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TITLE: The Productivity of Soviet Investment and the Economic Burden of Defense

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EXECUTIVE SUMMARY

Given the drastically reduced reservoir of manpower and the reduced ability to augment the economy's capital stock in the face of reduced growth, the Soviet system is ever more dependent upon growth of productivity to extricate it from stagnation. The key variable, if thoroughgoing institutional reform is excluded, lies in improving productivity of investment. The official embracement of technological progress as the current policy panacea recognizes this imperative.

The abysmal historical investment productivity record can be explained by a combination of ineffective investment policies and by overriding external influences, the most important of which is the superior priority accorded to defense production. Having analyzed specific investment policies in a recent publication, I will only summarize my conclusions in this study, while attention will be concentrated upon the impact of defense production upon investment productivity.

Among other misdirected policies contributing to an unfavorable capital productivity trend have been low rates of retirement of obsolescent assets, insufficient concentration on replacement of obsolescent capital as distinguished from investment in new installations, imbalances between investment in direct production and in supporting activities, and excessively high capital-labor ratios. These misdirected investment demand policies have been accompanied by slow progress in production of producer durables incorporating advanced technology. Ongoing and future trends in the structure of investment will lead to even higher capital-output ratios. The major shifts in direction of investment leading to this trend are toward energy sectors, pollution abatement, industrial health and safety, and consumer capital (housing and highways).

The foregoing investment demand deficiencies can be corrected, but any such changed effort will yield meager returns unless the rate of technological

improvement in producer durables production can be sharply improved. The hypothesis of this essay is that such improvement will be difficult to attain so long as defense production continues to receive higher resource priority and possess supporting institutional advantages. These advantages will be discussed in terms of quantitative and qualitative trade offs, respectively, between investment and defense.

Intercountry comparative studies show that among the major industrial market economies there have been inverse correlations between rank orders of GNP growth and the proportions of GNP allocated to defense expenditures. Similar negative correlations appear for rank order comparisons of growth rates of productivity in manufacturing and the defense/GNP ratios. Soviet experience is consistent with these findings.

However, the Soviet case does not conform to general negative correlation between the ratios of GNP devoted to investment and those devoted to defense. The Soviet Union has been exceptional in maintaining a high proportion of investment expenditures to total GNP while simultaneously devoting a higher proportion of its resources to defense than any other industrial economy particularly in the decade of the seventies. This unique resource allocation pattern can be explained by the USSR's system of central planning in which investment decisions were insulated from the adverse influences, capsulized by stagflation, which emerged in market economies after the onset of the energy crisis of the mid-seventies.

Therefore, it is necessary to search for resource trade-offs between defense and investment at lower levels of aggregation. The most revealing comparison is found in trends of Soviet machinery production allocated to investment and defense final demand. Since the early seventies defense has been receiving a rising proportion of machinery production, almost

entirely at the expense of investment. Even more dramatic and significant have been the trends in respective claims to increments in machinery output. Military durables received a fifth of the increase in machinery output from 1965 to 1972. Between 1972 and 1980 the share doubled. At the same time the incremental shares going to investment fell from two-thirds to half. In the current Five Year Plan ending in 1985, the military durables share will rise further to a range of 43 to 71 percent. The producer durables share will fall commensurately. Since new investment is the carrier of technology, the productivity implications of sharply declining investment shares are glaringly obvious.

Fragmentary information also provides clues as to the competitive product composition of machinery sales to defense and investment. If total sales of selected machinery products, as estimated in the reconstructed version of the official interindustry matrix for 1966, are compared with sales of these products to fixed investment final demand, as estimated in a recent book by a Soviet economist, significant final demand sales of such products in the reconstructed official matrix have not been allocated to either consumption or to fixed investment. Over half of final demand sales for such important machinery production sectors as precision instruments, electrical machinery and equipment, transportation equipment, and communications equipment exhibited this use pattern. In 1966 in the official U.S. interindustry matrix a large proportion of U.S. military procurement purchases were accounted for by these production categories. Assuming that the technological spectrum of durables procurement for defense purposes is relatively similar in the United States and the Soviet Union, the foregoing unallocated residuals may be regarded as rough approximations of the resource claims of Soviet defense from machinery production. Since 1966, the revealed focus of military hardware procurement has undoubtedly been reinforced in the

direction of technologically advanced machinery products. The implications of competition with investment for possible technological progress in producer durables production is clearly unfavorable.

If the constraincs imposed by the high resource priorities of defense production are apparent in terms of machinery allocation, they are at least equally so in the more intangible dimension of institutional environments. The inability of the machinery industries to incorporate advanced technology at a rate necessary to insure rising capital productivity has been ascribed to the systemic deficiencies which inhibit innovation throughout the Soviet system, except in the area of defense production. The principal problems are the propensity toward "self-reproduction" (perpetuation of current output composition) arising from lack of effective consumer demand under taut planning and the low level of product specialization flowing from the unreliability of external supply. These problems are reinforced by an incentives pattern which emphasizes current output relative to innovation.

In addition to these shortcomings in production, there are also serious drawbacks in the research and development process. There is no organizational coordination between R and D and production and no innovating initiative assumed by product suppliers. Furthermore, R and D organizational incentives are also faulty.

The defense production sector has managed to overcome these shortcomings, not by institutional reform but by overwhelming and circumventing the existing system of central planning. Not only does military production receive highest priority, but such advantages are reinforced at all levels of decision-making from the Politburo to the factory floor by favorable institutional arrangements absent in the rest of the economy. Innovation in the Soviet system is reserved to the highest levels of the Party and to

Gosplan. In defense production the leadership is personally active in innovation decisions and managerial incentives are structured to be sensitive to success in new product introduction.

Defense R and D is also more effective because producing organizations control their own R and D units. The latter are provided with excess production capacity for testing of prototypes. Finally, in the office of the Chief Designer there exists a coordinator of the entire innovation process. He functions like an aggressive supplier in a market economy.

The transferability of the defense institutional environment to producer durables production is not feasible so long as defense maintains its high priority within the central planning framework. Central planning yields favorable results in only a narrow spectrum of production. There might be selective transferability, as was evidenced in past campaigns for chemicalization and automation, with disruptive consequences for other production. It would be possible to integrate R and D and production, as has been tried in the Science-Production Associations, but these new organizations have not been granted authority necessary to function efficiently.

The ability of defense production to bypass the systemic deficiencies of the Soviet economy means that the less favored sectors must assume more of the burden of a highly bureaucratized system. Thus, so long as defense production continues to be placed on a pedestal, the likelihood for overcoming the shortcomings in producer durables production that inhibit advances in the productivity of investment is remote. The opportunity cost of defense appears most glaringly in the stagnation of the rest of the economic system.

I. RISING INVESTMENT PRODUCTIVITY IMPERATIVE

The Soviet economy over the past quarter of a century has deteriorated from the position of the most rapidly growing major industrial economy in the 1950s to be one of the slowest, except for the United Kingdom, in the late seventies.[1] Prospects for the decade of the eighties are even more dismal with the GNP growth rate not likely to exceed annual rates of 3.6 percent in the first half and 3.0 percent in the second half of the decade.[2] Such GNP growth rates imply limited possibilities for increases in per capita consumption at annual rates of no more than 1.9 percent and 1.3 percent, respectively.

