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The Slowdown in Soviet Industry, 1976-82

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Summary

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In trying to revive Soviet economic growth, the new leadership under General Secretary Andropov must contend with an especially difficult set of problems in industry. Industrial growth, which has been decelerating since World War II, slowed unusually sharply during 1976-82. Annual growth in industrial production averaged over 9 percent during the 1950s, 6.4 percent during the 1960s, and 5.9 percent in 1971-75. In 1976-80 the annual rate was only 3.2 percent, and it slowed to 2.4 percent in 1981-82.

Even more dramatic was the slump in productivity—the efficiency with which combined inputs of capital and labor are used. Despite strenuous efforts, the Soviets have been unable to halt this deterioration, and factor productivity declined at an average annual rate of 1.2 percent during 1976-82. Prospects for turning the situation around in the rest of the 1980s are not good. Although industrial growth in 1983 probably will be above 1982's low 2.2 percent, a continued downward drift in industrial growth and productivity is likely *

The surprising slowdown, which occurred within about 18 months in all of the 10 major branches of industry, stemmed from several key factors and many lesser ones. It was precipitated by a path-breaking investment decision—made by the government in 1975 and incorporated in the 1976-80 Five-Year Plan Directives—to try a new strategy for economic growth. Output gains were to depend mainly on improved efficiency (intensive growth); in the past, most of the growth in output had been achieved simply by massive increases in new plant and equipment and mobilizing more workers (extensive growth).

The decision was implemented vigorously in 1976—the first year of the new five-year plan—through a sharp cutback in the rates of growth planned for total new fixed investment and for industrial output. The planners evidently believed that if they reduced the pressure for ever greater output for a while, the industrial sector could raise its efficiency and improve the quality of its products, paving the way for an upsurge in industrial growth rates in subsequent years. But events went awry, and the planned temporary retreat turned into a rout.

* This paper investigates the principal causes of this dramatic turn in Soviet fortunes by examining the experience of each major industrial branch and assessing the interdependencies involved. The findings rest largely on a series of industrial case studies by the Office of Soviet Analysis. The approach is partly quantitative, in that it involves extensive analysis of statistical time series, but mainly qualitative, relying on a mass of reporting from the Soviet press and other sources.

The new strategy threw into sharp relief serious shortcomings in the investment process, and these played an important role in the industrial slowdown. Along with slowing investment growth, the strategy concentrated on renovating existing plants rather than building new ones. The scramble for allocations that ensued severely weakened the government's control over investment projects. A reallocation of investment in midplan (to finance a crash program to develop energy in West Siberia) made matters worse. The results were an upsurge in the volume of unfinished construction, a large falloff in additions to capacities, and many useless renovations that increased neither capacity nor efficiency. In general, the replacement of old machinery with new, more efficient types moved no faster than before.

Aside from these mistakes in investment planning, industrial growth was seriously damaged by the convergence of three critical constraints, which Soviet policy failed to head off. The first, and possibly most decisive, was a growing shortage of several key raw materials—iron ore, steel, lumber, and nonmetallic minerals. These (and other) shortages developed largely as a consequence of long-continued building of large facilities for producing intermediate and final products, to the relative neglect of investment in developing the supplies required for full use of those capacities. In particular, the planners had failed to take adequate account of the rapidly growing share of investment needed simply to offset depletion in the extractive industries. Growth of output of extractive raw materials, which had been slowing for many years, fell sharply after 1975.

Shortages of these critical inputs, along with deterioration of their quality, began to limit growth of production first in steel, forest products, and construction materials, and then in the processing industries themselves—chemicals, machinery, and paper. In addition, poor harvests in 1975 and again in 1979-82 led to raw materials shortages in consumer goods industries.

A second major constraint was in the supply of energy. Although many years of debate over energy development strategies showed some attention to the subject, the planners apparently did not realize how fast the problem was developing or the huge resources that would be required to cope with it. As fuel shortages began to plague the industrial sector after 1975, the planners responded with conservation campaigns—largely unsuccessful—and the crash program in West Siberia. Coal, which is both a raw material and a fuel, proved to be a particularly serious constraint. Its worsening quality and reduced availability adversely affected the production of electricity, with power outages, brownouts, and other malfunctions becoming frequent and damaging to efficiency, product, and equipment in most branches of industry in varying degree.

In addition, the electric power network operated under increasing strain as its reserve capacity decreased—a consequence of past failures to add new capacity. Unreliability in fuel and power supply became widespread, causing particular difficulty in the severe winter of 1978/79 and again in 1981/82.

Rapidly developing bottlenecks in rail transportation proved to be a third serious constraint on industrial growth and efficiency. Frequent failure of the railroads to meet shipment schedules led to intermittent plant shutdowns, production-line disruptions, and idle machines and workers. After years of relative investment neglect and improper investment allocations, the railroads finally neared the point of breakdown. Freight density, which had increased by 27 percent in 1971-75, essentially stagnated in 1976-80. That is, the railroads had reached the limit of their capacity to move ever more freight with their existing lines and technology. The leadership's growing alarm over the worsening transport situation was reflected in several decrees, some increase in investment, and (in 1982) the dismissal of the Minister of Railroads and designation of a Politburo member to oversee the sector.

Other developments added to the difficulties and took their toll on industrial growth:

- *Military priorities.* The priority claim of the military on production, fuel supplies, and transportation is a permanent burden, and the strain was worsened in 1979-82 by suddenly accelerated military demands on transport to convey men and material to Afghanistan and to facilitate the protracted large-scale troop maneuvers in western Russia that were part of the Soviet response to the events in Poland. The industrial slowdown almost certainly played a role in halting the growth in military procurement after 1975.

- *Changes in the rules of the game.* Managerial staffs of enterprises were burdened as never before by frequent changes in the rules governing incentives, with multiple campaigns to conserve on everything at once, with orders to join one or another large-scale experiment to test some new working arrangement, with pressure to reorganize or merge enterprises, and with accelerating demands to set up auxiliary farms and (in heavy industry) to produce more consumer goods. The constant change in the rules increased uncertainties and made incentive schemes less useful in stimulating efficiency. The administrative overkill, coupled with the operational difficulties faced by producers, surely weakened incentives for innovation. Finally, problems in motivating and disciplining workers also were evident--but whether they became more difficult in this period is hard to say.

- *Growing difficulties in planning.* The ability of Gosplan to plan (forecast) industrial growth with reasonable accuracy became progressively worse during 1976-82 for many key products as well as for overall growth. By CIA measures, industrial growth has failed to meet planned targets in every year since 1973 and by growing margins.

- *Foreign trade rigidities.* Rigidities in the conduct of foreign trade (five-year bilateral agreements in CEMA trade and a financial conservatism that blocked additional hard currency debt) limited any effort to use imports to alleviate domestic shortages.

Most of the unfavorable developments that converged to slow industrial growth and productivity during 1976-82 will continue to do so for the rest of the 1980s, and may intensify. According to the five-year plan, industrial investment will grow more slowly in 1981-85 than it did in 1976-80, but industrial output is to grow more rapidly—by 4.7 percent per year instead of the 3.2 percent achieved in 1976-80. Except perhaps for oil and gas, however, planned investment will be insufficient to create the capacities needed to achieve that accelerated growth in output. The current plan retains the policy of devoting the bulk of new investment to renovating existing facilities; this means, under Soviet conditions, that much of it may be wasted, as apparently it was during the last plan period.

Given the severity of present imbalance between the supplies of raw materials and energy and the capacities to produce finished goods, shortages are likely to continue, and the quality of many raw materials probably will deteriorate. In particular, the likely slow growth of steel production will constrain the growth of machinery and hence of investment and perhaps also weapons production. Good harvests, if they come, will raise growth rates in the food processing branch, but not much in industry as a whole. The railroads will continue to operate under severe strain; indeed, there is no clear indication that the planners have even agreed on how to attack their accumulated problems.

- Four other factors will add to industry's strained situation: greatly reduced availability of labor as a consequence of demographic factors; the continued sizable priority claim of the military on materials, investment, and transportation; accelerated pressure on enterprises to economize on all resource inputs simultaneously; and incentive schemes of Byzantine complexity. Although the campaign recently launched by Andropov to impose discipline on one and all may have favorable effects initially, such tactics seem unsuited to the long-range task of solving chronic productivity problems. Major systemic reforms, which might provide a solution in the long run, are not on the leadership's agenda as yet. Even if launched, they would be unlikely to boost industrial growth and productivity for many years.

Sluggish industrial growth will slow the growth of GNP through the 1980s. The Soviets will probably adjust to this, as they have already in the past, by dealing fairly evenhandedly with the three major claimants—consumption, defense, and investment, allocating roughly similar shares of annual GNP increments to each. Such "muddling through" should enable them to maintain some forward momentum for consumption, to continue upgrading weapons capabilities, and to support growth with additional investments. Alternative strategies not only would be risky, but probably could not be even carried out.

The Soviets also will continue to import technology from the West to relieve shortages in critical areas such as finished steel and oil and gas equipment. However, the real growth in purchases will be constrained both by slower growth of hard currency earnings and by continued Soviet reluctance to pile up debt to the West.

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The Slowdown in Soviet Industry, 1976-82

The Statistical Record of Performance

Soviet industrial production has grown more slowly in each successive five-year period since 1950. Industrial growth averaged 9.2 percent in the 1950s, and factor productivity improved rapidly during the decade.[1] During 1961-75, production growth continued to slow progressively, and productivity growth rates, although far below those of the 1950s, were improving. Table 1 shows the data by five-year periods for industry as a whole and for 10 major branches. Although the slowdown in growth of output during 1961-75 occurred in most of the branches, the patterns were quite diverse. Growth patterns for labor and capital inputs and factor productivity also varied considerably among branches, the growth of inputs dropping considerably in most cases and total productivity rising.

A clear break in these trends and patterns occurred in 1976-80 (the 10th Five-Year Plan), and the new situation has persisted through 1982 (see figure). Average annual growth of total industrial output dropped sharply—from 5.9 percent in 1971-75 to 3.2 percent in 1976-80 and to 2.4 percent in 1981-82. Similar abrupt falloffs in five-year average growth rates occurred in all branches except light industry. Moreover, the sharp deterioration in growth began in 1976, the first year of the new five-year plan, for industry as a whole and for all branches except electric power and light industry.

Thus, the overall industrial growth rate fell from 6.4 percent in 1975 to 4.0 percent in 1976 (by far the sharpest fall in percentage points in any year since 1956—when the growth rate was twice as high). The slide in growth rates between 1975 and 1976 in the eight branches ranged from 0.9 percentage point for construction materials to 6.4 percentage points for food processing. In both electric power and light industry, spared the first year, the abrupt falloff in growth took place a year later—in 1977, when performance in the other branches and in industry as a whole stabilized or improved a little.

Besides the marked downward deviation from trend displayed in nearly all branches and in industry as a whole, three other notable developments characterized industrial growth in 1976-82. First, while the pattern is not uniform, growth rates for the branches of industry tended to fluctuate more widely than in earlier quinquennia. (An exception is the food processing branch, where annual growth rates have always been erratic because of the volatility in agricultural output.) Second, in industry as a whole and in most branches, once the break in trend occurred, performance continued to deteriorate along the new, steeply declining trend line.

Third, the sharp falloff in growth of output in industry and its branches in 1976-82 was associated statistically with a modest reduction in the growth of inputs (capital stock and man-hours of labor) and an absolute decline in the productivity of these inputs (see figure). In industry as a whole during 1976-80, the growth of capital stock slowed by only 1 percentage point compared with 1971-75, and the growth rate of man-hours rose slightly. Together, they increased considerably faster than output, so that factor productivity declined by 1.2 percent annually (it had grown by 1 percent annually during 1971-75). The growth of capital stock dropped moderately in all branches except fuels, where it rose a little. The growth of man-hours speeded up somewhat in all branches except machinery and chemicals, where growth of labor inputs slowed by nearly 1 percent annually, and forest products, where man-hours declined a bit more slowly. The growth of capital and labor inputs combined

[1] Unless otherwise indicated, growth rates are based on the CIA index of industrial production (SPIOER). A full description of the nature and derivation of this index is given in *USSR: Measures of Economic Growth and Development, 1950-80*, US Congress Joint Economic Committee, Washington, 1982, pp. 169-244. Productivity of capital and labor combined, termed "factor productivity," is calculated using a Cobb-Douglas (linear homogeneous) production function. Annual growth rates for labor and capital and the weights used to combine them are given in appendix B.

Table 1
Average Annual Rates of Growth
of Output, Inputs, and Productivity
in Soviet Industry, 1961-82

Percent

	1961-65	1966-70	1971-75	1976-80	1981-82
Total industry					
Output	6.6	6.3	5.9	3.2	2.4
Inputs					
Labor	2.9	3.1	1.5	1.6	0.8
Capital	11.4	8.8	8.7	7.7	7.3
Total	6.9	5.7	4.9	4.5	3.9
Productivity					
Labor	3.5	3.1	4.4	1.6	1.5
Capital	−4.4	−2.3	−2.6	−4.2	−4.6
Total	−0.3	0.5	1.0	−1.2	−1.4
Ferrous metals					
Output	7.2	5.1	4.0	1.0	−0.5
Inputs					
Labor	2.9	2.0	0.1	0.4	1.0
Capital	11.7	8.7	7.7	6.4	5.7
Total	7.1	5.2	3.7	3.3	3.2
Productivity					
Labor	4.2	3.0	3.9	0.6	−1.5
Capital	−4.0	−3.4	−3.4	−5.0	−5.8
Total	0.1	−0.1	0.3	−2.2	−3.6
Nonferrous metals					
Output	7.7	7.5	5.9	2.3	1.0
Inputs					
Labor	5.7	2.0	0.1	0.7	0.7
Capital	11.6	8.8	8.7	7.8	7.2
Total	8.5	5.2	4.2	4.1	3.7
Productivity					
Labor	1.8	5.4	5.8	1.5	0.4
Capital	−3.5	−1.2	−2.6	−5.1	−5.7
Total	−0.8	2.1	1.6	−1.7	−2.6
Fuels					
Output	6.3	5.0	5.0	3.1	1.8
Inputs					
Labor	−0.8	0.2	−1.2	0.2	1.9
Capital	7.5	6.9	7.7	7.9	8.8
Total	2.7	3.0	2.5	3.4	4.8
Productivity					
Labor	7.1	4.8	6.3	3.0	−0.1
Capital	−1.1	−1.7	−2.5	−4.4	−6.4
Total	3.5	1.9	2.4	−0.3	−2.9
Electric power					
Output	11.5	7.9	7.0	4.5	2.8
Inputs					
Labor	5.4	3.5	1.5	2.3	1.9
Capital	13.4	10.3	7.9	6.1	5.7
Total	10.2	7.6	5.3	4.6	4.2
Productivity					
Labor	5.8	4.3	5.5	2.2	0.8
Capital	−1.7	−2.1	−0.8	−1.5	−2.8
Total	1.2	0.3	1.6	−0.1	−1.4
Machinery					
Output	7.2	7.0	8.0	5.0	3.6
Inputs					
Labor	6.1	4.1	2.8	1.8	0.7
Capital	11.4	9.8	10.6	9.6	8.5
Total	7.7	5.7	5.1	4.1	3.0
Productivity					
Labor	1.0	2.8	5.0	3.1	2.9
Capital	−3.6	−2.5	−2.4	−4.2	−4.5
Total	−0.5	1.2	2.8	0.8	0.6
Chemicals					
Output	12.0	8.9	8.6	3.6	2.8
Inputs					
Labor	9.2	4.9	2.2	1.4	1.2
Capital	17.6	13.0	10.6	9.1	8.8
Total	12.9	8.5	5.8	4.7	4.5
Productivity					
Labor	2.5	3.8	6.3	2.2	1.6
Capital	−4.8	−3.6	−1.8	−5.0	−5.5
Total	−0.8	0.4	2.6	−1.1	−1.6
Wood, pulp, and paper					
Output	2.6	2.9	2.6	−0.3	1.8
Inputs					
Labor	−0.7	0.3	−0.6	−0.4	0.4
Capital	11.1	6.9	8.3	6.5	6.1
Total	2.8	2.3	2.1	1.7	2.1
Productivity					
Labor	3.3	2.5	3.1	0.1	1.4
Capital	−7.7	−3.8	−5.3	−6.4	−4.1
Total	−0.2	0.6	0.5	−1.9	−0.2

Table 1 (continued)

Percent

	1961-65	1966-70	1971-75	1976-80	1981-82
Construction materials					
Output	5.4	5.8	5.4	1.2	0.0
Inputs					
Labor	0.7	3.4	1.4	0.8	−0.1
Capital	14.6	8.2	9.7	7.0	5.3
Total	5.2	5.0	4.1	2.8	1.7
Productivity					
Labor	4.6	2.3	4.0	0.3	0.1
Capital	−8.1	−2.3	−3.9	−5.4	−5.0
Total	0.2	0.8	1.3	−1.6	−1.7
Light industry					
Output	2.6	7.2	2.7	2.7	0.9
Inputs					
Labor	0.8	3.4	0.1	0.6	−0.5
Capital	9.2	8.4	8.7	6.3	6.5
Total	3.4	5.0	2.7	2.4	1.7
Productivity					
Labor	1.8	3.7	2.6	2.0	1.4
Capital	−6.0	−1.2	−5.5	−3.4	−5.2
Total	−0.7	2.1	0.0	0.3	−0.8
Food processing					
Output	6.9	5.8	3.9	1.1	2.4
Inputs					
Labor	1.9	2.4	0.7	0.6	0.5
Capital	11.5	7.6	7.1	5.7	5.8
Total	6.2	4.8	3.6	3.0	2.9
Productivity					
Labor	4.9	3.4	3.2	0.4	1.9
Capital	−4.2	−1.6	−3.0	−4.4	−3.2
Total	0.6	1.0	0.3	−1.8	−0.5

Note: Total factor productivity is calculated using a Cobb-Douglas (linear homogeneous) production function. Inputs of labor and capital are weighted with their respective income shares in 1970 as estimated in the derivation of GNP at factor cost in that year. All estimates for 1982 are preliminary.

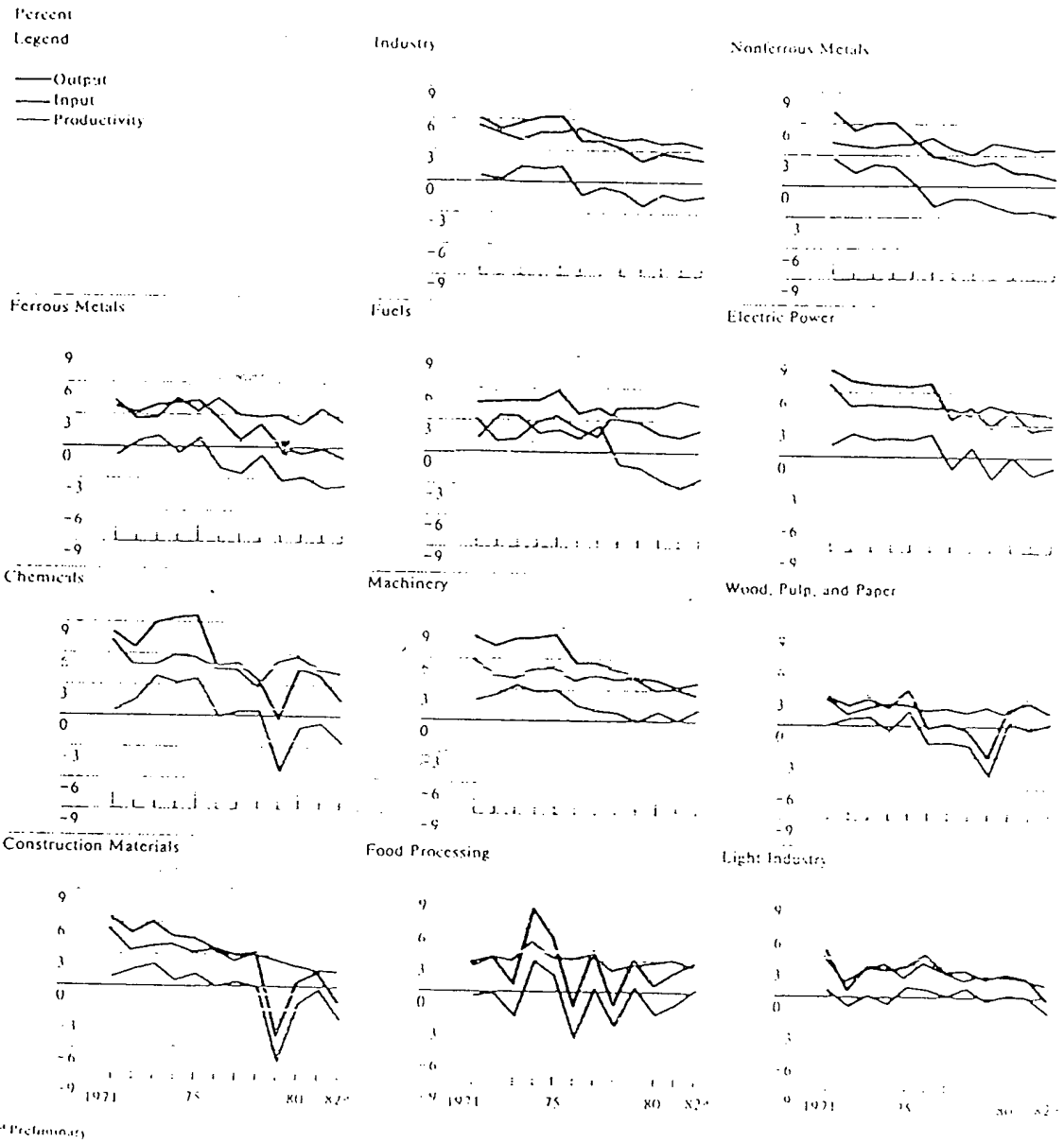
fell moderately in all branches except fuels, where it speeded up from 2.5 percent per year in 1971-75 to 3.4 percent per year in 1976-80. Growth of inputs was more rapid than that of output in all branches but machinery and light industry.

Thus, factor productivity declined in eight of the 10 branches at average annual rates ranging from 0.1 percent in electric power to 2.2 percent in ferrous metallurgy; productivity growth fell by over two-thirds in machinery and rose only slightly in light industry. In contrast, no branch had registered a decline in productivity during the preceding five-year plan period. In fact, productivity gains were larger in 1971-75 than they had been in the 1960s, in industry as a whole and in nearly all of its branches. Following the abrupt falloff during 1976-80, factor productivity deteriorated further in both 1981 and 1982.

The startling contrast between the first and second half of the 1970s in productivity of resource use in the industrial sector shows up most vividly in the data on year-to-year changes during 1971-82 given in table 2. Data for the years 1976-82 are studded with minus signs, whereas only a handful appear in the years 1971-75.

