Modern apartment building, Frunze, Kirgiz Republic
Courtesy Jimmy Pritchard

Precise information concerning wages, including the level of the minimum wage, was not publicly available in the late 1980s. Western analysts did not agree on the size of wage differentials, although these differences were generally considered to be smaller than was the case in the West. According to Western estimates, however, important party and government personages received as much as five times the average salary. Outstanding scientists and selected intellectuals also prospered.

The average worker received fringe benefits totaling about 30 percent above and beyond his or her salary. These benefits included free education and health care, paid vacations, and other government-subsidized services. In addition to wages, the regime used other incentives, such as cash bonuses paid to both individuals and groups of workers and "socialist competitions," to spur the work force on to greater efforts.

Economic Policy

Socialist theory provides no practical guidelines or objective criteria for determining priorities for the various economic sectors and ensuring balanced growth of the entire economy. The direction of economic development depends upon decisions made by planners on the basis of their evaluation of the country's needs, taking

into account political, military, and other noneconomic considerations.

Past Priorities

The Bolsheviks (see Glossary), who assumed power in late 1917, sought to mold a socialist society from the ruins of old tsarist Russia. This goal was ambitious and somewhat vague; Karl Marx and Friedrich Engels, who developed Marxism (see Glossary), provided no blueprints for specific economic policies and targets. Chaotic conditions produced by World War I and subsequent struggles during the Civil War (1918–21) made pursuit of coherent policies difficult in any case. The economic policies initially adopted by the regime were a mixture of principle and expedience.

Soon after taking power, the regime published decrees nationalizing the land, most industry (all enterprises employing more than five workers), foreign trade, and banking. At the same time, for tactical reasons, the government acquiesced in the peasants' seizure of land, but the new leaders considered the resulting fragmented parcels of privately owned land to be inefficient.

Beginning in 1918, the government made vigorous but somewhat haphazard efforts to shape and control the country's economy under a policy of war communism (see Glossary). But in 1920, agricultural output had attained only half its prewar level, foreign trade had virtually ceased, and industrial production had fallen to a small fraction of its prewar quantity. Such factors as the disastrous harvest of 1920, major military actions and expenditures by the Red Army, and general wartime destruction and upheaval exacerbated the economy's problems.

In 1921 Vladimir I. Lenin called a temporary retreat from application of the ideological requirements of Marxist doctrine. His new approach, called the New Economic Policy (NEP), permitted some private enterprise, especially in agriculture, light industry, services, and internal trade, to restore prewar economic strength. The nationalization of heavy industry, transportation, foreign trade, and banking that had occurred under war communism remained in effect.

In the late 1920s, Stalin abandoned NEP in favor of centralized planning, which was modeled on a project sponsored by Lenin in the early 1920s that had greatly increased the generation of electricity. Stalin sought to rapidly transform the Soviet Union from a predominantly agricultural country into a modern industrial power. He and other leaders argued that by becoming a strong centrally planned industrial power, the country could protect itself militarily from hostile outside intervention and economically from

the booms and slumps characteristic of capitalism (see Industrialization and Collectivization, ch. 2).

The First Five-Year Plan (1928–32) focused rather narrowly upon expansion of heavy industry and collectivization of agriculture. Stalin's decision to carry out rapid industrialization made capital-intensive techniques necessary. International loans to build the economy were unavailable, both because the new government had repudiated the international debts of the tsarist regime and because industrialized countries, the potential lenders, were themselves coping with the onset of the Great Depression in the early 1930s. Stalin chose to fund the industrialization effort through internal savings and investment. He singled out the agricultural sector in particular as a source of capital accumulation.

The First Five-Year Plan called for collectivization of agriculture to ensure the adequacy and dependability of food supplies for the growing industrial sector and the efficient use of agricultural labor to free labor power for the industrialization effort. The regime also expected collectivization to lead to an overall increase in agricultural production. In fact, forced collectivization resulted in much hardship for the rural population and lower productivity. By 1932 about 60 percent of peasant households had joined state farms or collective farms. During the same period, however, total agricultural output declined by 23 percent, according to official statistics. Heavy industry exceeded its targets in many areas during the plan period. But other industries, such as chemicals, textiles, and housing and consumer goods and services, performed poorly. Consumption per person dropped, contrary to the planned rates of consumption.

The Second Five-Year Plan (1933–37) continued the primary emphasis on heavy industry. By the late 1930s, however, collectivized farms were performing somewhat better (after reaching a nadir during the period 1931–34). In 1935 a new law permitted individual peasants to have private plots, the produce of which they could sell on the open market. According to official statistics, during the Second Five-Year Plan gross agricultural production increased by just under 54 percent. In contrast, gross industrial production more than doubled.

The Third Five-Year Plan (1938–41) projected further rapid industrial growth. The government soon altered the plan, however, in an attempt to meet the growing danger of war, devoting increasing amounts of resources to armaments. When the country went to war with Finland (1939–40), serious disruptions occurred in the Soviet transportation system. Nonetheless, during these years the economy benefited from the absorption of Estonia, Latvia,

Lithuania, Bessarabia, and the eastern part of Poland and from the growing trade with Germany that resulted from the 1939 Nazi-Soviet Nonaggression Pact (see Glossary; Prelude to War, ch. 2).

After the German invasion of 1941, damage to the economy in both human and material terms was devastating. The regime virtually abandoned the Third Five-Year Plan as it sought to mobilize human and material resources for the war effort. During World War II, an increasing proportion of products and materials were allocated centrally, and Gosplan took over more of the balancing and allocation plans. Wartime economic plans did not officially replace the traditional planning process but were simply superimposed as needed to cover activities and goods essential to the war effort (see The Great Patriotic War, ch. 2).

The Fourth Five-Year Plan began in 1945. During the early years of the period, attention focused on repair and rebuilding, with minimal construction of new facilities. Repair work proceeded briskly, with spectacular results. The country received no substantial aid for postwar reconstruction, Stalin having refused to consider proposals for participation in the Marshall Plan (see Glossary) in 1947. Hungary, Bulgaria, Romania, and especially defeated Germany made reparations payments to the Soviet Union, however, consisting in large part of equipment and industrial materials. Entire German factories and their workers were brought to the Soviet Union to train Soviet citizens in specialized work processes. Although the government never published definitive statistics, an authoritative Western assessment estimated the value of reparations at an average of 5 billion rubles per year between 1945 and 1956. The exertions of the country's inhabitants, however, coupled with ambitious economic strategies, proved most crucial for the recovery.

During the war years, the government had transferred substantial numbers of industrial enterprises from threatened western areas to Asian regions of the country. After the war, these facilities remained at their new sites as part of an effort to promote economic development. These locations had the advantage of being near raw materials and energy sources. The government also deemed it strategically sound to have the important installations of the country distributed among several regions.

Like earlier plans, the Fourth Five-Year Plan stressed heavy industry and transportation. The economy met most of the targets in heavy industry. The performance of agriculture again lagged behind industry. Western observers believed that factors in agriculture's poor performance included a paucity of investment, enforcement of a strict quota system for delivery of agricultural products

to the state, and tenuous linkage between wages and production, which deprived farmers of incentives. Housing construction, community services, and other consumer items also lagged noticeably. During the final years of the plan, Stalin launched several grandiose projects, including building canals and hydroelectric plants and establishing tree plantations in the Armenian, Azerbaydzhan, Georgian, and Ukrainian republics and in the Volga River area of the Russian Republic to shield land from drying winds. Collectively, these efforts were referred to as "the Stalin plan for the transformation of nature."

Throughout the Stalin era, the pace of industrial growth was forced. On those occasions when shortages developed in heavy industry and endangered plan fulfillment, the government simply shifted resources from agriculture, light industry, and other sectors. The situation of the consumer improved little during the Stalin years as a whole. Major declines in real household consumption occurred during the early 1930s and in the war years. Although living standards had rebounded after reaching a low point at the end of World War II, by 1950 real household consumption had climbed to a level only one-tenth higher than that of 1928. Judged by modern West European standards, the clothing, housing, social services, and diet of the people left much to be desired.

Although Stalin died in 1953, the Fifth Five-Year Plan (1951–55) as a whole reflected his preoccupation with heavy industry and transportation, the more so because no single leader firmly controlled policy after Stalin's death (see Collective Leadership and the Rise of Khrushchev, ch. 2). In many respects, economic performance pleased the leadership during the period. According to government statistics (considered by Western observers to be somewhat inflated), the economy met most growth targets, despite the allocation of resources to rearmament during the Korean War (1950–53). National income increased 71 percent during the plan period. As in previous plans, heavy industry received a major share of investment funds. During the final years of the Fifth Five-Year Plan, however, party leaders began to express concern about the dearth of consumer goods, housing, and services, as they reassessed traditional priorities. The new prime minister, Georgii M. Malenkov, sponsored a revision of the Fifth Five-Year Plan, reducing expenditures for heavy industry and the military somewhat in order to satisfy consumer demand. The newly appointed first secretary (see Glossary) of the party, Khrushchev, launched a program to bring under cultivation extensive tracts of virgin land in southwestern Siberia and the Kazakh Republic to bolster fodder and livestock production. Although Malenkov lost his position as prime minister in 1955, largely as a

result of opposition to his economic policies, the austere approach of the Stalin era was never revived.

An ambitious Sixth Five-Year Plan was launched in 1956. After initial revision, prompted at least in part by political considerations, the regime abandoned the plan in 1957 to make way for a seven-year plan (subsequently reduced to a five-year plan) that focused particularly on coal and oil production and the chemical industry. Khrushchev, who became principal leader after 1956, took particular interest in these areas of production. The seven-year plan provided substantial investment funds—over 40 percent of the total—for the eastern areas of the country. Khrushchev also sponsored reforms to encourage production on the private plots of collective farmers.

During the seven-year plan, industrial progress was substantial, and production of consumer durables also grew. The national income increased 58 percent, according to official statistics. Gross industrial production rose by 84 percent, with producer goods up 96 percent and consumer goods up 60 percent. Growth rates slowed noticeably during the final years of the plan, however. Party leaders blamed Khrushchev's bungling efforts to reform the centralized planning system and his tendency to overemphasize programs in one economic sector (such as his favorite, the chemical industry) at the expense of other sectors (see Reforming the Planning System, this ch.). Agriculture's performance proved disappointing in the 1960s; adverse weather in 1963 and 1965, as well as Khrushchev's interference and policy reversals, which confused and discouraged the peasants' work on their private plots, were contributing factors. Khrushchev's economic policies were a significant, although not sole, reason for his dismissal in October 1964.

The Eighth Five-Year Plan (1966–70), under the leadership of Khrushchev's successor as party head, Brezhnev, chalked up respectable growth statistics: national income increased 41 percent and industrial production 50 percent, according to government statistics. Growth in producer goods (51 percent) outpaced that in consumer goods (49 percent) only slightly, reflecting planners' growing concern about the plight of consumers. During the late 1960s, Brezhnev raised procurement prices for agricultural products, while holding constant retail prices for consumers. Agriculture thus became a net burden on the rest of the economy. Although production increased, the sector's performance remained unsatisfactory. The country had to import increasing amounts of grain from the West.

In the Ninth Five-Year Plan (1971–75), a slowdown in virtually all sectors became apparent (see The Economy, ch. 2). National

income grew only 28 percent during the period, and gross industrial production increased by 43 percent. The 37 percent growth rate for the production of consumer goods was well below the planned target of 45.6 percent. Problems in agriculture grew more acute during the period. The gap between supply and demand increased, especially for fodder.

Results for the Tenth Five-Year Plan (1976–80) were even more disappointing. National income increased only 20 percent and gross industrial production only 24 percent. The production of consumer goods grew a meager 21 percent. Western observers rated the growth of the country's gross national product (GNP—see Glossary) at less than 2 percent in the late 1970s.

For Soviet leaders, the modest growth rates were a perplexing problem. The ability to maintain impressive growth rates while providing full employment and economic security for citizens and an equitable distribution of wealth had always been one area in which supporters of the Soviet system had argued that it was superior. Soviet leaders could point to many achievements; by virtually any standard, the gap between the Soviet economy and the economies of other major industrialized powers had narrowed during the years of Soviet rule. Throughout the early decades of the economy's development, plans had emphasized large, quick additions of labor, capital, and materials to achieve rapid, "extensive" growth.

By the 1970s, however, prospects for extensive growth were limited. During the 1960s, the Soviet Union had shown the fastest growth in employment of all major industrial countries, and the Soviet Union together with Japan had boasted the most rapid growth of fixed capital stock. Yet Soviet growth rates in productivity of both labor and capital had been the lowest. In the 1970s, the labor force grew more slowly. Drawing on surplus rural labor was no longer possible, and the participation of women in the work force was already extensive. Furthermore, the natural resources required for extensive growth lay in areas increasingly difficult, and expensive, to reach. In the less-developed eastern regions of the country, development costs exceeded those in the European parts by 30 percent to 100 percent. In the more developed areas of the country, the slow rate at which fixed assets were retired was becoming a major problem; fixed assets remained in service on average twice as long as in Western economies, reducing overall productivity. Nevertheless, in the late 1970s some Western analysts estimated that the Soviet Union had the world's second largest economy, and its GNP continued to grow in the 1980s (see table 31, Appendix A).

Serious imbalances characterized the economy, however, and the Soviet Union lagged behind most Western industrialized nations in the production of consumer goods and services. A stated goal of Soviet policy had always been to raise the material living standards of the people. Considerable progress had been made; according to Western estimates (less flattering than Soviet), from 1950 and 1980 real per capita consumption increased 300 percent. The country's leaders had devoted the bulk of the available resources to heavy industry, however, particularly to "production of the means of production." Levels of consumption remained below those of major capitalist countries and most of the socialist countries of Eastern Europe. By the late 1970s, policy makers had recognized the need to improve productivity by emphasizing quality factors, efficiency, and advanced technology and tapping "hidden production reserves" in the economy.

Concern about productivity characterized the Eleventh Five-Year Plan (1981–85). The targets were rather modest, and planners reduced even those after the first year of the period. Achievements remained below target. The plan period as a whole produced a modest growth rate of 3 to 4 percent per year, according to official statistics. National income increased only 17 percent. Total industrial output grew by 20 percent, with the production of consumer goods increasing at a marginally higher rate than producer goods. Agricultural output registered a meager 11.6 percent gain.

The Twelfth Five-Year Plan, 1986–90

When Gorbachev attained power in 1985, most Western analysts were convinced that Soviet economic performance would not improve significantly during the remainder of the 1980s. "Intensification" alone seemed unlikely to yield important immediate results. Gorbachev tackled the country's economic problems energetically, however, declaring that the economy had entered a "pre-crisis" stage. The leadership and the press acknowledged shortcomings in the economy with a new frankness.

Restating the aims of earlier intensification efforts, the *Basic Directions for the Economic and Social Development of the USSR for 1986–1990 and for the Period to the Year 2000* declared the principal tasks of the five-year plan period to be "to enhance the pace and efficiency of economic development by accelerating scientific and technical progress, retooling and adapting production, intensively using existing production potential, and improving the managerial system and accounting mechanism, and, on this basis, to further raise the standard of living of the Soviet people." A major part of the planned increase in output for the 1986–90 period was to result from the

Privately owned café, Moscow
Courtesy Irene Steckler

introduction of new machinery to replace unskilled labor. New, advanced technologies, such as microprocessors, robots, and various computers, would automate and mechanize production. Obsolete equipment was to be retired at an accelerated rate. Industrial operations requiring high energy inputs would be located close to energy sources, and increasing numbers of workplaces would be in regions with the requisite manpower resources. Economic development of Siberia and the Soviet Far East would continue to receive special attention.