The role of investment is critical in explaining both past and future growth trends. For most of the historical time frame the role of capital as a source of growth has been uniquely high for the Soviet Union, accounting for over 40 percent of all factor and productivity contributions.[3] This high dependence upon investment is further indicated by growth rates for capital stock well over double those of other major economies, other than Japan.[4]

However, the ability of the Soviet system to generate rapid rates of increase in investment has not been matched by equal performance in the return on its investment; on the contrary, its record of capital productivity growth has been the

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[1] Central Intelligence Agency, National Foreign Assessment Center, Handbook of Economic Statistics, 1981, Table 13.

[2] Daniel Bond, "Macroeconomic Projections of the Burden of Defense in the Soviet Economy," contribution to Joint Economic Committee, Workshop on Soviet Military Economic Relations, July 1982.

[3] Stanley Cohn, "The Soviet Path to Economic Growth: A Comparative Analysis," Review of Income and Wealth, March 1976. Table 5.

[4] Ibid., Table 2.

poorest among the major industrial powers by a wide margin.[5] This decidedly mixed investment performance has serious implications for economic growth in the eighties with the exhaustion of the underemployed agricultural labor pool and the severe demographic constraints on manpower increments, together with much reduced possibilities for growth of investment. Investment growth rates will be limited by both reduced GNP growth rates and competition for crucial inputs from defense programs. While combined labor and capital inputs increased by annual growth rates of over 4 percent in the sixties, their rate of increase declined to an average rate of 3.7 percent in the early seventies and 3.2 percent in the 1976-80 period. In the early eighties they will increase by only 2.3 percent per annum and in the 1986-90 period by only 2.0 percent per annum. Therefore, productivity trends, for both labor and capital inputs become the key determinants of Soviet growth in the current decade. Should productivity gains not improve over the miserable performances of the seventies, the growth of GNP will be reduced over its range by a full percent, virtually eliminating any rise in consumption levels.

A. Sources of Low Investment Productivity: Investment Policies and Organizational Deficiencies

Explanations of low investment productivity may be divided into those influences flowing directly from investment policies and those emanating from exogenous causes. Among the latter grouping the most important are organizational

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[5] Stanley Cohn, "Sources of Low Productivity in Soviet Capital Investment," contrubtion to Joint Economic Committee, Soviet Economy in the 1980s: Problems and Prospects, Table 5.

[6] Daniel Bond, op. cit.

deficiencies in producer durables production and the competition for vital material and human productive inputs with defense production. The role of investment-policies have been analyzed in detail in a recent publication of the author.[7] In this publication the findings will be presented in summary form.

Although the choice of official investment priorities is a seemingly capital-intensive one, the structure of investment allocations has not depressed productivity performance. A major contributor has been asset retirement policies. On the average, fixed assets (non-residential) have been retained in service twice as long as those in the major market economies. This prolonged retention of obsolescent low productivity capital has been reinforced by the low share of investment devoted to replacement of obsolescent assets, as distinguished from creation of new assets. In recent years the replacement share has been about a fifth, compared with nearly half in the United States. Together these two policies account for about half of the negative capital productivity trend rate.

Productivity has also been depressed by the rapid additions to capital stock compared with additions to employment. In addition to this imbalance in the production function, industrial investment has neglected mechanization of auxiliary supporting operations in favor of direct production activites. This mechanization imbalance reduces productivity of both labor and capital.

These inefficient policies of capital usage have been compounded by the inability of Soviet machinery industries to produce the high technology machinery and equipment required to realize the productivity gains from a heavier emphasis on replacement investment. The reasons relate both to managerial incentives and production organization.* Productivity of capital has been further lowered by the rising proportion of investment immobilized in uncompleted construction

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[7] See footnote 5 reference.

* These deficiencies are elaborated in part III of this report.

projects. Furthermore, prolongation of asset lives requires heavy outlays for capital repairs. Repair activities are particulary wasteful users of both skilled manpower and producer durables.

During the decade of the eighties, changing investment priorities will further exacerbate the productivity challenge. The rising stress on energy investment skews investment toward the most capital-intensive sectors. Implementation of environmental protection and industrial health and safety measures will divert investment from its most productive potential uses. Rising energy constraints may lead to underutilization of existing assets. Finally, any belated recognition of consumer investment needs will also steer investment toward such capital-intensive sectors as housing and highway construction.

B. Low Capital Productivity and Resource Competition with Defense

The foregoing summary does not pose any causative adverse impacts on the productivity of investment arising from resource competition with defense programs. The role of defense competition is a major one with both quantitative and qualitative impacts. The remainder of this study will be directed toward exposition and analysis of investment and defense relationships.

In macroeconomic dimensions, defense resource competition was not a significant competitive claimant before the Tenth Five Year Plan of the late seventies. While defense expenditures have been rising at a fairly steady 4 percent rate since the early sixties, the growth rate for fixed investment was sustained at 6-7 percent in the sixties and nearly five percent in the early seventies. It was only when the GNP growth rate slipped below 3 percent after 1973 that the investment growth rate dropped below the 4 percent rate which has been sustained for defense. With the prospect for growth of GNP in the current decade below the likely defense rate and the defense share of GNP half that of fixed investment, neither investment nor consumption can rise more rapidly than GNP. Therefore, the determination

to maintain an annual expansion of 4 percent in military expenditures severely constrains the aggregate volume of investment growth. However, the major constraint arises from the slower pace of overall economic growth, which is only partially explained by the steady, overriding defense commitment.

In the eighties the defense priority will affect investment more potently in the productivity dimension. As will be elucidated in the following section, defense competition cuts most deeply into claims for output of the machinery industries and into claims for scientific and technological resources.

Not only does defense production deny key material, human, and technological inputs to investment, it also greatly diminishes the effectiveness with which these inputs are used. As will be elucidated in the section dealing with the qualitative impacts of defense programs, the enforcement of priorities is much more determined for defense production and the organizational arrangements for R and D and innovation are superior. The usual inefficiencies of Soviet central planning are circumvented for defense production, but at a high cost of concentrating the inefficiencies on non-military production, including the relatively favored producer durables production.

II. INVESTMENT PRODUCTIVITY AND THE BURDEN OF DEFENSE--QUANTITATIVE ASPECTS

A. Aggregate Trade-offs in Comparative Perspective

The various approaches to estimating the resource trade-offs between the productivity of investment and defense claims on resources can be initially evaluated in a broad international comparative perspective. A cross section study for 13 market economies for the 1960s and 1970s estimated rank correlations for defense expenditure and other selected economic variables. There are statistically significant and strongly negative correlations between rank orders for defense expenditures and defense shares of GNP and rank orders for GNP growth rates. (Table 1)

TABLE 1

Spearman Rank Correlation Coefficients

	Defense Spending / GDP	Investment / GDP
GDP Growth Rate		
60s and 70s	-.58*	
70s	-.49*	
60s	-.53*	
Investment / GDP		
60s and 70s	-.52*	
70s	-.61*	
60s	-.42	
Manufacturing Productivity Growth		
60s and 70s	-.66*	.56*
70s	-.43	.64*
60s	-.75[8]	.54*

*Statistically significant at 95% level.

SOURCE: See Appendix Table C.

The negative correlation between defense spending ratios and GNP growth rates can be explained by similar strong and significant negative correlations between the rank orders for defense spending ratios and for investment ratios (investment as shares of GNP) and equally strong and positive correlations between investment ratios and gross domestic product growth rates. Finally, the foregoing strong negative rank correlations hold between defense spending ratios and manufacturing productivity growth rates. The linkage between the latter two variables is explained by the strong positive rank correlations between investment ratios and manufacturing productivity growth rates.