Again, the decisive year was 1976, when productivity in industry slumped badly, with declines in four of the 10 branches, large falloffs in growth in four others, and an increase in only one—electric power. Thereafter, productivity in industry as a whole declined erratically in each subsequent year, as it did in ferrous and nonferrous metallurgy and in construction materials. Productivity fell in eight out of 10 branches in

Growth in Outputs, Inputs, and Productivity in Soviet Industry



[a] Preliminary

Table 2
Annual Growth in Output, Inputs, and Productivity in Soviet Industry, 1971-82

Percent

	1970 (Weight)	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982 •
Total industry													
Output	100.0	6.1	5.1	5.7	6.3	6.4	4.0	4.0	3.3	2.1	2.8	2.5	2.2
Productivity		0.6	0.3	1.5	1.3	1.5	−1.2	−0.5	−0.9	−2.2	−1.1	−1.6	−1.3
Ferrous metals													
Output	7.2	3.8	3.3	4.0	4.2	4.4	2.7	0.7	2.2	0.0	−0.5	−0.1	−0.9
Productivity		−0.7	0.6	1.1	−0.5	0.9	−1.9	−2.4	−0.7	−3.1	−2.7	−3.7	−3.5
Nonferrous metals													
Output	3.9	7.2	5.4	6.1	6.2	4.6	2.9	2.6	2.1	2.4	1.4	1.3	0.8
Productivity		2.6	1.3	2.1	1.9	0.3	−1.9	−1.2	−1.2	−1.9	−2.5	−2.4	−2.8
Fuels													
Output	9.8	4.7	4.8	4.9	4.9	5.8	3.7	4.2	3.2	2.9	1.8	1.5	2.1
Productivity		1.4	3.5	3.4	1.8	2.1	1.3	2.5	−1.1	−1.4	−2.5	−3.3	2.4
Electric power													
Output	6.8	8.1	7.1	6.8	6.7	6.6	6.0	3.6	4.7	2.9	4.5	2.5	3.0
Productivity		1.1	2.1	1.6	1.7	1.6	2.1	−1.1	0.9	−2.0	0.0	−1.7	−1.0
Machinery													
Output	31.4	8.2	7.3	8.0	8.1	8.4	5.7	5.7	5.0	4.3	4.1	3.4	3.8
Productivity		2.0	2.5	3.5	2.8	3.0	1.5	1.0	0.8	0.0	0.9	0.1	1.1
Chemicals													
Output	6.3	8.1	6.7	9.0	9.5	9.7	4.8	5.2	3.6	−0.2	4.7	4.0	1.6
Productivity		0.6	1.6	3.9	3.1	3.7	0.0	0.5	0.5	−5.3	−1.1	−0.7	−2.6
Wood, pulp, and paper													
Output	7.7	2.8	2.0	2.7	1.8	3.6	−0.1	0.3	−0.4	−2.9	1.7	2.3	1.4
Productivity		0.1	0.7	0.8	−0.5	1.4	−1.7	−1.6	−1.9	−4.8	0.4	−0.4	−0.2
Construction materials													
Output	6.5	6.5	5.1	6.1	4.8	4.6	3.7	3.1	3.3	4.6	0.5	1.4	1.4
Productivity		0.9	1.6	2.1	0.6	1.2	0.1	0.5	0.0	−7.1	−1.6	−0.3	−3.0
Light industry													
Output	8.0	4.5	0.7	2.8	2.6	2.9	4.1	2.5	2.6	1.8	2.3	1.9	−0.1
Productivity		0.6	−0.9	0.1	−0.7	0.9	0.7	0.1	0.8	−0.4	0.2	0.0	−1.5
Food processing													
Output	9.5	2.5	3.3	0.8	2.9	5.2	−1.2	4.0	−1.1	3.1	0.7	1.9	2.8
Productivity		−0.4	−0.2	−2.3	2.9	1.6	−4.4	0.3	−3.2	0.4	−2.1	−1.2	0.2

• Preliminary.

1979, 1981, and 1982 and in six out of 10 in 1980. Productivity turned negative in the long-favored chemicals branch in 1979 and stagnated in the machinery branch.

Causes of the Great Industrial Slowdown, 1976-82

The Causes in Brief

Several major factors and many minor ones brought about the dramatic drop in the growth rate of industrial output in the 10th Five-Year Plan; their relative contributions cannot be measured quantitatively. The drop was precipitated by a decision—announced by Gosplan Chairman Baybakov in early December 1975—to cut sharply the growth rate planned for industrial output in 1976 to more than 2 percentage points below the rates planned and achieved in 1975. Simultaneously, Baybakov announced that the planned growth of total new fixed investment was to be cut to less than half the rate of increase shown for 1975. Both cutbacks affected virtually every industrial branch in varying degree.

In fact, achieved growth rates of both output and investment dropped abruptly in 1976—but the upsurge in growth and productivity planned for the rest of the plan period never came. For one thing, the planners had given the production system a shock from which it never recovered and had set in motion processes in the sphere of investment that proved seriously adverse. Specifically, the concentration of investment on renovating existing enterprises—a key part of the new investment strategy—not only engaged most enterprises in the investment process, thus hampering the flow of production at least temporarily, but also produced an investment mix that neither added proportionately to new capacity nor replaced much old technology with efficient new varieties. For another thing, a substantial reallocation of industrial investment was made suddenly in midplan (1978) to fund a crash program to develop oil and gas resources in West Siberia.

In devising and launching this new growth strategy (which was intended to yield a decisive increase in the efficiency of resource use and improvement in the quality of products), the planners evidently overlooked the severity of three looming constraints that threatened future production. The first, and possibly most critical, constraint was in the supply of several basic raw materials and intermediates—iron ore, coal, steel, lumber, and nonmetallic minerals. Widespread shortages were about to appear, largely as the consequence of long-continued investment in manufacturing capacities to the relative neglect of developing the raw materials supplies essential to full use of those capacities. In particular, the planners did not adequately note that each year's neglect of the extractive industries increased the share of investment that would eventually be needed to offset depletion. Shortages of extractive raw materials, along with an apparent worsening of their quality, began to limit output growth first in steel, lumber, and construction materials, and then in the processing industries themselves—chemicals, machinery, and paper. Poor harvests in 1975 and again in 1979-82 led to raw materials shortages and reduced growth in food processing.

The second looming constraint was in energy. Despite many years of debate about the need for "big" energy strategies,[2] the planners apparently did not correctly gauge the speed with which this constraint was developing or appreciate how costly it would be to cope with. As fuel shortages began to plague the industrial sector, the planners responded with conservation campaigns and the crash program in West Siberia. Coal, which serves both as raw material and as fuel throughout industry, proved to be a particular constraint, reducing the quality of electric power. Power outages, brownouts, and other malfunctions became damaging in varying degrees to product, equipment, and efficiency in most branches.

Third, despite warnings from specialists, the planners chose to ignore the fact that the railroads, which carry the vast bulk of industrial freight and large quantities of coal and oil products, were strained to the verge of breakdown—the legacy of parsimonious investment improperly allocated and of the apparent belief that

freight densities could be raised forever. Rail bottlenecks began to appear early in the plan period and worsened to the point of near crisis in the particularly severe winter of 1978/79. Industrial production was continually hampered as raw materials arrived late and finished products piled up awaiting transport. A leading Soviet transportation specialist had warned in 1976 that the railroads would prove to be the Achilles' heel of the 10th Five-Year Plan. He was right.

Several other important developments added to the troubles of an industrial sector already suffering from cutbacks in investment and the planners' neglect of these three growing constraints. Planners continued to give high priority to military production and transport, and the strain on an already taut situation was made worse by unexpected military demands arising from the invasion of Afghanistan and the large-scale army maneuvers that figured in the Soviet response to the events in Poland. Rigidities in the conduct of foreign trade (five-year bilateral agreements in the case of CEMA trade and financial conservatism blocking additional hard currency debt) hampered the use of trade to alleviate domestic shortages. Finally, managerial staffs of industrial enterprises were burdened as never before by the need to deal somehow with frequent changes in the rules governing incentives, with campaigns to conserve on everything at once, with orders to join one or another large-scale experiment to test some new working arrangement, with pressure to form new organizational arrangements, and—in the case of heavy industry—with escalating demands to produce more consumer goods.

In sum, the sharp downward break in the trend of industrial growth rates came in 1976 and was precipitated by the planners, thinking to reinvigorate industrial production and accelerate productivity gains by allowing a brief period of reduced tautness to encourage efficiency mechanisms and to build up reserve stocks.[1] An alternative hypothesis—that the planners fully perceived the seriousness of the looming constraint on growth and deliberately slowed the economy to meet it—seems less likely, since decisive action to deal with rapidly developing energy and transportation problems were not taken until late in 1977. The break, when it came, was reinforced by the swift joining of the three lurking constraints—in raw materials, energy, and transportation—that were the culmination of many years of bad investment decisions. These difficulties were further compounded by the persistence of the familiar malfunctionings of the administrative system. The chickens finally had come home to roost.

The factors described above seem sufficient, therefore, to account for the abrupt deterioration in industrial performance that began in 1976. They had their effect on both management and labor.

The sudden cutback in planned growth of output in 1976 and a lesser cut in investment allocations for 1976-80 surely persuaded industrial managers to redouble their efforts to maintain a safety factor to ensure their meeting even those reduced plans for growth of output. They probably tried even harder to obtain a cushion of raw materials and labor, perhaps to offset the less-than-expected investment. These managerial attitudes would have been reinforced over time by three factors: (1) much press discussion about impending general labor shortages, (2) the burgeoning problems with supplies, energy, and transportation, and (3) the adjustment of plans for both outputs and inputs during the year to take account of the growing difficulties.

At the same time, the many disruptions to the production process in factories must have made the workers feel helpless and indifferent. In addition, plants that actually decreased production kept their workers on the payroll anyway, not only as a safety factor but also because of a systemic constraint against dismissing workers through no fault of their own and against their will.[2] That retention, in itself, reduced labor productivity.

[1] A good discussion of this strategy is given in an article by two Soviet investment specialists. See *Izvestiya Akademii Nauk Seriya Ekonomicheskaya*, No. 6, 1982, pp. 66-76.

[2] For a discussion of this systemic feature, see David Granick, "Soviet Use of Fixed Prices: Hypothesis of a Job Rights Constraint," in Steven Rosefielde (ed.), *Economic Welfare and the Economics of Soviet Socialism*, Cambridge, Cambridge University Press, 1981, pp. 85-104.

An alternative or additional explanation for the slowdown might also be advanced—that a substantial part of it results from a "social factor." This concept emphasizes prevalent absenteeism, alcoholism, labor turnover, and shirking, along with erosion of incentive in workers who cannot find desired goods and services on which to spend wages. These manifestations have been discussed widely in recent years under the headings of "declining worker morale," "growing pessimism," and "worsening quality of life." One prominent Soviet economist asserts in the open press that at least half of the slowdown in labor productivity is the result of the "social factor."

But to attribute much of the recent dramatic slowdown to a "social factor," one would need evidence that worker discipline worsened greatly after 1975. There are many allegations of laxity, but it is far from certain that matters worsened; Soviet press sources, in fact, state that rates of labor turnover and absenteeism, while still "too high," have been decreasing since 1970.[1] Although the growth of per capita consumption has slowed along with that of the economy, the government also has managed since 1976 to maintain work incentives by providing increases in goods and services sufficient to approximately match the growth of the population's incomes. With the harvest failures of 1979-82, however, widespread food shortages have appeared, especially for meat, spawning queues, black markets, and some local rationing. No doubt worker frustration has risen as a consequence.

The Growth Strategy That Boomeranged

The Strategy in Industry. In early December 1975, Gosplan chairman Nikolay Baybakov detailed a radical new strategy for dealing with two chronic problems of the economy and industry—inefficiency in the use of resources and poor quality of the products. The new approach (embodied in the 10th Five-Year Plan) was to sharply reduce the planned growth in new fixed investment—in the economy and in industry. This strategy was in line with that earlier announced by Brezhnev for the plan, and its implementation was begun vigorously in 1976. The change probably had several motivations, but the most important ones seem to have been:

- A determination to arrest the decline in the output/capital ratio, which had accelerated in industry in 1971-75.
- A conviction that lower growth targets, by easing the pressure on managers, would enable them to use resources more efficiently and to turn out better quality products.
- A belief that slower growth of investment would reduce plan tautness, allow accumulation of inventories, and substantially improve the efficiency of the investment process.
- A belief that if investment growth (with its high demands on machinery and construction resources) was reduced, the economy could reach a better balance between the growth of these branches and the growth of raw materials supporting them.

Managerial incentive structures were simultaneously reoriented to achieve similar ends.

In Baybakov's words, "the targets for 1976 are permeated with the idea of improving the efficiency and quality of all work. National economic proportions, the buildup of production potential, and the distribution of resources all are subordinated to this goal." For the first time, ministries were given specific targets for raising the technical level of production and for producing items that would merit the state Seal of Quality. The plan for 1976 scheduled an industrial growth rate of 4.3 percent, well below either the 6.7 percent planned for 1975 or the 6.4 percent attained. In an even more drastic move, the planners scheduled increases of only 3.5 percent in total new

[1] L. Kostin, a first deputy director of the State Committee on Labor and Social Problems, states that during the 1970s the average loss of worktime per worker per year declined from 2.9 days to 1.7 days in industry and from 4.1 days to 2.7 days in construction. Labor turnover rates in the two sectors dropped by 24 percent and 31 percent, respectively. In 1980-81, labor turnover declined almost as much as in the previous seven or eight years. Intrashift losses and losses related to excused absence have also decreased. See *Khozyaystvo i pravo*, No. 11, 1982, p. 34. Another source states that labor discipline has not worsened in recent years. In the 1970s, losses due to unexcused absences decreased by 2.5 percent per year and the share of excused absences was cut in half. See *Ekonomicheskaya gazeta*, No. 48, 1982, p. 13

fixed investment and 2.5 percent in construction, these rates were less than half as great as the increases planned and achieved in 1975.

Apparently the strategy for 1976 had not been finally agreed upon in good time, however, for Baybakov's statements reveal considerable confusion and inconsistency in the specifics of implementation:

- From the incomplete plan data published for 1976, it appears that growth targets were cut back from those planned for 1975 for machinery, electric power, chemicals, and construction materials, but not for fuels and raw materials, perhaps reflecting an effort to overcome past lags in these products.

- The machinery output goal, though lower, still reflected an increase over 1975's growth—despite a drastic reduction in planned investment growth.

- Although Baybakov projected large increases in planned growth of investment in some branches of industry (notably in chemicals, machinery, and the light and food industries), actual investment allocations turned out entirely otherwise, suggesting a major plan correction.

Overall, planned industrial investment, which had increased by 8.8 percent in 1975, increased by 4.3 percent in 1976. All branches received large cutbacks in growth, except for ferrous metals, where investment had declined in 1975. Investment actually decreased in the construction materials and consumer goods branches, while the growth rate dropped from 20 percent to 7 percent in the machinery branch.

Along with the reduction in growth, the new investment strategy in general called for concentrating investment on projects that were already near completion, in order to maintain substantial growth in industrial plant and equipment. Put differently, the backlog of unfinished construction was to be cut in a major way. Moreover, the bulk of industrial investment (64 percent in 1976) was to be allocated to reconstruction, expansion, and renovation of existing enterprises, instead of to construction of new ones, and the share of equipment in the investment mix was to be raised substantially.

The planners, acutely aware of the labor crunch approaching in the 1980s and of the continuing slide in the productivity of capital, may have considered the 10th Five-Year Plan a particularly auspicious opportunity to launch an all-out push for "intensive" or efficiency-generated growth (*intensifikatsiya*). By Soviet measures, industrial growth had remained high during the Ninth Five-Year Plan (1971-75)—7.5 percent annually, not much lower than the 8.5 percent during 1966-70. More important, annual labor productivity advance had speeded up a little—from 5.8 percent to 6.0 percent. For the most part, the physical goals of the Ninth Five-Year Plan had not been badly underfulfilled, and the plan for 1975 was being met in such key sectors as fuels, major kinds of chemicals, and machinery—and also in railroad freight turnover and investment. During 1971-75, by Soviet measures, annual growth rates for the fuels and ferrous metals branches generally were holding above 5 percent, and those for the so-called progressive sectors—chemicals and machinery—were holding above 10 percent.

Although during the 1970s the planners talked about the growth of raw materials sectors being inadequate to meet the demand, there is no evidence that they anticipated critical shortages. Theoretically, the decision to slow investment would in itself reduce the demand for final products and produce the hoped-for adjustment among sectoral growth rates.

Effects of the Strategy. The slowdown in industrial growth planned for 1976 (possibly accompanied by more than proportional reductions in material input allocations) was reflected immediately in the performance of industry in January and in successive months during 1976. For the year as a whole, industrial growth dropped to 4.0 percent, not far from the 4.3 percent planned. All branches but electric power and light industry shared in the downturn, but large shortfalls from planned growth occurred in the most "progressive" branches—machinery and chemicals. As indicated above, the slowdown of 1976 was supposed to be temporary—that is, to form an efficient

base for an upsurge in later years to accomplish the 1976-80 Plan's goal of an average annual growth of 6.5 percent. Instead, the planned retreat turned into a rout, as industrial growth stagnated and then declined, with factor productivity growth turning negative in 1976 and remaining so.

The sudden large cutback in growth of industrial investment, coupled with a crash reallocation toward Siberian oil in midplan and the push for concentrating investment in existing enterprises, proved highly disruptive.[4] Moreover, the policy of concentrating investment on nearly finished projects failed: investment had risen by 22.3 percent by the end of 1980, but unfinished construction in industry had risen by 29.5 percent.[5] The concentration of investment in renovation of existing enterprises was intended to limit the demand for labor and to speed up the replacement of old machinery with modern machinery of greater productivity.

In the implementation of this seemingly sensible strategy, events went awry. Because it was easier to do and also more profitable for construction organizations, much renovation that was done turned out to involve mostly expansion and reconstruction, with little replacement. Also, with slowed growth of investment and machinery production, as well as continued pressure to produce more output, enterprises kept old capital in operation as long as possible, so, retirement rates for machinery and equipment, a low 2.3 percent in 1976, were only 2.5 percent in 1980. Industrial investment was associated with a large drop in additions of new capacity: additions in 1976-80 were smaller in 28 out of 39 industrial categories than in 1971-75 (table 3).

The scramble after a share of the investment pie led to a situation in which the authorities were losing control over investment projects; over 80,000 industrial establishments were being built or renovated in the late 1970s. Proliferation of localized investment projects disrupted production and lured away production workers. The machinery industry proved unable to satisfy the increased demand for modern equipment, imports were insufficient to fill the gap, and the investment process became more strung out. With increasing competition for slower growing investment funds, the imbalances between investment in raw materials and in final goods capacities could not be corrected, even if the planners had foreseen the magnitude of the problem and had taken fully into account the rapid rise in investment costs per unit of capacity.

The falloff in additions to new capacities in 1976-80, especially for provision of raw materials, was evidently a constraining factor on growth of production and efficiency in that period. According to a leading Soviet specialist writing in a major economic journal, part of the gains of the preceding plan had been realized through an increased use of capacity. However, by 1975 the utilization rate generally exceeded 90 percent everywhere, making further increases in output from that source nearly impossible because of rapidly rising unit costs associated with such high-capacity usage. In his view, most sectors were operating under capacity strain at the start of 1976. Thereafter, a drop in utilization rates set in, at first due to the accelerated need to take out overloaded equipment for repair and to seemingly greater difficulties in operating newly commissioned installations, many of which were not really completed. Later, significant declines in use of capacity began to arise in a number of branches because of shortages of raw materials ("interbranch and intrabranch disproportions" in Soviet parlance) and the disruptions brought about by reconstruction and renovation programs at existing plants.

This situation was particularly evident in steel, fertilizer, and finally machinery, as initial shortages of one critical raw material started a chain reaction. The failure to substantially increase capacity additions in the extractive branches was particularly serious, since a large and growing share of annual additions must go merely to offset depletions.

[4] This section has benefited from a study by the Soviet emigre economist Boris Rumer. See *The Dynamics of the Capital Coefficient of USSR Industrial Output: Investment Process in Soviet Industry*, Final Report to National Council for Soviet and East European Research, 1982, pp. 1-47.

[5] This comparison may be somewhat in error because investment data are reported in so-called comparable prices and unfinished construction data are reported in prices actually paid. The relationship between the two sets of prices is not clear.

Table 3
Gross Addition of New Capacities and Investment in Soviet Industry, 1966–80

Branch	New Capacities			Total Investment * (Billion rubles)		
	1966-70	1971-75	1976-80	1966-70	1971-75	1976-80
Ferrous metals				9.93	12.90	15.20
Iron ore (million tons)	120.5	131.5	134.0			
Crude steel (million tons)	18.1	10.9	14.3			
Rolled metals (million tons)	14.3	12.2	7.4			
Steel tubing (million tons)	2.5	2.4	1.9			
Fuels (coal)				7.24	8.34	9.76
Coal (million tons)	95.1	114.2	90.4			
Coal cleaning (million tons)	59.4	34.4	42.5			
Electric power (million kilowatts)	54.6	58.1	54.0	13.63	17.00	19.39
Machinery				22.44	37.72	53.92
Turbines (million kilowatts)	4.3	5.6	3.1			
Transformers (million kilowatts)	28.2	20.6	10.3			
Excavators (thousand units)	5.2	6.7	13.6			
Metalcutting lathes (thousand units)	21.5	25.4	12.8			
Forge-press machines (thousand units)	8.1	7.9	12.9			
Automobiles (thousand units)	423.9	973.9	244.5			
Roller bearings (million units)	179.5	208.4	124.9			
Tractors (thousand units)	121.0	70.6	113.8			
Grain combines (thousand units)	12.0	22.5	38.5			
Chemicals				10.99	15.62	22.16
Fertilizer (million tons of standard units)	33.2	38.0	39.3			
Sulfuric acid (million tons)	4.2	8.6	9.7			
Caustic soda (thousand tons)	1,221	1,038	505			
Chemical fibers (thousand tons)	151.2	349.4	262.9			
Synthetic resins and plastics (thousand tons)	706	981	150.5			
Tires (million units)	8.3	12.9	13.2			
Wood, pulp, and paper				5.73	7.72	9.10
Lumber (million cubic meters)	4.6	5.3	4.5			
Cellulose (million tons)	2.2	2.1	0.9			
Paper (thousand tons)	502	509	271			
Cardboard (thousand tons)	1,359	803	350			
Construction materials				6.31	8.46	9.23
Cement (million tons)	17.4	20.7	11.0			
Asbestos roofing (million standard units)	1,302	1,264	597			
Reinforced concrete structures/parts (million cubic meters)	24.2	29.4	25.5			

Table 3
Gross Addition of New Capacities and Investment in Soviet Industry, 1966-80 (continued)

Branch	New Capacities			Total Investment * (Billion rubles)		
	1966-70	1971-75	1976-80	1966-70	1971-75	1976-80
Light industry				5.28	7.03	8.48
Hosiery (million pairs)	294.1	52.6	44.1			
Knitwear (million pieces)	410.3	162.5	63.5			
Leather shoes (million pairs)	149.0	67.4	21.6			
Spindles installed (million units)	3.1	2.2	2.0			
Looms installed (thousand units)	47.6	41.6	17.5			
Food processing				9.31	11.57	13.40
Granulated sugar (thousand tons per day)	682	861	545			
Meat (thousand tons per shift)	2.2	4.1	3.1			
Dairy products (thousand tons per shift)	12.4	12.3	9.4			
Cheese (tons per shift)	312.6	260 9	92.8			
Vegetable oil (thousand tons per day)	4.4	2.8	4.1			

* Investment data are in constant 1973 prices.