Gorbachev tackled the problem of laxness in the workplace and low worker productivity (or, as he phrased it, the "human factor") with great vigor. This attention to individual productivity and discipline resulted in the demotion or dismissal of influential older officials who had proved to be corrupt or ineffective. Gorbachev called for improved motivation among rank-and-file workers and launched a vigorous antialcohol campaign (also a priority under Andropov).

At the Central Committee plenum in January 1987, Gorbachev demanded a fundamental reassessment of the role of the government in Soviet society. His economic reform program was sweeping, encompassing an array of changes. For example, it created a new finance system through which factories would obtain loans

at interest, and it provided for the competitive election of managers (see Reforming the Planning System, this ch.). These changes proceeded from Gorbachev's conviction that a major weakness in the economy was the extreme centralization of economic decision making, inappropriate under modern conditions. According to Abel Aganbegian, an eminent Soviet economist and the principal scholarly spokesman for many of Gorbachev's policies, the Soviet Union was facing a critical decision: "Either we implement radical reform in management and free driving forces, or we follow an evolutionary line of slow evolution and gradual improvement. If we follow the second direction, . . . we will not achieve our goals." The country was entering "a truly new period of restructuring, a period of cardinal breakthroughs," he said, at the same time stressing the leadership's continuing commitment to socialism.

In one of his most controversial policy decisions, Gorbachev moved to encourage private economic activities and cooperative ventures. The action had clear limits, however. It established a progressive tax on profits, and regulations limited participation mainly to students, retired persons, and housewives. Full-time workers could devote only their leisure hours to private activities. Cooperatives that involved at least three people could engage in a broad range of consumer-oriented activities: using private automobiles as taxis, opening private restaurants, offering private medical care, repairing automobiles or appliances, binding books, and tailoring. In addition, the reform encouraged state enterprises to contract with private individuals for certain services. Other regulations gave official approval to the activities of profit-oriented contract brigades. These brigades consisted of groups of workers in an enterprise or collective farm who joined together to make an internal contract with management for performance of specific tasks, receiving compensation in a lump sum that the brigade itself distributed as it saw fit. Additional decrees specified types of activities that remained illegal (those involving "unearned income") and established strict penalties for violators. The new regulations legitimized major portions of the second economy and permitted their expansion. No doubt authorities hoped that the consuming public would reap immediate, tangible benefits from the changes. Authorities also expected these policies to encourage individuals who were still operating illegally to abide by the new, more lenient regulations.

In keeping with Gorbachev's ambitious reform policies, the specific targets of the Twelfth Five-Year Plan (1986–90) were challenging. The targets posited an average growth rate in national income of about 4 percent yearly. To reach this goal, increases in

labor productivity were to average 4 percent annually, a rate that had not been sustained on a regular basis since the early 1970s. The ratio of expenditure on material inputs and energy to national income was to decrease by 4 to 5 percent in the plan period. Similar savings were projected for other aspects of the economy.

The plan stressed technical progress. Machine-building output was to increase by 40 to 45 percent during the five-year period. Those sectors involved in high technology were to grow faster than industry as a whole. The production of computers, for example, was to increase 2.4 times during the plan period. Growth in production of primary energy would accelerate during the period, averaging 3.6 percent per year, compared with 2.6 percent actual growth per year for 1981–85. The plan called for major growth in nuclear power capacity. (The Chernobyl' accident of 1986 did not alter these plans.)

Capital investment was to grow by 23.6 percent, whereas under the Eleventh Five-Year Plan the growth rate had been only 15.4 percent. Roughly half of the funds would be used for the retooling necessary for intensification. The previous plan had earmarked 38 percent for this purpose. Agriculture would receive large investments as well.

The plan called for a relatively modest improvement in the standard of living. The share of total investment in services was to rise only slightly, although the proportion of the labor force employed in services would continue to grow.

The regime also outlined very ambitious guidelines for the fifteen-year period beginning in 1986. The guidelines called for a 5 percent yearly growth in national income; national income was projected to double by the year 2000. Labor productivity would grow by 6.5 to 7.4 percent per year during the 1990s. Projected modernization of the workplace would release 20 million people from unskilled work by the year 2000. Plans called for increasingly efficient use of fuels, energy, raw materials, metal, and other materials. The guidelines singled out the provision of "practically every Soviet family" with separate housing by the beginning of the twenty-first century as a special, high-priority task.

Results of the first year of the Twelfth Five-Year Plan, 1986, were encouraging in many respects. The industrial growth rate was below target but still respectable at just above 3 percent. Agriculture made a good showing. During 1987, however, GNP grew by less than 1 percent, according to Western calculations, and industrial production grew a mere 1.5 percent. Some problems were the result of harsh weather and traditional supply bottlenecks. In

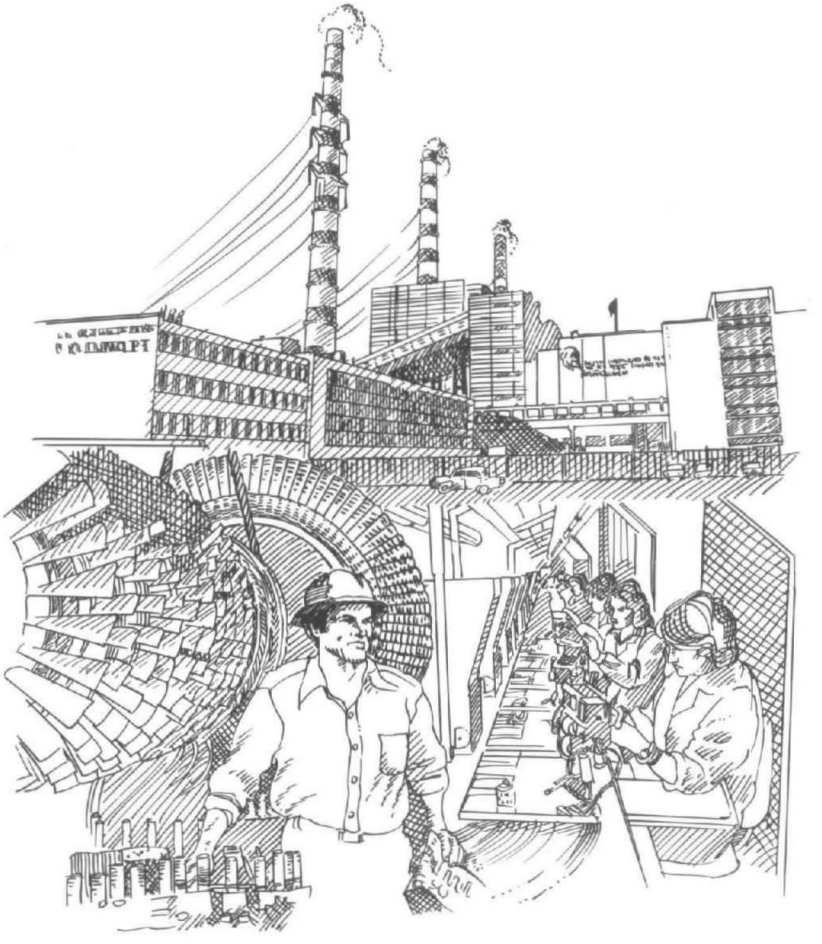
addition, improvements in quality called for by Gorbachev proved difficult to realize; in 1987, when the government introduced a new inspection system for output at a number of industrial enterprises, rejection rates were high, especially for machinery.

Many of Gorbachev's reforms that immediately affected the ordinary working person—such as demands for harder work, more rigid quality controls, better discipline, and restraints on traditionally high alcohol consumption—were unlikely to please the public, particularly since the rewards and payoffs of most changes were likely to be several years away. As the Nineteenth Party Conference of 1988 demonstrated, party leaders continued to debate the pace and the degree of change. Uncertainty about the extent and permanence of reform was bound to create some disarray within the economy, at least for the short term. Western analysts did not expect Gorbachev's entire program to succeed, particularly given the lackluster performance of the economy during the second year of the Twelfth Five-Year Plan. The meager results of past reform attempts offered few grounds for optimism. But most observers believed that at least a portion of the reforms would be effective. The result was almost certain to benefit the economy.

* * *

The economic reforms of the mid-1980s have attracted the attention of many Western observers. As a result, English-language sources of information about the new measures are plentiful. An especially useful compendium of reports about the changes is *Gorbachev's Economic Plans,* produced by the United States Congress. An earlier collection of reports submitted to the United States Congress, entitled *The Soviet Economy in the 1980s,* remains useful. Valuable analyses of the "traditional," pre-reform Soviet economy, still essential for an understanding of the nature and extent of the reforms of the mid- and late 1980s, may be found in *The Soviet Economy,* edited by Abram Bergson and Herbert S. Levine, and in *Modern Soviet Economic Performance* by Trevor Buck and John Cole. For ongoing observation and commentary on the changing economic scene, the interested reader may consult current issues of the periodicals *Soviet Studies* and *Soviet Economy* as well as relevant issues of the Joint Publications Research Service. For earlier development of the Soviet economy, standard works such as Maurice Dobb's *Soviet Economic Development since 1917* and Alec Nove's *An Economic History of the U.S.S.R.* remain indispensable. (For further information and complete citations, see Bibliography.)

Chapter 12. Industry



Aspects of industry

SINCE THE BOLSHEVIK REVOLUTION of 1917, industry has been officially the most important economic activity in the Soviet Union and a critical indicator of its standing among the nations of the world. Compared with Western countries, a very high percentage of the Soviet population works in the production of material goods. The Communist Party of the Soviet Union (CPSU) considers constant growth in heavy industry vital for national security, and its policy has achieved several periods of spectacular growth. However, industrial growth has been uneven, with notable failures in light and consumer industries, and impressive statistics have often concealed failures in individual branches. And, in the late 1980s, reliable statistics continued to be unavailable in some areas and unreliable in others.

The Soviet Union is blessed with more essential industrial resources than any other nation. Using the most accessible of those materials, industries such as textiles and metallurgy have thrived since the 1600s. Large industrial centers developed almost exclusively in the European part of the country. Examples of such centers are the Donbass (see Glossary), the Moscow industrial area, and the Kursk and Magnitogorsk metallurgical centers, all of which are still in full operation. But intense industrial activity eventually exhausted the most accessible resource materials. In the late twentieth century, reserves have been tapped in the adjacent regions, especially the oil and gas fields of western Siberia. Most of the remaining reserves are outside the European sector of the country, presenting planners with the formidable task of bridging thousands of kilometers to unite raw materials, labor, energy, and centers of consumption. The urgency of industrial location decisions has grown as production quotas have risen in every new planning period. Moreover, the nature and location of the Soviet labor force presents another serious problem for planners.

Joseph V. Stalin's highly centralized industrial management system survived into the late 1980s. Numerous councils, bureaus, and committees in Moscow traditionally approved details of industrial policies. The slow reaction time of such a system was adequate for the gradual modernization of the 1950s, but the system fell behind the faster pace of high-technology advancement that began in the 1960s. Soviet policy has consistently called for "modernization" of industry and use of the most advanced automated equipment—especially because of the military significance of high technology.

Although policy programs identified automation as critical to all Soviet industry, the civilian sector generally has lagged in the modernization campaign. The priority given to the military-industrial sector, however, not only prevented the growth that planners envisioned but also caused the serious slowdown that began around 1970. In a massive effort to restructure the system under *perestroika* (see Glossary), planners have sought ways to speed decision making to meet immediate industrial needs by finding shortcuts through the ponderous industrial bureaucracy.

Another strain on the industrial system has been the commitment to improving production of consumer goods. Nikita S. Khrushchev, first secretary (see Glossary) of the CPSU in the late 1950s and early 1960s, initially tried to temper the Stalinist priority of heavy industry. Khrushchev's idea was followed with varying degrees of enthusiasm; it became more binding as consumers learned about Western standards of living and as officials began stating the goal more forcefully in the 1980s.

Development of Soviet Industry

Russian industrial activity began before 1700, although it was limited to metal-working and textile factories located on feudal estates and required some help from English and Dutch advisers. The largest industrial concerns of the seventeenth century were owned by the Stroganov trading family. In the first quarter of the eighteenth century, Peter the Great applied Western technology more widely to establish larger textile, metallurgical, and naval plants for his military ventures. This first centralized plan for Russian industrialization built some of the largest, best-equipped factories of the time, using mostly forced peasant labor. After a decline in the middle of the eighteenth century, Russian industry received another injection of Western ideas and centralized organization under Catherine the Great. Under Catherine, Russia's iron industry became the largest in the world.

Another major stage in Russian industry began with the emancipation of the serfs in 1861, creating what would eventually become a large industrial labor force. When he became tsar in 1881, Alexander III used this resource in a new, large-scale industrialization program aimed at finally changing Russia from a primarily agricultural country into a modern industrial nation. Lasting until 1914, the program depended on massive assistance from western Europe. From 1881 to 1914, the greatest expansion occurred in textiles, coal, and metallurgy, centered in the Moscow area and the present-day Ukrainian Republic (see fig. 1). But compared with

the West, major industrial gaps remained throughout the prerevolutionary period.

Beginning in 1904, industry was diverted and disrupted by foreign wars, strikes, revolutions, and civil war. After the Civil War (1918–21), the victorious Bolsheviks (see Glossary) fully nationalized industry; at that point, industrial production was 13 percent of the 1913 level. To restart the economy, in 1921 Vladimir I. Lenin introduced the New Economic Policy (NEP—see Glossary), which returned light industry to private enterprise but retained government control over heavy industry. By 1927 NEP had returned many industries to their prewar levels. Under Stalin, the First Five-Year Plan began in 1928. This planning system brought spectacular industrial growth, especially in capital investment. More important, it laid the foundation for centralized industrial planning, which continued into the late 1980s. Heavy industry received much greater investment than light industry throughout the Stalin period. Although occasional plans emphasized consumer goods more strongly, considerations of national security usually militated against such changes.

Industry was again diverted and displaced by World War II, and many enterprises moved permanently eastward, into or beyond the Ural Mountains. Postwar recovery was rapid as a result of the massive application of manpower and funds. Heavy industry again grew rapidly through the 1960s, especially in fuel and energy branches. But this growth was followed by a prolonged slowdown beginning in the late 1960s. Successive five-year plans resulted in no substantial improvement in the growth rate of industrial production (see table 32, Appendix A). Policy makers began reviewing the usefulness of centralized planning in a time of advanced, fast-moving technology. By 1986 General Secretary Mikhail S. Gorbachev was making radical suggestions for restructuring the industrial system.

Industrial Resources

Although plentiful raw materials and labor are available to Soviet industrial planners, geographic factors are especially important in determining how these resources are used. Because the main resources are available in an uneven pattern, industrial policy has produced uneven results. Innovative recombination of labor, fuels, and other raw materials has had some success but has also met substantial resistance.

Raw Materials

In 1980 the Soviet Union produced about 20 percent of total world industrial output, and it led the world in producing oil, cast

iron, steel, coke, mineral fertilizers, locomotives, tractors, and cement. This leadership was based on self-sufficiency in nearly all major industrial raw materials, including iron ore, most nonferrous metals, solid and liquid fuels, water power, and minerals. The country has at least some reserves of every industrially valuable nonfuel mineral, although tin, tungsten, and mercury are present only in small quantities and bauxite is imported for the aluminum industry. Despite these material advantages, the country's geography hinders exploitation. Large portions of the remaining coal, oil, natural gas, metal ores, and minerals are located in inaccessible regions with hostile climates.