Soviet experience is consistent with these general findings. If the USSR is fitted into the sample it would rank first in its defense/GNP ratio and sixth in its GNP growth rate. It would rank tenth in its manufacturing productivity growth rate. However, the consistency of Soviet experience does not hold for the correlation between defense and investment as proportions of GNP in the 1970s. Its investment/GNP ratio ranked tenth in the sixties, but rose to third in the seventies, while its defense/GNP ratio remained first in both decades.

The differing Soviet investment response in the 1970s is probably explained by differences in the determinants of investment in market and planned economies. Investment expectations in market economies were severely blighted by the aftermath of the energy shocks of 1973-74 and 1979. The sharp decelaration in growth combined with inflation (stagflation) was most uncongenial to potential investors. While Soviet investment plans were also constrained by reduced GNP growth rates, they did not experience the high volatility

which characterizes cyclical investment patterns in market economies.

Therefore, as a first approximation, the burden of defense in the Soviet Union is empirically evident in terms of constraints on the growth rates of both national product and manufacturing productivity. However, the constraint on the volume of investment expenditures appears to be much weaker in the Soviet Union than in other industrial economies especially in the decade of the seventies when the GNP growth slowdown was world-wide.

B. Aggregate Trade-off Dynamics Between Defense and Investment

If available estimates of ruble values and growth rates for Soviet GNP and its major end-uses are analyzed, there has been no trade-off between defense and investment claims to available resources over the past two decades (Table 2). While there are inconsistencies in the underlying Central Intelligence Agency estimates,[8] they are not of a magnitude large

Table 2

Percentage Shares of Soviet GNP by End-Uses

Use	1960	1965	1970	1975	1980
Consumption	57.7	54.0	54.2	53.8	53.6
Investment	24.2	27.3	28.2	30.6	33.0
Other	4.8-8.2	4.2-6.9	3.9-6.1	2.5-4.0	-1.6-+1.6
Defense	9.9-13.3	11.8-14.5	11.5-13.8	11.6-14.1	11.8-15.0

[8] Joint Economic Committee, USSR: Measure of Economic Growth and Development, 1950-80. See Appendix B for discussion of the estimates.

enough to change the foregoing conclusion. During the early and late seventies the GNP growth rate declined to 3.7 and 2.7 percent, respectively, from rates above 5 percent during the previous decade, yet the shares for both investment and defense were rising.[9] In terms of changing GNP shares, investment has been even more favored than defense.

However, this seemingly favorable treatment of investment as a resource claimant is not applicable to capital productivity. While the productivity trend has been continuously negative, performance has appreciably worsened in the seventies.[10] Analysis of the causal relationship between defense expenditures policy and worsening investment productivity requires the more focused approach presented in the next section of this study.

C. Focused Trade-offs and Their Impacts on Investment Productivity - Aggregative Aspects

Since the modest GNP growth rates planned and projected for the eighties preclude any return to the higher investment growth rates of preceding decades, higher investment productivity becomes a crucial variable to any effort to avoid stagnation. The key to improved capital productivity is better technological progress, which, in turn, depends upon investment in technologically advanced producer durables.

As indicated in Table 3, growth rates for capital stock, and for its producer durables component, have been falling since the mid-seventies for both the economy as a whole and for industry. However, these trends understate the impact upon capital productivity, because the average age of

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[9] Ibid., Tables A-7 and C-4.

[10] Footnote source 1, Table 43

capital has been rising rapidly, not only because of reduced rates of investment, but also because of falling rates of retirement of obsolescent capital.[11]

A more sensitive indicator is provided by trends in investment growth rates (Table 3). For both the entire economy and for industry there have been sharp declines in growth rates for investment as a whole and for

Table 3

Trends in Growth Rates of Capital Stock and Its Producer Durables Component

(Annual average rates)

	Total Stock		Producer Durables	
Period	Economy	Industry	Economy	Industry
1960-65	8.5	9.1	10.6	11.4
1965-70	7.5	8.7	9.7	9.4
1970-75	7.9	8.6	9.7	9.3
1975-81	6.7	7.5	8.2	8.6

Trends in Growth Rates for Fixed Investment and Its Producer Durables Component

(Annual average rates)

	Total Investment		Producer Durables	
Period	Economy	Industry	Economy	Industry
1960-65	6.3	6.8	11.1	10.7
1965-70	7.6	6.8	7.6	7.9
1970-75	6.9	6.8	8.9	7.5
1975-80	3.5	3.9	6.3	6.7

SOURCES: Stanley Cohn, "Sources of Low Productivity in Soviet Capital Investment", contribution to Joint Economic Committee, Soviet Economy in the 1980s: Problems and Prospects, Appendixes A and B. Narodnoe Khoziaistvo SSSR, 1922-1982

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[11] D. Palterovich, "Obnovlenie oborudovaniia i tekhnicheskoe perevooruzhovanie proizvodstva," Planovoe Khoziaistvo, August 1980, p. 104.

producer durables since the mid-seventies. However, machinery production growth rates and those for the producer durables component of machinery have also exhibited similar trends, especially since 1975. Such parallel trends would imply that the general decline in growth constrained advancement in all sectors of production, including machinery. The influence of defense competition for smaller increments in resources is not apparent. The negative impact of high defense priorities upon investment may be found in the rising defense claim to output of the machinery producing sectors (Table 4).

Table 4

Distribution of Final Demand for
Domestic Soviet Machinery Production (percent)

Year	Consumer Durables	Producer Durables	Military Durables	Foreign Trade Balance
1965	13.6	70.2	19.0	-2.8
1972	13.8	68.1	19.7	-0.9
1980	12.6	60.9	30.1	-3.9
1985 Low	12.8	56.8	32.8	-2.6
1985 High	10.2	46.6	37.2	-4.3

SOURCE: Daniel Bond and Herbert Levine, The Soviet Machinery Balance and Military Durables, contribution to Joint Economic Committee, Soviet Economy in the 1980s: Problems and Prospects, Table 1.

Until the early seventies, the military claim on machinery production was a steady fifth of the total, with over two-thirds of output reserved for fixed investment and the remaining 13-14 percent for the consumer. Since 1972 the

military share has risen continuously, almost entirely at the expense of reduced shares for investment. Further investment erosion has been cushioned by a rising proportion of machinery imports. By contrast in the United States the military durables proportion of total machinery output fell from 20.7 percent in 1967 to 13.9 percent in 1972.[12] The reduced military share was shifted about evenly to consumer and producer durables production. Preliminary estimates for 1979 indicate a further fall in the military share to 9.9 percent.[13] With the U.S. consumer durables proportion about double that of the USSR, any major shifts in the military claim on machinery can be accomodated by both consumption and investment, whereas in the Soviet use pattern only investment has the margin to offset changing military durables proportions.

A more sensitive indicator of the opportunity cost of military durables production is provided by estimating its proportion of the growth in overall machinery output. In the 1965-72 period military durables absorbed a fifth of general machinery growth. This share doubled in the 1972-80 period. At the same time the producer durables share of the general machinery increment fell from two-thirds to about half. There was little change in the proportion accruing to consumer goods.