Source: *Narkhoz*, 1980, pp. 328-29, 338.

Growing Shortages of Raw Materials

In an ever-widening circle, shortages of raw materials have hampered industrial production over the past several years. The problem is virtually universal. Shortages of iron ore, coking coal, and scrap metal contributed in a major way to the near stagnation in steel production. Shortages of rolled steel products eventually contributed to the large decline in the growth of machinery production; and this decline (along with the effect of shortages of steel and building materials on construction) retarded the investment process. The railroads complained that they were not receiving enough steel rails

Shortages of coke and refinery byproducts curtailed production of certain important chemicals, leading to curtailed production in others of the interdependent chemicals subbranches. Part of the chemicals branch was hurt by shortages of cellulose, caused in part by declining timber production. Declining timber production was the principal factor in the near collapse of growth in the woodworking and pulp and paper subbranches. Difficulties in obtaining various nonmetallic minerals depressed growth in basic chemicals, fertilizers, and construction materials (notably in the cement industry, a key supplier to producers of other kinds of construction materials). Difficulties in obtaining various chemical fibers and dyes hampered operations of textile and footwear plants, as did the deteriorating quality of raw cotton and leather. Production of electricity was adversely affected by growing shortages and worsening quality of coal. Finally, periodic interruptions in supplies of agricultural raw materials led to the greatly reduced performance of the food-processing branch, despite massive imports in recent years.

The problems with extractive raw materials (coal, ores, and nonmetallic minerals) reflect the culmination of two major factors. First, Soviet investment allocations for many years have favored the building of processing facilities, the larger the better, at the

expense of developing the sources of raw materials required for their operation. Coal, iron ore, phosphate rock, and quarry materials are notable examples of long-continued neglect. Second, the costs of extracting such raw materials have been skyrocketing, as older sources are depleted and new sources must be sought. Moreover, the share of investment allocations needed merely to offset depletions has been rising rapidly.

Meanwhile, the quality of coal and ores has been deteriorating as the highest yielding sources are used up, and this further increases the need for investment in various kinds of initial processing operations. The relative neglect of such enrichment facilities to improve the physical and chemical properties of the coal has added to the burden of the railroads, compelling them to transport billions of tons of debris, and raised costs for users. Finally, because of inadequate attention to costs, too much of the available investment has been allocated to already developed facilities at the expense of developing new ones. (Shortages of agricultural raw materials, in contrast, stem mainly from a run of poor weather in 1979-82.)

The impact of raw materials shortages on production and productivity in individual branches of industry is discussed in appendix A. Here, we elaborate with respect to two of the most critical materials—coal, as both a raw material and a fuel, and steel.

The Pinch in Coal Supplies. Declining growth in production of coal and its deteriorating quality were especially hard on production and productivity in electric power and ferrous metallurgy during 1976-82.[4] These two branches consume, respectively, almost one-half and one-fifth of total raw coal output. Coal shortages also were reported to have hampered operations of cement and chemicals plants and of electrified railroads. Shortages of coal, but especially its deteriorating quality, contributed substantially to the power outages and frequency deviations that plagued electric power supply. These shortcomings, in turn, impaired the industrial performance of power customers. Shortages of coal also frustrated Soviet plans to raise the share of coal in total fuel consumption during 1976-80.

Steel production was constrained by inadequate supplies of coking coal, which comprises about one-fourth of total raw coal production. After rising by 16 million tons during 1971-75 and 5 million tons in 1976, production of coking coal stagnated in 1977 and dropped by 8 million tons in 1978-80. This decline helped to foil plans to raise efficiency in steel production by greater use of basic oxygen furnaces instead of the obsolete open-hearth furnaces (which still account for the bulk of capacity). The basic oxygen furnace produces steel at lower cost, but it requires about 50 percent more pig iron per ton of steel. Coking coal is a major raw material for pig iron production.

The Steel Vise. The near collapse in the growth of rolled steel products in 1976-82—a mere 3.4 percent for the period—has constrained growth in the machinery and metalworking branch, and consequently growth in the machinery and equipment component of investment.[5] Shortages of steel have also limited growth of construction and may have contributed to a slowed growth of military production. The problem is not merely of slow-growing total steel supplies but also of the snail's pace at which the industry has been shifting its mix of final products to meet the rapidly rising requirements—both civilian and military—for high-quality and specialty steels to produce such modern products as automobiles, aircraft, consumer durables, large-diameter pipe, and an array of advanced weapons systems.

The imbalance between the steel turned out by basic producers and that required by their customers stems from long-continued investment allocations to crude

[4] The discussion of the coal industry in this paper relies heavily on two CIA papers: NFAC Research Paper ER 80-10154 (Unclassified), March 1980, *USSR: Coal Industry Problems and Prospects*, and [redacted]

[5] The

steel capacities rather than to finishing capacities. Even in the late 1970s, about nine-tenths of total investment in the steel sector was earmarked for facilities to boost crude steel production.

After a drop of 1.9 percentage points in 1976, the growth rate for machinery remained stable for one year and then gradually declined to less than 4 percent in 1981-82; the growth of steel production dropped sharply although erratically. The government was able to sustain the growth of machinery production for a time, partly by increasing imports of rolled ferrous metals and curtailing the growth of steel exports. The bulk of the imports are high-quality steel products from the West, which have claimed a steadily rising share of Soviet hard currency imports. During 1976-81, hard currency imports of steel products rose by 37 percent and totaled $17.4 billion; in real terms imports rose 23 percent.

Faltering steel production also held back investment, which both through construction and new equipment is a major consumer of steel. The USSR succeeded in meeting its investment plan for 1976-80, but did so in part by importing machinery and equipment, as well as steel products. During that period it imported a total of 10-15 billion rubles' worth of machinery and equipment annually, roughly one-fifth of annual investment in equipment. The bulk of such imports came from Eastern Europe, but the Soviets also continued to import large amounts from the West. Imports rose from $4.6 billion in 1975 to $6 billion in 1980, but dropped to $4.5 billion in 1981. The investment plan was not met in 1981, reflecting the impact of low growth in steel and machinery production and slower growth of imports—along with the usual snags in the construction process.

Agricultural Shortfalls. The USSR had a poor harvest in 1975, a bumper crop in 1976, average harvests in 1977 and 1978, and poor ones in 1979-82. Despite large imports of grain, sugar, and some other products, shortages of agricultural raw materials contributed importantly to the falloff in production and productivity growth in 1976-82 in food processing and, to some extent, in light industry. Their impact on overall industrial performance in 1976-82, however, was not large, as the tabulation indicates:

	Average Annual Rates of Growth	
	Production	Factor Productivity
Total industry	2.9	−1.3
Industry (excluding light and food branches)	3.2	−1.4

Imports of grain and other foodstuffs affected industrial production indirectly, however. The need to transship them from seaports added to the burdens of the railroads and may have diverted cars from transport of other industrial raw materials and finished products. On the other hand, the normal demands on the railroads for transport of farm products probably were reduced in 1979-82 as a consequence of poor crops. The net effect of these offsetting factors is hard to assess.

We conclude, therefore, that agricultural shortfalls can account for little of the greatly worsened performance of industry as a whole in 1976-82. Such factors as shortages of coal, steel, and energy, increasing railway congestion, and planning mistakes were far more important.

Energy Constraints

In the second half of the 1970s, industrial production and productivity began to be hurt by growing tautness in supplies of fuel and power, manifested in particular in increased irregularity of supply. Total energy supply to the economy (measured in tons of standard fuel) grew at an average of 4 percent annually during 1976-80, a little less than the nearly 5 percent annually during 1971-75. The falloff started in 1976, with steady declines in growth each year thereafter, to 2.4 percent in 1981. Growth was 2.7 percent in 1982. The industrial sector consumed an estimated 53 percent of final energy consumption in 1980, about the same as in 1970. Energy use per ruble of industrial

Table 4
USSR: Distribution of Industrial Investment by Branch, 1961-81

Percent

	1961-65	1966-70	1971-75	1976-80	1975	1976	1977	1978	1979	1980	1981
Total industry	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ferrous metals	8.9	8.3	7.6	6.9	7.2	7.2	7.2	6.7	7.1	6.6	6.1
Nonferrous metals	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fuels	19.7	19.6	19.1	21.5	19.2	19.3	20.2	21.5	22.2	24.0	25.1
Coal	7.1	6.0	4.9	4.4	4.4	4.3	4.3	4.5	4.5	4.5	4.4
Oil	9.5	9.2	9.4	12.0	9.8	10.0	10.6	11.6	12.9	14.3	16.0
Gas	2.3	3.7	4.3	4.7	4.6	4.5	4.8	4.9	4.5	4.7	4.2
Electric power	11.6	11.3	10.0	8.8	9.4	9.3	8.4	8.6	8.7	9.0	8.8
Machinery	14.6	18.6	22.1	24.7	24.2	24.8	24.8	24.6	24.5	24.7	25.4
Chemicals	9.1	9.2	9.2	10.1	9.7	9.8	10.5	11.8	9.9	8.6	7.7
Wood, pulp, and paper	5.7	4.9	4.7	4.1	4.5	4.4	4.5	4.2	3.9	3.7	3.8
Construction materials	6.0	5.7	5.5	4.1	4.8	4.1	4.4	4.0	4.2	4.0	4.0
Light industry	3.5	4.5	4.3	3.9	4.1	4.3	3.9	3.7	3.7	3.8	3.8
Food processing	9.1	8.5	7.7	6.1	7.6	6.6	6.1	5.8	6.1	6.3	6.1
Other	11.9	9.6	9.6	9.7	9.3	10.3	9.8	9.2	9.7	9.4	9.4

Sources: Percentages for the years 1961-80 were calculated from data in constant 1973 prices given in DDI Reference Aid [redacted] (Unclassified), August 1982, *Soviet Statistics on Capital Formation*. Percentages for 1981 are given in *Narkhoz 1922-1982*, p. 371. The 1981 data include small amounts of investment made by collective farms; data for other years exclude such investment.

output (value added in 1970 prices) was stable in 1976-80, whereas it had risen by roughly 4 percent during 1971-75.

Evidence of shortages of fuel and electricity began to appear in 1976-77, along with leadership concern about their actual and potential effects on industrial growth. Actions to cope with the continued slowdown in growth of coal, oil, and electric power included numerous decrees issued beginning in 1977, many conservation campaigns, and crash efforts to increase production of fuels, buttressed by a huge increase in investment for development of oil supplies, focusing on West Siberia (table 4). Stiff new fines were imposed on excessive fuel consumption by industrial enterprises, and controls over the distribution of oil and gas were centralized in a new State Committee. Finally, increasing efforts (largely unsuccessful) were made to get industrial users, particularly power plants, to switch from oil to gas or coal.

As production growth rates for energy continued to drop, the disruptive impact of energy shortages and power interruptions increased. The situation was particularly bad in the harsh winters of 1978/79 and 1981/82. The effects were widespread. Sporadic shortages of fuels and power were blamed for the precipitous fall in growth of cement production in the late 1970s; the impact has been especially severe in winter. Power outages also have led to production losses in many branches, as well as costly damage to equipment. Interruptions of supplies of natural gas disrupted the production of ammonia in some plants in 1978-79. Power outages and shortages of crude petroleum and gas used as raw materials curbed the growth of output of synthetic resins, synthetic fibers, plastics, and chemicals used in medicines and food supplements. Power outages, gas cutoffs, and shortages of gasoline also are reported to have interfered

with production of agricultural products, notably milk and meat, and affected the health of animals in large livestock complexes.

In one way or another, almost all branches of industry have been hurt by deficiencies in the supply of electricity. Power outages, brownouts, and frequency irregularities were common after 1975 and were often cited as causes of production shortfalls. Moreover, the quality of electricity supply deteriorated seriously, primarily as a result of the increasing tautness under which the power distribution system was operating. With reserve capacities dwindling and demand growing everywhere, the system has had to operate more frequently at maximum capacity, increasing the risk of power-plant failure. This precarious situation stemmed from the failure to add new capacities in previous periods. More than ever, the branches of industry have had to compete with other consumers and with each other for power, presenting the power network managers with an increasingly difficult juggling act and causing some rationing. Finally, though the falloff in growth rate of electric power output was not out of line with that for industry as a whole, a growing amount of the power produced was being lost in transmission—7.9 percent in 1975 and 8.3 percent in 1980—and thus was not available to consumers.

The decreased quality of electricity supply is reflected in the growing share of power that is supplied at below-standard frequency and voltage. In 1973 supply was at below-standard *frequency* for 4.6 percent of calendar time; in 1977 this share was 80 percent. And in 1975, the power system operated with reduced (below-standard) *voltage* one-seventh of the time; by 1978 the share was one-half. In addition, actual power outages occurred more often, as a result either of rationing attempts or of power-plant failures. The declining quality of coal, which accounts for more than one-third of fuel usage in power plants, contributed to the failures by increasing the damage to equipment and the strain on the power network.

Such irregularities cause serious losses. Deviations from voltage and frequency standards damage equipment, ruin small electric motors, disrupt continuous processes, spoil products, and raise costs. Soviet sources assess the damage from reduced quality of power at over 1.7 billion rubles annually. The irregularities also increase the use of electricity: consumption of electricity per ruble of industrial production — rose somewhat during 1976-80, whereas it had declined during 1966-75. The industrial branches most affected probably were metallurgy, machinery, and chemicals, which together consumed an estimated 38 percent of total production of electric power in 1980. Ironically, coal production also suffered, because increased mechanization of coal mines greatly raised the demand for electricity.

Transportation Snarls

A substantial, although unquantifiable, share of the blame for the falloff in industrial growth during 1976-82 must be assigned to growing bottlenecks in the transportation of both raw materials and finished products.[9] A mass of anecdotal evidence for all branches of industry points to intermittent plant shutdowns, production-line disruptions, machines and workers idle for lack of raw materials, and pileups of finished products on loading docks. The principal culprit was the railroads, which carry nearly all coal, lumber, and ores, the vast bulk of metallurgy and machinery products, and about two-fifths of petroleum products. According to an article in a major economics journal, Gosplan research institute estimates the yearly losses due to unmet transport needs at 6.5 billion rubles in industry and over 4 billion rubles in agriculture. Table 5 illustrates the performance of transport relative to industrial output.

For decades Soviet railroads have been hauling a rapidly growing volume of industrial freight without undue difficulty, because the network was expanding and the density of its use was rising rapidly. Freight density (ton-kilometers of freight per route km) increased 23 percent in 1966-70 and 27 percent in 1971-75.

By 1975, however, the railroads had reached the limit of their capacity to move ever more freight on the existing network with existing technology. The continued attempts to push the intensity of use even further

[9] This section draws heavily on work by Holland Hunter and Deborah A. Kaple, in particular on their "Transport in Trouble," in *Soviet Economy in the 1980s: Problems and Prospects*, US Congress, Joint Economic Committee, Washington, D.C., 1982, part 1, pp. 216-241.

Table 5
USSR: Average Annual Rates of Growth of Industrial Production and Freight Transportation

Percent

	1966-70		1971-75		1976-80		1981-82	
Industrial output	6.3		5.9		3.2		2.4	
Total freight	6.7		6.3		3.5		1.8	
Railroad freight	5.0		5.3		1.2		0.4	
	1975	1976	1977	1978	1979	1980	1981	1982
Industrial output	6.2	4.0	4.0	3.3	2.1	2.8	2.5	2.2
Total freight	5.4	4.5	3.7	5.6	0.6	3.3	2.5	1.2
Railroad freight	4.5	1.8	1.1	3.0	−2.3	2.7	1.8	−1.0

* Freight is measured in ton-kilometers.

clogged the system's arteries, rendering it accident prone, and severely reduced its efficiency. In 1976-80 freight density essentially stagnated, freight train kilometers per engine-day and freight car kilometers per car-day dropped by nearly 10 percent, and labor productivity leveled off. Excessive freight density causes transport irregularities, limits mobility and maneuverability, adds to turnaround time, and reduces train speeds. In the late 1970s, turnaround time increased by a day to reach 10 days (against a norm of six days), and average freight train speed fell by 3 km per hour. Abnormal freight pileups and delays in deliveries became evident in 1976 and increased in severity thereafter.

In 1979 the railroads' growing strain, aggravated by severe winter weather, brought congestion in the freight yards of a number of railroads to such a critical level that traffic declined rapidly and emergency steps had to be taken. A similar situation apparently also occurred in 1982. All this impaired industrial growth.

The railroads' problems are deep seated and critical. They are rooted in past investment priorities and imbalances in development of facilities. The share of the railroads in total investment as well as in transport and communications investment, declining steadily for several decades, has not been sufficient to keep them abreast of growing transport needs. Besides, the investment mix and the quality and mix of rolling stock were poor. The planners focused on building new rail lines (the BAM is a notable example), on double-tracking existing lines, and on electrifying the most heavily burdened lines. But they neglected development of yard capacities, especially at junction points, seeming to believe they could increase line densities without expanding terminals and marshaling yards.

During the 1970s, moreover, production of diesel locomotives stagnated, output of rails rose only 7 percent, and production of freight cars actually declined—by 3 percent annually after 1976. Imports of railroad equipment, which are substantial and come mainly from Eastern Europe, declined after 1974, perhaps reflecting Soviet optimism about success of their planned program to expand domestic production capabilities. Production of spare parts for locomotives generally was less than half of that planned, so that a substantial number of engines were perennially idled and awaiting repair. The total number of freight cars in the inventory may be adequate, but there are far too few specialized cars. Decrepit standard boxcars are often used to transport items such as grain and fertilizer, for which they are unsuited, with consequent large losses in transport

The problems of the railroad equipment industry in 1976-82 are similar to those plaguing machinery industries in general, with the added factor that its high-quality steel and production facilities may be preempted for military needs; most freight cars are made in plants that also produce military goods. Over 40 percent of freight trains are pulled by diesel-electric locomotives, which have become increasingly unreliable; they are said to be "delicate" and complex, hard to maintain, and prone to break down. New freight cars are shoddy; for example, hopper doors reportedly spring open when ore is loaded.

Other circumstances have compounded these difficulties. The amount of freight transported in the Soviet Union is excessive for a country at its level of industrial development, even granting that geographical factors make much long-distance shipping necessary. A Soviet transportation specialist, writing in the open press, recently calculated that the annual volume of total transport (apparently by rail) per capita in the USSR is 14.4 tons, compared with 6.3 in the United States, and 3.6 in the European Economic Community. He asks, "Why is it that we are always transporting and transporting and are unable to call a halt?" The reasons seem to be that established freight rates are low and unrelated to real costs; incentives to keep costs down are weak; and, with production organized in vertical hierarchies, each prefers to deal with units in its own hierarchy rather than with outsiders. Although Gosplan set up an Interdepartmental Commission for the Rationalization of Freight Shipments in 1972, ton-kilometers of freight transported by all modes have usually increased faster than either GNP or industrial output.

Moreover, the railroads themselves are becoming increasingly parochial, favoring their own regions and dragging their feet on cooperation with one another. In the mid-1970s there were 26 railroads and 172 divisions, while at the end of 1982 there were 32 and 185. Railroad managers complain that in recent years a growing share of their workers has been diverted from line operations to repair work and to construction. Neither the railroads nor their customers have much incentive to care for freight cars, which often are shuffled from place to place dirty and in need of repair, handled carelessly, and damaged in loading and unloading.

In addition, primary materials are often shipped in unprocessed form, adding greatly to the transport burden, and matters seem to be getting worse instead of better. For instance, a Soviet press source states that in 1980, 24 percent of shipped coal that had been mined underground consisted of rocks and debris, compared with 21 percent in 1965, and that usable ore made up only 34 percent of all ore shipped, against 40.8 percent in 1965. Finally, "campaigns" or suddenly announced new priorities—today for grain, tomorrow for coal, and always for the military—snarl the movement of freight.

The leadership has been viewing the transportation bottlenecks with growing alarm in recent years. At least five major decrees have addressed the problem. The first one, adopted in February 1977, directed the Ministry of the Railroads to speed up work on track and roadbed improvement and also raised the sector's investment priority a bit. In 1979 another decree increased financial penalties on both railroads and customers for improper handling of freight cars and ordered a quicker turnaround. A party resolution of March 1980 demanded that party cadres step up their efforts to straighten out the mess in railroad transportation. A general decree issued in 1980 dealt with transport in 1981-85, and another, adopted in December 1982, spelled out measures to improve management and incentives.

Commissions for Coordination of Transport have been established under Republic Councils of Ministers, without notable impact. In late November 1982 the Minister of Railroads was replaced, and Politburo member Geydar Aliyev was given special responsibility for overseeing the railroads.

Other Important Impediments to Industrial Growth

Many other factors also hampered productivity growth in industry during this period.[1] We discuss here the three important factors generated by the policymakers in Moscow.

[1] For a listing of these factors, see Herbert S. Levine, "On the Possible Causes of the Deterioration of Soviet Productivity Growth in the Period 1976-1980," in US Congress, Joint Economic Committee, *Soviet Economy in the 1980s: Problems and Prospects*, Washington, D.C., 1982, part I, pp. 153-168.

Military Priorities. The overriding priority accorded to defense has complicated an increasingly difficult situation in the industrial sector. Military machinery accounts for perhaps 25 percent of total value added in machinery and a roughly similar share of common-use durables such as trucks; the military share in construction output is about 10 percent. In both machinery and construction, military orders not only have priority but also absorb a disproportionate share of high-quality materials and labor.

Possibly even more important, military requirements have an unquestioned priority claim on fuel supplies and on railroad and truck transport facilities. When industry, construction, and transport are all operating under severe strain, as in 1976-82, this military priority is even more burdensome. The normal demands of the military on transport, in particular, increased sharply during 1979-81 with the invasion of Afghanistan and the protracted, large-scale troop maneuvers that were part of the Soviet response to events in Poland. This delays civilian industrial shipments, and late delivery of raw materials and the accumulation of finished products disrupt production flows, with chain-reaction effects throughout the industrial sector.

Foreign Trade Rigidities. Partly for political reasons, the Soviet Union has made a set of specific trading arrangements with various countries, and these block one way of dealing promptly with domestic shortages and rising costs of raw materials and energy. Over half of the USSR's total trade is controlled by five-year trade agreements with other Communist countries. Changing reciprocal delivery patterns in the middle of a plan period is always extremely difficult and cannot be done quickly. Several bureaucracies in Moscow must agree that foreign trade can solve a given domestic problem, and then the government must seek agreement from a foreign partner with its own bureaucratic procedures. Except for some price adjustments for oil and some assistance to Poland, the USSR did not alter its commitments to other socialist countries in 1976-80, and the only cutbacks made in 1981-82 were in oil deliveries.

