOD reported that:

"In the United States, the total computer R&D effort, civilian and military, is estimated at about \$1 billion per year. The major fraction of this is supported by Defense and space, indirectly or directly."

Although the two sets of figures are not in agreement, they substantiate that there is an undetermined, but possibly significant, amount of industry R&D in computers that would benefit the Nation's defense activities.

#### DOD METHODOLOGY AND DATA

In general the methodology used by DOD quantified the Soviet Union military R&D efforts according to dollar equivalents for comparison with United States efforts. This was accomplished in four steps.

##### 1. Intelligence community estimates of R&D expenditures

The intelligence community analyzed the Soviet Union budget to estimate financial inputs into military R&D efforts. DOD officials informed us that the unitemized, or secret, part of the all-union science budget was considered the primary funding source for military-related R&D (R&D for military weapons, space, and atomic energy). Soviet Union data since 1958 do not show this breakdown; consequently the intelligence community's estimates of Soviet Union military-related R&D were extrapolated upwards on the basis of the 1950-57 trend. The intelligence community converted rubles to dollars by using a \$2 conversion rate.

The financial input data were further refined by costing, in dollars, the relatively open Soviet Union civil space program. The intelligence

community based its estimates on what it calculated the United States would have had to spend to duplicate the Soviet Union civil space facilities and accomplishments. These estimates were then subtracted from the estimated military-related R&D expenditures. The residual represented, in dollars, the Soviet Union military R&D, including atomic energy. Because of Soviet Union secrecy, there is no direct way to reasonably estimate the R&D expenditures for weapons systems under development or for civil atomic energy.

2. DOD's technological assessment  
of outputs

In fiscal year 1970 DOD initiated a study to compare the military and space technological outputs of the United States with similar outputs of the Soviet Union from 1960 to 1968. The study estimated the time required for technological improvements and the number of years the Soviet Union took to reach given levels of United States weapons technology.

From intelligence data, discussions with specialists, and subjective judgments of DOD officials, technological-lead assessments were made of the two countries' space achievements and about 100 of their military weapons systems. The technological-lead assessments for individual weapons and space systems were then summarized into five major system categories. DOD states that the technological-lead assessment summaries for the five categories do not represent specific weighted averaging of the individual systems but are consistent with them and correlate with the broader impressions and experiences of informed persons.

The study revealed that, during the period from 1960 to 1968, the United States maintained its 2- to 3-year lead in weapons technology and established a 2- to 3-year lead in space technology. DOD reasoned that, since technological leads were increased by greater relative effort, the United States military R&D effort must have been equivalent to that of the Soviet Union and the United States space effort must have been 10 to 20 percent greater than that of the Soviet Union.

3. Comparison of estimated expenditures  
with output results

DOD compared the results of its technological-lead assessments with its estimates of the United States military R&D expenditures, the National Aeronautics and Space Administration's estimate of the United States civil space program, and the intelligence community's estimates of the Soviet Union military R&D and space expenditures for the period from 1960 to 1968. DOD reasoned that, if comparative estimates of the two countries' financial inputs were generally in agreement with the assessments of their comparative outputs, the reliability of the intelligence community's estimates of the Soviet Union financial inputs, as expressed in dollar equivalents, would be validated. In addition, the cause-and-effect relationship between financial inputs and technological outputs would be demonstrated.

DOD claimed that it was able to find a clear correlation between the relative inputs and outputs. DOD added that the intelligence community's estimates of Soviet Union R&D inputs could vary as much as plus or minus 20 percent and still fit observed technological outputs. DOD reasoned that greater variances in estimates of Soviet Union expenditures would be outside the bounds of observed results.

Because of the reported correlation between the estimated financial inputs and technological outputs, DOD expressed confidence in the intelligence community's dollar estimates of the Soviet Union military R&D budgets.

4. Projection of current and future  
budgets based on 1960-68 analyses

DOD used the intelligence community's estimates of the Soviet Union's military R&D funding from 1968 to project current and possible future Soviet Union R&D results. DOD compared the Soviet Union budget estimates with similar United States financial data that DOD had developed and found that the Soviet Union military R&D expenditures had been exceeding those of the United States in ever-increasing amounts from 1968.

## OBSERVATIONS

Secrecy concerning the nature of the Soviet Union science data requires a number of assumptions in estimating Soviet Union military-related R&D expenditures. We were not permitted to review the intelligence community's supporting documentation for its estimates of the Soviet Union's military-related R&D budgets or the equivalent costs of Soviet Union efforts in civil space technology. Therefore we are unable to comment on the reasonableness of such estimates. However, as noted in the Stockholm International Peace Research Institute's SIPRI Yearbook of World Armaments and Disarmament 1969-70, experts who have made detailed studies of Soviet Union science data either make no estimates or make rough order-of-magnitude estimates. Those experts making rough estimates differ among themselves by as much as 50 to 100 percent.

The difficulty in estimating Soviet Union military-related R&D expenditures is further complicated by the fact that the Soviet Union budget is stated in rubles and consequently, for comparative purposes, it is necessary to convert the rubles into their dollar equivalents. There is no generally accepted rate for converting rubles expended for R&D into their dollar equivalents. The yearbook states that the exchange rates used in the various private studies, where conversion was attempted, ranged from \$1.30 to \$3.50 a ruble.