Alternative projections of machinery output and its principal uses during the Eleventh Five Year Plan (1981-85) show further rises in the military claims on the growth in machinery output. Within the likely machinery production growth range of 30-40 percent, the producer durables annual growth range of

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[12] U.S. Department of Commerce, The Input-Output Structure of the U.S. Economy: 1967. The Input-Output Structure of the U.S. Economy, 1972.

[13] U.S. Department of Commerce, Bureau of Industrial Economics, Sectoral Implications of Defense Expenditures, 1982.

10-12 percent, and the consumer durables annual growth range of 5-6 percent, military durables will absorb between 43 and 71 percent of the increment in machinery output.* The producer durables share will be further eroded to a range of 47-57 percent, a trend with unfavorable implications for future investment prospects. The consumer durables share will range from 10 percent to the 1980 share of 13 percent. As will be demonstrated in the following discussion on the productivity of future producer durables, there is little prospect of productivity offsets to declining incremental investment rates. Rather the likelihood is one of continued poor productivity performance, thereby compounding the unfavorable impact of decelerating investment growth rates.

D. Focused Trade-offs and Investment Productivity Impacts--Product Group Aspects

The investment productivity implications of the rising military claim on machinery production would be clearer if the machinery use pattern for these two major claimants could be estimated. The Soviet input-output matrixes aggegate all non-consumption final demand into a single column, unlike the presentation of separate investment and defense columns in the U.S. matrixes. A recent Soviet publication makes it possible to estimate investment final demand for the machinery rows in the Soviet matrixes. If the row investment magnitudes are deducted from the aggegative non-consumption estimates of the reconstructed official matrix, then most of the residual can be presumed to be used for military procurement. The remainder is comprised of inventory accretions and net foreign trade flows.

*The lower range assumes an increase of 30 percent in machinery production, and increases in producer durables purchases of 12 percent and of consumer durables of 6 percent. For the upper limit the respective growth rates are 40 percent, 10 percent, and 5 percent.

The comparison is for the year 1966. The investment use estimates[14] are for that year and for 1977, but unfortunately the official matrix for 1977 has not been published.[15] If Fal'tsman's investment final demand estimates for 1966 are deducted from the reconstructed official input-output non-consumption aggregates by rows, significantly large residuals appear for the following product categories—electrotechnical machinery and equipment, mining and metallurgical machinery and equipment, precision instruments, transportation machinery and equipment, and radio and other machine building (large electronic products).*

As is demonstrated in Appendix A, both matrixes are net of foreign trade and the magnitude of inventory accretions of producer durables is very small. Presumably, the unexplained sales of mining and metallurgical equipment may well consist of additions of uninstalled equipment. Therefore, the unexplained sales residuals for the other machinery categories may well represent military durables purchases.

The share of non-consumption final demand for the four machinery production sectors with likely defense usages, taken as a group, comprises over 58 percent. For each of these four sectors more than half of final demand sold to other than consumers probably went to military procurement in 1966. Since 1966 the rising technological intensity of defense durables must have been reflected

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[14] V.K. Fal'tsman, Potentsial investitsionnogo mashinostroienie SSSR, Nauka, 1981.

[15] The 1966 matrix is obtained from Barry Kostinsky, The Reconstructed 1966 Soviet Input-Output Table: Revised Purchasers' and Producers' Prices Tables (Foreign Economics Report No. 13), U.S. Department of Commerce, 1976.

*See Appendix A for detailed derivation of residual estimates.

in disproportionate increases in purchases from these machinery production sectors. At the same time there has been a major shift in the proportion of investment durables deliveries toward such production sectors as instruments, automation equipment, and computers.[15a]

This possible distribution of military durables procurement closely resembles the U.S. military durables procurement pattern for 1967. In that year the following machinery product rows in the U.S. interindustry matrix comprised as proportions of total durables procurement (percent); -- ordinance -- 25; communications equipment -- 20; aerospace equipment -- 31; electrical, electronic, and scientific equipment -- 7, and shipbuilding -- 5.[16] While conceded to be less sophisticated, the sectional composition of Soviet military technology still resembles that of the United States more closely than the sectional composition of any non-defense expenditure category. Given the closer resemblance, the similarity of composition of the major expenditure proportions for military durables is not unexpected.

[15a] V.K. Fal'tsman, V. Bonsov, "Mobil'nost' mashinostroeniia", Planovoe Khoziaistvo, November 1982, p. 81.

[16] U.S. Department of Commerce, The Input-Output Structure of the U.S. Economy: 1967, Government Printing Office, 1976.

The qualitative impact on investment productivity resulting from major defense claims on such machinery sectors as communications equipment, transportation equipment, precision instruments and electrical equipment is adverse. Increased production of producer durables is dependent upon production of these high technology machinery sectors which cater so heavily to defense procurement. The more advanced technological content of defense durables adds to the cogency of the requirement.

III. INVESTMENT PRODUCTIVITY AND THE BURDEN OF DEFENSE--QUALITATIVE ASPECTS

Not only can the superior development of military technology, compared with that of producer durables, be explained by higher priorities for machinery output, but also by more effective organization at both the research and production levels. The superior organizational environment for defense production is obtained by procedures which exacerbate the disadvantages under which producer durables production occurs. There are deficiencies in organization and incentives which plaugue the entire Soviet system. In production of military durables these shortcomings are overcome, not by their correction, but by circumvention and short circuiting of the existing system of centralized control. This section will examine how these deficiencies constrain technological innoviation, how defense producers overcome these, and how the privileges accorded to defense production worsen the environment for production of producer durables.

The demonstrated inability of the machinery industries to support the nec-

essary technological reequipment of obsolete capital[17] arises in first instance from inappropriate incentives. In Soviet terminology, there is a propensity by Soviet managers toward "self-reproduction," i.e., toward the perpetuation of the existing composition of production and production technology with their assured sources of supply and near certainty of customary bonuses.[18] The same Soviet critic observes that existing incentives lack the necessary stimuli to compel the producer to improve existing output and introduce new products.

Slow technological progress is also explained by the chronic seller's market which prevails for producer durables production. The tradition of taut planning has been characterized as 'planned scarcity' by a Soviet scholar.[19] Under such circumstances there is little pressure from effective consumer demand for technologically improved products. A perceptive Soviet economist points out that a glaring weakness of economic organization is the absence of effective consumer sanctions and choices.[20] As will be discussed in the next section, there is a potent customer for military production.

Organizationally, the main deficiency for securing technological advance is the low level of product specialization. Although there are over 20 machinery producing ministries, product specialization does not match administrative specialization.* The prevailing production pattern is one of generalized machinery

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[17] P.I. Voshchanov, B.I. Efimov, "Problemy Sbalansiorovannogo razvitiia investitsionnykh otraslei ekonomiki," Izvestiia Akademiia Nauk SSSR, Seriia Ekonomicheskaia, No. 2, 1982, p. 54.

[18] S.A. Kheinman, "Organizational and Structural Factors in Economic Growth," JPRS 76388, USSR Report, Economic Affairs, No. 937, September 9, 1980, p. 65. Translation from Ekonomika i Organizatsiia Promyshlennogo Proizvodstva, May 1980.

[19] Ibid.

[20] S.A. Kheinman, "Zadachi razvitiia mashinostroeniaa," Voprosy Ekonomiki, August 1981, p. 31.