If a potential solution involves hard currency payments, the political and economic tradeoffs have to be assessed, agreement reached, and sources of supply or sale obtained. During 1976-81, the Soviet Union did indeed raise its hard currency imports substantially - a policy facilitated by earnings generated from the huge increase in the international price of oil and some other commodities. Imports in those six years nearly doubled in real terms compared with the preceding six years. Imports of machinery and equipment made up nearly one-third of the total and imports of ferrous metals about 15 percent.

Nonetheless, when faced with trade deficits and a rising foreign debt after 1977, Soviet authorities chose to curtail the growth of imports rather than to increase debt, even though Western banks and governments probably would have financed the much larger imports that their business firms were eager to supply. Thus, financial conservatism (and perhaps also concern about "excessive" dependence on Western capitalist countries) deterred the Soviets from importing goods as a way of easing some domestic difficulties

Despite growing shortages of raw materials for steelmaking, the USSR continued to be a net exporter of iron ore (pellets), coking coal, and scrap steel, mainly to other Communist countries. It continued to export agreed quantities of timber, even though shortages were constraining the planned growth of output in domestic woodworking and paper factories.

The goods received in return for these exports proved useful, no doubt. But the point is that Soviet planners, as they try to alleviate domestic problems, have only limited flexibility to make adjustments, given the policymakers' reluctance to contract a large hard currency debt.

Changes in the Rules of the Game. To an extent never witnessed in a previous five-year plan period, the planners flailed about during 1976-80 in search of ways to improve the "economic mechanism."[1] Their actions added to the burden of enterprise managerial staffs, already hard pressed simply to obtain enough

[1] This section relies heavily on two CIA papers: NFAC Research Paper ER 77-10769 (Unclassified), December 1977, *Organization and Management in the Soviet Economy: The Ceaseless Search for Panaceas*, and

supplies to keep production going. During 1976-82, the government issued decree after decree changing the rules of the game: rules for determining incentive funds, to be "stable" for the whole 1976-80 period; and revision of those rules within the first year; new rules for determining managerial bonuses, and revisions in those rules; procedures for enforcing counterplanning, and changes in them; and so on.

At the same time, the planners engaged groups of enterprises in economic experiments to test new kinds of success indicators, new approaches to planning the wage fund, new approaches to profit sharing, new ways of financing research and development programs, and new schemes for saving labor, electricity, materials, and the like. In addition, enterprises were pressured to amalgamate into large combines, to form labor brigades in their work force, to manufacture consumer goods of some kind, and to establish subsidiary farms to supply food to workers.

In the bureaucracy itself, more and more coordinating committees and councils were set up to oversee this or that worsening regional or intersectoral problem. Finally, campaignomania was much in evidence—for "thrift," conserving fuel, saving electricity, collecting scrap metal and paper, ferreting out waste, and uncovering "hidden reserves."

The demand on the time and energy of managerial staffs to adjust to the successive revisions in planning and administration was not trivial. The constant change in the rules increased uncertainties and made incentive schemes less useful in stimulating efficiency. The administrative overkill, coupled with the objective difficulties faced by producers, surely weakened incentives for innovation. Even by the statistics officially used to gauge "scientific and technical progress," performance deteriorated during 1976-80:

- The number of new technologies introduced rose at only half the rate of the previous five years.
- The number of new models of machines continued to decline.
- The number of pieces of equipment modernized rose by only 12 percent, despite the effort to focus investments in that area.

In contrast, the number of products awarded the State Seal of Quality in 1980 was a startling 52,300—more than four times the 12,000 in 1975. This might suggest that the complex new procedures to certify product quality—with their considerable demands on the time of managerial staffs—had achieved outstanding results. But one would also expect consumer complaints about quality to diminish, efficiency to improve with all those "high-quality" machines and industrial goods, and Soviet manufactures to sell better in Western markets. This did not happen.

During the late 1970s Gosplan's task of compiling and enforcing economic plans became increasingly complex and difficult. For one thing, the decision radically to slow the growth of output and investment in itself made planning more difficult because of the need to allocate smaller increments among ever more vocal claimants. The decision to shift some investment and labor to energy development, taken in 1977, added to the difficulties, which were intensified after 1978 by the need to cope with weather-related shortfalls in agriculture.

Adding to Gosplan's task was the decision to "improve" planning by grafting onto the traditional method of planning (by branch and region) a separate method of planning for, and distributing of materials to, a growing number of special programs. Specifically, Gosplan has been made a quasi-ministry for a rapidly rising number of large special projects, to which materials and equipment are allocated directly by Gosplan itself rather than by the ministries normally responsible for that general kind of project. Such special projects numbered 136 in 1970, 173 in 1975, and 303 in 1981. In 1979-80, Gosplan was reorganized to help it cope with this growing burden.

The ability of Gosplan to plan (forecast) industrial performance with reasonable accuracy became progressively worse during 1976-82, even by Soviet official (inflated) measures. By those measures, the plan for growth in industrial output during 1960-75 was met in all but three of the 16 years—1964, 1969, and 1972. The reported performance generally exceeded

[redacted]

the announced plan by 1 percentage point or more. In contrast, the plan was not met in any of the years 1979-82, even by official measures." Table 6 depicts the situation in industry during 1976-82. Large deviations from planned outcomes also occurred with respect to industrial labor productivity and freight turnover.

Even more significant, perhaps, was the planners' growing difficulty in forecasting physical output of such key products as coal, crude steel, finished steel, fertilizer, and cement. It is not surprising, given the poor agricultural record, that Gosplan's forecasts for light industry and food processing were far off the mark.

The picture presented by official data is thus one of failure of plan "discipline"—a failure that must have dismayed both the planners and the political leadership. By CIA measures, industrial growth has failed to meet its planned target in every year since 1973—and by growing margins. Major midplan revisions evidently were made in the annual plan each year from 1979 through 1982: the government announced that the annual plans had been met, even though the reported actual growth of output in each year was well below the officially published plan. The plan fulfillment report for 1981 revealed that 13 of the 30 listed ministries and administrations had failed to meet their output plans. Only three failed to do so in 1982—but in that year it was an "amended" plan that was reported "fulfilled." Industrial growth was reported as 2.8 percent, while the originally announced target had been 4.7 percent.

Outlook

Most of the unfavorable developments that converged to slow industrial growth during 1976-82 will continue to do so during the rest of the 1980s, and they may intensify. Consequently, industrial growth will probably continue to trend downward. Planned growth of industrial investment has been reduced for 1981-85—it is to be 23 percent higher than it was in 1976-80, whereas in that period it was 30 percent higher than in 1971-75. For industrial output, however, planned growth is to accelerate—to 4.7 percent per year from the 3.2 percent achieved in 1976-80. (In 1981-82, the average annual rate of increase of industrial output was only 2.4 percent.)

Except perhaps in oil and gas, planned investment will be inadequate to add capacities needed for planned growth in output, especially in the extractive branches, where both depletion rates and investment costs will continue to rise rapidly. Retaining the policy of concentrating the bulk of new investment on renovating existing enterprises, under Soviet conditions, means that much of this investment may be wasted, as it apparently was in the previous plan with the same policy.

These considerations, given the severity of the already existing imbalances in raw materials and energy supplies relative to finishing capacities, indicate that raw materials and energy shortages and a deterioration in the quality of many materials will continue. In particular, slow growth of steel production will constrain growth of machinery and hence of investment. Good harvests, if they come, will raise growth rates in food processing appreciably, and to a small extent in industry as a whole. The railroads will continue to operate under severe strain; indeed, there is no clear indication that the planners have even agreed on how to attack the long-developing problems of that sector. Finally, industry's strained situation will be compounded by reduced availability of labor, by continued difficulties in planning, and by administrative pressures on everyone to "achieve" on everything at once.

Although the ongoing campaign to enforce plan and labor discipline may have favorable effects initially, such tactics can hardly be suitable as a long-run solution to the USSR's productivity problems. Systemic reform is not on the leadership's agenda as yet and, even if launched, would take many years to bear fruit in terms of boosting economic growth and productivity—as 15 years of the Hungarian minireform have shown.

" Announced growth rates are believed to be reasonably accurate reflections of actual intentions and may properly be compared with CIA ex post measures of growth of output. Soviet official ex post measures of growth are believed to be seriously biased upward as a consequence of double-counting and disguised price inflation. See NFAC Research Paper [redacted] August 1980, *Comparing Planned and Actual Growth of Industrial Output in Centrally Planned Economies*

Table 6
Planned and Actual Growth Rates in Soviet Industry, 1971-82

Percent

	1971-75	1971	1972	1973	1974	1975	1976-80	1976	1977	1978	1979	1980	1981	1982
Total														
Planned	8.0	6.9	6.9	5.8	6.8	6.7	6.5	4.3	5.6	4.5	5.7	4.5	4.1	4.7
Reported	7.4	7.7	6.5	7.5	8.0	7.5	4.5	4.8	5.7	4.8	3.4	3.6	3.4	2.8
CIA	5.9	6.1	5.1	5.7	6.3	6.4	3.2	4.0	4.0	3.3	2.1	2.8	2.5	2.2
Ferrous metals														
Planned	5.1						4.8							
Reported	5.1	5.3	4.8	5.5	4.3	5.8	1.9	4.7	1.5	2.9	0.0	0.7	0.0	
CIA	4.0	3.8	3.3	4.0	4.2	4.4	1.0	2.7	0.7	2.2	0.0	−0.5	−0.1	−0.9
Nonferrous metals														
Planned	8.4						4.6							
Reported														
CIA	5.9	7.2	5.4	6.1	6.2	4.6	2.3	2.9	2.6	2.1	2.4	1.4	1.3	0.8
Fuels														
Planned	5.8						4.5							
Reported	5.9	6.1	5.7	5.4	5.9	6.4	3.0	3.8	4.3	3.5	1.3	2.0	1.9	
CIA	5.0	4.7	4.8	4.9	4.9	5.8	3.1	3.7	4.2	3.2	2.9	1.8	1.5	2.1
Electric power														
Planned	7.9						5.6							
Reported	7.1	8.5	7.3	6.8	6.4	6.0	5.0	7.8	3.3	5.1	3.6	5.3	2.2	
CIA	7.0	8.1	7.1	6.8	6.7	6.6	4.5	6.9	3.6	4.7	2.9	4.5	2.5	3.0
Machinery														
Planned	11.4						9.2							
Reported	11.6	11.5	11.7	12.1	11.3	11.6	8.2	9.2	9.0	8.7	7.6	6.2	5.9	
CIA	8.0	8.2	7.3	8.0	8.1	8.4	5.0	5.7	5.7	5.0	4.3	4.1	3.4	3.8
Chemicals														
Planned	11.5						10.2							
Reported	10.5	10.5	9.1	11.7	11.2	10.7	5.7	7.9	5.7	5.3	3.5	5.3	5.5	
CIA	8.6	8.1	6.7	9.0	9.5	9.7	3.6	4.8	5.2	3.6	−0.2	4.7	4.0	1.6
Wood, pulp, and paper														
Planned	5.8						4.3							
Reported	5.2	6.1	4.7	4.5	5.2	5.7	1.5	2.3	3.0	1.5	−1.4	2.2	3.6	
CIA	2.6	2.8	2.0	2.7	1.8	3.6	−0.3	−0.1	0.3	−0.4	−2.9	1.7	2.3	1.4
Construction materials														
Planned	7.1						5.4							
Reported	7.2	8.5	6.4	6.9	5.6	6.9	1.9	3.5	2.7	2.6	−0.6	1.3	1.9	
CIA	5.4	6.5	5.1	6.1	4.8	4.6	1.2	3.7	3.1	3.3	−4.6	0.5	1.4	−1.4

Table 6 (continued)

Percent

	1971-75	1971	1972	1973	1974	1975	1976-80	1976	1977	1978	1979	1980	1981	1982
Light industry														
Planned	6.6						4.9							
Reported	4.6	6.6	2.8	3.6	3.6	5.0	3.4	4.0	3.1	3.7	2.1	3.5	2.7	
CIA	2.7	4.5	0.7	2.8	2.6	2.9	2.7	4.1	2.5	2.6	1.8	2.3	1.9	−0.1
Food processing														
Planned	6.2						4.3							
Reported	5.4	5.3	3.8	4.6	7.9	4.9	1.4	−1.5	4.7	1.5	2.2	0.7	1.4	
CIA	3.9	2.5	3.3	0.8	7.9	5.2	1.1	−1.2	4.0	−1.1	3.1	0.7	1.9	2.8

[a] The Soviets do not report the output of nonferrous metals.
Sources: Planned growth rates either were directly reported or were calculated by CIA based on a sample of reported data. Reported growth rates are given or calculated from data given in *Narkhoz* 1975, pp. 196-197; *Narkhoz* 1978, p. 38; *Narkhoz* 1980, p. 127; *Narkhoz* 1922-82, p. 156. CIA data are from tables 1 and 2; those for 1982 are preliminary.

This table is Unclassified.

The Growth Strategy—More of the Same

As revealed in the plan for 1981-85, the growth and investment strategy launched in the preceding plan is to be maintained. Total investment in 1981-85 is scheduled to be only 10.4 percent above the total for 1976-80, a rate of increase pared down to little over half the rate that was planned and achieved in 1976-80. In contrast, industrial production is to speed up—from 3.2 percent annually in 1976-80 to 4.7 percent in 1981-85. Substantially faster growth is planned for all branches except electric power, where growth is to slow markedly (table 7). To meet those goals, industrial labor productivity is to rise by 23 percent. The gain realized in 1976-80 was 8.5 percent by CIA measures and 17 percent by Soviet measures.

Industrial investment is scheduled to rise by 23 percent in 1981-85 over that of the preceding five years. This is more than twice the growth rate planned for total investment in the economy in the same period, but it is well below industry's 30-percent gain in 1976-80 over 1971-75. Continuing the trend begun in the late 1970s, the fuel and energy branches are to be given priority. Investment is scheduled to rise by 63 percent in oil (excluding pipelines), 120 percent in gas, 20 percent in coal, and 20 percent in electricity. As now, the lion's share of these allocations is to go to developing resources in the Eastern regions. In the other industrial branches, investment in fertilizer production is to rise by 11 percent, in machinery "substantially," and in ferrous metallurgy by 30 percent. Given these stated priorities, investment in the remaining branches will necessarily grow very slowly or decline.

Specific investment allocations have been announced for several branches of industry. When these allocations are matched with (1) planned rates of growth of output and (2) information about past trends in capital/output ratios, they are shown in most cases to be inadequate to the tasks.[a] In the case of oil and gas extraction, the USSR may be unable to implement fully the huge increments planned for investment and the crash programs under way. In general, it appears

[a] See

Table 7
USSR: Average Annual Rates of Growth of Industrial Production, 1971-82, and Planned Rates for 1981-85

Percent

	1971-75	1976-80	1981-82	1981-85
Total industry	5.9	3.2	2.4	5.0
Ferrous metals	4.0	1.0	−0.5	2.8
Nonferrous metals	5.9	2.3	1.0	4.0
Fuels	5.0	3.1	1.8	2.3
Electric power	7.0	4.5	2.8	2.3
Machinery	8.0	5.0	3.6	7.0
Chemicals	8.6	3.6	2.6	5.7
Wood, pulp, and paper	2.6	−0.3	1.8	3.4
Construction materials	5.4	1.2	0.0	3.4
Light industry	2.7	2.7	0.9	3.5
Food processing	3.9	1.1	2.4	4.2

Note: Percentages are based on CIA's industrial production index. Growth rates planned for 1981-85 are CIA estimates based on Soviet-announced growth rates in value terms or for a sample of key products. The Soviets have announced an overall growth rate of 4.7 percent for 1981-85.

that the planners are not sufficiently taking into account the rapid rise in investment costs per unit of capacity (showing the same blind spot as they did in the preceding five-year plan). This rise is nearly universal, particularly in the extractive and energy sectors. It means that industrial growth is likely to fall well below the planned figure—if only because of the mismatch between production targets and planned growth and allocation of investment.

Meanwhile, the investment allocation strategy of the 1970s is still being followed:

- Investment is to be concentrated on fewer projects.
- The volume of unfinished construction is to be brought down from 87 percent to 65 percent of annual capital investment.
- The bulk of investment in industry is to be devoted to renovation of existing enterprises.

There is every reason to suppose that this blueprint will run into the same obstacles in the 1980s as in the late 1970s and that the USSR will suffer a further curtailment in the addition of new capacities without offsetting benefits in terms of increased output from existing capacities. (The addition of new capacities in 1981 was below the average annual additions in 1976-80 in all but nine of 43 reported categories.)

The authorities expect to obtain additional output by using capacities at higher rates, and they claim a slight improvement in this regard in 1981. As a recent Gosplan collegium report recognized, however, the key to continued success will be elimination of the present widespread imbalances between raw materials supplies and finished goods capacities. Press and other sources indicate that raw materials shortages of various kinds continued to be a major factor in industrial performance in 1981-82. The collegium directed Gosplan departments to come up with suggestions on ways of improving capacity use rates and speeding up mastery of new capacities, and to submit these suggestions as part of plan documentation for 1983.

Although the evidence is fragmentary, there is no clear indication that investment allocations are being restructured radically enough to overcome the noted imbalances. The process would be lengthy in any case, since the imbalances have been accumulating for over two decades.

We have no clues as to the investment policies that will be pursued in the 12th Five-Year Plan (1986-90). In the past two years there has been considerable debate in the press as to whether the growth of investment should be speeded or slowed and on the sectoral priorities that should govern its allocation. The outcome of this debate might be reflected in decisions to revise the plans for 1984-85, but it is more likely that any change in strategy will be revealed in the directives for the 1986-90 Plan.

Supplies of Key Raw Materials

Shortages of essential raw materials are likely to limit industrial growth for several years at least; they will certainly keep production in 1985 well below plan. Most critical, perhaps, are steel and chemicals. Sluggish growth of steel production will constrain growth

of the machinery industries—the suppliers of equipment for investment, consumer durables, and weapons. Reduced growth of chemicals production will hamper production in a variety of industries to which it provides raw materials. Slow growth of construction materials output will be a further drag on investment.

Steel. Barring a radical change in Soviet investment and foreign trade policies, domestic steel production will continue to be limited by inadequate supplies of raw materials and hence will fall far short of the 2.8-percent average annual growth planned for 1981-85; production actually fell in 1981-82. Because depletion rates will rise for both iron ore and coking coal, the share of investment needed to replace depleted mines will mount. The average ore content of raw ore is also likely to fall, necessitating greater investment in beneficiating plants.

The present imbalance between raw material supplies and steelmaking capacities is the legacy of long-continued investment priority for steelmaking, to the relative neglect of raw materials. Correction of this imbalance will take many years, and as yet there are no signs that investment priorities are being altered to that end. Although investment in ferrous metallurgy in 1981-85 is scheduled to be some 30 percent above that in 1976-80 (against a 12-percent rise in 1976-80 compared with 1971-75), a substantial share of the larger increment will be absorbed by rising costs per unit of capacity at all stages of production.

Moreover, the Soviets intend to double the share of the steel sector's investment that is devoted to finished rolled steel production, particularly adding new facilities to make cold rolled steel, tinplate, large diameter pipe, and transformer steel. While this capacity is badly needed, it requires greater energy and labor inputs than other steel production does.

Production of coking coal probably will continue to decline, because much of the investment planned for the coal industry will go to development of the Ekibastuz and Kansk Achinsk basins, which do not produce coking coal. Larger shares of investment in both steel and coal also are going for the control of air and water pollution. Meanwhile, Soviet plans to boost scrap metal procurements will require considerable additional investment in processing facilities and will further strain railroad capabilities.

Unless the Soviets resort to large-scale imports, raw material availabilities will seriously limit attempts to improve the efficiency of steelmaking—that is, to raise the share of steel smelted in basic oxygen and electric arc furnaces, the dominant process in all other major steelmaking countries. Even though unit costs are lower and yields higher, the basic oxygen furnace requires 50 percent more pig iron per ton than does the obsolete open-hearth process, and electric arc furnaces require twice as much scrap per unit of output. In addition, such a shift in basic processes requires the construction of new facilities, which takes years. As for scrap supplies, a fundamental reorganization of the entire collection process would seem to be required to boost supplies substantially for steel mills.

Shortages of steel, in turn, mean that existing steelmaking facilities must be kept in operation, even if they are old and obsolete. This raises repair bills, siphons off investment, and adds to the already large number of workers engaged in auxiliary work, including repair. Unless the Soviets can find the means to break the raw materials constraint on both production and modernization, productivity growth in the ferrous metallurgy sector is unlikely to recover to its earlier levels.

The USSR could economize on raw materials and make more final steel products if it could raise the yield—the number of tons of rolled products per ton of crude steel. The yield in 1981 was 69 percent, a ratio that has changed little since 1950. The principal way to raise the yield is to increase the share of continuously cast steel in the total.[13] It was the Soviets who developed the continuous casting process, but they did not adopt the technology widely. In 1980 this process accounted for over half of steel production in

[13] Se[illegible]

Japan and Western Europe, about one-fifth in the United States, and only 11 percent in the USSR. Soviet sources estimate that continuous casting raises the yield by about 12 percent and provides substantial savings in energy and labor. Plans call for the share of continuously cast steel to more than double by 1985, a feat that would require as much new casting capacity as was introduced in 1966-80. However, the Soviet plans for total production of crude and rolled steel in 1985 seem inconsistent with the goal for continuous casting, because they imply little improvement in yield.

Chemicals. The plan for 1981-85 schedules an increase of 30 to 33 percent in chemicals production (a 19.4-percent increase was achieved in 1976-80). Growth in 1981-82 was less than half the rate needed to meet this ambitious plan.

In general, the prospects for a substantial upturn in the growth rate of chemicals production and a reversal of the decline in productivity depend on two tasks: (1) providing operating plants with raw materials and reliable power supplies and (2) straightening out the present mess in the branch's investment program. Performing the first task depends in part on the prospects for petroleum refining, coke byproducts, and electricity supply and in part on the success of the second.

Investment allocations to the chemicals branch in 1981-85 have not been announced, but surely will not grow at past rates. The huge amount of investment poured into the industry in the 1970s (including a mass of foreign technology) and the nature of its present malaise suggest that the planners have tried to go too far much too fast. At present, the branch has considerable excess capacity for end products and perhaps even for some intermediates (ammonia, for example). Rather than scheduling large amounts of additional capacity (as in fertilizer), the industry's managers probably would be better served if the planners focused on developing appropriate raw material supplies, notably sulfur and phosphates, and the needed support facilities and on using existing plants more effectively.

Construction Materials. Output of construction materials is scheduled to increase by 17 to 19 percent in 1981-85, well above the 6-percent increase achieved in 1976-80. Cement production is to rise from 125 million tons in 1980 to 140-142 million tons in 1985. In 1981-82 output of construction materials essentially stagnated and production of cement declined.

The many factors that contributed to the large drop in production and productivity in the construction materials branch are rooted deeply in the system, its priorities, and its operating methods—and are likely to persist. Investment allocations to the branch as a whole in 1981-85 have not been announced, but the cement subbranch is to get 1 billion rubles; this is an increase of 11 percent, whereas the increase for industry as a whole is 23 percent.