Geographic Location Factors

Historically, Soviet industry has been concentrated in the European sector, where intensive development has depleted critical resources. Examples of severely reduced resources in the older industrial regions are the Krivoy Rog and Magnitogorsk iron deposits and the Donbass coal area, upon which major industrial complexes were built. Long before the German invasion of 1941, Soviet industrial policy looked eastward into Siberia and Soviet Central Asia to expand the country's material base. According to a 1977 Soviet study, 90 percent of remaining energy resources (fuels and water power) are east of the Urals; however, 80 percent of industry and nearly 80 percent of all energy requirements are in the European part of the Soviet Union. Since 1917 an official policy goal has been to bring all Soviet regions to a similar level of economic development. Periodically, leaders have proclaimed the full achievement of this goal. But in a country of extremely diverse climates, nationalities, and natural resources, such equality remains only a theoretical concept. Industrial expansion has meant finding ways to join raw materials, power, labor, and transportation at the same place and in suitable proportions. For example, many eastern regions have abundant resources, but the labor supply either is too small or is culturally disinclined to work in modern industry (see Distribution and Density, ch. 3).

The Territorial Production Complexes and Geographic Expansion

One Soviet answer to the problem of the location of industry has been the concept of the territorial production complex, which groups industries to efficiently share materials, energy, machinery, and labor. Although plans call for such complexes (see Glossary) in all parts of the Soviet Union, in the late 1980s the most fully developed examples were chiefly to the east of the Urals or in the Far North; many were in remote areas of Siberia or the Soviet Far

Park in Moscow with a permanent exhibition praising the economic achievements of the Soviet people
Courtesy Irene Steckler

East. The complexes vary in size and specialization, but most are based near cheap local fuel or a hydroelectric power source. An example is the South Yakut complex, halfway between Lake Baykal and the Pacific Ocean. This industrial center is based on rich deposits of iron and coking coal, the key resources for metallurgy. Oil and natural gas deposits exist not far to the north, and the area is connected with the Trans-Siberian Railway and the Baikal-Amur Main Line. An entirely new city, Neryungri, was built as an administrative center, and a number of auxiliary plants were designed to make the complex self-sufficient and to support the iron- and coal-mining operations. The temperature varies by 85°C from winter to summer, the terrain is forbidding, and working conditions are hazardous. But considering that the alternative is many separate, isolated industrial sites with the same conditions, the territorial production complex seems a rational approach to reach the region's resources. Integrating several industries in a single complex requires cooperation among many top-level Soviet bureaucracies, but in the early 1980s the lack of such cooperation delayed progress at centers such as the South Yakut complex.

Starting in the 1960s, the government pursued large-scale incentive programs to move workers into the three main Soviet

undeveloped regions: Siberia, Central Asia, and the Far East. Such programs justified bonuses for workers by saving the cost of transporting raw materials to the European sector. At the same time, some policy makers from other parts of the country had not supported redesignation of funds from their regions to the eastern projects. In 1986 the Siberian Development Program was launched for coordinated, systematic development of fuel and mineral resources through the year 2000. Despite specific plans, movement of Soviet labor to the undeveloped regions has generally fallen short of plans since the peak migration of World War II. Poor living and working conditions have caused "labor flight" from Siberian construction projects. By 1988 there were strong hints that intensified development would again be emphasized in the more accessible industrial centers west of the Urals and that more selective investment would be made in projects to the east and southeast of that boundary.

The Labor Force and Perestroika

The nature of the work force has a direct impact on industrial policy. In 1985 nearly 75 percent of the nonagricultural work force was making material goods, and that percentage was shrinking very slowly as nonmanufacturing service occupations expanded. The rate of the shift away from manufacturing actually was decreasing during the 1980s. Meanwhile, one-third of industrial workers remained in low-skilled, manual jobs through the 1980s, and slow population growth was limiting the growth of the work force. Nevertheless, significant groups of workers were better educated and more comfortable with mechanized and automated manufacturing than the previous generation. In the late 1980s, labor shortages were expected to stimulate faster automation of some industries. Official modernization plans called for eliminating 5 million manual jobs by the year 1990 and 20 million by the year 2000, and reductions were targeted for specific industries. Reductions in the labor force could not always be planned for areas where available labor was decreasing naturally. This situation meant that job elimination could bring unemployment in some places—especially since most of the jobs eliminated would be those requiring the least skill. Because unemployment theoretically cannot exist in a socialist (see Glossary) state, that prospect was a potentially traumatic repercussion of the effort at industrial streamlining.

Poor labor ethics have traditionally undermined Soviet industrial programs. Gorbachev's *perestroika* made individual productivity a major target in the drive to streamline industry in the late 1980s. But the goal met substantial resistance among ordinary workers

because it called for pegging wages directly to productivity and eliminating guaranteed wage levels and bonuses.

Thus, the Soviet Union possessed a vast labor base that was very uneven in quality. In economic plans for the last decade of the twentieth century, planners placed top priority on redistributing all resources—human and material—to take advantage of their strengths. The drive for redistribution coincided with an attempt to streamline the organization of the industrial system.

Industrial Organization

Beginning with the First Five-Year Plan (1928–32), Soviet industry was directed by a complicated, centralized system that proved increasingly inflexible as its equipment base became more sophisticated. Major problems arose in allocation of resources between military and civilian sectors, centralized planning of diverse industries, and systemic changes that would make industry responsive to rapid technological developments.

The Complexes and the Ministries

In the late 1980s, industry was officially divided into seven industrial complexes, each complex (see Glossary) responsible for one or more sectors of production. The seven complexes, which were directly responsible to the Council of Ministers, were agro-industrial, chemicals and timber, construction, fuel and energy, machine building, light industry, and metallurgy. The Ministry of Light Industry was the only ministry in its complex and was intended as the foundation for a consumer industry complex, dubbed the "social complex" by the government. The remaining six complexes included several ministries to oversee one broad type of industry. For example, the fuel and energy complex included the all-union ministries of atomic power, coal, construction of petroleum and gas enterprises, the gas industry, the petroleum industry, and power and electrification. The ministry system included three types of organization: all-union (national level only), union-republic (national and republic levels), and republic (to run industry indigenous to a single republic). Ministries in the construction materials, light industry, nonferrous metallurgy, and timber complexes were in the union-republic ministry category. But machine building had all-union ministries because unified national policy and standards were considered critical in that field. Ministries with major military output fell outside this ministry structure, under the superministerial direction of the Military Industrial Commission. That body oversaw all stages of defense industry, from research

to production, plus the acquisition and application of foreign technology (see Military Industries and Production, ch. 18).

The Industrial Planning System

Industrial policy statements were issued by the CPSU at party congresses (see Glossary). A typical statement came from the Twenty-Seventh Party Congress in 1986: "In accelerating scientific and technical progress, a leading role is assigned to machine building, which must be raised to the highest technical level in the shortest possible time." In reaching such broad goals, the top planning level was the Council of Ministers, which represented the all-union ministries included in the seven industrial complexes. The council's decisions were passed to the State Planning Committee (Gosudarstvennyi planovyi komitet—Gosplan), which formulated specific programs to realize broad party goals. Then programs moved down through the bureaucracy to individual enterprises (see Glossary), and recommendations and changes were made along the way. The programs then reversed direction, returning to the Council of Ministers for final approval. The final planning form was the five-year plan, a concept originated by Stalin in 1928 (see The Twelfth Five-Year Plan, 1986–90, ch. 11; table 30, Appendix A).

After the First Five-Year Plan, planning was completely centralized in the all-union ministries. In day-to-day operations, this system consistently delayed interministry cooperation in such matters as equipment delivery and construction planning. An example was electric power plant construction. Planners relied on timely delivery of turbines from a machine plant, whose planners in turn relied on timely delivery of semifinished rolled and shaped metal pieces from a metallurgical combine (see Glossary). Any change in specifications or quantities required approval by all the ministries and intermediate planning bodies in the power, machine, and metallurgical industries—a formidable task under the best of circumstances.

Structural Reform of Industry

Perestroika called for wholesale revision of the industrial management system and decentralization of policy making in all industries. Elements of the management bureaucracy opposed such revision because it would place direct responsibility for poor performance and initiative on industry officials. Initial adjustment to the program was slow and uneven; in the late 1980s, tighter quality control cut production figures by eliminating substandard items. In mid-1988, eighteen months after *perestroika* had been introduced

in major industries, official Soviet sources admitted that much of the program was not yet in place.

The Military-Industrial Complex

Growth in the Soviet economy slowed to 2 percent annually in the late 1970s, and it remained at about that level during the 1980s, after averaging 5 percent during the previous three decades. Because military supply remained the primary mission of industry, the military was protected from the overall slowdown. Thus, in 1988 the military share of the gross national product (GNP—see Glossary) had grown to an estimated 15 to 17 percent, up from its 12 to 14 percent share in 1970. The actual percentage of industrial resources allocated to military production has always been unclear because of Soviet secrecy about military budgets. Most military production came under the eighteen ministries of the machine-building and metal-working complex (MBMW), nine of which were primarily involved in making weapons or military matériel (see table 33, Appendix A).

Other "military-related" ministries sent a smaller percentage of their output to the military. Among their contributions were trucks (from the Ministry of Automotive and Agricultural Machine Building, under MBMW), tires and fuels (from the Ministry of Petroleum Refining and Petrochemical Industry, outside MBMW), and generators (from the Ministry of Power Machinery Building, under MBMW), plus any other items requested by the military. In overall control of this de facto structure was the Defense Council (see Glossary), which in the 1980s was chaired by the general secretary of the CPSU. Although the Council of Ministers nominally controlled all ministries, including those serving the military, military issues transcended that authority. In 1987 an estimated 450 research and development organizations were working exclusively on military projects. Among top-priority projects were a multiministerial laser program, generation of radio-frequency energy, and particle-beam research—all applicable to future battlefield weapons. In addition, about fifty major weapons design bureaus and thousands of plants were making military items exclusively. Such plants had first priority in resource allocation to ensure that production goals were met. Most defense plants were in the European part of the Soviet Union, were well dispersed, and had duplicate backup plants. Some major aircraft plants were beyond the Urals, in Irkutsk, Novosibirsk, Tashkent, Komsomol'sk-na-Amure, and Ulan-Ude.

In making military equipment, the primary goals were simplicity and reliability; parts were standardized and kept to a minimum.

New designs used as many existing parts as possible to maximize performance predictability. Because of these practices, the least experienced Soviet troops and troops of countries to which the equipment was sold could operate it. But the practices have also caused the Soviet military-industrial complex, despite having top priority, to suffer from outmoded capital equipment, much of which is left over from World War II. Western observers have suggested that the dated "keep-it-simple" philosophy has been a psychological obstacle to introducing the sophisticated production systems needed for high-technology military equipment.

Western experts have assumed that without substantial overall economic expansion, this huge military-industrial complex would remain a serious resource drain on civilian industry—although the degree of that drain has been difficult to establish. To ameliorate the situation, *perestroika* set a goal of sharply reducing the military share of MBMW allocations (estimated at 60 percent in 1987) during the Twelfth Five-Year Plan. Civilian MBMW ministries were to receive an 80 percent investment increase by 1992. And emphasis was shifting to technology sharing by military designers with their civilian counterparts—breaking down the isolation in which the two sectors have traditionally worked.

Industrial Research and Design

The Soviet Union has long recognized the importance of its domestic research and development system to make its industry competitive. Soviet research and development relies on a complex system of institutes, design bureaus, and individual plant research facilities to provide industry with advanced equipment and methodology (see Research, Development, and Production Organizations, ch. 16). A result of the system's complexity has been poor coordination both among research organizations and between research organizations and other industrial organizations. Bottlenecks existed because much research was classified and because Soviet information distribution systems, e.g., computers and copying machines, lagged far behind the West.

A barrier between theoretical and applied research also hindered the contribution of the scientific research institutes (*nauchno-issledovatel'skie instituty*—NIIs) to industry. Institutes under the Academy of Sciences (see Glossary), which emphasized theoretical research, often did not contribute their findings directly for practical application, and an institutional distrust has existed between scientists and industrial technicians. Newer organizational structures, such as scientific production associations (*nauchno-proizvodstvennye ob''edineniia*—NPOs), have combined research,

design, and production facilities so that technical improvements will move into the production phase faster. This goal was an important part of *perestroika* in the late 1980s. It was especially critical in the machine-building industry, for which a central goal of the Twelfth Five-Year Plan was to shorten installation time of new industrial machines once they were designed.

Soviet industrial planning was aimed at being competitive with the West in both civilian and military industry. After years of lagging growth, by the mid-1980s authorities had recognized that the traditional Stalinist industrial system made such goals unreachable. But improvement of that system was problematic for several reasons. New emphasis on the civilian sector could not be allowed to jeopardize military production; research and development was never connected efficiently with industrial operations; the huge industrial bureaucracy contained vested interests at all levels; and personal responsibility and individual initiative were concepts alien to the Soviet Marxist-Leninist system. The most optimistic Western forecasters predicted gradual improvements in some areas, as opposed to the dramatic, irreversible changes suggested by the Soviet industrial doctrine of the late 1980s.

Machine Building and Metal Working

As the supplier of production machinery to all other branches of heavy industry, the machine-building and metal-working industry has stood at the center of modernization efforts, and its support of the military has been especially critical (see Industrial Organization, this ch.). But because of the systemic problems discussed earlier, in the late 1980s substantial inertia remained in machine building. Progress in one program was often negated by a bottleneck in another, and all industry felt the impact of this uneven performance.

The Structure and Status of the Machine-Building and Metal-Working Complex

In 1987 the machine-building industrial complex, one of the seven industrial complexes, included 300 branches and subbranches and a network of 700 research and planning organizations. Officially designated the machine-building and metal-working complex (MBMW), it was the most inclusive and varied industrial complex. Its three major types of products, were military hardware, consumer durables, and industrial machinery and equipment. In 1989 eighteen ministries were included, manufacturing a wide range of machinery; nine of the ministries chiefly produced military weapons or matériel. Ministries within MBMW often split the

jurisdiction within a particular specialization. For example, although instrument manufacture fell mainly under MBMW's Ministry of Instrument Making, its Ministry of the Aviation Industry and Ministry of the Shipbuilding Industry controlled manufacture of the instruments they used in their products. The contributions of MBMW included machines for mining, agriculture, and road building; equipment for conventional and nuclear power plants; oil and gas drilling and pumping equipment; and metal-working machines for all branches, including the military. In the mid-1980s, restructuring in the machine industry was a central theme of *perestroika* because most industries needed to update their machine stock. Western studies in the 1980s showed that 40 to 60 percent of industrial production was earmarked for military uses. In the 1980s, government policy encouraged industry to buy domestic machinery to counter a frequent preference for more reliable foreign equipment. (A 1985 study by MBMW's Ministry of Heavy Machine Building said that 50 percent of that ministry's basic products did not meet operational requirements.) In the late 1970s and early 1980s, the German Democratic Republic (East Germany) sent half its machine exports to the Soviet Union. At the same time, Soviet machine exports fell behind machine imports, after exports had reached a peak in 1970.