*This conclustion is less applicable to those machinery ministries exclusively engaged in defense production: Ministries of General Machine Building, Defense Industry, and Medium Machine Building.

production by most ministries. Even in the production of general purpose semi-fabricate inputs, such as gears, castings, forgings, and stampings, the degree of specialization is far lower than in U.S. industry.[21] There is no organized arrangement for production of single unit customized equipment by specialized machinery enterprises. Instead, such needs are met by small machine shops within the consuming organization with the expected results of high cost and retarded technological standards.[22]

This reliance on high cost, technologically backward internal sources of supply reflects the systemic propensity toward self-sufficiency, or vertical integration, in Soviet production practice. Such behavior arises in response to the unreliability of deliveries of planned input flows. One Soviet economist has described reliance on such supply sources as "insurance capacities."[23] Successful development of production specialization is contingent upon development of a tradition of reliable sub-contracting.[24]

Within the context of central planning such a goal can be attained only if the prevalent practice of taut planning is superseded by explicit long term plans which anticipate changes in technology and provide for the inputs necessary to produce advanced finished products. The current Eleventh Five Year Plan is pioneering in this direction. One of the more perceptive Soivet economists also contends that more rapid technological progress requires the establishment of new machinery producing ministries which specialize in the output of general purpose intermediate products.[25] He also proposes the creation of supra-ministerial organizations to coordinate the production relationships among machiery producing

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[21]Footnote 16 reference, p. 70.

[22]Ibid., p. 71

[23]Iu.V. Subotskii, "Role of Production Specialization in Reducing Scattering," JPRS 80078, USSR Report--Economic Affairs, No. 998, Feb. 14, 1982, p. 38. Translation from Ekonomika i Organizatsiia Promyshlennogo Proizvodstva, November 1981.

[24]G. Ia. Kurbatova, "Mashinostroenie i investitsionnye protsessy," Ekonomika i Organizatsiia Promyshlennogo Proizvodstva, March 1982, p. 83.

[25]Footnote 16 reference, p. 72.

ministries.[26] As will be discussed later, there is a precedent in military production for this innovation. Such a solution is vintage Soviet in its distrust of management and preference for centralized control, even at the cost of adding a new layer of bureaucracy.

Thus far, retarded technological advance has been analyzed in terms of production challenges. There are also deficiencies in research, development and innovation to consider. In market economies much technical progress arises from sales pressures by suppliers of equipment, as distinct from demands of users. Within the Soviet system, as we have seen, the taut atmosphere weakens customer-supplier relationships, leading to either self-sufficiency or purchases from non-specialist producers with little incentive to innovate. The absence of competition among producers and of direct supplier-customer ties strongly impedes innovation in the Soviet system. Brezhnev decried this propensity in salty language, "Innovation is avoided as the devil flees from incense."[27]

Unlike the arrangements in military production, there is organizational separation between research and development and production in non-military production. Furthermore, there is no central coordinating mechanism for interrelating R and D and production in the planning process. Not only have planners been derelict in making R and D relevant to future technological needs, but also the incentives system for R and D organizations stresses utilization of budget appropriations, not completion of projects.[28] Such rewards clearly encourage

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[26] S.A. Kheinman, "Organizatsionno-strukturnye faktory ekonomicheskogo rosta," Ekonomika i Organizatsiia Promyshennogo Proizvodstva, June 1980, p. 78.

[27] L.I. Brezhnev, Pravda, March 31, 1971.

[28] R. Amann, J.M. Cooper, Industrial Innovation in the Soviet Union, Yale University Press, 1982, p. 14.

proliferation of projects and dispersion of resources. Incentives for design bureaus, which develop working models, are based upon the number of designs produced, with higher material rewards being paid for inclusion of new non-standardised components.

The isolation of research institutes from production tends to impart an academic ethos in their orientation. There is pre-occupation with scientific originality, as compared with technical feasibility or economic viability.[29] Thus, there is absence of innovative drive from the supply side, which compounds that induced by faulty incentives on the demand side. In defense production organizational arrangements have evolved to overcome these innovation disincentives.

A. Organizational and Priortiy Advantages of Defense Production

The traditional Soviet economic model of central planning in performance, as distinguished from the theoretical ideal, does not apply to defense production anymore than the functioning neoclassical model of the market applies to U.S. military production. Soviet defense technology has maintained close parity with that of the United States; in non-military technology the Soviets have largely conceded that they must increasingly rely on imports of foreign prototypes.

The barriers of inadequate incentives and organization which have constrained civilian technological advance have been surmounted in defense production not through basic organizational reforms, but by overwhelming and circumventing the existing system of central planning. The methods used result in further intensifying the systemic inefficiencies which hinder civilian technological progress.

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[29] Ibid., p. 196.

At all levels of decision-making there exist institutional arrangements, formal and informal, to enforce defense production priorities.[30]

1. The Politburo, the Party's supreme policy-making body, is intimately involved in detailed defense program decisions. Selected key lower level personnel in the defense production sector have direct access to this top level.

2. The Defense Council (Sovet Oborony), is, in effect, a sub-committee of the Politburo. It is believed to be responsible for the chief initiatives in weapons development. Leading Poliburo members and leaders in defense operations and production are represented on this body. Innovation, therefore, stems from pressure by the Ministry of Defense and the Party leadership.

3. Under the Council of Ministers, the Military-Industrial Commission is primarily responsible for meshing defense production and research and development with general economic planning. This organization has members from defense production ministries, the Ministry of Defense, Gosplan, the Central Committee and the Secretariat of the Party.

4. Within Gosplan there is a separate defense production division. In the detailed planning process defense needs have the highest priority.

5. At the enterprise level, there are inspectors in uniform from the Ministry of Defense in all units producing output of interest to the military. They are mainly experienced engineering officials. They have the right to refuse delivery of defective products.

It is obvious from the foregoing list of points of pressure along the full reach of the economic hierachy that the Ministry of Defense is a clamorous customer

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[30] Arthur Alexander, Decision-Making in Soviet Weapons Procurement, International Institute for Strategic Studies, Adelphi Papers Nos. 147 and 148, 1978, pp. 9-23.

who can shape production and technology to satisfy its needs. Producers are positively induced toward this end by being assured of priority access to the necessary human and material inputs. Managerial bonuses simply reward defense production risk takers, because bonuses are structured to favor production of new products rather than stressing continued output of proved technological content. In effect, the risk is partially borne by the consumer and is also lessened by a more efficient linkage to R and D, as will be discussed subsequently, than in the case of civilian production.

If the presence of a demanding consumer supported at the highest levels in the Party and government overcomes the inertia toward "self-reproduction" endemic in non-military production, the overriding priorities of military output with much greater assurance of timely delivery obviates the propensity toward self-sufficiency and lack of specialization which plagues the civilian industrial sectors.

Technological progress in defense production is further aided by giving defense production ministries direct control over research and development and top priority in contracts with their suppliers. In effect, Gosplan cedes this margin of control which it exercises over civilian production sectors to intermediate defense production echelons (ministries).

The key role in defense R and D and production coordination is played by the Chief Designer.[31] He is nominally in charge of the unit in the technology development process in which production prototypes are developed. In effect, he plays the same role in the Soviet system exercised by an innovating supplier in a market economy. The non-military portion of Soviet production has no counterpart to such supplier initiative. This function is reserved to Gosplan,

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[31] Amann and Cooper, cp. cit., p. 317.

which chooses to subordinate such initiative to the more pressing issue of rationing production with current technology among high priority claimants. Given its annual taut planning challenge, Gosplan is not structured to devote its energies to furthering technological advancement.