With the sharply rising investment costs that are inevitable, addition of new capacities will be slow, and the inefficiencies associated with an aged capital stock will persist. The construction materials branch will have few resources to use for mechanizing the numerous labor-intensive auxiliary processes that prevail; and this constraint guarantees the persistence of labor shortages.

Unless fuel and power supplies can be made more reliable, their limitations will also continue to hamper production of construction materials. Plans for cement production call for the use of much less energy per unit of output. This goal is to be accomplished in part by a planned halt in the shift to higher grades of cement (which require more energy to produce) and in part by an increase in the share of dry-process cement in total output from 14.6 percent in 1980 to 16.9 percent in 1985. But conversion to the dry process will put a greater strain on raw materials, require large investment outlays, and take several years.

With the investment allocations in prospect and the focus on saving energy, the branch will be unable to improve its raw material supply position appreciably. The plan to use more metal wastes and fly ash instead

of rock products will run afoul of probable continued slow growth in metallurgy and electric power, along with transport constraints. The probable slow growth of cement production, in turn, will continue to constrain growth in other construction materials subbranches and in the construction industry as well.

Energy Supplies

Soviet plans call for growth of 2.3 percent in total output of fuels annually in 1981-85, somewhat less than the 3.1 percent achieved annually in 1976-80.[*] In physical terms, a total increase of 8.2 percent is scheduled for coal production, 4.4 percent for oil, and 44.8 percent for gas. All of the factors that caused productivity growth to decline precipitously after 1977 will still be operating in 1981-85 and beyond.

Growth of capital stock, especially in the oil extraction and gas sectors, will accelerate as a result of the 65-percent rise in investment planned for the fuels industry as a whole. Allocations are scheduled to increase by 20 percent in the coal sector, 63 percent in oil, and 120 percent in gas. Large increments are also scheduled for construction of oil and gas pipelines.

In all three subbranches, however, rapidly rising shares of investment must go simply to offset depletion of old mines and wells. Investment costs per unit of new capacities will continue to rise, because coal and oil extraction are encountering less favorable geologic conditions and because most new capacities must be developed in the harsh and costly environment of the USSR's eastern regions. There are no clear signs as yet that sufficient investment is going to upgrade gas storage and distribution facilities, the inadequacy of which caused serious problems in 1978-82.

Soviet policymakers appear to have decided also to allocate to fuel production whatever labor it seems to need to keep supplies growing at acceptable rates. Employment in the fuels industry, which declined during 1971-77 and rose sharply during 1978-82, has been absorbing ever larger shares of total industrial employment. If it continues to rise at the rates of 1978-82 and if investment plans are carried out, total labor and capital inputs in the fuels branch will rise faster than in 1976-80 (3.5 percent annually). Given a planned annual growth of only 2.3 percent in output, one can conclude that the planners themselves are anticipating a continued drop in productivity. Even their relatively modest production goals for fuels may be too ambitious, particularly for coal, since the conditions that constrained production in the latter part of the 1970s are likely to deteriorate even further.

Slow growth of coal production continues to cause problems in the steel, chemicals, and electric power industries. Almost all of the gains in output of raw coal in 1981-85 will come from Ekibastuz and Kansk-Achinsk, where the heat content of coal is less than that in older basins. Hence, the decline in the average heat value of coal will continue. The average quality of coal also will continue to deteriorate because Ekibastuz coal is full of rock and debris, and Kansk-Achinsk coal is subject to spontaneous combustion and to freezing in transport and storage. The technology for dealing with these problems is for the most part still on the drawing board; indeed, decisions about the best long-run strategy for capitalizing on the huge Kansk-Achinsk reserves have yet to be taken.

Problems with the supply of electricity also seem likely to create difficulties for industrial enterprises. The revised 11th Five-Year Plan calls for output of electricity to rise to 1,555 billion kilowatt-hours in 1985, 3.7 percent annually. New capacity totaling 68.9 million kW is to be introduced, 21.3 million kW of which is to be nuclear power capacity. A pronounced shift in the structure of fuel use is planned, with the share of coal to rise from 37.3 percent to 39.6 percent, that of oil to drop from 35.7 percent to 25.9 percent, and that of gas to rise from 24.2 percent to 31.5 percent. In 1981-82, electricity production rose by an average of 2.8 percent, and new capacity totaling 10.4 million kW was commissioned in 1981.

[*] This section relies heavily on research done for two CIA papers currently in preparation.

The 1981-85 investment plan for electric power is unrealistic. The planned commissioning of new capacity (27 percent more than that achieved in 1976-80), coupled with an estimated increase in total investment (20 percent over that of 1976-80), implies a reduction in investment costs per unit of new capacity to the level experienced in 1971-75. However, unit costs in 1976-80 were 23 percent higher than in 1971-75. Because of the large share of nuclear and coal-fired power plants in planned capacity and rising capital costs in general, the cost of a unit of capacity is bound to rise further. Unless investment funds are boosted substantially, the Soviets cannot expect to add more new units than they did in 1976-81. Moreover, the investment program may be jeopardized by shortages of equipment; production of turbines, generators, and steam boilers fell in 1976-81.

Given these murky prospects for growth in capacity, production of electric power promises to be well below plan in 1985. The system will continue to operate under strain, despite the reduced growth in demand associated with lower economic growth. Hence, problems with quality of electricity are likely to continue to plague customers, especially if the relative share of coal-fired plants is raised as planned.

Breaking Transportation Bottlenecks

The 11th Five-Year Plan schedules an increase of 3.7 percent annually in total freight traffic and 2.7 percent annually in railroad freight traffic, both measured in ton-kilometers. Since industrial output is scheduled to rise much more rapidly than this, the plan implies a considerable reduction in the volume of freight per unit of output. Specifically, the plans call both for a reduction in tonnage relative to industrial output and a halt to the long-term increase in average distance of shipments (it rose 7 percent during the 1970s). The planners evidently expect the railroads to overcome their difficulties: total freight carried is scheduled to rise more than twice as rapidly as it did in 1976-80.

Although total allocation of investment to transport has not been announced, the railroads are to get an increase of 22 percent—over twice the increase planned for total investment. With this investment, the railroads are to add 3,600 km of new lines, 5,000 km of second tracks, and 6,000 km of electrified lines and to provide 15,000 km of lines with automatic signaling systems. These planned additions are about the same as those made in 1976-80, but the proposed 22-percent rise in investment outlays seems inadequate, given the rapid rise in costs. In 1976-80 the cost of adding 1 km of line rose by 58 percent and that of 1 km of second track by 43 percent.

Although the plan calls for an increase in the capacities of railway stations and junctions, there is no sign that overriding priority is being given to that task; rather, the focus seems to be on adding tracks. The Soviet transportation expert who correctly predicted the bottlenecks of the past five-year plan maintains that, unless yard capacities are radically upgraded, the clogging of the railroads that was observed in 1979 will become chronic.

The new plan has begun badly. Growth rates of total freight traffic and railroad freight in 1981-82 were far below the planned average. Railroad traffic declined in 1982 and the efficiency of performance worsened, according to statements in the plan fulfillment report. In addition, the plans for construction of railroad facilities were seriously underfulfilled in 1981 and reported to have been behind schedule in 1982.

The difficulties of the railroads are particularly severe. Congestion on key routes and at major terminal districts has lowered average freight train speeds, raised freight car turnaround time, and increased the number of accidents. Projects are under way for electrifying and double tracking heavily burdened lines, building some short bypass lines, lengthening station tracks, and increasing yard capacities, but they have not yet begun to relieve congestion. The system needs to get balance among motive power, rolling stock, and line and terminal facilities—a problem difficult to solve in the short run and under strain.

Initially, the new leadership has given much attention to the transport sector—replacing personnel, extending the 1979 reforms to the sector, and holding high-level meetings. Meanwhile, the campaign to enforce discipline is being actively conducted, along with another campaign to enlist industrial enterprises and

other shippers in the repair of damaged freight cars. Nonetheless, the severe problems encountered in 1981-82 show how difficult it will be to turn the situation around. Hence, continued transport snarls can be expected to dampen industrial growth.

Other Important Factors

Labor. In the 1980s the industrial sector will have to contend with yet another strain—a greatly reduced availability of additional labor.[1] According to the plan, industrial employment is to rise by roughly 0.5 percent annually in 1981-85; it rose 0.8 percent annually in 1981-82. In the 1980s as a whole the overall labor force will rise at only about the planned 0.5 percent—half the rate of the 1970s. This means that industry will face fierce competition with other sectors for labor. Industrial employment is likely to rise no more than 1 percent annually, and much of the increment probably will go to provide a work complement for new enterprises and to man the crash energy development programs. Regional imbalances in labor supply will complicate the problem.

Industrial managers now are being put under severe pressure to stabilize or reduce their work force. Already, incentives have been tied to meeting plans for labor productivity (among several other targets), employment ceilings have been imposed in annual plans and penalties established for failure to meet them, a universal Shchekino-type laborsaving scheme has been authorized, and brigade forms of labor organization in factories are being vigorously pushed. Retaining a qualified labor force, enhancing work incentives, and maintaining work discipline will pose grave difficulties for industrial managers during the rest of the decade.

Foreign Trade. Imports could provide some relief for domestic difficulties, particularly in the case of finished steel products, chemical feedstocks, and selected kinds of machinery and equipment. However, the Soviets evidently intend to pursue conservative trade policies at least through 1985. The share of trade with socialist countries is scheduled to rise, and the growth of trade with other countries is to slow markedly. Although the USSR has cut back on deliveries of oil and perhaps some other materials to Eastern Europe, its commitment to those countries remains large. Any major adjustments to augment domestic supplies by cutting back exports would present difficult political problems. The East Europeans have been reluctant to increase their investment in CEMA resource development projects in the USSR again, as they did in the 1970s, and no new projects were scheduled in the 1981-85 Plan.

Imports from the West are likely to increase more slowly in the rest of the 1980s than in the 1970s. Hard currency earnings will be curtailed by a continued fall in oil exports, the failure of gas exports to completely offset those losses, and the poor prospects for exports of other commodities.[1] With Western cooperation, the USSR could, of course, finance a stepped-up import program by raising its foreign debt, but its past conservatism and the uncertain attitude of Western lenders suggest that this option will not be taken up. In any event, the planners may believe that, except for critically needed energy-related technology, their current need is to absorb the Western technology already imported and to use it more efficiently.

Planning and Incentives. The foregoing discussion of investment and growth prospects in key branches of industry indicates that the 11th Five-Year Plan is perhaps even less realistic than was the 10th. Planned investment allocations for most key branches are clearly inconsistent with output goals, even under reasonably optimistic assumptions about trends in capital/output ratios. The original plan targets for industrial growth in 1981 and 1982 were missed by wide margins. The investment plan for 1981 was not met, and a planned cutback in 1982 turned into an increase of 2 percent.

The industrial plan for 1982 evidently was radically changed some time during the year, and the plan for 1983 sets the lowest growth target for industrial output in Soviet history. This may be a planners' reaction to the shortfalls of the preceding four years measured by official indexes.

[1] See

[1] See

The recent planning failures stem partly from the unexpected tenacity of objective factors—successive poor harvests, stagnating steel production, transportation bottlenecks, and electric power failures. However, the central planning process itself is being greatly complicated by decisions that many large programs will be planned and managed separately from the routine sectoral plans. The burden on the central bureaucracy has been greatly increased, particularly affecting Gosplan, which is more and more acting as a quasi-ministry. Current indications are that this approach will continue, along with the many inefficiencies stemming from overcentralization.

It seems also that the new regime will try to enforce the complex planning and incentive arrangements set forth in the July 1979 decree, as modified by decrees in 1981-82 and changes that became effective in 1983.[9] These measures, which substantially increase central control over enterprises and establish incentive schemes of extreme complexity, are not likely to improve the efficiency of resource use in industry. Indeed, by adding to the burden on enterprise managerial staffs and further eroding incentives, they could make matters worse. Already, Soviet economists are pointing out many quirks in the new measures and proposing changes.

Along with the attempt to implement new rules of the game, the regime has launched a major campaign to enforce discipline on both workers and managers. These measures, which may be welcomed by many people, could have some short-run positive effects on output and productivity. If the past is any guide, however, the campaign will peter out. In any event, the basic problems that industry faces in the 1980s are not particularly amenable to solution by campaigns for discipline.

Outlook for Production and Productivity

This detailed qualitative analysis of the causes of the dramatic slowdown in industrial growth in 1976-82 and the prospects for turning the situation around strongly supports the assumptions that have recently been embodied in CIA's econometric model of the Soviet economy.[10] The model's projection is based on the assumption that the trends in industrial factor productivity observed in 1976-80 will continue through the 1980s. The analysis on which this paper is based suggests that this assumption is warranted, for the adverse features that caused factor productivity to slump badly in 1976-82 are deeply imbedded and are likely to continue.

According to the model's results, output seems likely to grow at best only about 2 percent annually in the 1980s (baseline case), a bit more rapidly in the first half than in the second half. Industrial output rose by 2.5 percent in 1981 and 2.2 percent in 1982. Growth will probably pick up a little in 1983, perhaps in part as a result of initial favorable effects of the new leadership's discipline campaign but also because 1982's low growth stemmed partly from poor weather and a particularly poor performance in the first five months. Since mid-1982, production of most industrial commodities has picked up on a seasonally adjusted basis. On balance, however, the rates of increase under Andropov are no higher than they were in the last months of Brezhnev's stewardship, and about the same as the trend rates of growth in 1978-82.

The growth of the capital stock will continue to slow as a result of reduced investment growth; and labor inputs also will grow more slowly, because of the inevitable sharply reduced growth of the labor force as a whole. Continuation of these trends implies an increase of about 3.5 percent annually in combined capital and labor inputs and an average annual decline of productivity of well over 1 percent, as was the case in 1976-82.

Implications for Soviet Behavior

Because the implications of slow economic growth for Soviet internal policies are considered in two CIA reports currently being prepared,[11] we provide only a brief treatment of the subject here

[9] See

[10] Two CIA papers provide the basis for these judgments

The slow pace of industrial growth that we project for the 1980s (about 2 percent per year) will seriously limit growth in other sectors and in the economy as a whole, since industry accounts for nearly half of Soviet GNP. Its slowness will be a drain on the rest of the economy because industry supplies indispensable materials and energy and because it produces the steel, machinery and equipment, and construction materials required for investment. Similarly, it will limit the USSR's ability to boost living standards substantially and to accelerate military production. Finally, slow industrial growth will constrain the growth of exports, curtailing the use of foreign trade as a means of lifting industry out of its doldrums (assuming no large-scale largess from the West).

Although other responses are possible, the present Soviet leadership (or party-dominated successors of the same generation) will most likely try to adjust to slower economic growth and will return to traditional methods as they seek to recover the earlier growth path. This means tinkering with planning, organization, and incentives and enforcing greater "discipline" in the economy and society. If this kind of "muddling through" is to be viable, it will have to deal rather evenhandedly with the three major claimants on resource allocations—consumption, defense, and investment—by allocating roughly similar shares of the annual increments in output to each one. In fact, the USSR has already been accommodating in more or less this way to the marked slowdown in growth during 1976-82.

Alternative strategies not only would be risky, but probably could not even be carried out. To maintain work incentives and preserve domestic tranquillity, the government needs to provide some forward momentum in consumption. Any major effort to accelerate defense or investment would immediately threaten this momentum; it would also require allocations of labor, steel, materials, and machinery that could not be provided from domestic sources. As regards investment, some growth probably is required to sustain economic growth. But the USSR is already making a huge investment effort, and its most imperative need is to radically raise the return from it, in terms of increased output. As for defense, the effort is already so large that substantial upgrading of weapons systems can occur (and has been occurring) even with reduced rates of growth in military spending.

As noted above, imports could relieve some domestic shortages, particularly in the case of high-quality finished steel products, chemical feedstocks, and selected kinds of machinery and equipment, most notably for oil and gas development. However, future imports will be constrained by much more slowly growing hard currency earnings and also by the likely continuation of Soviet reluctance to accumulate debt to the West (and—at least in the near term—by the reluctance of Western banks to increase their exposure in the USSR).

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Appendix A

How Individual Branches of Industry Fared

In the preceding section we considered the major reasons for the marked production slowdown in industry as a whole. That overall analysis derived from analysis of the factors that shaped the performance of each of the 10 major branches of industry. In this section we briefly describe the record of production and productivity growth in each branch in 1976-82 and assess the main factors that explain that record. The figures discussed are those in tables 1 and 2 and appendix B.

Ferrous Metals

Performance

The average annual growth of production in ferrous metallurgy, which carries 7.2 percent of the total weight in the CIA industrial production index (SPIOER), fell from 4 percent in 1971-75 to 1 percent in 1976-80. Corresponding rates for factor productivity are 0.3 percent and -2.2 percent. Output stagnated in 1981 and declined in 1982 by nearly 1 percent. Because labor and capital inputs almost held their own in 1976-82, the deceleration in the growth of output reflected a pronounced reduction in the productivity of those inputs. The sharp falloff in growth of both production and productivity occurred in 1976.

Crude steel production in 1982 was only 6 million tons above the 1976 level, whereas output in 1975 was 25 million tons higher than in 1970. Corresponding gains in output of finished rolled steel were 3 million and 18 million tons. For iron ore, the most critical raw material in steelmaking, the respective gains are 9 million and 38 million tons.

Factors Influencing Performance

If even the small productivity gain of 1971-75 had been maintained, growth of production in ferrous metallurgy would have increased 3 percent annually in 1976-80 instead of the 1 percent actually achieved. What went wrong? Unexpected shortfalls in availability of three critical raw materials (iron ore, coking coal, and scrap metal) account in large part for the slide. But transportation difficulties played a major role, too.

Output of *iron ore*, which had risen steadily by about 8 million tons annually in 1971-75, increased only 6.3 million tons in 1976 and dropped in 1979 and 1981; the average annual increment in 1976-82 was only 1.5 million tons. After many years of sustained gains, production has essentially leveled off in the Urals, Krivoy Rog, and the Kursk Magnetic Anomaly—three areas that together account for about four-fifths of total production.

Even worse, the quality of the ore began to deteriorate at a faster rate. Thus, the average ferrous content of working deposits dropped from 50 percent in 1950 to 44 percent in 1970 and to 35 percent in 1980. Almost nine-tenths of Soviet ore must now be enriched, an expensive process that eats up about 70 percent of total investment in the iron ore sector. In addition, iron ore mines were being depleted at an increasing rate, so that in 1976-80 three-fourths of the new capacities commissioned served merely to offset depletion of old mines. Investment allocations were inadequate to offset rising depletion rates and provide sufficient additional capacities.

Finally, Soviet sources indicate that longer delays were being encountered in getting newly commissioned mines into full production. For example, new mines with a scheduled annual capacity of 12 million tons of ore were commissioned at Krivoy Rog and Kursk in 1976; in 1979 these mines were producing 4.5 million tons.

Although reserves are large and conveniently near the blast furnaces, *coking coal* supplies became a major fetter on pig iron production and hence also on crude steel production in 1976-82. Production, which in 1971-75 rose every year for a total gain of 16 million

tons, stopped climbing in 1977 and declined every year thereafter. Output began to fall in the Donets and Kuznetsk basins, which account for nearly three-fourths of coking coal production. The reasons for the decline are those advanced above in the discussion of the coal industry.

About half of Soviet steel is smelted in furnaces using *scrap metal*, which is much cheaper to use than pig iron (according to Soviet calculations). That share changed little in the 1970s because scrap was in short supply. There were plans to emphasize production of electric steel, which costs less to produce than open-hearth steel, but its share remained at 10 percent of total steel production during 1976-80, largely because of scrap shortages. The shortages also constrained production in open-hearth furnaces, where scrap is interchangeable with pig iron; production of pig iron, in turn, was hampered by shortages of its main ingredients—iron ore and coking coal.

Scrap shortages do not seem to stem from lack of scrap metal, but rather from chronic problems in collecting and processing it. These problems evidently worsened in the last half of the 1970s, calling forth a party-government decree in 1980 demanding action to set matters right. The oft-cited difficulties include shortages of sorting equipment, few and poorly qualified workers, and fragmented responsibility. Assignments for scrap collection are parceled out among dozens of ministries, which accord them low priority. The creation in 1978 of a specialized all-union association for collection of steel scrap has not solved the problem.

The overloading of the *rail transport* system in the latter half of the 1970s had a particularly serious effect on ferrous metallurgy. The industry relies on railroads almost exclusively for delivery of its raw materials, which are bulky and must be transported increasing distances. Soviet steel plants typically operate with much lower inventories than Western plants (seven days' supply of coal and 15 of iron ore), so even a brief transport interruption will slow production.

With the changing geographic patterns of supply, the average distance of iron ore shipments has continued to rise, straining the already overtaxed rail network. For example, steel furnaces in the Urals now must obtain about one-fourth of their iron ore from Kursk, over 1,000 km away, or from the Kola Peninsula and the Ukraine, even farther. West Siberian mills also are becoming more dependent on long-distance shipment of ore.

Similar transport requirements prevail for coking coal. Thus, rapidly falling output in the Donets basin has forced the shipment of coal from the Kuznetsk basin to blast furnaces in the Ukraine, a distance of about 3,500 km. Transportation bottlenecks also have delayed the shipment of scrap metal.

Nonferrous Metals

Performance

Nonferrous metals carry 3.9 percent of the 1970 value-added weight in SPIOER.[a] Production had grown at an average annual rate of 7.5 percent in the 1960s and 5.9 percent in 1971-75, but grew by only 2.3 percent per year in 1976-80. Table 8 shows growth rates for subbranches of the industry.

The substantial drop in growth rates affected all but two of the subbranches. For the branch as a whole, the deceleration began in 1975, when growth fell to 4.6 percent after reaching 6.2 percent in 1974. The growth rate dropped by a similar amount to 2.9 percent in 1976 and then declined fairly steadily to less than 1 percent in 1982.

Growth of capital stock in nonferrous metallurgy fell by almost 1 percentage point in 1976-80, and labor inputs actually increased.[b] Thus, the slower growth of output reflected a large deterioration in productivity—from an average annual increase of 1.6 percent in 1971-75 to an average annual decline of 1.7 percent in 1976-80. In 1980-82, annual declines in productivity were well over 2 percent.

[a] This section relies in part on two CIA reports: NFAC Research Paper ER 80-10072 (Unclassified), March 1980, *The Lead and Zinc Industry in the USSR*, and

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[b] Estimates of productivity in nonferrous metals are tenuous, since capital stock data are not published and must be guessed from fragmentary information. Employment must be estimated indirectly from plan fulfillment data for the Ministry of Nonferrous Metallurgy, which is thought to be responsible for the bulk of nonferrous metals production.