The Planning and Investment Process of the Machine-Building and Metal-Working Complex

The Twelfth Five-Year Plan (1986–90) called for drastic production increases in the sectors producing instruments, machine tools, electrical equipment, chemicals, and agricultural machines. Fundamental investment changes were expected to raise machine production to new highs. Overall investment in the machine-building industry was to be 80 percent higher than in the Eleventh Five-Year Plan (1981–85). A crucial goal was to shorten the time between research breakthroughs and their industrial application, which had been a chronic bottleneck in the modernization of industry. Another goal of the Twelfth Five-Year Plan was to improve the quality of individual components and spare parts because their short service life was diverting too much metal to making replacement parts. In the mid-1980s, however, severe delivery delays continued for both spare parts and new machines ordered by various industries. *Perestroika* attempted to simplify the system and to fix responsibility for delays. As the largest consumer of steel in the country, MBMW had felt the impact of severe production problems in the metallurgy industry (see Metallurgy, this ch.). Automation was expected to add speed and precision to production lines. By

1987 nearly half of metal-cutting machine production was done with digital program control. New control complexes stressed microcomputers with high production capacity and low material requirements. Nevertheless, a 1987 Soviet study showed that 40 percent of the robots in machine plants were not working at all, and a 1986 study demonstrated that only 20 percent of the robots were providing the expected production advantages. A long-term (through the year 2000) cooperative program with the other members of the Council for Mutual Economic Assistance (Comecon) was expected to contribute new ideas for streamlining the Soviet machine-building industry (see Appendix B).

The Location of the Machine-Building Industry

Traditionally, the Soviet machine-building industries have been centered in the European part of the Soviet Union; large plants are located in Moscow, Leningrad, Khar'kov, Minsk, Gor'kiy, Saratov, and in cities in the Urals. In the 1980s, the industry was gradually adding major centers in the Kazakh Republic and other areas in Soviet Central Asia, Siberia, and the Soviet Far East. The instrument-building sector was more dispersed and had centers in Moscow, Leningrad, Kiev, Voronezh, Orel, Ryazan', Kazan', Gor'kiy, Riga, Minsk, Tbilisi, Chelyabinsk, Tomsk, and Frunze. Agricultural machines were produced near major crop areas. Examples of this concentration were Khar'kov in the Ukrainian Republic; Minsk in the Belorussian Republic; Lipetsk, Vladimir, Volgograd, and Chelyabinsk in the western Russian Republic; the Altai region in the eastern Russian Republic; and Pavlodar in the Kazakh Republic. Because low crop yield has been a chronic problem, the agricultural equipment industry has emphasized large mechanized tractor and harvester units that can cover vast, low-yield tracts economically.

The Automotive Industry

The Soviet automotive industry has developed on a much smaller scale than its United States counterpart. Although production grew rapidly during the 1970s and 1980s, the industry's close connection with the military made some production data inaccessible. From 1970 to 1979, automobile production grew by nearly 1 million units per year, and truck production grew by 250,000 per year. The production ratio of automobiles to trucks increased in that time from 0.7 to 1.7, indicating that more attention was being given to the consumer market.

Automobile production was concentrated in four facilities: the Volga (in Tol'yatti), Gor'kiy, Zaporozh'ye, and Likhachev

Figure 15. Automotive and Metallurgical Production Centers in the Western Soviet Union, 1988

(Moscow) plants (see fig. 15). The Volga plant was built in the late 1960s especially for passenger automobiles; by 1975 it was making half the Soviet total. The Likhachev and Gor'kiy plants, both in operation for more than fifty years, made automobiles and trucks. Truck production was less centralized, with plants in Kutaisi (Georgian Republic), the Urals, Tiraspol' (Moldavian Republic), Kremenchug (Ukrainian Republic), Minsk (Belorussian Republic), Mytishchi (Moscow area), and Naberezhnyye Chelny (eastern Russian Republic), the site of the large showpiece Kama plant built in the late 1970s. The Volga and Kama plants were located away from the established population centers; in both cases, new towns were built for transplanted workers. Long-term truck planning (through the year 2000) emphasized large capacity, fuel economy, and service life; the last two qualities were deficient in earlier models. The drive for fuel economy has encouraged the use of natural and liquefied gas. Heavy truck and trailer production was to occupy more than 40 percent of the truck industry by 1990, doubling tractor-trailer production. Vehicle parts plants were widely dispersed in the European sector of the country. Policy for the Soviet automotive industry has emphasized two divergent goals: increasing the supply of private automobiles as a symbol of attention to the consumer; and supporting heavy industry with improved equipment for heavy transport and material handling.

The Electronics Industry

Because of the drive for automation and modernization of production processes, the electronics industry increasingly supported many other industrial branches. Special emphasis was given to improving cooperation between electronics plants and the machine-building and metallurgy branches—a partnership severely hindered in many cases by the industrial bureaucracy. In official progress reports, all industries listed process automation and robotization as standards for efficiency and expansion, and conversion from manual processes has been a prime indicator of progress in heavy industry. At the same time, government policy has relied heavily on the electronics industry for televisions, recording equipment, and radios for the consumer market. None of those items came close to planned production quotas for 1987, however.

Beginning in the 1970s, the most important role of the electronics industry has been to supply lasers, optics, and computers and to perform research and development on other advanced equipment for weapons guidance, communications, and space systems. The importance of electronics for civilian industry has led to interministry research organizations that encourage the advanced military design sector to share technology with its civilian counterpart. Such an organization was called an interbranch scientific-technical complex (*mezhotraslevoi nauchno-tekhnicheskii kompleks*—MNTK). It united the research and production organizations of several ministries and had broad coordination control over the development of new technologies. Because of the military uses of Soviet electronics, the West has had incomplete specific data about it. In the early 1980s, an estimated 40 percent of Soviet electronics research projects had benefited substantially from the transfer of Western and Japanese technology. In the late 1980s, however, Soviet electronics trailed the West and Japan in most areas of applied electronics, although circuit design and systems engineering programs were comparable. The Soviet theoretical computer base was strong, but equipment and programming were below Western standards. Problems have been chronic in advanced fields such as ion implantation and microelectronics testing. The branches designated by Soviet planners as most critical in the 1980s were industrial robots and manipulators, computerized control systems for industrial machines, and semiconductors for computer circuits.

Metallurgy

Soviet industrial plans through the year 2000 have emphasized greater variety and higher quality in metals production to keep heavy industry competitive with the West. But the machinery and

production systems available to Soviet metallurgists in 1989 showed no signs of improving the inconsistent record the industry had established in meeting such goals. Following the Stalinist pattern, great success in some areas was hampered by breakdown in others. In the late 1980s, escape from this dilemma seemed no more likely than in earlier years.

Role of Metallurgy

Since the 1970s, the Soviet Union has led the world in the production of iron, steel, and rolled metals. In 1987 it produced about 162 million tons of steel, 114 million tons of rolled metal, and 20 million tons of steel pipe. Each of these figures was an increase of more than 2.5 times over those of 1960. Metallurgy has been the largest and fastest growing branch of Soviet industry, and metals supply remained vital to growth in virtually all other branches of industry. But yearly production increases were becoming more difficult because the cost of raw materials rose consistently in the 1980s, especially for metals such as molybdenum, nickel, magnesium, and rare earth metals, which were in increasing demand for high-quality steel alloys.

In the mid-1980s, the metallurgy industry was not meeting its goals for supplying high-quality finished metal to the manufacturing industries. Those industries were demanding higher-quality and stronger metals for new applications, such as high-pressure pipelines for oil and gas, high-capacity dump trucks and excavators, industrial buildings with large roof spans, corrosion-resistant pipe for the chemical industry, coated and treated rolled metals, and steel with high conductivity for electrical transformers. As military equipment became more sophisticated, it too required improved quality and performance from metal products. On the development side, advances in light-metal alloys using aluminum, magnesium, and titanium did provide materials for military aircraft and missiles that were among the best in the world.

Metallurgy Planning and Problems

Plans for the metallurgical industry for the 1990s stressed rebuilding older steel plants, vastly increasing the volume of continuous steel casting, and replacing open-hearth furnaces with oxygen or electric furnaces. In the period through the year 2000, a projected 52 percent of investment was to go for new equipment. This degree of investment would be a drastic turnaround because from 1981 to 1985 five times as much money was spent on equipment repair as on equipment purchase. Furthermore, to make highly pure steel, economical removal of sulfur is critical, but the scarcity

of low-sulfur coking coal requires new purification technology. Although Soviet experts agreed that all these steps were necessary to enhance the variety and purity of ferrous metallurgy products, serious obstacles remained. Bottlenecks were chronic in overall administration, between research and production branches, and between the industry and its suppliers in the machine-building sector. Meanwhile, a shortage of hard currency (see Glossary) hindered the purchase of sophisticated metal-processing equipment from the West.

Bottlenecks have also affected the Donetsk metallurgical plant, where a heralded program installed new blast furnaces in the mid-1980s but where no auxiliary equipment arrived to run them as designed. In many cases, industry spokesmen have blamed the research community for neglecting practical applications in favor of theoretical projects. Whatever the causes, large-scale improvement of Soviet metallurgical technology was spotty rather than consistent during the 1980s.

Metallurgical Combine Locations and Major Producers

As production capacity has expanded, iron and steel production operations have consolidated in large-scale facilities, designated as combines. Among them was the Magnitogorsk metallurgical combine in the Urals, which in 1989 was the largest Soviet metallurgical combine. It produced nearly 16 million tons of metal annually. Long-term plans targeted Magnitogorsk for complete modernization of casting operations in the 1990s. Other important metallurgical centers in the Urals were at Chelyabinsk and Nizhniy Tagil. The Ukrainian Republic had major combines at Krivoy Rog, Zhdanov, Zaporozh'ye, and Makeyevka. The Cherepovets combine was north of Moscow, the Lipetsk and Oskol combines were south of Moscow, and the Orsk-Khalilovo combine was at the southern end of the Urals. The European sector was the traditional location of Soviet metallurgy because of available labor and materials. Newer metallurgical centers at Karaganda (in the Kazakh Republic) and the Kuzbass (see Glossary) were in the Asian part of the Soviet Union where coking coal was readily available. Nevertheless, metal-consuming industries and known iron ore reserves remained mainly west of the Urals, and major expansion of the metallurgy industry east of the Urals was considered unlikely in the near future.

Nonferrous Metals

In addition to the ferrous metal (iron and steel) centers, nonferrous metallurgy also provided vital support for heavy industry, while

undergoing technical innovation. The nonferrous branches had already expanded into ore-rich regions outside traditional industrial regions: copper metallurgy into the Kazakh Republic, the Caucasus, and Siberia; aluminum into the Kazakh Republic, south-central Siberia, and Soviet Central Asia; and nickel into eastern Siberia, the Urals, and the Kola Peninsula. The Soviet Union possesses abundant supplies of nonferrous metal ores, such as titanium, cobalt, chromium, nickel, and molybdenum, used in steel and iron alloys. Cobalt and nickel were specially targeted for expansion in the 1980s. Lead and zinc mining was projected to expand in the Kazakh Republic and other areas in Soviet Central Asia, Siberia, and the Soviet Far East.

Chemicals

The chemical industry received intensive investment in the five-year plans of the 1980s. The long-term goal of the chemical investment program was to increase its share of total national industrial production from the 1975 level of 6.9 percent to 8 percent by the year 2000. As defined by Soviet planners, major divisions of the industry were basic chemical products; fertilizers and pesticides; chemical fibers; plastics and synthetic resins; and detergents, paints, and synthetic rubber for making consumer products.

Plastics

A vital part of the chemical industry is polymers. The polymer industry has been centered in regions where petrochemical raw materials were processed: the Volga, Ural, and Central economic regions (see fig. 16). Among their other uses, polymers are intermediate materials in making plastics that can replace metals in machinery, construction materials, engines, and pipe. Soviet policy recognized that wider use of plastics would mean cheaper, lighter, and more durable products for many industries. Therefore, long-term plans called for nearly doubling the contribution of synthetic resins and plastics to the construction industry by the year 2000. However, the Twelfth Five-Year Plan also scheduled a 50 percent increase in consumer goods made by the chemical industry.

Petrochemicals

Major new petrochemical plants in the 1980s were located at Omsk, Tobol'sk, Urengoy, and Surgut in the West Siberia Economic Region and Ufa and Nizhnekamsk in the Volga Economic Region. New West Siberia plants were developed as joint ventures with Western companies. The huge Tobol'sk plant refined fuels and made intermediate products for synthetic rubber and plastics.

The Tomsk complex in the West Siberia Economic Region produced 75 percent of Soviet polypropylene. Refineries at Moscow, Pavlodar (Kazakh Republic), Baku, and Groznyy (the last two based on oil from the Caspian Sea) advanced their motor fuel refinement operations to enhance fuel economy (see Fuels, this ch.).

Other Branches of the Chemical Industry

Some branches of the chemical industry have been located close to their raw materials. The chemical fertilizer industry has major plants using apatite in the Kola Peninsula, phosphates in the southern Kazakhstan Economic Region, and potassium salts in the Ural, Ukraine, and Belorussia economic regions.

Synthetic rubber production increased rapidly in the 1980s, providing tires for heavy industrial vehicles and for the increasing number of passenger vehicles. Soviet mineral fertilizer production led the world in the 1970s; because of agricultural failures, the chemical industry has been under great pressure to produce more pesticides, chemical fertilizers, and feed additives. Plans called for a 70 percent increase in mineral fertilizers from 1980 to 1990. In addition, chemical fibers were a growing part of the textile industry, which was vital to expanding consumer production.

Chemical Planning Goals

Soviet industrial planners have recognized that a high-technology chemical industry is indispensable for advancement in both heavy and light industry. Although Soviet chemical engineering has advanced in such areas as composite materials, which are used to make lighter airplanes, and photochemicals, major projects have depended heavily on foreign technology.

Because of the critical role of the chemical industry in technological advancement, a major campaign in the 1980s was aimed at improving domestic technology and reducing dependence on foreign technology in the chemical and petrochemical industry. In 1984 thirty-two scientific research institutes were conducting major petrochemical research under the academies of sciences. But the technical and investment contributions of British, French, Japanese, East German, West German, Italian, and Hungarian chemical firms remained crucial during that time. Many divisions of Soviet industry failed to produce as planned through the early 1980s, and massive investment did not have the expected effect. The goal for the year 2000 remained an overall increase of 2.4 times the 1980 level and that required a doubling of investments before 1990.