Of course, an effective Chief Designer can only successfully exert his enterprenuerial role with the strong backing of the Party leadership in its determination to maintain parity in military technology. Without high priorities for technological resources his efforts would be in vain, thus limiting the possibility of transferability to general application in the present environment.

The effectiveness of defense R and D, in addition to its administrative association with production ministries, is also favored by ample endowment with experimental production shops, which confer qualitative advantages in prototype development. Even more unique to the Soviet system is the encouragement of competition among Chief Designers. This clear spur to technological quality requires provision of adequate R and D and production capacities, in effect, requiring excess capacity. This is, of course, a luxury, denied to civilian industry in which supply constraints and demand overcommitment is the rule.

These special operating advantages do not remove many of the inefficiencies which plague Soviet production. In particular, they do not systematically remove the the propensity of managers, even in defense production, to prefer to maximize current output rather than assume the risk of introducing new products or processes. The structure of managerial incentives is much the same.[32] However, this deficiency is offset by specific production orders, incorporating new technology, backed by the highest authorities and monitored by military factory

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[32] Ibid., p. 342.

floor inspectors. There are also fewer supply uncertainties, which tend to add a risk element to new product introduction. The design bureaux, which are responsible for fulfillment of specific production contracts, show little concern for emphasizing ongoing enterprise production targets. Finally, many of the inevitable techincal difficulties which accompany the production of new products have been resolved by the experimental production shops attached to design bureaux. In essence, risks which confront Soviet industrial managers in the general model and inhibit technological progress, are absorbed in defense production by non-military production. Military production is provided with a risk cushion at the expense of other resource claimants.

Does superior technological performance in military production connote higher efficiency of resource use? If so, transferability of experience to general industrial production may be feasible. If efficiency is defined in terms of resource allocation, the cost of inputs required to yield a given output of defense goods, compared with the opportunity cost of using these inputs in non-military production, the answer is negative. Although precise quantification is not possible, the lavish allocation of high quality manpower, capital investment, and material flow inputs into defense production belies any propensity to economize on cost. In the narrower definition of efficiency, "X'efficiency" which measures the inputs necessary to yield output at the plant level, the record is more favorable. This success is attained because the high priority enjoyed by military production assures managers of timely delivery of high quality materials in contrast to the supply uncertainties which plague Soviet industry in general. Clearly this type of efficiency is not transferable to non-military sectors without a concomitant assurance of delivery priorities in these sections.

B. Transferability of Defense Technological and Production Performance to Economy as a Whole

The superior performance of the defense production sector is very evident to the Soviet leadership. At the XXIV Party Congress in 1971 Brezhnev stated, "Taking into consideration the high scientific and technical evel of the defense industry, the transfer of its experience, inventions and discoveries to all spheres of the economy acquires paramount importance."[33] The General Secretary was either disingenous or wishful, for implementation of his hopes would require wide sweeping reforms by him and his colleagues.

The dissemination of information and professional interchange between the defense and non-defense production sectors has been hampered by the security barrier which effectively insulates the former from the rest of the system. The possibilities for spin-offs from defense R and D are, thereby, diminished. More skeptical analysts would contend that the excessive secrecy, external publications limitations, and prejudiced personnel policies of the defense industry discourage entry of the best scientific talent.[34] As a result, the technical dissemination flow is the reverse of the conventional notion, i.e., from civilian to defense industry.

Given the privileged status of defense industries, their special privileges would have to be replicated for non-military production if the latter grouping is to equal the defense sectors' technological performance. Some features, which largely involve devolution of Gosplan authority to ministries, can be readily transferred. Those relating to high resource priorities are limited in their

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[33] Materialy XXIV S'ezda KPSS (1971), p. 46. Quoted in Amann and Cooper, op. cit., p. 408.

[34] Michael Agursky, The Research Institute of Machine Building Technology: A Part of the Soviet Military-Industrial Complex, Hebrew University, 1976, p. 32.

wider application. The stimulus from the pressure of a clamorous customer is even less likely.

There would be no resource cost if non-military production ministries were given control over the pertinent R and D organizations. In addition to enabling civilian producers to use research and development it would also be feasible to institute a research-production program coordinator on the model of the Chief Designer. Such institutional changes would reduce the authority of Gosplan. It would then be necessary to create a coordinating unit similar to the Military-Industrial Commission to reconcile the interests of the expanded production ministries and those of Gosplan.

By definition it would be impossible to extend defense production's high priority to the entire economy, but there could be selective extensions. In essence, this would be equivalent to the Soviet practice of campaignology. As in the case of military production, these priorities would have to be supported by the active intervention of a demanding consumer. This would involve empowering organizations responsible for investment with the influence of the defense establishment at all levels of decision-making. Furthermore, it would require the active intervention of the Party leadership. Since it would not be possible for the top leadership to be involved personally across the production spectrum, a solution within the central planning framework is an impossible alternative. Unless the existing top priority for defense were downgraded in favor of investment, the latter could not achieve the former's production performance.

Within the existing Soviet model innovation decisions are reserved to the Party leadership, Gosplan, and production ministries. Working level enterprises have neither the power nor the motivation to innovate. Technological progress in defense production has been achieved, not because barriers have been removed

through institutional reform, but because the innovating echelons concentrate their energies on this sector. Such a concentration of effort implies high opportunity costs for less favored production sectors.

The technological achievements in producer durables production, which have been the exceptions to the general sluggish trend, occurred because of special campaigns initiated from the highest decision-making levels. Among these were the chemicalization and automation successes of the late 1950s and 1960s. Similar isolated successes have been attained in such areas as numerically controlled machine tools.[35] In all such special cases, success depended upon direct participation by the top leadership in the initiation and implementation of plans. In effect, the defense production environment has been selectively applied to non-military production.

If the possibilities for transfer of innovation, resource priority, and effective demand to non-military production appear intractable under existing institutional arrangements, what about likelihood for consolidation of research and development and production under a single administration, as successfully demonstrated in the defense sector? In the 1970s Science-Production Associations (N.P.O. in the Russian acronym) were created in many branches of industry. Ideally the NPOs combined all phases of the innovation cycle into a defense-type administrative unit. However, in the implementation of the reform vested interests exerted crippling constraints. Ministerial insistence on primacy of current production plans squeezed spare capacity and structured managerial rewards so as to favor current output maximization over innovation. Furthermore, the combined R and D and production units were still treated as separate entities by Gosplan and the Central Statistical Administration, thereby thwarting the gains

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[35] Amann and Cooper, op. cit., p. 82.

from consolidation.[36] Finally, diffusion possibilities have been limited by the absence of systemic adjustments to encourage receptivity to technical change by potential users of the newly developed technologies.

IV. CONCLUSIONS AND POLICY IMPLICATIONS

As indicated at the onset of this study, improved investment productivity is vital if the stagnation in Soviet economic growth is to be overcome. Emerging trends in the distribution of investment point to continued rises in capital-output ratios. The likelihood that these propensities can be counterbalanced by qualitative improvements in the production of producer durables is a dim one, particularly if defense production continues to enjoy overriding resource priorities and effective superior political support.

The success of technological advance in defense production cannot be transferred to producer durables production within the central planning framework unless accompanied by a similar priorities transfer. The central planning decision-making structure is capable of promoting technological advance in only a narrow band of the economic spectrum. In the past there have been selective episodes in which capital goods production has been accorded high priority and adminstrative guidance, but campaignology is not an effective solution to the chronic poor productivity performance in producer durables production.