Table 8
Growth Rates in Nonferrous Metals

Percent

	1970 Weight	Average Annual Rates of Growth	
		1971-75	1976-80
Aluminum	27.1	7.4	2.9
Copper	23.2	5.4	2.2
Nickel	14.3	8.9	1.7
Zinc	10.3	3.5	0.2
Lead	8.5	2.8	0.7
Tin	5.9	3.6	0.7
Molybdenum	3.2	2.0	2.7
Titanium	2.0	8.4	3.4
Magnesium	1.7	4.1	1.2
Tungsten	1.6	3.2	2.4
Mercury	0.9	2.8	1.3
Cadmuim	0.8	3.5	0.3
Antimony	0.4	1.7	1.5

Factors Influencing Performance

By and large, the factors contributing to the much impaired performance of nonferrous metals in 1976-82 are similar to those affecting ferrous metallurgy. The basic activity consists of the extraction and smelting of a variety of ores. As with iron ore, the cost of extracting nonferrous ores has been rising rapidly. Costs are high anyway, because substantial shares of most metals are mined and processed in Siberia and Kazakhstan. Although reserves are estimated to be huge, current production is being obtained from poorer and less favorably situated mines at greater depths.

In addition, the average grade of ore is decreasing. According to Soviet press statements, the average grade of copper and zinc ores mined since the mid-1960s has decreased by about 50 percent and that of lead by about 40 percent.

New mines are being developed, but development of large new underground mines often takes 10 to 15 years. Old mines meanwhile are being depleted rapidly, so that a large and growing share of investment merely offsets depletion. Investment for nonferrous metals in 1971-75 was 49.3 percent greater than in 1966-70--rising considerably faster than investment for industry as a whole. Data for 1976-81 are not available, but growth of investment in the nonferrous metals branch may have decreased, as it did in the residual category of which the branch is a component.

Judging from the fragmentary information at hand, production and productivity in nonferrous metals were affected by the problems that plagued industry in general. Since smelting involves continuous operations, irregularities of supply of ores and fuels and fluctuations in quality of electricity reduced output and damaged equipment. Sporadic shortages of raw materials needed for processing (many of them imported) arose because of bottlenecks in railroad transportation. Finally, the branch experienced considerable delays in assimilating imported equipment.

Fuels

Performance

Production of fuels, with 9.8 percent of the value-added weight in SPIOER, rose more slowly (3.1 percent annually) in 1976-80 than in 1971-75 (5 percent annually). Inputs of labor and capital combined grew substantially faster in 1976-80, however; thus, all of the falloff in growth stemmed from a radical turnabout in productivity, which dropped 10 percent during 1978-82. Growth of fuels output dropped to less than 2 percent in 1981-82 and productivity declined by nearly 3 percent annually.

Growth of production fell off in all major components of the fuels industry except gas, in which average annual growth rates climbed from 8 percent in 1971-75 to 8.5 percent in 1976-80.[*] Growth rates in oil extraction dropped from 6.9 percent to 4.2 percent, with a concomitant deceleration in growth of oil refining. Coal production increased by only 2.4 percent during 1976-82—much less than its gain of 12.3 percent in 1971-75. It was the performance of coal that dragged down growth rates for both production

[*] In Soviet statistical reporting, the fuels industry comprises coal, oil extraction and refining, natural gas, peat, oilshale, and other minor fuels.

and factor productivity in the fuels sector, but the other fuels did not do well either. Average annual growth in their production declined from 6.8 percent to 4.8 percent; productivity apparently deteriorated far more sharply, falling by nearly 10 percentage points in 1976-80 after rising by 13 percentage points in 1971-75. In 1981-82, average annual growth of production of fuels other than coal fell to about 2 percent, and productivity continued to be sharply negative.

Factors Influencing Performance

The *oil* and *gas* industries have 54 percent of the 1970 value-added weight for the fuels branch.[9] The reasons for the dramatic slump in productivity in the oil and gas subbranches (including oil refining) are evident. In the case of oil, annual increments to production continued to drop because older fields in the Western regions and the Volga-Urals are in decline, and production in West Siberia was not growing fast enough to prevent a steady slide in the growth rate of total output. In particular, production from the USSR's largest field (Samotlor in Tyumen' Oblast, which accounts for roughly one-fourth of total production) is now in decline and new fields there have been small and more difficult to develop. Oil refining is constrained by slower growth in supplies of crude oil. Annual growth rates for gas remain high, but there have been reports of lags in constructing gas plants and pipelines and difficulties in expanding gas consumption as rapidly as the production potential warranted.

The deterioration in productivity in the last half of the 1970s is partly the consequence of the government's crash program to arrest these unfavorable developments by greatly increasing allocations of labor and investment. In the middle of the 10th Five-Year Plan, the government began a major reallocation of industrial investment in favor of oil. Total investment in oil in 1976-80 was 65 percent higher than in 1971-75. Annual investment rose from 3.8 billion rubles in 1975 to 6.8 billion in 1980 and to 8 billion in 1981. Oil's share in total industrial investment jumped from 10 percent in 1976 to 16 percent in 1981. Large amounts also were invested in oil pipelines.

A large and growing share of investment in the development of new production capacity, however, did not provide additional oil. The share required merely to offset rapidly rising depletion of old wells was 45.8 percent in 1961-70, 65.8 percent in 1971-75, and (by Soviet forecasts) 74 percent in 1976-80 and 87 percent in 1981-85.

Moreover, investment costs per unit of additional capacity have been rising rapidly, in part because development in the West Siberian fields is more costly. The crash program in 1977 to accelerate drilling in West Siberia diverted thousands of drillers from the older fields. It continued in 1978-82, with mounting costs in providing equipment, transportation, and related infrastructure. "Shockwork" takes its toll in efficiency, and the measured productivity drop in the fuels branch in 1976-82 probably reflects this fact, inasmuch as oil extraction accounts for more than one-fifth of employment and over half of the capital stock in the fuels branches exclusive of coal.

We have too little information to assess the role of oil refining in the falloff in productivity in the fuels branch. Output was constrained, of course, by slower growing supplies of crude oil. The technology-intensive refining sector probably had the same problems with transportation, equipment deliveries, delayed startup of new plants, and power shortfalls as did industry as a whole.

The gas industry faced difficulties similar to those in oil extraction. An increasing share of output is coming from West Siberia—41 percent in 1981 (13 percent in 1975). As in oil, the investment costs of gas extraction rise and difficulties multiply as the production focus moves eastward. The energy strategy announced in 1977 (all hands to Siberia!) also affected gas, but to a lesser extent. Its investment priority was raised a little; investment in gas took 4.7 percent of total industrial investment in 1976-81, against 4.3 percent during 1971-75. Substantial additional amounts were invested in pipelines, and the amount devoted to that purpose may have risen abruptly after 1977.

In any event, the decision made in December 1977 to accelerate gas extraction from the Urengoy field (and to build the pipelines and other infrastructure on a

[9] The discussion of oil and gas relies heavily on the following source: J. Richard Lee and James R. Lecky, "Soviet Oil Prospects," in US Congress, Joint Economic Committee, *Soviet Economy in a Time of Change*, Washington, D.C., 1979, vol. 1, pp. 581-599.

crash basis) enabled the USSR to meet the upper limit of an ambitious target for gas production—but increased capital costs even more. Because the domestic machinery industry could not supply equipment and pipe in the quantity and quality required, the Soviets had to spend considerable hard currency for Western equipment.

The *coal* industry, with 42.6 percent of the value-added weight in the fuels branch, contributed importantly to the falloff in growth and productivity in Soviet industry, both directly and indirectly, because of its great importance as both fuel and raw material. Value added in the coal industry rose scarcely at all during 1976-82, whereas it had increased by 12.3 percent in 1971-75. Man-hours decreased by about 5 percent in 1976-81, and capital stock grew by roughly 13 percent; corresponding percentages for 1971-75 are 9 percent and 25 percent. Labor productivity rose only about 5 percent, capital productivity declined by perhaps 12 percent, and factor productivity was negative after 1977, whereas it had grown by perhaps 10 percent during 1971-75.

The downturn in output growth came in 1976, that of productivity probably in 1978. In amounts, output of coal rose by about 11 million tons in 1976 and 1977 and by 1.5 million tons in 1978, and then declined in 1979, 1980, and 1981. In 1981, coal output was less than 3 million tons above the level of 1975, and production of coking coal had fallen by some 6 million tons. The total increment in annual output during 1976-81 was just 3 million tons, and the average calorific value per ton of coal fell somewhat. Output rebounded in 1982 but did not reach the level achieved in 1978.

The poor production record for coal since 1975 resulted from a steady decline in output in the western coal basins, particularly the large Donets basin, and sharply reduced growth after 1978 in output from eastern basins. Production declined after 1978 in the Kuznetsk basin, the country's second largest. Only one major basin, Ekibastuz, showed substantial gains in output; but here the coal has only 60 to 70 percent as much heat content as Donets and Kuznetsk coal, and none of it is suitable for coking.

The falloff in productivity growth in coal mining stems above all from an accelerated deterioration of mining conditions; this is especially rapid in the Donets and Kuznetsk basins, which in 1980 accounted for nearly half of total production and nearly three-fourths of the output of coking coal. In these (and, to a lesser extent, other older basins) coal miners each year are taking coal from thinner seams in deeper and gassier mines. In the Donets basin, for example, average mine depth nearly doubled and the average thickness of coal seams declined almost 25 percent during 1967-77. Despite a relatively short workweek, the grim working conditions made it difficult to attract and retain miners. Lack of amenities created similar problems for miners in the eastern regions. Labor shortages, coupled with greater diversion of workers to ancillary tasks such as repair and construction, suggest that existing capacities were not exploited to their potential.

Difficulties with equipment also seemed on the increase, causing breakdowns and excessive repair costs. In one large mine, for example, several million tons of coal were lost in 1979 because one of the largest elevators was out of service for almost one-third of the year. Shortages and poor quality of mining equipment and safety gear hampered production, especially in the Donets and Kuznetsk regions. Interruptions in, and the uneven quality of, electricity supplies also held down coal production.

Other reasons for the falloff in the growth of coal production in 1976-82 are (1) a continued (though decelerating) fall in man-hours, part of which stems from the reduction in the workweek in underground mines, and (2) a halving of the growth of capital stock. The latter resulted not from a slower pace of investment, but from sharply reduced gross commissioning of new mines—from a total of 114.2 million tons of capacity in 1971-75 to 90.4 million tons in 1976-80. Only 5.1 million tons were added in 1981. (As in oil, a rapidly growing share of these new capacities merely offsets depletion of old capacities. During 1976-80 the average annual depletion was 15 million tons of

capacity—it had been 7 million tons a decade earlier—and annual gross commissioning of new mines averaged 18 million tons.) Investment costs rose sharply, as did the volume of unfinished construction, and the period needed to bring newly commissioned mines to capacity apparently increased. The rebound in coal production in 1982 was associated with a jump in employment. Also, higher wages and better working conditions for coal miners were introduced in 1982.

Electric Power

Performance

Electric power has 6.8 percent of the total weight in the SPIOER. During 1976-82, output of electric power grew only about half as fast as it did in 1971-75, and more erratically. The rate of increase of capital stock fell moderately while that for labor turned upward. As a consequence, the growth of factor productivity in the branch was negative in 1976-82. In addition, the quality of electricity supplied to consumers deteriorated seriously, as reflected in power outages, erratic drops in voltage, and fluctuations in frequency. The growth rates of both output and productivity turned down markedly in 1977, a year later than in most other branches.

Factors Influencing Performance

In 1971-75 productivity gains accounted for 23 percent of the growth in electric power production. If that ratio had held in 1976-80, output would have risen by 6 percent annually instead of the actual 4.5 percent. Why did productivity growth fall off so much?

Electric power production is highly capital intensive and depends on the total capacity of power stations and on output per unit of capacity. During 1971-76, output per unit of capacity climbed by 1.5 percent annually, whereas by 1980 it had fallen below the 1976 level. This turnabout was partly the result of the increasing strain under which the power network was operating and partly the result of factors related to raw materials and transportation.

Annual additions to new (and presumably more productive) capacity were only about 4 to 5 percent of total capacities in the late 1970s, whereas they had been over 10 percent in the 1960s. Because of failure to meet plans for introduction of new capacity in 1976-80 (61 million kilowatts planned, 54 million kW completed) and the continued high demand for power, old plants were kept in operation instead of being retired on schedule. Plants with 25 million kW of capacity were slated for retirement in 1976-81, but only 6 million kW were actually retired. Obsolete plants now make up about 10 percent of total capacity, and their operation is marked by more frequent power outages and higher operating costs. Moreover, low retirement rates and smaller net addition to stock imply an increasingly aged capital stock, which requires much more repair and leads to partial or total shutdown of individual power plants.

Power outages were another result of the increased strain on reserve capacity—that is, on the system's ability to meet peak demand. In 1980 only 6 percent of total capacity of the unified power system (which controls about 97 percent of total Soviet capacity) was available for such purposes; this was well below the 10 to 11 percent available in 1970 (and below the 1980 plan of 11-percent reserve capacity). The number of hours per year when the maximum capacity of the system was used increased from 6,150 in 1970 to 6,230 in 1975 and to 6,560 in 1980—against a planned maximum use of 6,150 hours.

This reduction in relative reserve capacities (given continued strong demand) resulted in delayed equipment repair, an erosion of performance, and frequent use of old units that are inefficient and prone to break down. The operation of marginal facilities requires more repair crews, a factor that helps explain the continued high growth of the branch labor force—2.2 percent annually in 1976-82, when that of industry as a whole was 1.4 percent.

Another reason why capacities were ineffectively used was the growing difficulty with fuel, which makes up about 60 percent of the electric power sector's purchases of materials. Deliveries were inadequate for one thing; and to make matters worse they were erratic, and the coal delivered was of lower quality. Some of the shortfalls in fuel delivery were caused in turn by the railroads' difficulties in handling shipments of coal and oil—difficulties that increase in the winter, when power plants depend especially on coal. The power system has become more vulnerable to transportation failures because it still relies heavily on coal (37.3 percent of the total fuel requirements of the Ministry of Electric Power system in 1980), which increasingly has to be hauled long distances from Kazakhstan and Siberia to offset the decline in production in European Russia.

The electric power sector has also been constrained by production shortfalls in coal mines and the declining quality of the coal produced. In 1980 electric power consumed almost 27 percent of total coal production, and coal accounted for 37 percent of total fuel use. (The share of coal in total fuel consumption by electric power plants had dropped from 44 percent in 1975, despite the plan to raise it.)* During 1976-80 the energy value of coal used to generate electricity fell by 4 percent on average, but the energy value of Donets coal, used extensively in Ukrainian power plants, fell by 20 percent. A drop in the heat value of coal becomes a drop in the effective capacity of power plants fired by coal. Ekibastuz coal, which fuels about 30 percent of generating capacity in Kazakhstan and the Urals, has a high content of rock and debris. These damage coal-handling equipment, forcing emergency shutdowns of power plants.

Other factors detracting from the efficiency of electric power generation capacities have to do with flaws in the quality and design of new equipment and components supplied to the sector. Press criticisms of the quality of equipment are chronic; whether matters got worse in the latter part of the 1970s is hard to say. In view of the numerous reported difficulties in building power plants in that period, it seems likely that there were growing delays in bringing up to capacity the units actually put in place. The Minister of Electric Power refers to "unfinished construction" as one main reason for the underutilization of newly installed capacities. Overall, the value of unfinished construction in this branch exceeded annual investment in every year from 1975 to 1981, and by growing amounts—by 0.4 billion rubles in 1975 and by 1.8 billion rubles in 1981.

* These data relate to plants subordinate to the Ministry of Electric Power, which produces 90 percent of all power generated from fossil fuels.

Machinery

Performance

Output in the machinery branch of industry, which had risen at an average annual rate of 7 percent in 1966-70 and 8 percent in 1971-75, increased by 5 percent per year in 1976-80.** Factor productivity growth sprinted from 1.2 percent annually in 1966-70 to a remarkable 2.8 percent in 1971-75, and then fell to 0.8 percent in 1976-80. Although growth rates for both output and productivity in the machinery branch exceeded those for industry as a whole, their sharp falloff in 1976-80 contributed substantially to the deterioration in overall industrial performance since the branch has a weight of 31.4 percent in the index of Soviet industrial production.

The slump in growth of machinery in the last half of the 1970s was associated with a modest decline of 1 percentage point in both capital and labor inputs and a fall of 2 percentage points in the growth of productivity. In 1981-82 the growth of production averaged only 3.6 percent, and productivity growth continued to slow.

The decline in growth of machinery output in 1976-80 compared with 1971-75 occurred in each of the three major subbranches—producer durables, consumer durables, and military weapons. Among the subbranches of the civilian machinery component, the speed of the

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and James Grant, "Soviet Machine Tools Lagging Technology and Rising Imports," in US Congress, Joint Economic Committee, *Soviet Economy in a Time of Change*, Washington, D.C., 1979, vol. 1, pp. 554-580.

decline varied considerably. It was most rapid in automobiles, agricultural and transportation machinery, electrotechnical machinery, and metallurgical and mining equipment.

The year 1976 was the turning point for machinery as a whole and for each of the three major subbranches. The pattern of falloff was quite diverse among the individual subbranches of civilian machinery, however, and even more so among individual products. In a few subbranches (precision instruments and metallurgical and mining machinery and equipment) there was no decisive turning point. The downturn occurred in 1975 for automobiles and agricultural machinery and in 1974 for transportation machinery and equipment. For machine tools, the downturn did not occur until 1979.

In the machinery branch as a whole, after the initial abrupt decline in growth from 8.4 percent in 1975 to 5.7 percent in 1976, growth remained stable in 1977, slid to 3.4 percent in 1980, and rebounded a little in 1982. The pattern was diverse among the subbranches. Once the growth rate dropped off significantly, it failed to recover appreciably in nearly all of the subbranches.

Factors Influencing Performance

Although percentage growth of resources was smaller than in 1971-75, the machinery and metalworking branch continued to be supplied liberally with investment funds and labor in 1976-80. Total investment increased by 16.7 billion rubles and amounted to 24.7 percent of total industrial investment (compared with 14.8 billion rubles and 22.1 percent in 1971-75). The branch's share rose to 25.4 percent in 1981.

A clearly substantial share of investment in the branch consisted of imported machinery and equipment, although precise data are lacking. The machinery branch as a whole was little touched by the reallocation of industrial investment in favor of oil extraction that occurred in 1978-82. Employment grew at about 2 percent annually, faster than in any other branch except electric power. Thus, it appears that the supply of investment funds and workers was not an important cause of the drop in growth of production. The press does refer, however, to shortages of machine tool operators as a reason for failure to master new capacities on schedule.

The machinery branch was affected more than most others by the campaign to concentrate investment on renovating old plants rather than constructing new ones: the share of renovation in total machinery investment was 71 percent in 1975 and 80 percent in 1980. The fragmentary data on addition of new plants reveal a mixed picture. Relative to 1971-75, additions to capacities were higher for production of excavators, forge press equipment, tractors, and grain combines and lower for turbines, transformers, metal-cutting machine tools, automobiles, and bearings.

The principal raw materials for machinery production are supplied by the metallurgical industries, mainly in the form of rolled products. Ores and metals constitute the single largest item of purchased intermediate products for virtually all subbranches of machinery and metalworking: in 1972 purch[illegible] of ores and metals made up over half of the total in six of 26 subbranches, 30 to 50 percent in seven subbranches, 20 to 29 percent in nine others, and 13 to 19 percent in the rest. (These figures exclude subbranch purchases of their own products.)

The rapidly deteriorating performance of the metallurgical industries, particularly the steel industry, curtailed both the quantity and the quality of output of the machinery branch. In particular, the domestic steel industry could not supply the mix and quality of products that the machinery industries required if they were to upgrade their own output—a task they were being pressed as never before to accomplish. The Soviets were able to hold the growth of machinery output above 5 percent for a few years through large imports of rolled steel products of modern vintage, mostly purchased from the West. Imports proved insufficient, however, to compensate for declining domestic output of rolled steel; in 1979-82, shortages of metal were cited frequently as a cause for failure to meet machinery output plans.

The productivity of machinery plants also was eroded, albeit sporadically, by the economy's general problems with electric power and the distribution of oil and gas. The machinery and metalworking branch consumes 11 percent of all the electricity used in

industry, 13 percent of the oil, and 9 percent of the gas. Bottlenecks in freight transportation also impeded operations in machinery plants, interfering with raw material supplies and with shipments of final products to other machinery producers.

Primarily dependent on metal, the subbranches of machinery and metalworking also depend on one another. In particular, nearly all the others are substantial purchasers from two of the subbranches--electrotechnical and "other machinery" (mainly castings, forgings, stampings, and radio and electrical apparatus). It seems likely that deficiencies in one subbranch cause shortfalls in others. In particular, the growth of output slowed especially in 1976-80 in the electrotechnical subbranch, which is the second- or third-largest supplier (after metallurgy) for most of the other subbranches. Growth rates dropped considerably (perhaps in response) for "other machinery," the other major supplier.

Productivity in machinery plants suffered from two other important factors. The first was the appearance of underused capacities of one kind or another, mainly because the Soviets were building processing plants faster than they were expanding production of the raw materials and other inputs needed to operate them at capacity. For a variety of reasons, they were also having trouble bringing new capacities into full operation.

Moreover, even though overall capacity utilization rates for machinery have remained high (90 percent or better), there is evidently a substantial and growing amount of idle equipment. A Soviet source reports that the shift coefficient of use of metalworking equipment has declined in 11 machinery ministries since 1975. A common explanation given for idle equipment is lack of qualified workers. Also, it is evident that when capacity is underused, for whatever cause, the workers remain on the payroll, driving down the figures on labor productivity.

A final factor that probably accounts for some of the drop in productivity growth in the machinery industries is the efforts that were supposed to be made to change product mixes, reduce metal use, and modernize the design of machines—all in order to raise the efficiency of the industries purchasing machinery for investment and to increase the satisfaction of consumers purchasing durables. A push for better, newer, more efficient machines was in a sense the centerpiece in the effort to improve product quality and efficiency throughout the economy. To permit these changes, the growth rate planned for machinery in 1976-80 was cut back from that planned for the preceding five-year plan, and detailed programs for modernizing the structure and quality of output were laid on the responsible ministries.

By way of example, we can cite the machine tool subbranch, which the Soviets label the "core" of the entire machinery and metalworking branch because the quality and efficiency of tools determine the ability of producers of more complex machines and machine sets to modernize them and to work more efficiently. Soviet machine tool production is numerically the largest in the world, but its structure (and hence the stock) is antiquated by comparison with that of the West. The product mix is dominated by simple, standardized metalcutting tools, whereas Western production contains much larger shares of metalforming tools (for example, forge-presses). These are much more flexible to use and waste much less metal. In 1980 the USSR had 20 forge-press machines per 100 machine tools in its park, up from 17 in 1962; in the United States and Japan the equivalent number was about 31.

The Soviets have been altering the product mix at a glacial pace for years. In 1976-80 their output of metalcutting machine tools finally began to decline, while output of forge-press machinery rose 13.3 percent. Even so, in 1980 they produced nearly four times as many of the former as of the latter. The Soviets also have been trying to master production of modern numerically controlled machine tools. These made up 0.8 percent of total production in 1970, 2.4 percent in 1975, and 4.1 percent in 1980. Soviet numerically controlled tools, however, are obsolete and inefficient by Western standards.