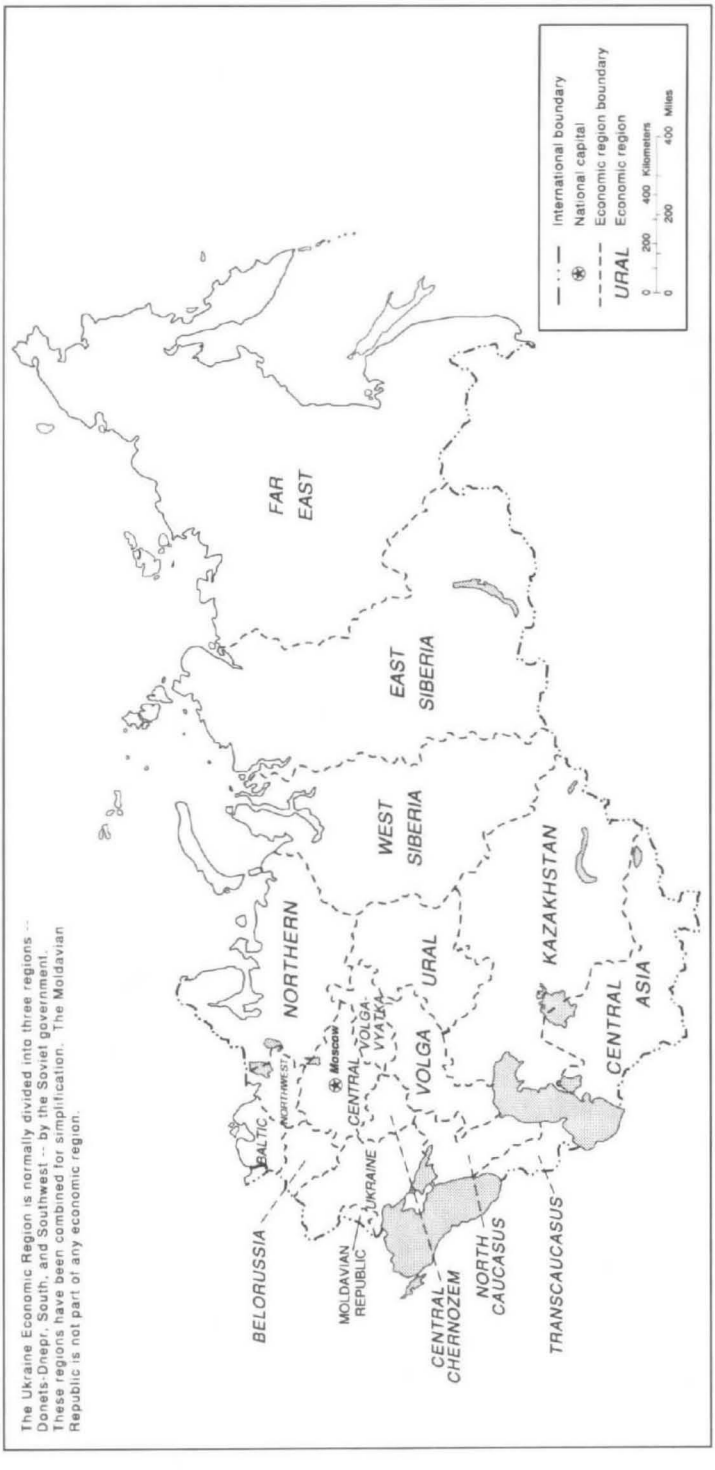


Figure 16. Economic Regions, 1985

Fuels

In the 1980s, fuels presented formidable problems for Soviet planners. Although the Soviet Union possessed enormous fuel reserves, it was difficult to balance extraction and transport costs, even as the drive continued for greater production levels. Fuel availability was a prime consideration in locating new industry. And long-term investment planning faced choices among coal, oil, and natural gas. Choices leaned strongly in the late 1980s toward gas over oil because of the greater reserves and cheaper transport of gas. Nevertheless, efforts also continued to formulate a "coal strategy" that would return coal to its former prominence. In 1988 about 28 percent of total national investment went into the Soviet fuel and energy complex, compared with nearly 12 percent in 1980.

Fuel Resource Base

The Soviet Union is self-sufficient in the three major fuels that drive its industry: coal, natural gas, and oil. It has long been a major exporter of oil and gas to its allies and to the West, and hard currency from those exports has financed the purchase of critical import commodities. In 1985 fuel and energy export provided 60 percent of Soviet hard-currency income. The question of which of the three major fuels should be emphasized has been a matter of continuous scrutiny and adjustment in government policy. The two largest users of coal are by far the metallurgy and electric power industries. Large amounts of oil products go for electric power, agriculture, transportation, and export; large amounts of natural gas go for electric power, metallurgy, the chemical industry, construction materials, and export.

Oil

After many years of occasionally spectacular growth, Soviet oil production began to level off in 1983, although the Soviet Union remained the world's largest oil producer. Since that time, Western experts have disagreed sharply about the amount and importance of production changes, especially because exact Soviet fuel reserve figures remained a state secret. It is known that at the end of the 1980s oil production did not increase significantly from year to year.

The Tyumen' reserves of western Siberia were a huge discovery of the 1960s that provided the bulk of oil production increases through the 1970s. By the end of that decade, Tyumen' had overtaken the Volga-Ural fields as the greatest Soviet oil region. The Volga-Ural fields had provided one-half the country's oil in the early 1970s but fell to a one-third share in 1977. By the mid-1980s,

Tyumen' produced 60 percent of Soviet oil, but there was already evidence that Tyumen' was approaching peak production.

Meanwhile, new policies in the early 1980s accelerated drilling rates throughout the country, especially in western Siberia, but lower yields made this drilling expensive. By 1980 the older oil reserves were already being exhausted. Substantial untapped reserves were confirmed in the Caspian, Baltic, and Black seas and above the Arctic Circle, but all of them contained natural obstacles that made exploitation expensive. Soviet planners relied on the discovery of a major new field comparable to those in western Siberia. But by 1987 no major discovery had been made for twenty-two years. In the mid-1980s, Soviet oil exploration concentrated on the farther reaches of the Tyumen' and Tomsk oblasts (see Glossary), east of the established western Siberian fields. Offshore drilling was centered on the Caspian, Barents, and Baltic seas and the Sea of Okhotsk. Several shipyards were building offshore drilling platforms, the largest being the yards at Astrakhan' and Vyborg. Foreign shipyards also provided offshore drilling equipment. In 1984 the Soviet Union had eleven semisubmersible platforms in operation.

The Soviet oil-drilling industry has relied heavily on Western equipment for difficult extraction conditions, which become more common as existing reserves dry up. The average service life of a Soviet-made drilling rig was ten years, compared with fifteen or twenty for comparable Western equipment. Centers of Soviet drilling rig production were in Volgograd, Sverdlovsk, and Verkhnyaya Pyshma, about twenty kilometers north of Sverdlovsk.

Increased distance from well to consumer was also a major concern for the oil industry. Ninety percent of oil was transported by pipeline. The Soviet oil pipeline system doubled in length between 1970 and 1983, reaching 76,200 kilometers. Before 1960 the system totaled only 15,000 kilometers of pipe (see Pipelines, ch. 14). As oil production leveled off in the 1980s, so did pipeline construction. In 1986 the Soviet Union had 81,500 kilometers of pipeline for crude and refined oil products (in 1989 the number of kilometers remained the same).

The oil boom of the 1970s in western Siberia brought rapid growth of Soviet oil-refining centers. In 1983 most of the fifty-three refineries were west of the Urals. At least five new facilities were built between 1970 and 1985. Soviet refining equipment fell below Western standards for such higher-grade fuels as gasoline, so that high-octane fuels were scarce and heavier petroleum products were in surplus.

The 2,000,000th harvester produced in Rostov-na-Donu, Russian Republic, where more than 80 percent of the country's harvesters are made
Courtesy Jimmy Pritchard

Natural Gas

Natural gas replaced oil as the "growth fuel" of the Soviet Union in the early 1980s. Gas is cheaper than oil to extract, and Soviet gas deposits are estimated to be three times larger than oil deposits. In 1983 an output of 536 billion cubic meters of gas put the Soviet Union ahead of the United States in gas production for the first time. In 1987 that figure rose to 727 billion cubic meters. As with oil, the majority of natural gas production (85 percent in 1965) came from the European sector until the 1970s. In that decade, the Volga-Ural and Central Asian fields dominated, but by 1983 western Siberia provided nearly 50 percent of Soviet natural gas. That area's Urengoy field was the largest in the world; its reserves were estimated at 7.8 trillion cubic meters.

Because of transport distance and harsh climate, fuel extraction in western Siberia is a monumental undertaking that becomes more formidable as the industry moves northward. Although high-power pumping stations are necessary to move gas over long distances, in the late 1980s the Soviet machine-building industry was not providing adequate equipment to maintain a steady flow through some of the major lines. The chief development target after Urengoy was the Yamburg field, directly to its north. Then, after 1990, major work was to begin in the Yamal Peninsula, for which preparations began in the late 1980s. But cost and environmental concerns

delayed the Yamal project in 1989. Because growth targets were based on the timely opening of large Yamal deposits, the delay was potentially a very serious setback. The center of the older Volga-Ural fields is Orenburg; other major gas fields are located in the Uzbek, Turkmen, and Ukrainian republics.

Soviet industrial planners were replacing oil with gas widely and successfully, and proportional investment in gas increased drastically in the late 1970s and 1980s. In 1988 the shares of oil and gas in the fuel balance were equal (at 39 percent) for the first time. Gas was also a vital export product. The main instrument of gas export policy was the pipeline connecting Urengoy (and, projected for 1990, the Yamburg field) with Western Europe. This line began pumping gas to four West European countries (Austria, France, Italy, and the Federal Republic of Germany [West Germany]) in 1984, despite strong opposition from the United States. Delivery was scheduled to increase to a steady rate of 57 billion cubic meters per year by 1990. In 1988 total Soviet gas exports reached 88 billion cubic meters, after adding Greece, Turkey, and Switzerland to the customer list. Meanwhile, pipeline reliability became a serious problem; hasty construction and poor maintenance caused many accidents and breakdowns in the system.

Coal

For about 150 years, coal was the dominant fuel in Russian and later in Soviet industry, and many industrial centers were located near coal deposits. In the 1960s, oil and gas replaced coal as the dominant fuel when plentiful, accessible supplies of these fuels were discovered. But coal remained an important energy source for much of Soviet industry. Total coal reserves, estimated in 1983 at 6.8 trillion tons, were the largest in the world, and since 1980 expanded coal production has been a standard goal of industrial planners. In the mid-1980s, approximately 40 percent of coal went to power-plant boiler units (steam coal) and 20 percent to metallurgy (coking coal). The rest went for export, to other industries, and to households. Shaft mines provided 60 percent of total production, surface mines the remainder.

Historically, the most important coal region has been the Donbass, on which the metallurgical industry was centered because of the cheap, plentiful coking coal it offered. Other traditional coking-coal centers were the Kuzbass in western Siberia and the Karaganda Basin in the northern Kazakh Republic. As deeper excavation and reclamation operations raised the cost of Donbass coal, other centers challenged its position as chief producer of coking coal. The second largest coal center in the European sector of the Soviet Union

was the Pechora Basin, where shaft mines were less deep and labor productivity much higher than in the Donbass. In most of the European sector, shaft mines had to be dug deeper, seams were growing thinner, and methane concentration was higher. Despite these conditions, in the late 1980s shaft mines were still providing 75 percent of high-quality coking coal.

The highest cost factor in Soviet coal production was transportation. Even when extraction was very expensive, regions such as the Donbass and the Moscow Basin remained practical because they were so close to the metallurgical centers they served. Conversely, Kuzbass coal extraction was cheap, but its high-quality coking coal had to be transported long distances to industrial centers (for example, 2,200 kilometers to the Magnitogorsk metallurgical center). Transport distance also required that new thermoelectric plants be located near the coal and water resources that fueled their steam boilers. In the late 1980s, Soviet coal experts called for gradually less reliance on the Donbass and increased emphasis on the Kuzbass. Increased investment at the Donbass had failed to maintain production levels, indicating the necessity of this step. But rail transport costs from the Kuzbass and Siberia would rise steeply with added volume. Experimental slurry lines were opened in 1988 to provide possible alternative long-distance coal transport to the west.

Future growth in coal production must come from east of the Urals, where an estimated 75 percent of the country's reserves lie. Most Siberian coal can be strip-mined, making production costs much lower and labor productivity much higher than shaft mining. Between 1977 and 1983, production in the Soviet Union's European basins fell by 32 million tons annually, and by the 1970s rail movement of coal westward across the Urals had doubled. To minimize transportation costs, major new power stations were built in the Kansko-Achinsk and Ekibastuz coal basins, whose low-quality brown coal, a cheap fuel, breaks down rapidly if transported over long distances. Coal from those mines required extensive processing before being burned in thermoelectric plants. By the year 2000, Kansko-Achinsk may be the most productive Soviet coal basin, with a planned yield of 400 million tons per year. The largest Soviet strip mine, Bogatyr, is located at Ekibastuz.

In the mid-1980s, low coal quality was still a major problem because efficient processing equipment was scarce. Huge reserves remained untapped in Siberia because of remoteness and low quality, but in the 1980s the South Yakut Basin in eastern Siberia was being developed with Japanese technical aid.

Uranium

In 1988 little was known specifically about the Soviet uranium industry. Nevertheless, foreign observers did know that the country possessed large, varied deposits that provided fuel for its fast-growing nuclear power program.

Power Engineering

Traditionally, generation and distribution of electrical power have been a high priority of Soviet industrial policy. The main generators of power, in order of importance, were thermoelectric plants burning fossil fuels (coal, oil, natural gas, and peat), nuclear power plants, and hydroelectric stations. The power industry has been one of the fastest growing branches of the economy; in 1985 power production reached 58 percent that of the United States. But the complexity and size of the country has made timely delivery of electricity a difficult problem. Huge areas of the northwestern Soviet Union, Siberia, the Soviet Far East, and Soviet Central Asia remained unconnected to the country's central power grid. Because the largest power-generating fuel reserves are located far from industrial centers, geography has limited the options of Soviet policy markers. In the early 1980s, power shortages were still frequent in the heavily industrialized European sector, where conventional fuel reserves were being fully used. Soviet policy depended heavily on large generating plants operating more hours per day than those in the West.

Energy Planning Goals

In 1986 the stated goals of Soviet energy policy were ambitious ones. The share of nuclear power was to increase drastically, and new, large-capacity nuclear plants were to be built, mainly in the European sector. Expansion of the natural gas industry was to contribute more of that fuel to power generation. More coal was to be available to thermoelectric stations from surface mining in remote fuel-and-power complexes such as Kansko-Achinsk and Ekibastuz, and larger thermoelectric stations were to be built near coal deposits. More hydroelectric plants were planned on rivers in Siberia, Soviet Central Asia, and the Soviet Far East. Ultra-high-voltage, long-distance power lines (including the longest in the world) would link thermoelectric power stations in Asia with European and Ural industrial centers and would connect Soviet nuclear plants with Warsaw Pact allies (see Appendix C). Better equipment was to limit power losses occurring over such lines. And alternative, renewable power sources such as wind and solar energy

were to be exploited for small-scale local needs. Because nuclear and thermal plants were expected to increase their share of power generation, in long-term planning the industry has concentrated on making the generating units of these plants larger and more efficient. In the European sector, a primary goal has been flexible response to high- and low-demand cycles—a feature that nuclear plants do not provide.

The Balance among Energy Sources

The Twelfth Five-Year Plan called for a period of intense construction of thermal and nuclear plants. By 1990 nuclear capacity was to reach almost 1.5 times its 1985 level. By the year 2000, most large thermal stations were to be capable of burning the abundant but low-quality coal mined east of the Urals. Berezovka, the largest Soviet thermoelectric station yet built, was scheduled to open at the Kansko-Achinsk fuel and power complex by 1990. The Unified Electrical Power System (see Glossary), which is the centralized energy distribution grid and the showpiece of the Soviet energy program, was to be connected with the Central Asian Power System by 1990, bringing 95 percent of the country's power production into a single distribution network.

Despite the presence of some of the world's largest hydroelectric stations, such as Krasnoyarsk, Bratsk, Ust'-Ilimsk, and Sayano-Shushenskoye, reliance on hydroelectric power is decreasing. All large, untapped rivers are east of the Urals—in the Kazakhstan, East Siberia, and Far East economic regions—and few major hydroelectric projects are planned west of the Urals. Although hydroelectric power is renewable and flexible, water levels are subject to unpredictable climatic conditions. Plans called for ninety new hydroelectric stations to be started between 1990 and 2000. The Twelfth Five-Year Plan called for nuclear power to displace hydroelectric power by 1990 as the second largest electricity source in the Soviet Union. The planned share of nuclear power in the national power balance for 1990 was 21 percent, while hydroelectric power was already below 15 percent in 1985. By comparison, nuclear generation represented a smaller percentage—15.5 percent—of power production in the United States in 1985. An estimated sixteen nuclear plants (forty-five reactors total) were operating in 1988.

The Soviet Union has led the world in magnetohydrodynamic power generation. This highly efficient method directly converts the energy of conventional steam expansion into power, using superconductor magnetic fields. The first magnetohydrodynamic plant in the world was built at Ryazan' in the mid-1980s.