Many experts, however, believe that a reasonable conversion rate for Soviet Union military R&D work would be from \$2 to \$3 a ruble. Consequently the \$2 rate which was used by the intelligence community may understate the Soviet Union R&D efforts.

As reported previously, technological-lead assessments for 1960-68 were based upon intelligence data, discussions with specialists, and subjective judgments of DOD officials. The Delphi method<sup>1</sup> was used to

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<sup>1</sup> Usually consists of a series of reported interrogations of persons whose opinions or judgments are of interest. After the initial interrogation of each person, each subsequent interrogation is accompanied by information regarding the preceding round of replies. The person is thus encouraged to reconsider and, if appropriate, change his previous reply in the light of the replies of other members of the group.

arrive at a consensus regarding weapon comparisons. Subjective judgments were used when the data were incomplete or controversial. Disagreements, when they occurred, were reported to be seldom larger than plus or minus 1 year. We had neither the expertise nor the time to independently test and evaluate the technological-lead assessments and therefore cannot comment on their reasonableness.

In comparing the two countries' financial inputs with their hardware outputs, we found that the degree of correlation varied significantly, depending on the choice of deflators used to adjust for inflationary pressures in the U.S. economy over the 9-year period. Inflationary pressures and effects on the Soviet Union R&D expenditures are not known, but DOD has stated that it is generally assumed that, because of the Soviet Union system of controlled prices and wages, rubles do not inflate. Effects of inflation on U.S. R&D expenditures, however, are well known and are adjusted for by using either (1) the gross national product (GNP) deflator which applies to the economy as a whole or (2) a special deflator derived for R&D goods and services.

According to DOD's technological assessment "Soviet RDT&E produced about the same number of major weapons systems prototypes at about the same rate of improvement as the U.S." Consequently, on the basis of comparable outputs, the United States military R&D expenditures (financial inputs) should have been equivalent to those of the Soviet Union. Over the 9-year period, however, United States military R&D expenditures, as estimated by DOD, exceeded comparable Soviet Union expenditures, as estimated by the intelligence community, by 11, 23, or 31 percent, depending on the use and choice of deflators.<sup>1</sup>

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<sup>1</sup> Both the GNP and the R&D deflators attempt to convert into constant 1968 dollars the funds expended for U.S. military R&D and civil space in the period from 1960 to 1971. The GNP deflator is based on the general purchase value of the dollar during 1968; the R&D deflator is based on what the dollar would have bought in R&D goods and services during 1968. The two values tend to inflate at different rates.

Because the U.S. economy in general and the R&D costs in particular have been inflating steadily from 1960 to the present, the use of either deflator to convert the less inflated 1960 through 1967 dollars into constant 1968 dollars increases the total amount of reported expenditures; conversely, converting the more inflated 1969 through 1971 dollars into constant 1968 dollars decreases the reported expenditures. Consequently, since DOD and the intelligence community report that United States expenditures exceeded those of the Soviet Union from 1960 to 1968 use of either deflator would increase these differences by increasing the reported United States expenditures.

The difference of 11 percent results from comparing expenditures on the basis of current dollars in lieu of constant dollars, i.e., without applying a deflator. This comparison assumes that both economies experienced the same relative amount of inflation over the 9-year period. The difference of 23 percent results from applying the GNP deflator to express the United States expenditures in constant 1968 dollars before comparing them with Soviet Union expenditures. The difference of 31 percent results from applying a special R&D deflator to the U.S. military R&D expenditures in lieu of the GNP deflator.

In regard to the above comparisons, DOD officials have stated that use of current dollars:

"\*\*\* is hardest to justify on economic grounds. The R&D deflator leads to the maximum difference but implies that there is no inflation in the Soviet R&D sector. The GNP deflator would seem to account for the differences in the general U.S. and Soviet economic systems and would imply an inflation in Soviet RDT&E relative to the general Soviet economy comparable to that in the U.S."

### CONCLUSION

On the basis of the limited information available to us, we believe that extreme secretiveness by the Soviet Union results in data which are insufficient for a realistic measurement of its military R&D efforts. At best, dollar valuations of Soviet Union military R&D programs are only rough guides to the Soviet Union's relative level of effort. In our opinion the general technological assessments as developed by DOD can provide only general support for those rough guides; they cannot refine them. Consequently, although we believe that the DOD methodology with its limited data base may be useful in indicating trends and the apparent magnitude of the Soviet Union military R&D threat, we have reservations as to its usefulness in quantifying relative efforts or spending gaps between the countries.

As you requested, we are making available to you a General Accounting Office staff study entitled "Comparison of Military Research

B-172553

and Development Expenditures of the United States and the Soviet Union," which contains detailed information obtained during our limited survey. Part I, entitled "Introduction" and "Research and Development Expenditures in the United States," is unclassified. Part II, entitled "Department of Defense Methodology for Assessing United States and Soviet Union Military Research and Development Efforts," is classified "Secret" as it is based, to some extent, on classified information.

In accordance with the agreement reached with your office, copies of this report are being sent today to the Chairmen of the Senate and House Committees on Armed Services, the Senate and House Committees on Appropriations, and the Senate and House Committees on Government Operations. Copies of the report are also being sent today to the Director, Office of Management and Budget. Copies of the report, together with copies of the staff study, are being sent to the Secretary of Defense.

Sincerely yours,



Comptroller General  
of the United States

The Honorable Thomas J. McIntyre  
Chairman, Subcommittee on Research  
and Development  
Committee on Armed Services  
United States Senate