Some partial improvements would be possible if capital goods producers were given control over their pertinent research and development activities. However, for such coordination to be effective, there would have to be changes in incentives for R and D organizations and provision for ample production capacity for development of prototypes. Local initiative in technological innovation would

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[36] Ibid., p. 33.

require establishment of an equivalent of the Chief Designer in defense production. As the experiment with Scientific-Production Associations (NPOs) has evolved, Gosplan has been reluctant to grant such necessary decision-making authority.

The achievements in defense production have been attained at high opportunity costs for non-military resource claimants. The systemic deficiencies of the Soviet system are, thereby, magnified for less favored sectors, including producer durables. Therefore, the prospect for improved technological progress in investment productivity appears to be unfeasible within the central planning model while defense continues to receive top resource priorities and the devoted attention of the Party leadership and planners.

The prospect for improved investment productivity is also dimmed by the rising increment in machinery production alloted to military durables. This trend is magnified by the high defense claim to high technology production industries, as revealed in interindustry matrixes. However, even if this increasing resource deprivation were reversed, the superior organizational environment for defense production means that non-military production labors under an efficiency handicap that thwarts any hopeful prospect of improved technological progress. Thus, the impact of high defense priority on Soviet economic growth is both potent and negative.

APPENDIX A

Estimation of Investment Final Demand Purchases by Machinery Production Sectors (Interindustry Matrix Rows)

In a recent publication, Potentsial investitsonnogo mashino-stroeniia SSSR, V.K. Fal'tsman includes a matrix (pages 56-57) showing the structure of investment equipment (producer durable) deliveries by 38 machinery production categories (rows) for the years 1966 and 1977. Purchases are estimated for the economy as a whole and for the following sectors separately--industry, agriculture, construction and transportation and communications. His magnitudes are in proportions of total deliveries for each sector (column). In 1966 his distribution accounts for 69.2 percent of total economy-wide delieveries. He excludes estimates for product categories in which the proportions are "not sufficiently high." The explicit share total for 1977 is somewhat smaller. For industry the explicit totals are even lower, 58.7 and 59.4 percent, respectively.

Since Fal'tsman does not provide a control total, it is presumed that he used the official estimate for producer durables investment, either for the years in question, or lagged a year to account for the average time lapse between production and reported inclusion in investment estimates. If this procedure is followed, ruble estimates can be obtained for each row entry in the investment final demand vectors.

The combination of the Fal'tsman matrix with the official estimate for producer durables investment thereby provides a breakdown of such investment by product categories. If his ruble row (product) estimates are compared with those derived from the reconstructed official interindustry matrix for 1966, significant unallocated magnitudes emerge. The interindustry matrix production totals are larger than Fal'tsman's investment deliveries for major product

groupings, such as transport machinery, radio and electronic products, electrical machinery and equipment, and mining and metallurgical equipment. Among the possible non-consumption final demand uses for these products, defense would comprise the principal claimant.

The 1966 interindustry matrix, as reconstructed by the Foreign Demographic Analysis Division (FDAD) team of Treml, Kostinsky, Gallik, and Krueger,* can be compared by machinery row categories with the implicit Fal'tsman estimates. It will be recalled that the official table combines all nonconsumption uses into a single final demand column. If the Fal'tsman estimates are deducted from the more inclusive interindustry matrix estimates, most of the difference can be presumed to represent sales of military durables. Since the interindustry estimates are net of foreign trade, the only other possible significant final use consists of inventory accretions.

In Soviet statistical recording practice inventory accretions of producer durables consist mainly of increments to unfinished construction in the form of uninstalled equipment. Installed equipment is classified as fixed capital; uninstalled equipment as working capital. The likely magnitude of such accretions in 1966 was insignificant. Total accretions to unfinished construction amounted to 2.9 billions rubles**. In 1970 only 12 percent of unfinished construction consisted of uninstalled equipment.*** Therefore, the bulk of the differences between the Fal'tsman and reconstructed interindustry matrix row totals can be presumed to consist of military durables.

*The interindustry matrix estimates used in this study are based on a further refinement of the official index by Barry Kostinsky, The Reconstructed 1966 Soviet Input-Output Table: Revised Purchasers' and Producers' Price Tables (Foreign Economic Report No. 13), U.S. Department of Commerce.

**Narodnoe Khoziaistovo SSSR v 1967 Godu, p. 629.

***V.P. Krasovskii, "Faktor Vremeni v Planovoi Ekonomike," Ekonomika, 1978, p. 60.

It is possible to approximate product classification equivalence by combining Fal'tsman's more numerous product groupings into the more inclusive interindustry matrix categories by reference to the classification scheme found in the original study by the F.D.A.D. team. Since the Fal'tsman estimates include sales from both domestic and foreign production, the relevant interindustry matrix comparison is non-consumption minus the net foreign balance. The purchasers' prices estimates of the matrix are used to conform with the Fal'tsman estimates. Table A-1 compares the two sets of estimates for machinery production categories with significant magnitudes.

The mining and metalurgical equipment difference may well represent the increase in uninstalled equipment. The transport machinery, precision instruments, and radio and other machine building differences could logically represent military durables sales. Perhaps some of the electrical machinery may also have military users. In 1967 over half of U.S. military procurement consisted of purchases of communications equipment and aircraft and parts. Another quarter consisted of ordinance products. Electrical, electronic, and scientific equipment comprised another 7 percent.

In Table A-1 the transport machinery, precision instruments, and equipment and radio and other machine building categories differences which sum to 3.86 billion rubles could comprise a substantial share of the Bond military durables sales estimate of 4.56 billion rubles for 1966. Of course, the validity of these comparisons rest upon the accuracies of the reconstruction of the official interindustry matrix by the F.D.A.D. team, upon my comparison of the two classification schemes, and upon the assumption that Fal'tsman was using official producer durables investment estimates. Should the 1977 official interindustry matrix be published and reconstructed, it would be enlightening to make a similar comparison for that year.

APPENDIX B

Inconsistencies in Estimates of Trends in End-Use Shares of Soviet G.N.P.

The most comprehensive estimates of trends in Soviet G.N.P. and its end-use and sector of origin components may be found in a recent C.I.A. study published by the Joint Economic Committee of Congress -- USSR: Measures of Economic Growth and Development, 1950-80. The division of G.N.P. by end-use does not include an explicit category for defense expenditures. Some defense outlays are included under consumption (military subsistence) and some under research and development. However, the major portion of defense spending is included in the residual grouping "outlays, n.e.c." (page 48).

In the tables which show trends in G.N.P. by end-use (Table A-6, A-7, and A-8), defense expenditures are incorporated in the categories noted in the preceding paragraph. However, there is an appendix table showing lower and upper bounds for defense expenditures by year in the same constant rubles (1970) used in other measurements (Table C-4).

In Table 2 of this paper these ruble estimates of defense expenditures have been combined with ruble trends for consumption, investment, and G.N.P. shown in Table A-6 of the publication. The "other" category in my Table 2 is a residual obtained by deducting the consumption, investment, and defense values from G.N.P. totals for each year. This procedure yields diminishing, and eventually negative, share values for the "other" category by 1980.