Obstacles to Power Supply

In the late 1980s, the Soviet power industry was far behind its planned expansion rate. Technology was not available for on-site burning of low-quality coal, nor for transmitting the power it would generate across the huge distances required. Moreover, the 1986 nuclear accident at Chernobyl' cast doubts on the reliability of the nuclear reactor models chosen to supply power to industrial centers in the European part of the Soviet Union. As in the case of fuels, planners faced long-term, irreversible choices among power sources.

Soviet nuclear and thermoelectric generation has relied heavily on unproven equipment and long-distance delivery systems, whose failure could slow operations in major industries. For example, the Chernobyl' incident resulted in major disruption of the industrial power supply. Although switching techniques could sometimes avoid long-term slowdowns, no permanent alternative power source existed if nuclear power failed in the European part of the Soviet Union. Meanwhile, in the late 1980s construction of new nuclear plants fell far behind schedule, and a 30 percent shortfall was expected in 1990 generation. Because hydroelectric stations fell behind in the same period, an added burden fell on thermoelectric facilities. Environmental concerns also caused local opposition to new nuclear and hydroelectric plants during this period.

Heat and Cogeneration

Although electrical energy is vital to Soviet industry, it is only about one-sixth the total energy generated in the country. Heat, which is also indispensable to industry, cannot be transported over long distances. Most heat came from central heat and power stations in urban and industrial centers, which burned coal, heavy oil, or natural gas to generate heat as well as electricity. In the 1980s, a major program developed large-scale generators to produce heat as a by-product in existing thermal and nuclear power plants. Steam from the latter can be sent as far as forty kilometers. This process, called cogeneration, centralizes the fragmented heat-generation system. In 1985 urban cogeneration plants provided 28 percent of total Soviet power.

The Consumer Industry

Soviet industry is usually divided into two major categories. Group A is "heavy industry," which includes all those branches already discussed. Group B is "consumer goods," including foods, clothing and shoes, housing, and such heavy-industry products as appliances and fuels that are used by individual consumers. From

Construction in southwest Moscow, location of the city's newest research and education institutes
Courtesy Jimmy Pritchard

the early days of the Stalin era, Group A received top priority in economic planning and allocation. Only in 1987 was the foundation laid for a separate industrial complex for consumer industry, named the "social complex." Initially, it lacked the extensive bureaucratic structure of the other six complexes, and it contained only the Ministry of Light Industry.

Consumer Supply in the 1980s

In 1986 shortages continued in basic consumer items, even in major population centers. Such goods occasionally were rationed in major cities well into the 1980s. Besides the built-in shortages caused by planning priorities, shoddy production of consumer goods limited actual supply. According to Soviet economists, only 10 percent of Soviet finished goods could compete with their Western equivalents, and the average consumer faced long waiting periods to buy major appliances or furniture. During the 1980s, the wide availability of consumer electronics products in the West demonstrated a new phase of the Soviet Union's inability to compete, especially because Soviet consumers were becoming more aware of what they were missing. In the mid-1980s, up to 70 percent of the televisions manufactured by Ekran, a major household electronics

manufacturer, were rejected by quality control inspection. The television industry received special attention, and a strong drive for quality control was a response to published figures of very high rates of breakdown and repair. To improve the industry, a major cooperative color television venture was planned for the Warsaw Television Plant in 1989.

The Logic and Goals of Consumer Production

Increased availability of consumer goods was an important part of *perestroika.* A premise of that program was that workers would raise their productivity in response to incentive wages only if their money could buy a greater variety of consumer products. This idea arose when the early use of incentive wages did not have the anticipated effect on labor productivity because purchasing power had not improved. According to the theory, all Soviet industry would benefit from diversification from Group A into Group B because incentives would have real meaning. Therefore, the Twelfth Five-Year Plan called for a 5.4 percent rise in nonfood consumer goods and a 5.4 to 7 percent rise in consumer services. Both figures were well above rates in the overall economic plan.

Consumer goods targeted included radios, televisions, sewing machines, washing machines, refrigerators, printed matter, and knitwear. The highest quotas were set for the first three categories. Although in 1987 refrigerators, washing machines, televisions, tape recorders, and furniture were the consumer categories making the greatest production gains compared with the previous year, only furniture met its yearly quota. Furthermore, industrial planners have tried to use light industries to raise the industrial contributions of such economic regions as the Transcaucasus and Central Asia, which have large populations but lack the raw materials for heavy manufacturing.

Textiles and Wood Pulp

The textile and wood pulp industries are traditional branches of light industry that remain essential to the Soviet economy. The major textile center is northeast of Moscow. Because the industry receives most of its raw material from the cotton fields of the Transcaucasus and Central Asia economic regions, transport is expensive. Although large-scale cotton cultivation began in the Soviet Union only in the early 1900s, textile plant locations were established in the nineteenth century, when the country still imported most of its raw cotton. Soviet planners have tried to shift the textile industry into the Transcaucasus and Central Asia economic regions, nearer the domestic cotton fields. But textiles have been

a well-established economic base for the Moscow area, and in the 1980s the bulk of the industry remained there. The Soviet wood pulp and paper industry is based on a vast supply of softwood trees. This industry is less centralized and closer to its raw material base than Soviet textiles; plants tend to be along the southern edge of forested regions, as close as possible to markets to the south and west (see Forestry, ch. 13).

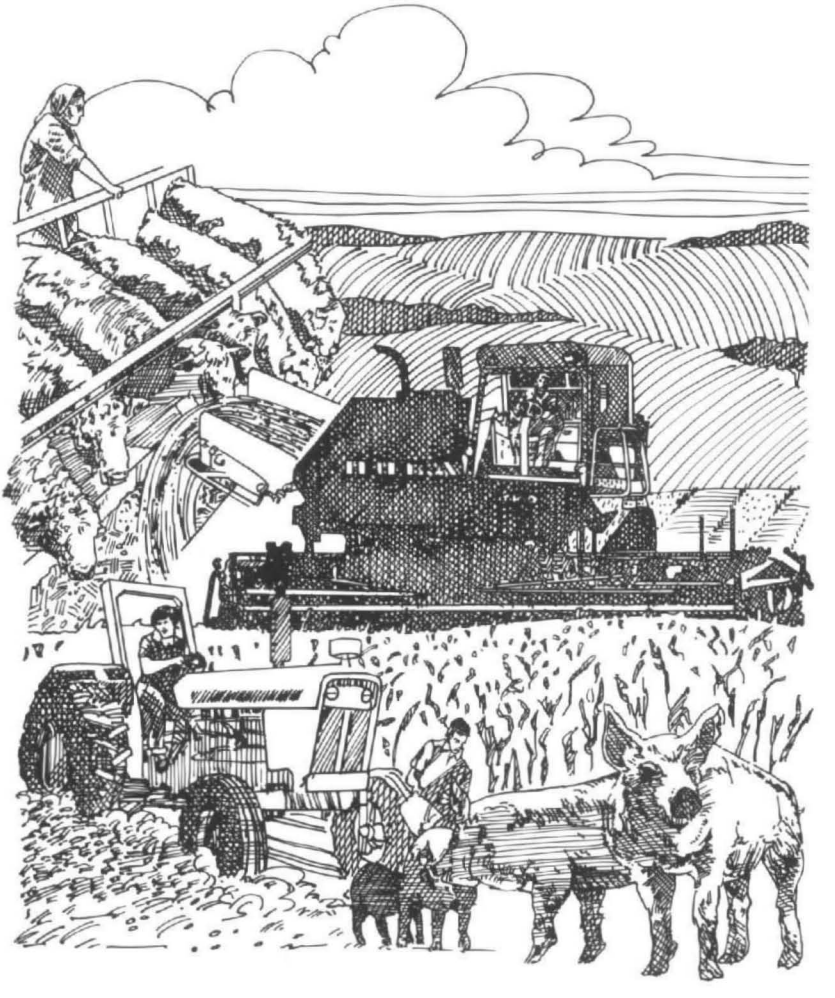
After the industrial stagnation in the 1970s and early 1980s, planners expected that consumer industries would assume a more prominent role in Soviet production beginning with the Twelfth Five-Year Plan. But despite a greater emphasis on light industry and efforts to restructure the entire planning and production systems, very little upturn was visible in any sector of industry in 1989. High production quotas, particularly for some heavy industries, appeared increasingly unrealistic by the end of that plan. Although most Soviet officials agreed that *perestroika* was necessary and overdue, reforming the intricate industrial system had proved difficult.

* * *

The *USSR Energy Atlas,* prepared by the United States Central Intelligence Agency, is a detailed picture of Soviet fuels and power generation in the mid-1980s, with forecasts of future developments. It includes extensive maps, tables, and a gazetteer. Konstantin Spidchenko's *USSR: Geography of the Eleventh Five-Year Plan Period* provides an overview in English (from a Soviet perspective, which must be taken into consideration but does not mitigate its value) of the geographical distribution of industry and the rationale of expansion and location. It also describes major industrial areas and their resource bases. *Gorbachev's Challenge* by Marshall I. Goldman provides a general background for the restructuring goals of Soviet industry in the late 1980s, with emphasis on technology transfer and the domestic research and development area. William F. Scott's article, "Moscow's Military-Industrial Complex," is a comprehensive look at the system of military planning and its relation to the overall industrial system. *Siberia and the Soviet Far East,* edited by Rodger Swearingen, is a collection of articles describing in detail the economic and political factors in planning development of fuel and energy east of the Urals, with emphasis on oil and natural gas. J.P. Cole's *Geography of the Soviet Union* contains two chapters describing the geographical influence on Soviet industrial policy, including all major branches. Vadim Medish's *The Soviet Union* offers chapters on the scientific research establishment and economic planning, valuable background information in understanding Soviet

industrial policy. Also, the collection of study papers for the Joint Economic Committee of the United States Congress, entitled *Gorbachev's Economic Plans,* covers Soviet economic planning and performance, industrial modernization, the role of the defense industry in the economy, and Soviet energy supply, with short articles on specific subtopics. (For further information and complete citations, see Bibliography.)

Chapter 13. Agriculture



Images of agriculture

AGRICULTURE CONTINUED TO FRUSTRATE the leaders of the Soviet Union in the 1980s. Despite immense land resources, extensive machinery and chemical support industries, a large rural work force, and two decades of massive investment in the agricultural sector, the Soviet Union continued to rely on large-scale grain and meat imports to feed its population. Persistent shortages of staples, the general unavailability of fresh meats, fruits, and vegetables in state stores, and a bland, carbohydrate-rich diet remained a fact of life for Soviet citizens and a perennial embarrassment to their government.

Although in terms of total value of output the Soviet Union was the world's second leading agricultural power and ranked first in the production of numerous commodities, agriculture was a net drain on the economy. The financial resources directed to this sector soared throughout the 1970s and by the mid-1980s accounted for nearly one-third of total investment. The ideologically motivated policy of maintaining low prices for staples created an enormous disparity between production costs and retail food prices. By 1983 the per capita food subsidy amounted to nearly 200 rubles, which the consumer had to pay in higher prices for nonfood products.

Although gross agricultural production rose by more than 50 percent between the 1950s and 1980s, outstripping population growth by 25 percent, the consumer did not see a proportionate improvement in the availability of foodstuffs (see table 34, Appendix A). This paradox indicated that the Soviet Union's inability to meet demand for agricultural commodities was only partly the result of production shortfalls and that much of the blame was attributable to other factors. Chief among these were the processing, transportation, storage, and marketing elements of the food economy, the neglect of which over the years resulted in an average wastage of about one-fourth of agricultural output. Soviet experts estimated that if waste in storage and processing were eliminated, up to 25 percent more grain, 40 percent more fruits and vegetables, and 15 percent more meat and dairy products could be brought to market.

The heavily centralized and bureaucratized system of administration, which has characterized Soviet agriculture ever since Joseph V. Stalin's campaign of forced collectivization (see Glossary), was the dominant cause of the sector's overall poor performance. Inflexible production directives from central planning

organs that failed to take local growing conditions into account and bureaucratic interference in the day-to-day management of individual farms fostered resentment and undermined morale in the countryside. The result was low labor productivity, the system's most intractable problem. Despite its systemic flaws, however, Soviet agriculture enjoyed certain successes. The standard of living of farm workers improved, illiteracy was reduced, incomes grew, better housing and health care were provided, and electricity was brought to virtually all villages. Farming practices were modernized, and agriculture received more machinery and became less labor intensive (see table 35, Appendix A). Ambitious irrigation and drainage projects brought millions of additional hectares under cultivation. Large livestock inventories were built up, particularly during the 1970s and 1980s. And the increased prominence accorded agriculture, coupled with wiser policies exploiting the profit motive, appeared to be paying dividends, as bumper grain harvests were reported in Mikhail S. Gorbachev's first two years in power.

Policy and Administration

Stalin's Legacy

In the 1980s, the basic structure and operation of Soviet agriculture retained many of the features of the system that became entrenched during Stalin's regime. Under Stalin agriculture was socialized, and a massive bureaucracy was created to administer policy. This bureaucracy was highly resistant to subsequent reform efforts.

Stalin's campaign of forced collectivization, begun in the autumn of 1929, confiscated the land, machinery, livestock, and grain stores of the peasantry. By 1937 approximately 99 percent of the countryside had been collectivized. Precise figures are lacking, but probably 1 million kulak (see Glossary) households with nearly 5 million members were deported and were never heard from again. About 7 million starved to death as the government confiscated grain stores. In defiance, peasants slaughtered their livestock rather than surrender it to the collectives. As a result, within five years the number of horses, cattle, and hogs in the country was halved, and the number of sheep and goats was reduced by two-thirds.

Aside from the immediate devastation wrought by forced collectivization, the experience left an enduring legacy of mutual distrust and hostility between the rural population and the Soviet authorities. The bureaucracy that evolved to administer agriculture was motivated more by political than by economic considerations. Its objectives were to industrialize agriculture, create a rural

proletariat, and destroy peasant resistance to communist rule. Once entrenched, the bureaucracy relished its power, dictating policy from the top down with little regard for the opinions of individual farmers and even farm managers, who better understood local conditions. Such policies resulted in abysmally low labor productivity and massive waste of resources. This situation persisted into the 1980s, when the Soviet farmer was on average about one-tenth as productive as his American counterpart.

During Stalin's regime, virtually all farmland was assigned to the two basic agricultural production entities that still predominated in the 1980s—state farms and collective farms. The state farm (*sovetskoe khoziaistvo*—sovkhoz) was conceived in 1918 as the ideal model for socialist agriculture. It was to be a large, modern enterprise, directed and financed by the government, with a work force receiving wages and social benefits comparable to those enjoyed by industrial workers. By contrast, the collective farm (*kollektivnoe khoziaistvo*—kolkhoz) was a self-financed producer cooperative, which farmed land granted to it rent free by the state and which paid its members according to their contribution of work. Although in theory the kolkhoz was self-directed, electing its own managing committee and chairman, in reality it remained under the firm control of state planning and procurement agencies. Chairmen who did not meet ideological purity requirements were removed. Sovkhozy operated much like any other production enterprise (see Glossary) in the Soviet command economy, with production targets and operating budgets determined by distant planning organs. The entire output of sovkhozy was delivered to state procurement agencies. Kolkhozy also received procurement quotas, but they were free to sell excess production in collective farm markets, where prices were determined by supply and demand. Because kolkhozy were self-financed, they received somewhat higher prices for their products. Nevertheless, the income of the kolkhoz resident was usually lower than that of the sovkhoz resident. In general, labor productivity on the sovkhoz was higher, probably because of its access to better machinery, chemicals, and seed and because it could specialize in the crops best suited to its region. The kolkhoz was constrained to produce a variety of crops and livestock, which decreased efficiency.