Writing in 1979 in the leading government newspaper, the Minister of the Machine Tool Industry criticized the haphazard approach to planning and

developing the machinery sector. Reciting a litany of problems, he declared that a "disproportion" had arisen during 1961-75—the machine tool subbranch had been expanded "with no consideration" for the requirements of the rest of machine building and metalworking or for the machine tool industry's share in the fixed assets of other machinery branches, thus slowing down efforts at renovation. Nonetheless, investment allocations to the machine tool industry in 1979 were cut 25.6 percent from those originally planned. Output of tools has increased far faster than the training of workers, so that there are 26 percent more lathes than lathe operators and 60 percent more milling machines than machine operators. It has proved difficult to organize the production of machine tools in sets (and supplied with auxiliary equipment), as sought by customers to raise efficiency, because of the persistent practice of planning and allocating tools in units. Finally, the product mix of plants producing machinery for specialized branches of industry, such as food processing, has been planned without properly taking into account the customers' requirements.

The stress on changing product mixes and improving product quality put pressure on the area of greatest comparative disadvantage for Soviet machinery producers. Both goals are likely to disrupt production, require relatively more labor, and demand upgraded material inputs from other producers. At the same time, machinery producers were being required to implement investment programs involving reconstruction and reequipment of their physical plant—potentially highly disruptive to smooth production flows.

Both programs took their toll on production and productivity growth—and the benefits evidently were disappointing. Despite a plethora of statistics showing large increases in the share of high-quality products in total output in machinery ministries, complaints from users continued unabated, and machinery exports to the demanding markets of the West (except for ships and cars built with Western technology) remained miniscule. Moreover, machinery plants replaced their own equipment as slowly as before: annual retirements remained at the 2-percent level. Despair over the sector's progress produced a major party-government decree in August 1978 demanding that it modernize itself with dispatch

Chemicals

Performance

The chemicals branch, although it represents only 6.3 percent of SPIOER in terms of its value-added weight, contributed disproportionately to the slump in growth of industrial production and productivity in the second half of the 1970s.[a] The branch grew by 8.6 percent annually in 1971-75 but only 3.6 percent annually in 1976-80, while combined factor productivity rose 2.6 percent annually in the first half of the 1970s and declined by 1.1 percent annually in the second. Production and productivity growth rates deteriorated further in 1981-82. Growth in capital stock fell moderately, and growth in labor inputs slowed substantially. All but one of the subbranches shared in the large drop in the growth of production, as shown in table 9.

Although investment allocations to industry as a whole declined in 1979-80, total investment in the chemicals branch increased at about the same pace in 1976-80 as in 1971-75. The branch's share in total state industrial investment therefore increased from 9.2 percent to 10.1 percent. In marked contrast to most other branches of industry, the chemicals branch had a relatively small share (about 65 percent) of its investment allocated to reconstruction and renovation of existing enterprises. The figure for total new capacities commissioned in 1976-80 increased over that for 1971-75 for the production of fertilizers, sulfuric acid, synthetic resins and plastics, and tires. In three products where introduction of new capacities was smaller, unusually large amounts had been introduced in the previous two five-year periods.

For the branch as a whole, the value of unfinished construction increased 75 percent in 1971-75 and 51 percent in 1976-80—the worst record in all of industry. In 1980, unfinished construction was nearly double the value of investment.

[a] The

Table 9
Average Annual Growth of Production in the Chemicals Branch

Percent

	Weight	1971-75	1976-80
Total chemicals	100	8.6	3.6
Mineral chemicals	5	11.7	5.7
Basic chemicals	35	9.4	3.3
Dyes	2	−1.3	1.8
Synthetic resins and plastics	7	11.2	5.1
Chemical fiber	9	8.9	4.3
Organic and synthetic chemicals	12	5.9	4.7
Paints and lacquers	6	5.9	−1.7
Rubber products	19	8.4	3.1
Synthetic rubber	5	9.7	5.3

Factors Influencing Performance

The two main causes of the dramatic downturn in the performance of the high-priority chemicals branch seem to have been an array of problems relating to raw materials and extraordinary difficulties in mastering new capacities. Contributing factors were shortages of raw materials and fuel, irregularity of gas and electricity supply, and insufficient transport facilities.

With respect to raw materials inputs, the subbranches of the chemicals industry are highly interdependent. Thus, purchases from other chemicals subbranches make up over half of total external materials purchases in synthetic resins and plastics and in rubber products. They contribute from one-fifth to over two-fifths in nearly all the rest. The principal external sectors providing key raw materials are electric power, petroleum refining, and coke products.

A large body of press reporting has cited shortages of raw materials as a critical factor in the drop in growth rates throughout the industry. The high level of interdependence among the subbranches assures that slackened growth in any one of them will quickly produce a chain reaction. In fact, every subbranch except synthetic fiber and dyes experienced a large fall in growth rates (3 to 7 percentage points) in 1976. In most cases, growth rates continued to decline; a rebound occurred in 1980, only to be reversed in 1981 and 1982.

The raw materials problem is examined in more detail below for two interdependent subbranches (chemical fibers and synthetic resins and plastics) and for one important product (fertilizer).

About half the production of the chemical fiber branch consists of synthetic fibers, for which the principal raw materials (intermediate) are synthetic resins. The synthetic resins subbranch, which ships 20 percent of its gross output to the chemical fiber subbranch, had a dramatic drop in its growth rate. The other major product of the chemical fiber subbranch is artificial fibers, which use as essential materials sulfuric acid, caustic soda, and cellulose—all of which experienced sharply reduced growth in 1976-80. According to many statements in Soviet publications, the quality of raw materials for both synthetic and artificial fibers was poor.

Production of synthetic resins and plastics depends directly on intermediate products obtained primarily from the organic and synthetic chemicals subbranch and to a lesser extent from the mineral chemicals and basic chemicals subbranches. Production of these intermediates depends, in turn, on coking byproducts and byproducts obtained from petroleum refining and gas extraction. The same intermediates are also in demand by other sectors, yet the output of the principal subbranch involved—organic and synthetic products—experienced slower growth.

The raw materials problem has also affected production of fertilizer, both phosphate (very important in raising grain yields) and nitrogen. Phosphate fertilizers accounted for 26 percent of total production (measured in nutrient units) in 1976-80. The growth of production was less than one-fourth of the increase originally planned for the period. Production was seriously constrained by insufficient supplies of phosphate rock and sulfuric acid. The USSR has large reserves of phosphates and some sulfur, but output

currently is obtained from poorer grade sources and at increasing cost. Phosphates are mined mainly in the remote Kola Peninsula and in Kazakhstan, where working conditions are difficult, opening of new mines is time consuming, and the nutrient content of the ore has steadily decreased. The increasing cost of mining sulfur has led the USSR to try to obtain it as a by-product of natural gas recovery and metal smelting, a task that has also proved to be time consuming.

The principal raw material for nitrogen fertilizer, accounting for over 41 percent of total output, is natural gas, which is required for making the intermediate—ammonia. Interruptions in gas supplies have curtailed production of ammonia, particularly in the winter of 1978/79. The loss of gas supplies from Iran also interfered somewhat with ammonia and fertilizer production in Transcaucasia.

A problem common to all raw materials for fertilizers is the failure to coordinate the opening of new fertilizer plants with provision of appropriate capacities for production of intermediates and their raw materials. Coordination is critical for a sector undergoing rapid expansion, such as the chemicals branch.

Various subbranches were plagued by shortages of essential raw materials obtained from branches outside the chemicals industry. For example, coke by-products provide important ingredients for production of dyes, synthetic rubber, organic and synthetic products, and mineral chemicals; but production of coke was severely constrained by the decline in coking coal output after 1976. Decline in output of cellulose after 1978 created problems for producers of chemical fibers. The fall in production of vegetable oil after 1975, coupled with slow progress in shifting to use of synthetic raw materials (glycerine, for example) constrained production of paints and lacquers, as well as organic and synthetic products.

Lack of sufficient packaging materials often either held up shipment of fertilizers or caused large losses from forced shipment in bulk. Bulk shipments were held up because of shortages of specialized freight cars or wasted by the use of ordinary boxcars. Similar problems were prevalent for consumer-related chemical products such as detergents.

Difficulties in commissioning new facilities and bringing them up to rated capacity were widespread throughout industry, but seemed to afflict the chemicals branch particularly. One reason, probably, was the extremely rapid growth of the capital stock. This growth was faster in the chemicals branch than in any other during the whole 1960-80 period and was second only to that in machinery in 1976-80. Another reason, especially important in the recent period, is the concerted effort to expand facilities in the eastern regions or establish new ones there, nearer to newly expanding sources of energy. A third factor was that the expansion program used a relatively large share of foreign technology, which caused particular difficulties in assimilation into the domestic routine.[5]

In 1976-80 the capital stock in the chemicals branch rose by 9.1 percent annually. During the period, 39.3 million tons of fertilizer capacity (standard units) were commissioned, raising total capacity by more than one-third.[6] For a variety of reasons—related to raw materials, labor supply, and equipment—most new facilities were operating far below capacity. Overall, the use of fertilizer production capacity declined from 81 percent in 1975 to about 69 percent in 1980, according to our calculations—an extension of data compiled by Professor Philip Hanson, a Western Soviet specialist.

Capacities for producing 1.5 million tons of synthetic resins and plastics were introduced in 1976-80, exceeding by more than 50 percent those added in 1971-75. Much of this new capacity represented construction of large specialized facilities to produce newer kinds of products and intermediates; it takes much longer to master such facilities than smaller ones using older technologies. Similar considerations apply to chemical fibers, where new capacity additions also were large. In both subbranches the rates of capacity use evidently declined, as it did in fertilizer plants, and for similar reasons.

[5] See NFAC Research Paper ER 78-10554 (Unclassified), October 1978, *Soviet Chemicals Equipment Purchases from the West: Impact on Production and Foreign Trade*

[6] Even with the recent massive buildup of its chemical production capabilities, the USSR remains a large and growing net importer of chemicals. In 1980, imports from the West alone totaled $1.6 billion

An important factor contributing to underuse of commissioned capacities for production of final products was a pervasive failure to provide the new facilities with required sources of raw materials, gas, electric power supply, and transport. Speaking to a party plenum about the existence of idle fertilizer plants, Brezhnev said in November 1979, "It turns out that there are shortages of raw materials and gas. What were they thinking about earlier? Why did they allocate money for the construction of factories, if they were not sure they could be able to operate? We are entitled to put these matters before Comrade Kostandov (Minister of the Chemical Industry) and the State Planning Committee." Much anecdotal evidence supports Brezhnev's assertions about the mismatch between end-product capacities and capacities for required material inputs. Plant capacity was also idled by shortages of skilled workers and by high labor turnover.

Difficulties in commissioning and assimilating capacities seem to have been most acute in Siberia, where a great many facilities are being built. This is an effort to raise the region's share in total chemical output, which was only about 10 percent in 1980. Projects in a variety of subbranches were begun there in the 1970s, and most of them are not yet in operation.

Imports played a large role in the expansion of the chemicals industry in the 1970s. Purchases of equipment for the industry rose from 2.1 billion rubles in 1971-75 to 7.6 billion rubles in 1976-80, some two-thirds coming from the West. Purchases of Western technology contributed perhaps one-fifth or more of total investment in 1976-80. Western technology has figured most prominently in the investment programs for the fertilizer, synthetic resins and plastics, and synthetic fibers subbranches. There is ample evidence of Soviet difficulties in coping with an infusion of foreign technology on such a scale, with fertilizer and ammonia facilities being leading examples. These difficulties, reflected in a huge backlog of unfinished construction, probably explain why imports of chemical equipment were cut back by more than 30 percent in 1981.

As already noted, the activities of the chemicals branch are highly energy intensive. In 1972 it used, for either fuel or raw materials, 13.1 percent of industrial consumption of gas (in heat-equivalent units), and in 1980 it used an estimated 15 percent of industrial consumption of electricity.

Troubles caused by intermittent gas deliveries, especially after 1978, interfered with production. Chemical plants also were hampered by irregularities in electric power supplies, which sometimes shut plants down partly or completely, damaged equipment, and spoiled products. Because chemical plants use continuous processes, they are especially vulnerable to damage from fluctuations in voltage. Even brief power outages can produce serious damage to equipment and products. Like other branches, the chemical branch was affected by the overloading of railroad capacities and shortages of freight cars (especially clean tank cars) and the consequent delays both in receiving raw materials and in shipping finished products.

Wood, Pulp, and Paper

Performance

The forest products branch, which had been a drag on industrial production and productivity growth in the 1960s and early 1970s, became an anchor in the second half of the 1970s. In 1981-82 the branch's performance improved considerably but was still well below that of the first half of the 1970s. The branch carries 7.7 percent of the value-added weight in SPIOER. Production actually declined at an average annual rate of 0.3 percent and productivity at nearly 2 percent per year in 1976-80. (The comparable figures for 1971-75 were average annual gains of 2.6 percent and 0.5 percent, respectively.) Man-hours declined throughout the 1970s, but at a slower rate in the latter half. Capital stock also grew markedly more slowly in 1976-80, reflecting an absolute decline in investment and a reduction of the branch's share in total industrial investment from 4.7 percent to 4.1 percent.

The forest products branch comprises five subbranches, shown below with their relative shares in 1970 value added:

Logging	37
Lumber and woodworking	34
Furniture	15
Pulp and paper	13
Wood chemicals	1

Available data permit calculation of factor productivity measures for logging, lumber and woodworking (including furniture), and pulp and paper (table 10). The results show that the greatly worsened performance of the branch in 1976-80 reflects swift deterioration of performance in all three categories, but especially in the pulp and paper branch. Growth of output in the woodworking branch would have been much slower, except for the inclusion of the relatively fast-growing furniture sector.

Factors Influencing Performance

Problems with the supply and delivery of raw materials evidently were the principal cause of the poor record of the forest products branch in the last half of the 1970s. The logging subbranch (in which growth has been slow for many years) provides the principal raw material to the lumber and woodworking subbranch, and one or the other of these two supplies the other three. In 1972 the logging subbranch supplied 54 percent of the purchases of the lumber subbranch, 30 percent of those of the pulp and paper subbranch, and 58 percent for wood chemicals. Within the lumber and woodworking subbranch, the lumber sector supplied 49 percent of material purchases for the plants of the woodworking sector and 32 percent of those for furniture factories. The decline of output in logging in 1976-80, along with continued net exports of roundwood, severely limited wood supplies for the other subbranches.

Although forests cover a third of Soviet territory, 70 percent are located in Siberia and the Far East. The most accessible forested areas have already been exploited, and reforestation is being neglected—forcing recourse to new forests, ever more remote and costly to exploit. A specialist in Gosplan's Economics Institute said in a press article in 1982 that "in the past five years" (presumably 1977-81) the Ministry of Timber, Pulp and Paper and Wood Processing Industry put into operation only half as many lumbering areas as had been planned and that the areas abandoned exceeded those brought into production by 25 percent. (The ministry manages somewhat over half of total Soviet logging activity.)

Logging enterprises depend on government forestry services to preserve and maintain the forests. Government expenditures for forestry maintenance, however, increased only 1.8 percent in real terms during 1976-80—considerably less than the increase of a little over 4 percent in 1971-75. The logging process itself suffered from inadequate and unskilled labor, poor quality of machinery, and perennially slipshod practices. To meet their plan goals, for example, loggers often cut oversize trees, damaging their machinery. Chronic labor shortages, the result of bad working conditions, have evidently become worse in recent years.

Transportation problems complicated matters greatly for the forest products branch. In 1978-79, large shortfalls in deliveries of wood to pulp and paper plants resulted from tieups on the railroads, which handle the vast bulk of shipments. The shortfalls left most pulp and paper enterprises without reserve stocks, forcing them to rely almost exclusively on day-to-day deliveries. The burden on railroads is compounded by the Soviet practice of shipping undressed logs, a reluctance to float them down rivers even when this is feasible, and a deliberate decision by Gosplan to restrict the use of ships for transporting timber. At the other end, shortages of railroad cars are reported to have caused such pileups of finished paper, that mills have had to stop production.

The press has often cited fuel and energy shortages as reasons for shortfalls in performance in the forest products branch. Inadequate supplies of gasoline hamper logging and lumbering. Pulp and paper mills have experienced temporary shutdowns as a result of interruptions in electricity supply (because they operate on continuous flows) as well as damage to machinery and products in process as a result of power fluctuations.

Table 10
Average Annual Percentage Rates of Growth in Three Wood Products Categories

	Logging		Lumber and Woodworking, Plus Furniture		Pulp and Paper	
	1971-75	1976-80	1971-75	1976-80	1971-75	1976-80
Output	0.8	−2.2	3.2	0.7	5.0	0.5
Inputs	0.9	0.7	2.7	2.2	3.4	3.3
Productivity	−0.1	−2.9	0.5	−1.5	1.6	−2.7

Productivity in the forest products branch was affected by the cutback in investment growth and the manner in which investment was used. The cutback was accompanied by a large drop in the growth of domestic production of machinery for the branch, and imports probably did not increase at all in real terms. Some three-fourths of new investment was allocated to reequipping and reconstructing existing enterprises. In the pulp and paper subbranch in 1976-80, the new capacities added were less than half those added in the previous five years.

Press reporting suggests that, despite billions of rubles of investment, the average age of the capital stock is rising and much of it is obsolete. Most sawmill equipment is said to be over 30 years old. One Soviet press source states that while 4,000 modern sawmills could handle the timber that is cut each year, the USSR employs 135,000 one- and two-story gang mills to do the job. To take the bark from logs, the Soviets use chain debarkers, which remove a good share of the wood as well. Spare parts are in short supply; for example, in 1979 the Soviet press reported that only a third of the blades required in machines for chipping wood for paper were supplied, causing frequent idling of chipping machines. Finally, there is much complaint that new machinery supplied to the logging and paper sectors is little or no better than the equipment it replaced—but at double or triple the price

Construction Materials

Performance

The construction materials branch, with eight subbranches and 6.5 percent of the SPIOER weight, contributed to the abrupt falloff in both production and productivity in industry as a whole during 1976-80.[a] Productivity growth in the branch exceeded the all-industry average during 1961-75 but fell below it in 1976-80. Average annual growth of output fell much more sharply in construction materials—from 5.4 percent in 1971-75 to 1.2 percent in 1976-80—than in industry as a whole. In 1981-82, production stagnated and productivity continued to decline.

Available data permit a calculation of factor productivity for one important subbranch (glass and porcelain products—one-eighth of the total branch weight) and for the other seven branches combined. Productivity rose in the glass and porcelain sector in 1976-80, but fell markedly in the rest of the branch. Growth rates of output were sharply lower in all eight subbranches in 1976-80, as table 11 shows. In most subbranches the falloff began in 1976.

[a] This section relies in part on research done for DDI Research Paper, currently in preparation, *Cement: An Industry in Trouble With Few Options*

Table 11
Average Annual Percentage Rates of Growth of Construction Materials Output

	Weight	1971-75	1976-80
Cement	7.8	5.6	0.5
Concrete	27.3	5.8	1.2
Wall materials	18.2	2.3	−1.6
Asbestos cement	1.6	5.8	−1.0
Roofing materials	1.2	5.7	−0.5
Construction ceramics	2.6	4.9	2.2
Other construction materials	28.7	6.1	1.2
Glass and porcelain	12.6	7.3	4.2

Growth of both employment and the capital stock declined during 1976-80. Total investment (including that in glass and porcelain) in 1976-80 was 9.7 billion rubles, or 4.3 percent of total industrial investment, whereas the comparable figures were 9.5 billion rubles and 5.5 percent in 1971-75. Essentially unchanged investment, along with rising investment costs and continued stress on renovating and reequipping existing plants, led to a large cutback in the addition of new capacities—in the case of cement, from almost 21 million tons in 1971-75 to 11 million tons in 1976-80.

Factors Influencing Performance

Shortages of raw materials and irregular supplies of fuels and power were the most important causes for the abrupt slowing of production and productivity growth in the construction materials branch. The seven subbranches other than glass and porcelain are linked by closely intertwined input/output relationships. The key subbranch is cement, which sells over 60 percent of its product to the six other construction subbranches. Growth of production of cement dropped from 6.5 percent in 1975 to 1.9 percent in 1976 and continued to fall thereafter. Improving the quality of cement caused a small part of the slowdown (it is more costly and difficult to produce high-grade varieties), but most of it resulted from mounting difficulties with raw materials and power.

Quarry materials are the principal ingredient in cement. In construction, as in other branches, Soviet investment policy has favored construction of finished product capacity to the relative neglect of developing the requisite raw materials. To be economical, cement plants should be located near a quarry with ample reserves. The standard is 50 years of reserves in the United States but only 25 years in the USSR—and even that rule is often violated in practice. Worse still, Soviet policy favors construction of plants with capacities of 2 to 3 million tons per year—four times the size of the average US cement plant. When these huge plants exhaust the nearby quarries, they must bring in their heavy, bulky materials from elsewhere, adding to the railroads' already heavy burden and making themselves vulnerable to delays in shipments.

In addition, the quality of the quarry products has been deteriorating as marginal sources are exploited, and having to prepare the low-quality materials for use in cement kilns adds to delays and increases costs. Although industrial byproducts (blast furnace slag, nonferrous wastes, and fly ash) can be used as raw materials for cement, their quantity, too, has fallen off with the drop in growth rates in the metals and electric power branches. Finally, industry sources report shortages of chemical additives and serious problems with supplies of refractories, which are used to reline rotary kilns to protect them from intense heat and that have now been placed on a list of "deficit" products.

Irregularity in deliveries of fuels and power pushed down cement production and probably hurt other subbranches as well. Purchases of fuels and electricity make up nearly one-fourth of the materials purchases of cement plants, making the industry heavily energy intensive. At present, gas provides 60 percent of fuel needs, with coal and oil supplying most of the remainder. Limitations of gas storage and distribution networks have caused production losses for cement plants.

More important, however, have been shutdowns caused by irregularity in the supplies of electricity. Lack of power stops the grinding of materials, and,

when heating fails, the kiln must shut down immediately. Sporadic shutdowns of this kind are particularly harmful, because they shorten the life of the already scarce refractory kiln lining, causing more frequent breakdowns and costly repairs.

Problems with capital equipment also have worsened. Over half of the cement kilns are over 20 years old, and many of the huge new ones that the Soviets favor operate inefficiently and probably never should have been built. A shift to dry-process technology, in predominant use in Western countries, has slowed to a crawl and is beset with technological difficulties. The amount of repair work has skyrocketed with the aging of the capital stock and, particularly, the growing share of huge kilns. Shutdowns for repair (and delays in repair because of shortages of labor and materials) have taken their toll on production and efficiency. Soviet sources state, for example, that the downtime for large-size kilns has risen 30 to 40 percent since 1974, and that the poor quality of repair work has made breakdowns and industrial accidents more frequent.