This incongruous result is explained by lack of consistency between the defense expenditures time series and those for other end-use categories. In the publication there is a disclaimer concerning the consistency of the defense estimates with those for other end-uses (page 123). The statement indicates that the defense estimates are "independent" even though these are

produced by the C.I.A. They are independent because they are based upon "a detailed list of their defense programs and ruble values derived from a variety of sources" (page 121). By contrast the other G.N.P. estimates are untimately obtained from official Soviet income flows.

As noted in the next, even though Table 2 contains this underlying inconsistency, the magnitude is not large enough to invalidate the conclusions based upon the table.

Comparison of Fal'tsman and Reconstructed Interindustry Matrix Estimates of Investment and Non-Consumption Purchases by Machinery Production Categories

(Billions of Rubles)

Interindustry Matrix Product Category (1)	Fal'tsman Matrix Product Category (2)	Interindustry Matrix Estimate (3)	Fal'tsman Matrix Estimate (4)	Column 3 Less Column 4 (5)
Energy and power equipment	Turbines, atomic power equipment, boilers, energy machinery	.91	.68	.23
Electrical technical machinery and equipment	Transformers, welders, electric heaters, low voltage apparatus	1.53	.34	1.21
Machine tools	Metalcutting tools, woodworking equipment, stamping-pressing machinery	.86	.74	.12
Precision instruments	Automation instruments and lines	.68	.32	.36
Mining and metallurgical equipment	Metallurgical and mining equipment, drilling equipment, oil field equipment	2.19	.90	1.29
Pumps and compressors	Pumps and compressors, chemical equipment	1.37	.74	.63
Light and food industry equipment	Light and food industry equipment, refrigeration equipment	1.17	.61	.56
Hoisting and transport equipment	Lifting and hoisting equipment	.73	.36	.37
Construction equipment	Construction machinery	.71	.54	.17
Construction materials equipment	Construction materials equipment	.26	.07	.19
Transport machinery and equipment	Railroad cars and machinery, ships	4.28	2.06	2.22
Automotive equipment	Autos and trailers	1.02	1.22	-.20
Agricultural machinery and equipment	Tractors, tractor accessories, agricultural machinery	1.56	2.11	-.64
Radio and other machine building	Communications equipment	2.63	1.09	1.57

SOURCES: See textual explanation

Appendix C

Table C

Comparative Rank Orders and Growth Rates for Selected National Product Variables

	Military Spending As Proportion of G.D.P.		Average Real Growth in Gross Domestic Product		Fixed Investment As Proportion of G.D.P.		Private Consumption As Proportion of G.D.P.		Rates of Change in Output per Hour in Manufacturing Productivity	
	Percent	Rank Order	Percent	Rank Order	Percent	Rank Order	Percent	Rank Order	Percent	Rank Order
United States										
1960-79	7.4	2	3.6	12	17.6	14	63.0	3	2.6	12
1970-79	6.1	2	3.3	7.5	17.3	14	63.4	2	2.4	11
1960-69	4.8	2	3.9	11	17.9	13	62.6	4.5	2.8	12
United Kingdom										
1960-79	5.4	3	2.5	14	18.4	13	62.8	4	2.9	11
1970-79	6.9	3	2.2	13	19.0	13	61.1	3	2.1	12
1960-69	5.9	3	2.8	14	17.8	14	66.4	2	3.6	11
France										
1960-79	4.6	4	4.8	2.5	22.7	8	61.1	5	5.5	6
1970-79	3.9	4	3.9	5	23.1	7	61.0	4	5.3	6
1960-69	5.4	4	5.6	3	22.4	7	61.6	6	5.8	7
West Germany										
1960-79	3.9	5	3.9	10.5	24.1	5	55.6	11	5.4	7
1970-79	3.5	5.5	3.0	11	23.3	6	54.7	12	5.2	4.5
1960-69	4.3	5	4.7	10	24.7	4	56.4	11.5	5.5	3
Sweden										
1960-79	3.8	6	3.4	11	22.4	9	55.6	11	5.1	8
1970-79	3.5	5.5	2.0	12	21.3	11	53.3	13.5	3.7	8
1960-69	4.0	7	4.6	9	23.4	6	57.6	10	6.3	5
Netherlands										
1960-79	3.7	7	3.2	8.5	23.4	5	55.6	11	n.a.	n.a.
1970-79	3.3	7	3.1	9.5	22.6	8	54.8	11	n.a.	n.a.
1960-69	4.1	6	5.2	4.5	24.6	5	56.4	11.5	n.a.	n.a.
Norway										
1960-79	3.3	8	4.4	5.5	29.8	2	63.2	2	6.3	2
1970-79	3.2	8	4.5	2	31.4	2	60.9	5	7.3	1
1960-69	3.5	8	4.3	12	28.3	2	65.2	1	6.4	6

Appendix C

Table C

Comparative Rank Orders and Growth Rates for Selected National Product Variables

	Military Spending As Proportion of G.N.P.		Average Real Growth in Gross Domestic Product		Fixed Investment As Proportion of G.N.P.		Private Consumption As Proportion of G.N.P.		Rates of Change in Output per Hour in Manufacturing Productivity	
	Percent	Rank Order	Percent	Rank Order	Percent	Rank Order	Percent	Rank Order	Percent	Rank Order
Belgium										
1960-79	3.1	9	4.2	8.5	21.4	11	63.9	1	6.1	6
1970-79	1.8	9	3.3	7.5	21.6	10	64.3	1	5.0	7
1960-69	3.2	10.5	5.0	7	21.3	11	63.6	3	7.1	2.5
Italy										
1960-79	2.9	10	4.5	6	20.8	12	63.9	1	6.1	6
1970-79	2.6	10	3.1	9.5	20.4	12	64.3	1	5.0	7
1960-69	3.2	10.5	5.7	2	21.2	12	63.6	3	7.1	2.5
Canada										
1960-79	2.1	11	4.8	2.5	22.9	10	59.1	7	3.9	9
1970-79	2.0	12	4.4	3	22.4	9	57.1	6	3.5	9
1960-69	3.4	9	5.2	4.5	22.0	8.5	60.9	7	4.3	9
Denmark										
1960-79	2.6	12	3.9	10.5	22.8	7	59.3	6	5.6	5
1970-79	2.4	11	2.9	12	23.8	5	55.6	8	5.3	1
1960-69	2.8	12	4.8	8.5	22.0	8.5	62.6	4.5	6.9	4
Australia										
1960-79	1.2	13	4.6	5.5	26.7	3	57.3	9	n.a.	n.a.
1970-79	1.1	13	4.0	4	27.2	3	55.2	10	n.a.	n.a.
1960-69	1.2	13	4.8	8.5	26.2	3	59.1	8	n.a.	n.a.
Japan										
1960-79	0.9	14	6.5	1	32.7	1	55.4	13	8.1	1
1970-79	0.9	14	5.5	1	33.1	1	55.1	9	5.2	4.5
1960-69	0.9	14	11.2	1	32.3	1	55.5	13	10.8	1
South Korea										
1960-79	32.5	1	6.1	6	23.1	6	56.1	14	3.7	10
1970-79	11.0	1	3.5	6	24.9	6	53.1	13.5	3.1	10
1960-69	12.0	1	5.1	6	21.8	10	55.3	14	4.0	10

Sources: Council on Economic Priorities, The Costs and Consequences of Reagan's Military Buildup, 1982, pp. 50-54.
Central Intelligence Agency, National Foreign Assessment Center, Handbook of Economic Statistics, 1981, pp. 30,56,60.