Several watershed decisions by Stalin's successors reduced the differences between the two types of farms. Among these decisions were the 1958 elimination of state-operated machine tractor stations, which had given the party leverage over the kolkhoz by controlling its access to heavy farm machinery; the establishment in 1965 of a minimum wage, pension, and other benefits for kolkhoz

workers; and the 1967 decision to make the sovkhoz a self-financed entity, which in theory the kolkhoz had been from the start. Not only was there a trend toward convergence of the features of the two types of farms, but there was also a pattern of official conversion of smaller, less solvent kolkhozy to sovkhozy. As a result, in 1973 the total sown area of sovkhozy surpassed that of kolkhozy for the first time. The total number of kolkhozy decreased from 235,500 in 1940 to 26,300 in 1986. But after the March 1989 Agricultural Plenum of the Central Committee of the Communist Party of the Soviet Union (CPSU), it appeared likely that the proliferation of sovkhozy would cease. Even one of the most conservative Politburo members, Egor K. Ligachev, who was named chairman of the party's Agrarian Policy Commission in September 1988, recommended gradually converting sovkhozy into cooperatives and leasing collectives.

A third production entity that survived from Stalin's era was the private plot, known in Soviet jargon as the "personal auxiliary holding." These plots were ideologically unpalatable to the bureaucrats, but they were tolerated as a means for farmers to produce their own food and supplement their incomes. The plots were small (roughly half a hectare) and were assigned one to a household. Peasants were allowed to consume whatever was grown on the plot and sell any surplus—either at the collective farm markets or to state or cooperative marketing agencies. The contribution of private plots to the nation's food supply far exceeded their size. With only 3 percent of total sown area in the 1980s, they produced over a quarter of gross agricultural output, including about 30 percent of meat and milk, 66 percent of potatoes, and 40 percent of fruits, vegetables, and eggs.

Evolution of an Integrated Food Policy

After the death of Stalin, an integrated food policy gradually evolved. Nikita S. Khrushchev was the first Soviet leader to demonstrate serious concern for the diet of the citizenry. In fact, it was his obsession with increasing the consumption of meat and dairy products that drove Khrushchev's controversial agricultural program. He switched the country's prime wheat-growing lands to the production of corn, which was supposed to feed an ever-increasing number of livestock. Khrushchev believed that the lost wheat production could be offset by extensive farming in the semi-arid virgin land of the Kazakh Republic and southwestern Siberia. However, his program, underfinanced from the start, did not produce the desired results, a major factor in his fall from power in 1964.

Agricultural tractor on road between Tallin, Estonian Republic, and the Latvian border
Courtesy Jonathan Tetzlaff
Cornfield on a state farm south of Moscow
Courtesy Jimmy Pritchard

Like his predecessor, Leonid I. Brezhnev considered agriculture a top priority. Unlike Khrushchev, however, he backed his program with massive investments. During his tenure, the supply of livestock housing increased 300 percent, and similar increases in the delivery of chemical fertilizers and tractors were recorded. Brezhnev's Food Program, announced in 1982, was intended to guide agriculture throughout the 1980s. It provided for even larger investment in the agro-industrial complex (*agro-promyshlennyi kompleks*—APK), particularly in its infrastructure (see The Complexes and the Ministries, ch. 12). The program also set up regional agro-industrial associations (*regional'nye agro-promyshlennye ob''edineniia*—RAPOs) to administer all elements of the food industry on the *raion* (see Glossary), oblast (see Glossary), *krai* (see Glossary), and autonomous republic (see Glossary) levels. The program's overriding objective was improving the availability of food for the consumer. Production goals now referred to per capita consumption of meat, fruit, vegetables, and other basic foods. Unlike previous campaigns, the Food Program gave the same prominence to reducing waste as to increasing output.

In 1988 Gorbachev, who had been the Central Committee secretary for agriculture when the Food Program was announced, appeared to be pursuing a two-pronged approach to agricultural administration. On the one hand, he attempted to improve the APK's efficiency through further centralization, having merged five ministries and a state committee in late 1985 into the State Agro-Industrial Committee (Gosudarstvennyi agro-promyshlennyi komitet—Gosagroprom). Eliminated were the Ministry of Agriculture, the Ministry of the Fruit and Vegetable Industry, the Ministry of the Meat and Dairy Industry, the Ministry of the Food Industry, the Ministry of Agricultural Construction, and the State Committee for the Supply of Production Equipment for Agriculture. But, on the other hand, he called for delegation of greater decision-making authority to the farms and farmers themselves.

Gosagroprom proved to be a major disappointment to Gorbachev, and at the March 1989 Agricultural Plenum of the Central Committee, the superministerial body was eliminated. Moreover, Gorbachev complained that the RAPOs meddled excessively in the operations of individual farms, and he urged abolishing them as well. The general thrust of the reforms proposed at the plenum was to dismantle the rigid central bureaucracy, transfer authority to local governing councils, and increase the participation of farmers in decision making. Gorbachev also elected to give the individual republics greater freedom in setting food production goals that were consistent with the needs of their people.

A key objective of Gorbachev's *perestroika* (see Glossary) was to increase labor productivity by means of the proliferation of contract brigades throughout the economy. Agricultural contract brigades consisted of ten to thirty farm workers who managed a piece of land leased by the kolkhoz or sovkhoz under the terms of a contract making the brigades responsible for the entire production cycle. Because brigade members received a predetermined price for the contracted amount of output plus generous bonuses for any excess production, their income was tied to the result of their labors. After 1987 family contract brigades also became legal, and long-term leasing (up to fifteen years) was enacted—two reforms that in the opinion of some Western analysts pointed toward an eventual sanctioning of the family farm. Because contract brigades enjoyed relative autonomy, much of the administrative bureaucracy resisted them. Nevertheless, in 1984 an estimated 296,100 farm workers had already banded together in contract brigades, and the document *Basic Directions for the Economic and Social Development of the USSR for 1986–1990 and for the Period to the Year 2000* (a report presented to and subsequently adopted by the Twenty-Seventh Party Congress) called for their wider use (see Reforming the Planning System, ch. 11). The March 1989 Agricultural Plenum endorsed contract brigades and agricultural leasing, a major victory for Gorbachev's reform effort.

Soon after assuming power in 1985, Gorbachev demonstrated his intention of reforming another enduring feature of Soviet food policy—the maintenance of artificially low retail prices for staples in the state stores. In 1986 he raised prices for certain categories of bread, the first such increase in over thirty years. But much remained to be done in this critical area. For example, milk and meat prices had not been adjusted since 1962. The bill for food subsidies in 1985 came to nearly 55 billion rubles (for value of the ruble—see Glossary); of this, 35 billion rubles was for meat and milk products alone. By June 1986, the absurdity of the food subsidy policy had become a matter of open discussion in upper echelons of the party, and higher prices were expected to take effect by the end of the Twelfth Five-Year Plan (1986–90).

Land Use

Although the Soviet Union has the world's largest soil resources, climatic and hydrological conditions make farming a high-risk venture, even within the most favorable zone, the so-called fertile triangle. This tract has the general shape of an isosceles triangle, the base of which is a line between the Baltic and Black seas and the apex of which is some 5,000 kilometers to the east near Krasnoyarsk.

To the north of this triangle, the climate is generally too cold, and to the south it is too dry for farming. Because of the Soviet Union's northern latitude (most of the country lies north of 50° north latitude; all of the United States except Alaska lies south of this latitude) and the limited moderating influence of adjacent bodies of water on the climate of much of the country, growing conditions can dramatically vary from year to year. As a consequence, crop yields fluctuate greatly. Only about 27 percent of the Soviet Union is considered agricultural land, of which roughly 10 percent is arable (see fig. 17). About 15 percent of Soviet territory is too arid, 20 percent too cold, 30 percent too rugged, and 8.5 percent too marshy to permit farming. And in areas where the growing season is long enough, rainfall is frequently inadequate; only 1.1 percent of the arable land receives the optimal precipitation of at least 700 millimeters per year (compared with 60 percent of arable land in the United States and 80 percent in Canada).

North of the fertile triangle lie the treeless Arctic tundra, covering 9.3 percent of the country's territory, and an immense coniferous forest, the taiga, which occupies 31 percent of the territory. The tundra is an inhospitable region of permafrost and swampy terrain, agriculturally suitable only for reindeer herding. In the taiga zone, the climate becomes increasingly continental from the northwestern reaches of the country eastward into Siberia. East of the Yenisey River, permafrost is pervasive, and throughout the taiga vast swampy tracts and infertile podzol preclude all agricultural activity except for reindeer herding and limited cultivation of hay, rye, oats, barley, flax, potatoes, and livestock along the southern frontier of the zone. Of far greater economic importance are the forestry and fur industries of the taiga.

Along its southwestern periphery, the taiga merges with a mixed hardwood and conifer forest, which accounts for another 8.2 percent of the country's total area. This zone is shaped like a triangle with its base in the west formed by the Estonian, Latvian, Lithuanian, Belorussian, and northwestern Ukrainian republics and its apex in the east at a point beyond the Kama River. With heavy application of fertilizers, the gray-brown soils of the region can be relatively productive. Much of the land is highly marshy and requires costly drainage measures. The mixed-forest zone supports meat and milk production and the widespread cultivation of hay, oats, rye, buckwheat, sugar beets, potatoes, and flax. Wheat is also grown in the area, but with only limited success because of the shortness of the season.

A transitional forest-steppe zone stretches in a belt 250 to 500 kilometers wide from the western Ukrainian Republic to the Urals,

occupying approximately 7.7 percent of Soviet territory. This area has the best agricultural land in the Soviet Union because of the richness of its chernozem (see Glossary) soil, the abundance of precipitation, and the temperateness of the climate. A wide variety of grains, sugar beets, and livestock are raised here. The most serious problem confronting agriculture in the zone is severe water and wind erosion, which has resulted from the removal of much of the forest cover.

Farther south are the vast open steppes, which extend from the Moldavian Republic in a northeasterly direction across the northern part of the Kazakh Republic as far as Krasnoyarsk, covering roughly 15 percent of the Soviet Union. It is a region of relatively low precipitation, where periodic droughts have calamitous effects on agriculture. Because the lighter soils of this region are nearly as fertile as the chernozem of the forest-steppe and because the growing season is longer, when moisture is adequate, crop yields can be large. Irrigation is widely practiced throughout the steppe, particularly in the middle and lower Volga River Valley and in the southern Ukrainian and Kazakh republics. The primary crop of the region is wheat, although barley is also widely sown. Corn is an important crop in the Donets-Dnepr region, and millet is sown along the Volga and on the Ural steppes. Sugar beets, sunflowers, fruits, and vegetables are also cultivated on a large scale.

Immediately south of the steppes is a zone of semidesert and desert that includes the northeastern edge of the Caucasus region, the Caspian Lowland and lower Volga River Valley, the central and southern Kazakh Republic, and all of Soviet Central Asia. Irrigation projects of epic proportions make agriculture in this arid region possible. Among the most noteworthy of these projects in the 1980s were the Karakum Canal (see Glossary), over 1,100 kilometers of which had been completed by 1988, designed to provide irrigation water for 1.5 million hectares in the Turkmen Republic; the Fergana Valley in the Uzbek Republic, with over 1 million hectares under irrigation; the Golodnaya Steppe, west of the Fergana Valley, where over 500,000 hectares were irrigated; and numerous other projects exploiting the limited water resources of the Vakhsh, Amu Darya, Chu, Syr Darya, Zeravshan, Kashka Darya, and other Central Asian rivers. The region specialized in such crops as cotton, alfalfa, and fruits and vegetables; the raising of sheep, goats, and cattle was widespread.

In the Caucasus region, two small subtropical areas along the Black and Caspian seas specialize in exotic crops such as citrus fruit, tea, and tobacco, as well as grapes, other fruits, early vegetables, and cotton. The mountains provide pasturage for sheep and goats.

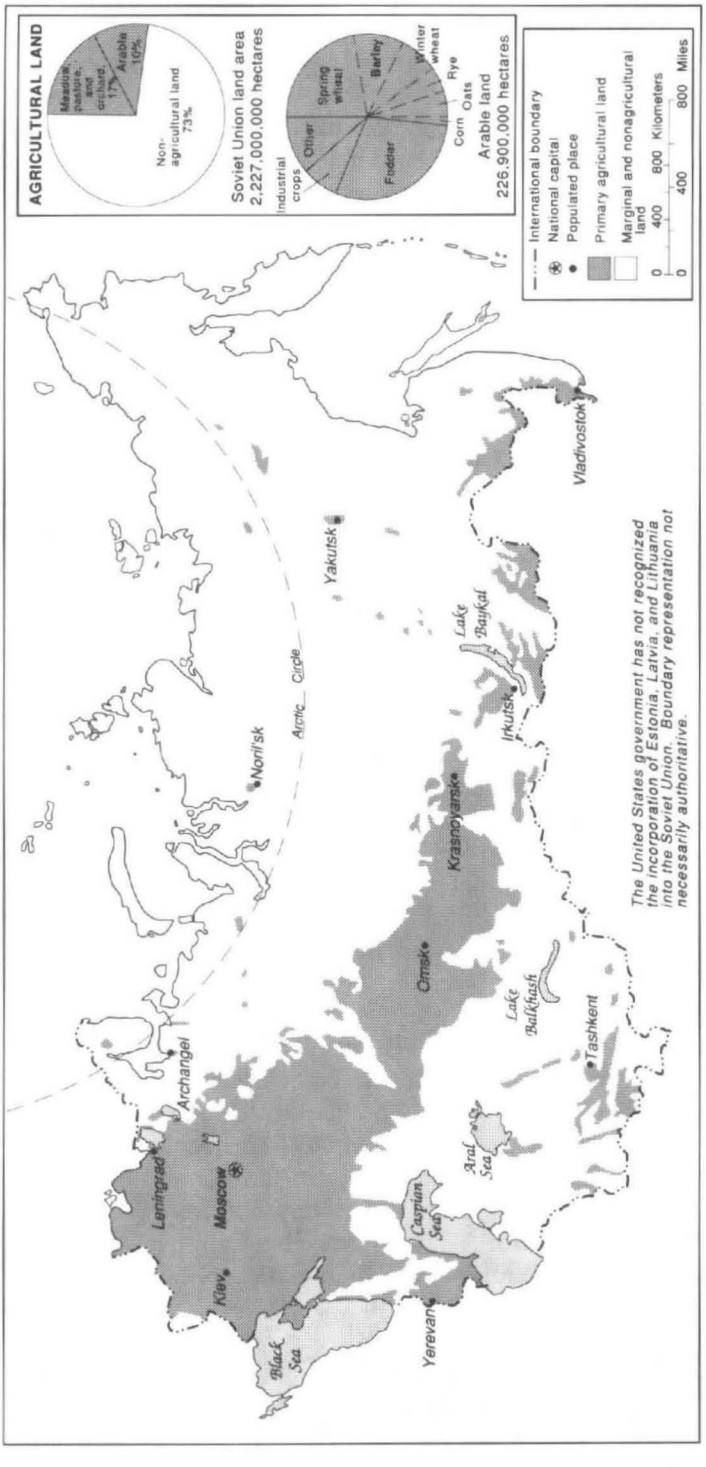


Figure 17. Land Use, 1982

Agriculture is a productive enterprise on the southern rim of eastern Siberia and the Soviet Far East, primarily in the Amur, Bureya, and Zeya river valleys; Olekminskly Raion in the central Yakut Autonomous Republic; and Primorskiy Krai on the Sea of Japan. The area is well suited for livestock, especially beef and dairy cattle, wheat, rice, sugar beets, and other crops.