Snail's pace growth in cement supplies has constrained the production of precast concrete: growth rates for this subbranch dropped almost as steeply as those for cement. Other limiting factors have been shortages of steel reinforcing materials and of crushed stone. The latter problem has caused the concrete plants of some construction administrations to operate only one-fifth of the time in recent years.

The inadequate production and poor quality of rock products is attributed to: past failure to allocate sufficient investment; a fetish of developing large deposits, to the neglect of numerous, accessible small ones; lack of suitable machinery for crushing and extraction, forcing the use of machinery designed for coal extraction; and fragmentation of administrative responsibility for construction materials.

Growing bottlenecks in transportation also have restricted output in the construction materials branch. Because of irrational location patterns, more materials must be transported longer distances, with large losses along the way. A Soviet press source states that one-eighth of all cement produced is lost in the process of storage and transport. In the case of cement, transport losses have been aggravated by shortages of special cement cars, and additional losses occurred because storage space was inadequate. Investment in storage capacities, as in raw materials, has been slighted in favor of building more and ever larger kilns.

Light Industry

Performance

Table 12 provides data on the performance of light industry and its three subbranches during 1966-80. The branch accounts for 8 percent of the weight in the industrial production index.

Light industry's performance was consistently poor in all three subbranches throughout the 1970s, in marked contrast to its good record in 1966-70. The growth of output and productivity in the sewn goods subbranch was substantially better in the last half of the 1970s than in the first half, whereas the opposite was true of the other two. Since there was no overall deterioration in the performance of the branch in 1976-80, it did not contribute to the worsened performance in industry as a whole. Therefore, this discussion focuses on the reasons for the branch's relatively poor record during 1971-80.

In 1981-82, however, the growth of output in light industry (0.9 percent) dropped well below that of industry as a whole (2.4 percent). Factor productivity in light industry declined in those two years.

Factors Influencing Performance

In light industry the growth rate of capital stock was somewhat higher in 1971-75 than in 1966-70 and then dropped—from 8.7 percent per year to 6.3 percent. The decline resulted mainly from a halving of investment growth (from 36 percent to 17 percent). Nevertheless, the increase in the stock was large—51 percent in 1971-75 and 36 percent in 1976-80. The textile subbranch accounted for over three-fifths of all investment in the branch. Newly commissioned capital assets represented 39 percent of the initial (1970) value of the stock; those introduced in 1976-80 represented 35 percent of the 1975 value of the stock.

Table 12
Performance of the Light Industry Branch

Percent

	Output			Inputs			Factor Productivity		
	1966-70	1971-75	1976-80	1966-70	1971-75	1976-80	1966-70	1971-75	1976-80
Light industry	7.2	2.7	2.7	5.0	2.7	2.4	2.1	0.0	0.3
Textiles	4.8	2.7	1.8	3.6	2.5	2.3	1.2	0.2	−0.5
Sewn goods	12.2	3.5	4.5	6.2	3.3	2.0	6.0	0.2	2.5
Leather, fur, and footwear	5.3	0.6	0.7	4.4	2.5	2.4	0.9	−1.9	−1.4

In contrast to the 1960s, the great bulk of recent investment in light industry has been directed toward reconstructing and reequipping existing enterprises rather than building new ones. The refurbishing share rose from 40 percent in 1970 to 64 percent in 1975 and 75 percent in 1980—by far the most rapid rise in all of industry. The inevitable disruptions accompanying such reconstruction likely contributed to the poor record of the branch in the 1970s. Moreover, the modified investment pattern and reduced growth was accompanied by a large reduction in commissionings of new capacities.

Investment evidently was directed less toward enhancing capacity than toward improving product quality, saving labor, reducing other costs, improving plant layouts and working conditions, and generally modernizing an aged capital stock. As a consequence, shortages of capacities per se may have added to the branch's problems. A number of press sources state that this was the case, citing specifically a shortage of spindles as a reason for failure to meet output goals for cotton cloth. Equipment shortages are a perennial complaint of managers of plants in the shoe subbranch.

Most equipment for the branch is now produced in the Ministry of Light and Food Machinery, set up in 1965. Production doubled during the 1970s, amounting to 766 million rubles in 1980. In addition, a substantial amount of equipment is imported, principally textile equipment from Czechoslovakia and East Germany. Imports have more than doubled in real terms since 1970; they accounted for nearly one-fourth of total branch investment during 1976-80 and over one-third of that in the textile subbranch.

The press provides a mass of complaints about the provision of equipment for light industry. The ministry responsible seldom meets plans for production; production and imports together fall short of demand. The ministry produces no spare parts for old equipment, so plants must make their own. The quality of new equipment is poor, and its prices (relative to productivity) are rising. Much of the imported equipment is not state of the art, requires raw materials of better quality than is available domestically, and therefore fails to boost productivity. Finally, the low priority accorded to implementing the branch's investment projects is cited as a reason for long delays in their completion.

Difficulties in attracting and retaining a qualified work force were also evident. Total employment in light industry rose 4.2 percent in the 1970s—far below its 28-percent rise in the 1960s. About 80 percent of those employed are women. Average wages are the lowest among major branches of industry—in 1980, 80 percent of the all-industry average. Roughly half of all light industry workers are in the sewn goods subbranch, where wages are about 74 percent of the all-industry average and where the share of women is highest. Working conditions in the light industries are

poor, marked by hazardous machinery, excessive noise, high temperatures, tension, dust, and multiple shifts. As a consequence, the labor force is of relatively low quality and labor turnover is high.

It is not clear, however, that these chronic problems became worse in the 1970s. Shortages of labor were commonly cited as causes of production shortfalls in new and expanded enterprises. According to the Minister of Light Industry, in 1976-81, 21 to 22 percent of all new jobs in his plants were unfilled, as against 18 to 19 percent in industry as a whole. The Soviets are allocating considerable investment funds to improving working conditions in the factories, and recent government decrees have had a similar aim.

It has proved difficult to assess the contribution of raw materials availabilities to the reduced performance of light industry in the 1970s. Except in the case of flax for linen fabric, quantities of agricultural raw materials in themselves do not seem to have been a serious problem. Press accounts complain not so much about shortages as about the deteriorating quality of raw materials, particularly cotton. This requires textile plants to clean the fibers, reducing final output per ton procured and raising production costs. In the case of hides to be processed into leather, the press reported both quantitative shortages and poorer quality.

An evaluation of these data should take into account that, in general, the Soviets have been shifting slowly toward the use of synthetic fiber in cloth and artificial leather for shoes. With respect to raw materials purchased from the chemical industry, there were many allegations of shortages of synthetic fiber and thread, dyes, plastic materials for shoes, and tannin for leather.

The Soviets import sizable quantities of raw materials and semifabricates for the textile industry, notably wool, yarns and thread, and hides. The volume of these imports rose steadily during the 1970s, except for hides, purchases of which declined somewhat. Imports of synthetic yarn, negligible in 1970, grew rapidly, with those in 1980 almost double those in 1979. The Soviets export large amounts of cotton fiber. Despite widespread complaints about shortages of cotton fabrics at retail, cotton exports rose steadily throughout the 1970s in real terms.

Food Processing

Performance

Although its weight in total value added in industry is small (9.5 percent), the food branch contributed to the falloff in both production and productivity growth in industry in the 1970s, especially in 1976-80. Output declined in 1976-80 in four subbranches engaged in processing agricultural products—meat, sugar, vegetable oil, and fruit and vegetable processing.

The food processing branch comprises 10 subbranches. Calculations of input and productivity measures can be made for four of these, which together make up 48.1 percent of the branch weight. The results are given in table 13 along with those for the branch as a whole. The table shows output data alone for the six subbranches for which productivity measures cannot be obtained because of lack of data on labor and capital. The decline in growth of output in the 1970s occurred in all subbranches except bread. During 1976-80, two subbranches—flour and confectionery—improved somewhat, but otherwise performance deteriorated, sometimes badly.

Three of the four subbranches for which productivity calculations can be made had worse records during 1976-80 than did the food branch as a whole. (Productivity in these branches declined by 2.3 percent and in the six other branches by only 1.3 percent.) The slip in growth of output between 1971-75 and 1976-80 also was much greater in the four branches.

Growth of production picked up in 1981-82 to an average annual rate of 2.4 percent, and the decline in productivity slowed appreciably. The improved performance resulted in part from better harvests of fruits and vegetables and continued imports of grain and sugar.

Table 13
Performance of the Food Processing Branch

Percent

	Output			Inputs			Factor Productivity		
	1966-70	1971-75	1976-80	1966-70	1971-75	1976-80	1966-70	1971-75	1976-80
Total	5.8	3.9	1.1	4.8	3.6	3.0	1.0	0.3	−1.8
Fish	6.8	7.8	2.3	5.7	4.2	2.9	1.1	3.6	0.7
Meat	6.7	7.3	−0.8	5.4	5.0	3.5	1.2	2.3	−4.3
Dairy	9.8	4.0	1.1	5.9	4.7	3.5	3.9	−0.7	−2.5
Sugar	−1.5	0.4	−0.5	1.6	1.5	2.0	−3.1	−1.1	−2.5
Flour	3.4	0.4	2.0						
Bread	1.2	1.8	1.5						
Confectionary	4.6	2.3	3.5						
Vegetable oil	−0.1	3.5	−5.2						
Fruits and vegetables	7.9	6.6	−0.7						
Beverages	8.5	2.7	1.7						

Factors Influencing Performance

The large decline in production and productivity growth in 1976-82 had its origin in inadequate supplies of raw materials and a deterioration in their quality. Raw and auxiliary materials account for over 80 percent of food production costs, and about 70 to 75 percent of raw materials come from agriculture, directly or indirectly. Agricultural output changed little in 1976-80; and the first year of the period followed a disastrous harvest in 1975 that forced down output and productivity in the food branch in 1976.

To stave off an even worse decline in food processing, the government greatly increased imports of grain (to shore up meat production), sugar, and oilseeds. Even so, output declined in 1976-80 in the meat, sugar, and vegetable oil subbranches. The fish catch declined in 1976-80, mainly as a consequence of international restrictions on Soviet access to foreign waters. Reduced supplies of raw fruits and vegetables contributed to the drop in output in fruit and vegetable processing and to the large drop in growth of production of alcoholic beverages.

Compounding the problems with supplies of raw materials was the apparently worsening quality of many of them. Soviet sources provide evidence of a fall in the sugar content and general condition of sugar beets, the oil content of sunflower seeds, and the sugar content of grapes.

While battling raw-materials problems, the food processing branch had to adjust to a dramatic reduction in the growth of investment in 1976-80—a mere 3 percent more than in 1971-75—and to a campaign to concentrate new investment on reconstruction and recquipment of existing plants. This policy, coupled with the low priority of the branch, produced a large rise in unfinished construction and a large drop in additions to new capacities.

Numerous complaints about the domestically produced equipment provided to the branch suggest that efficiency was little enhanced by its installation in either new or old facilities. An industry spokesman stated in 1979, for example, that 45 to 50 percent of domestically produced equipment was obsolete when acquired. The branch also had considerable difficulty in assimilating imported equipment. Inadequate storage, refrigeration, and transport facilities were often cited as causes for large losses in both raw materials and finished products.

Employment expanded slowly in the 1970s, although a little faster in the second half. Its fairly stable growth despite wide fluctuations in output suggests that workers are kept on the payroll regardless of what is happening to production, with much underemployment. (The press reports large amounts of downtime due to interruptions in the flow of raw materials). Labor-hoarding is understandable in a branch whose wages are the second lowest in all of industry, where working conditions are often unpleasant, and where manual labor is prevalent. The food industry has low prestige as well, which helps to explain statements that labor shortages were the main cause of the slow assimilation of new capacities.

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Appendix B

Annual Percentage Growth in Output, Inputs, and Productivity in Soviet Industry, 1971-82

	1970 Weight	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Total industry													
Output	100.0	6.1	5.1	5.7	6.3	6.4	4.0	4.0	3.3	2.1	2.8	2.5	2.2
Inputs													
Labor	52.4	2.0	1.1	0.6	2.0	1.7	2.2	1.5	1.7	1.3	1.1	0.9	0.7
Capital	47.6	9.4	9.0	8.5	8.4	8.6	8.8	8.1	7.0	7.9	7.1	7.8	6.9
Total	100.0	5.5	4.8	4.2	4.9	4.9	5.3	4.6	4.2	4.4	3.9	4.1	3.6
Productivity													
Labor		4.0	4.0	5.1	4.3	4.7	1.7	2.5	1.6	0.7	1.7	1.6	1.5
Capital		3.1	-3.6	-2.4	-1.8	-2.0	-4.4	-3.7	-3.5	-5.4	-4.0	-4.9	-4.3
Total		0.6	0.3	1.5	1.3	1.5	-1.2	-0.5	-0.9	-2.2	-1.1	-1.6	-1.3
Ferrous metals													
Output	7.2	3.8	3.3	4.0	4.2	4.4	2.7	0.7	2.2	0.0	-0.5	-0.1	-0.9
Inputs													
Labor	51.7	0.0	-0.2	-0.4	1.1	0.0	1.4	0.3	-0.2	0.0	0.8	0.7	1.2
Capital	48.3	9.6	6.1	6.5	8.8	7.4	8.4	6.4	6.5	6.8	4.0	7.2	4.1
Total	100.0	4.5	2.8	2.9	4.7	3.5	4.7	3.2	3.0	3.2	2.3	3.8	2.6
Productivity													
Labor		3.8	3.6	4.4	3.1	4.5	1.3	0.4	2.5	0.0	-1.3	-0.8	-2.1
Capital		-5.3	-2.6	-2.3	-4.1	-2.8	-5.3	-5.3	-4.0	-6.4	-4.3	-6.8	-4.9
Total		-0.7	0.6	1.1	-0.5	0.9	-1.9	-2.4	-0.7	-3.1	-2.7	-3.7	-3.5
Nonferrous metals													
Output	3.9	7.2	5.4	6.1	6.2	4.6	2.9	2.6	2.1	2.4	1.4	1.3	0.8
Inputs													
Labor	51.7	0.1	-0.4	-0.2	0.9	0.1	1.3	0.3	-0.2	1.2	1.1	0.2	1.1
Capital	48.3	9.2	9.2	8.5	7.8	9.0	8.8	7.6	7.1	7.9	7.3	7.6	6.7
Total	100.0	4.4	4.1	3.9	4.2	4.3	4.9	3.8	3.3	4.4	4.1	3.7	3.8
Productivity													
Labor		7.1	5.9	6.3	5.2	4.5	1.6	2.2	2.2	1.2	0.3	1.0	-0.3
Capital		-1.9	-3.5	-2.2	-1.5	-4.1	-5.5	-4.7	-4.7	-5.2	-5.5	-5.9	-5.5
Total		2.6	1.3	2.1	1.9	0.3	-1.9	-1.2	-1.2	-1.9	-2.5	-2.4	-2.8

Annual Percentage Growth in Output, Inputs, and Productivity in Soviet Industry, 1971-82 (continued)

	1970 Weight	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Fuels													
Output	9.8	4.7	4.8	4.9	4.9	5.8	3.7	4.2	3.2	2.9	1.8	1.5	2.1
Inputs													
Labor	57.0	−0.6	−3.6	−2.2	−0.5	0.2	−1.3	−3.1	2.8	1.3	1.3	1.9	1.9
Capital	43.0	8.8	7.2	6.4	7.9	8.3	7.6	8.3	6.3	8.5	8.5	9.2	8.4
Total	100.0	3.3	1.2	1.4	3.0	3.6	2.4	1.6	4.3	4.4	4.4	5.0	4.6
Productivity													
Labor		5.3	8.1	7.3	5.4	5.6	5.1	7.6	0.4	1.5	0.4	−0.4	0.2
Capital		−3.7	−2.3	−1.4	−2.8	−2.3	−3.6	−3.8	−3.0	−5.2	−6.2	−7.0	−5.8
Total		1.4	3.5	3.4	1.8	2.1	1.3	2.5	−1.1	−1.4	−2.5	−3.3	−2.4
Electric power													
Output	6.8	8.1	7.1	6.8	6.7	6.6	6.9	3.6	4.7	2.9	4.5	2.5	3.0
Inputs													
Labor	39.0	2.3	0.3	0.2	2.0	2.7	1.6	2.2	2.3	3.0	2.4	1.5	2.3
Capital	61.0	10.0	8.0	8.2	6.8	6.4	6.7	6.4	5.3	6.3	5.9	6.1	5.3
Total	100.0	6.9	4.9	5.0	4.9	4.9	4.7	4.7	4.1	5.0	4.5	4.3	4.1
Productivity													
Labor		5.7	6.8	6.5	4.6	3.8	5.2	1.4	2.3	−0.1	2.1	0.9	0.7
Capital		−1.7	−0.8	−1.4	−0.2	0.2	0.2	−2.7	−0.6	−3.2	−1.4	−3.4	−2.1
Total		1.1	2.1	1.6	1.7	1.6	2.1	−1.1	0.9	−2.0	0.0	−1.7	−1.0
Machinery													
Output	31.4	8.2	7.3	8.0	8.1	8.4	5.7	5.7	5.0	4.3	4.1	3.4	3.8
Inputs													
Labor	69.9	3.4	2.3	2.9	3.3	3.1	1.9	2.1	2.2	2.0	1.0	0.9	0.5
Capital	30.1	12.6	10.0	10.0	9.9	10.5	9.5	11.2	8.9	9.7	8.5	9.1	7.9
Total	100.0	6.1	4.6	4.3	5.2	5.3	4.1	4.7	4.2	4.3	3.2	3.3	2.7
Productivity													
Labor		4.6	4.8	5.9	4.7	5.2	3.8	3.6	2.7	2.2	3.0	2.5	3.3
Capital		−3.9	−2.5	−1.8	−1.6	−1.9	−3.4	−4.9	−3.6	−4.9	−4.0	−5.2	−3.8
Total		2.0	2.5	3.5	2.8	3.0	1.5	1.0	0.8	0.0	0.9	0.1	1.1
Chemicals													
Output	6.3	8.1	6.7	9.0	9.5	9.7	4.8	5.2	3.6	−0.2	4.7	4.0	1.6
Inputs													
Labor	55.3	2.3	1.0	2.0	2.7	2.8	1.6	1.3	0.4	2.3	1.2	1.1	1.3
Capital	44.7	14.1	10.1	8.8	10.3	9.7	8.8	8.9	6.4	9.4	11.9	9.4	8.1
Total	100.0	7.4	5.0	5.0	6.0	5.8	4.8	4.7	3.0	5.4	5.9	4.7	4.3
Productivity													
Labor		5.7	5.6	6.9	6.6	6.7	3.2	3.9	3.2	−2.5	3.5	2.9	0.3
Capital		−5.3	−3.1	0.2	−0.7	0.0	−3.7	−3.4	−2.7	−8.8	−6.4	−5.0	−6.0
Total		0.6	1.6	3.9	3.3	3.7	0.0	0.5	0.5	−5.3	−1.1	−0.7	−2.6

Annual Percentage Growth in Output, Inputs, and Productivity in Soviet Industry, 1971-82 (continued)

	1970 Weight	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982*
Wood, pulp, and paper													
Output	7.7	2.8	2.0	2.7	1.8	3.6	−0.1	0.3	−0.4	−2.9	1.7	2.3	1.4
Inputs													
Labor	69.5	−0.2	−1.2	−1.0	−0.2	−0.3	−0.3	−0.2	−0.6	0.0	−0.7	0.8	0.0
Capital	30.5	9.5	7.1	8.8	8.1	8.1	6.4	7.1	6.6	6.7	5.8	7.2	5.1
Total	100.0	2.7	1.3	1.9	2.3	2.2	1.7	1.9	1.5	2.0	1.3	2.7	1.5
Productivity													
Labor		3.0	3.2	3.7	2.0	3.9	0.3	0.6	0.2	−2.9	2.3	1.5	1.4
Capital		−6.1	−4.8	−5.6	−5.8	−4.1	−6.0	−6.3	−6.5	−9.0	−3.9	−4.6	−3.6
Total		0.1	0.7	0.8	−0.5	1.4	−1.7	−1.6	−1.9	−4.8	0.4	−0.4	0.2
Construction materials													
Output	6.5	6.5	5.1	6.1	4.8	4.6	3.7	3.1	3.3	−4.6	0.5	1.4	−1.4
Inputs													
Labor	66.5	2.6	0.8	0.3	1.7	1.4	1.3	0.3	1.1	0.8	0.6	−0.2	0.0
Capital	33.5	11.6	9.0	11.5	9.1	7.3	8.3	7.2	7.6	6.6	5.1	5.6	5.0
Total	100.0	5.5	3.5	3.9	4.1	3.4	3.6	2.6	3.2	2.7	2.1	1.7	1.6
Productivity													
Labor		3.8	4.3	5.8	3.1	3.2	2.4	2.8	2.1	−5.3	−0.1	1.6	−1.4
Capital		−4.6	−3.6	−4.8	−4.0	−2.5	−4.2	−3.8	−4.0	−10.5	−4.4	−4.0	−6.1
Total		0.9	1.6	2.1	0.6	1.2	0.1	0.5	0.0	−7.1	−1.6	0.3	3.0
Light industry													
Output	8.9	4.5	0.7	2.8	2.6	2.9	4.1	2.5	2.6	1.8	2.3	1.9	−0.1
Inputs													
Labor	68.3	1.0	−1.1	−0.3	0.9	−0.2	2.4	0.4	−0.2	−0.1	0.6	−0.1	−0.9
Capital	31.7	10.5	7.8	9.6	8.8	6.7	5.7	7.1	6.1	7.3	5.4	6.5	6.5
Total	100.0	3.9	1.6	2.7	3.3	2.0	3.4	2.5	1.8	2.2	2.1	1.9	1.4
Productivity													
Labor		3.5	1.9	3.2	1.7	3.0	1.7	2.2	2.8	1.8	1.7	2.0	0.8
Capital		−5.4	−6.5	−6.2	−5.6	−3.6	−1.4	−4.3	−3.3	−5.2	−2.9	−4.3	−6.2
Total		0.6	−0.9	0.1	−0.7	0.9	0.7	0.1	0.8	−0.4	0.2	0.0	−1.5
Food processing													
Output	9.5	2.5	3.3	0.8	7.9	5.2	−1.2	4.0	−1.1	3.1	0.7	1.9	2.8
Inputs													
Labor	53.8	1.2	0.4	−0.2	1.7	0.4	0.5	1.5	−0.1	0.7	0.7	0.6	0.3
Capital	46.2	5.0	7.2	7.1	8.8	7.3	6.8	6.4	5.0	5.1	5.4	6.2	5.2
Total	100.0	2.9	3.5	3.1	4.9	3.5	3.3	3.7	2.2	2.7	2.9	3.2	2.6
Productivity													
Labor		1.3	2.8	0.9	6.1	4.7	−1.6	2.5	−1.0	2.4	0.0	1.7	2.5
Capital		−2.4	−1.7	−6.0	−0.7	−1.9	−7.4	−2.2	−5.8	−1.9	−4.5	−4.0	−2.4
Total		−0.4	−0.2	−2.3	2.9	1.6	−4.4	0.3	−3.2	0.4	−2.1	−1.2	0.2

* Preliminary