Throughout the Soviet era, massive projects have been undertaken to expand the area of arable land. Drainage efforts have been concentrated in the northwest, i.e., the Belorussian, Estonian, Latvian, Lithuanian, and northwestern Russian republics. The great expense of drainage is justified by the proximity of these areas to major urban centers, where demand for farm products is highest. Between 1956 and 1986, the area of the nation's drained farmland more than doubled from 8.4 million to 19.5 million hectares. The area under irrigation increased from 10.1 million hectares in 1950 to 20.4 million hectares in 1986. Of this total, Soviet Central Asia accounted for 8.5 million, the Russian Republic for 6.1 million, and the Ukrainian Republic for 2.4 million hectares. In 1984 Gorbachev claimed that irrigated land yielded all the country's cotton and rice, three-quarters of its vegetables, half of its fruit and wine grapes, and a quarter of its feed crops. In 1986 drained or irrigated farmland accounted for almost a third of total national crop production. Irrigation has had a decidedly mixed record. On the one hand, it has transformed semiarid and arid regions into farmland, making the Soviet Union one of the world's chief producers of cotton, for example. On the other hand, excessive water withdrawal from the rivers Amu Darya and Syr Darya has practically destroyed one of the world's largest lakes, the Aral Sea, by depriving it of its major sources of water (see Environmental Concerns, ch. 3; Satellite imagery of the Aral Sea in 1987, p. 117).

Production

Agricultural self-sufficiency has been the goal of Soviet leadership since the Bolshevik Revolution (see Glossary), but it was not until the late 1940s that food supplies were adequate to prevent widespread hunger. Farm output had suffered greatly as a result of Stalin's policies of forced collectivization, low procurement prices, and underinvestment in agriculture; at the time of his death in 1953, both the quality and the quantity of the food supply were inferior to that of the precollectivization period.

Under Khrushchev and Brezhnev, improved agricultural performance became a top priority, and sown area for major crops increased (see table 36, Appendix A). By 1983 the APK accounted for more than 40 percent of the total value of the country's fixed

capital assets, created 42 percent of total national income, and provided 75 percent of total retail turnover in state and cooperative trade. In spite of the massive investments of the 1970s and 1980s, however, the sector generally did not perform well. Whereas the annual growth rate of agricultural output averaged 3.9 percent between 1950 and 1970, it actually declined to 1.2 percent in the decade of the 1970s. And between 1981 and 1985, grain output averaged only 180.3 million tons, substantially below the 1976–80 average of 205 million tons and not even matching the 1971–75 average of 181.6 million tons.

In 1986 this downward trend was reversed, as the fourth best grain harvest in Soviet history was recorded—210.1 million tons. In spite of severe winter weather and a late spring, the 1987 harvest was even larger, 211.3 million tons, marking the first time in Soviet history that output exceeded 200 million tons for two consecutive years. Gorbachev's policies of increased reliance on contract-brigade farming and delegation of broader decision-making authority to local managers were given partial credit for this improvement in agricultural performance.

Another important contributing factor to the improved agricultural performance of 1986 and 1987, according to Western analysts, was the cumulative effect of nearly two decades of heavy investment in the agricultural infrastructure. Notable progress had been made in livestock housing, machinery manufacturing, and fertilizer production. Nevertheless, much remained to be done. As many as 40 percent of the nation's farms still lacked storage facilities, and the average farm was hundreds of kilometers from the nearest grain elevator or meat-packing plant. Much of the rural road network was not hard surfaced and during the rainy seasons became impassable. Although the Soviet Union had become the world's largest tractor manufacturer, surpassing the United States by 4.5 times in the 1980s, the quality of this machinery was low and spare parts were virtually nonexistent. Enormous progress had been made in the development of the agricultural chemical industry, and deliveries increased substantially (see table 37, Appendix A). The expansion of transportation, storage, and packaging capacity did not keep pace with it. Over 10 percent of the chemical fertilizer produced never reached the farms.

Grain

Grain crops have long been the foundation of agriculture in the Russian Empire and the Soviet Union. In 1986 grain was grown on 55.3 percent of the total sown area of 210.3 million hectares. The most widely cultivated grain crops continued to be wheat (48.7

Bessarabian Market, Kiev, Ukrainian Republic
Courtesy Jimmy Pritchard

million hectares, or 23.2 percent of the total sown area), followed in order by barley (30.0 million hectares), oats (13.2 million hectares), rye (8.7 million hectares), pulses (6.7 million hectares), corn for grain (4.2 million hectares), millet (2.5 million hectares), buckwheat (1.6 million hectares), and rice (600,000 hectares). The area sown with wheat declined steadily throughout the 1970s and 1980s, reaching a thirty-year low in 1987. And the total area occupied by grain fell during each year from 1981 through 1986, as more land was laid fallow or planted in fodder crops.

Although the total area allotted to grain in 1986 (116.5 million hectares) was only slightly greater than that allotted in 1960 (115.8 million hectares), total output throughout the period steadily rose, thanks to the use of more productive farming methods, improved seed, and heavier application of fertilizers. For example, average wheat yields rose from 1.34 tons per hectare between 1966 and 1970 to 1.6 tons per hectare between 1976 and 1980 (a figure slightly skewed by the record harvest of 1978), 1.45 tons per hectare from 1981 to 1985, and 1.89 tons per hectare in 1986. At the same time, rye, barley, oats, and corn yields were also gradually rising.

The Soviet Union has never had an oversupply of feed grains, and before Brezhnev's era it was customary to conduct wholesale slaughter of livestock during bad harvest years to conserve grain

for human consumption. Beginning in the early 1970s, however, the standard policy was to import the grain needed to sustain large livestock inventories. Thereafter, the Soviet Union appeared destined to be a permanent net importer of grains. During the Eleventh Five-Year Plan (1981–85), the country imported some 42 million tons of grain annually, almost twice as much as during the Tenth Five-Year Plan (1976–80) and three times as much as during the Ninth Five-Year Plan (1971–75). The bulk of this grain was provided by the West; in 1985, for example, 94 percent of Soviet grain imports were from the noncommunist world, with the United States supplying 14.1 million tons.

Technical Crops

So-called technical crops are widely and successfully cultivated in the Soviet Union. Among such crops are cotton, sugar beets, sunflowers and other crops producing oilseeds, flax, and hemp. In 1986 these crops were grown on 13.7 million hectares, about 6.5 percent of the total sown area. In the 1970s, the Soviet Union assumed the position of the world's largest producer of cotton, averaging more than 8 million tons of raw cotton per year. Virtually all of the country's cotton was grown on irrigated lands in Central Asia and the Azerbaydzhan Republic; the Uzbek Republic alone accounted for 62 percent of total output between 1981 and 1985.

The Soviet Union has been very successful at cultivating sunflowers, accounting for over half of world output. The crop flourishes in the low-precipitation southern zones, especially in the Donets-Dnepr and northern Caucasus regions. The area allotted to sunflower cultivation steadily decreased from a peak level of 4.8 million hectares in 1970 to 3.9 million hectares in 1987. Total output also dropped, but thanks to improved seed stock and more effective use of intensive technology, the decrease in production was not proportionate to the reduced area for cultivation. The average annual harvest between 1971 and 1975 was slightly below 6 million tons, and in 1987 it amounted to 6.1 million tons.

Since the early 1970s, sugar beets have occupied roughly the same amount of farmland as the other major technical crops—cotton and sunflowers—averaging some 3.5 million hectares. Sugar beet production, concentrated in the central and western Ukrainian Republic, the northwestern Caucasus, and the eastern areas of the Kazakh Republic and other Soviet Central Asian republics averaged 88.7 million tons per year between 1976 and 1980, well above the previous high of an average of 81.1 million tons per year in the 1966–70 period. Between 1981 and 1985, output fell to 76.3 million tons annually but rose thereafter, reaching 90 million tons

in 1987. Although in the 1980s sugar beets continued to provide over 60 percent of the country's sugar production, the Soviet Union was becoming increasingly dependent on raw sugar imported primarily from Cuba, e.g., from 2.1 million tons per year between 1966 and 1970 to 4.9 million tons per year between 1981 and 1985.

Grown for fiber and as a source of linseed oil, flax has been particularly successful in the mixed-forest zone northwest of Moscow and in the Belorussian, Estonian, Latvian, Lithuanian, and northwest Ukrainian republics. Although the area sown to flax steadily decreased from 2.1 million hectares in 1940 to only 980,000 hectares in 1986, production actually rose from 349,000 tons of fiber in 1940 to a peak of 480,000 tons in 1965 and to 366,000 tons in 1986.

Hemp, the other significant fiber crop, has been grown since the eighteenth century, although its area of cultivation has steadily decreased from about 600,000 hectares in 1940 to fewer than 100,000 hectares in 1986. Used in making rope, string, and rough cloth, hemp is grown primarily in the central chernozem area south of Tula and in the northern Caucasus.

Forage Crops

Since Khrushchev's campaign to raise the consumption of meat products, the Soviet Union has been expanding the cultivation of forage crops to feed a larger number of livestock. This trend was reinforced under Brezhnev's tenure, particularly after the announcement of the Food Program in 1982. Thus the area occupied by forage crops grew dramatically from 18.1 million hectares in 1940 to 63.1 million hectares in 1960; it remained virtually unchanged throughout the 1960s and then steadily rose to reach a high of 71.4 million hectares in 1986, when it accounted for approximately one-third of the total sown area. The area occupied by perennial hay crops (alfalfa and clover) nearly doubled between 1960 and 1986, while annual grasses and corn for silage were cultivated on a gradually diminishing scale. Total nongrain feed production, including corn for silage, feed roots, and hay and green fodder, increased steadily from 427.4 million tons in 1960 to 554.6 million tons in 1986.

Potatoes and Vegetables

A staple of the Russian diet for centuries and an important animal feed source, potatoes are grown on private plots throughout the country. They are cultivated on a large scale in the Ukrainian, Belorussian, Estonian, Latvian, and Lithuanian republics and in the central European part of the Russian Republic. The area

devoted to growing potatoes decreased steadily between 1960 (7.7 million hectares) and 1986 (6.4 millon hectares), although potatoes still accounted for nearly three-quarters of the total area devoted to vegetable crops. Potato harvests also declined substantially—from an average of 94.8 million tons annually between 1966 and 1970 to fewer than 78.4 million tons per year in the 1980–85 period.

Traditionally, the most widely grown vegetables in addition to potatoes have included beets, carrots, cabbages, cucumbers, tomatoes, and onions. These crops have been grown on an ever larger scale since the 1960s, and in 1986 they occupied nearly 1.7 million hectares. Yields increased proportionately, reaching a record 29.7 million tons in 1986. Thanks to the proliferation of large clusters of hothouses, it was possible to supply fresh cucumbers and tomatoes, among other produce, to the residents of major urban centers throughout the year. With private plots yielding roughly 40 percent of the vegetable harvest, much of the population, particularly the kolkhoz residents, grew a portion of their own produce.

Other Crops

Fruit cultivation in the Soviet Union is most successful in the southern, more temperate zones. The tiny Moldavian Republic, with its fertile soil and ample sunshine, produces more fruit and berries than all but the Ukrainian and Russian republics. In 1986 it harvested 1.2 million tons, as compared with 3.3 million tons in the Ukrainian Republic (which has 18 times more land area) and 2.9 million tons in the entire Russian Republic (which is 506 times the size of the Moldavian Republic). Orchards and vineyards occupied their largest area between 1971 and 1975, with a yearly average of 4.9 million hectares. However, the area allotted to noncitrus fruits decreased steadily from 3.8 million hectares in 1970 to 3.0 million hectares in 1986. Significant crops were table and wine grapes, which were widely grown in the warmer southern regions. The Azerbaydzhan and Moldavian republics accounted for over 40 percent of the total grape harvest, but the Ukrainian, Georgian, and Uzbek republics and the southern Russian Republic were also major producers. Citrus fruit growing was limited to the Black Sea coast of the Georgian Republic and a small area of the southeastern Azerbaydzhan Republic. In 1986 the Georgian Republic produced 97 percent of the total national harvest of 322,000 tons of citrus fruit.

Tea, a traditional beverage of Russians and the peoples of the Caucasus and Central Asia, is another specialty crop of the Georgian Republic, which accounted for 93.4 percent of national production in 1986. Other important centers of tea growing are the

Azerbaydzhanis at a central market in Baku display produce, including peppers, tomatoes, cabbages, and pomegranates. Courtesy Jimmy Pritchard

Azerbaydzhan Republic and Krasnodarskiy Krai in the Russian Republic. The area reserved for tea cultivation grew significantly between 1940 and 1986, going from 55,300 to 81,400 hectares. Production rose steadily during the 1950s and thereafter, reaching a peak of 620,800 tons in 1985. Despite increased yields, however, larger tea imports were necessary to meet consumer demand and reached 108,000 tons (equal to 17.4 percent of domestic production) in 1985.

Tobacco, like tea, is a fixture of Soviet life. The crop flourishes in the warmer southern regions, particularly in the Moldavian Republic, which produced about a third of the 1984 harvest. Other centers of tobacco cultivation are Central Asia and the Caucasus, which accounted for roughly 30 percent and 25 percent of the 1984 harvest, respectively. In 1940 only 72,800 tons were grown, but by 1984 tobacco output had more than quadrupled, reaching 375,700 tons. Production, however, did not keep pace with demand, and in 1984 about 103,000 tons (equal to more than 27 percent of domestic output) had to be imported.

Animal Husbandry

Because it is less restricted by climatic conditions, livestock raising is more widely distributed across the Soviet Union than is the cultivation of crops. For example, in the cooler, wetter northern regions of the European part of the country, where few cash crops can be grown, dairy farming is profitable because of the proximity to urban markets and the ready availability of fodder. In the 90 percent of the country considered nonarable, various forms of animal husbandry are practiced, such as reindeer herding in the Arctic and sheep, goat, and cattle grazing on the grasslands of Central Asia and Siberia. Nevertheless, it is the fertile triangle that has always accounted for the bulk of the nation's animal products.

Animal husbandry has received special attention since the late 1950s, and a primary goal of Soviet agriculture has been to increase the production and consumption of meat, milk, and eggs (see table 38, Appendix A). This effort has resulted in significantly larger numbers of livestock. For example, the number of cattle more than doubled between 1955 and 1987, rising from 56.7 million to 121.9 million head. During the same period, the number of hogs rose even more dramatically (from 3.9 million to 80 million head), and the number of sheep grew by half to reach 141.5 million head. The number of goats and horses in 1987 stood at 6.5 and 5.8 million head, slightly higher than in 1980 but well below the 1955 figures of 14.0 and 14.2 million head, respectively. Indeed, throughout

Herder with cows on a road south of Moscow
Shepherd with his sheep, Azerbaydzhan Republic
Courtesy Jimmy Pritchard

the Soviet period, the number of horses steadily declined as agriculture became more mechanized.

Larger numbers of animals notwithstanding, food output per animal continued to lag far behind Western standards. For example, milk production per cow averaged roughly half that reported in Finland, where the climate is certainly no more favorable. And even though the Soviet Union had achieved a ratio of cattle-to-human population comparable to that of the United States, beef production per head in 1986 was 35 percent lower. Similarly, pork output per head fell some 30 percent below the figure for the United States. According to Western analysts, this low livestock productivity resulted from inadequate feed supplies in general and a deficiency of protein in feed rations in particular. Domestic producers of protein supplement from cotton and sunflower seeds and pulses were unable to meet demand, which the government did not satisfy through imports. This decision took a heavy toll on livestock productivity.

To streamline livestock raising, a new type of production entity emerged in the 1960s and became increasingly prominent—industrialized livestock enterprises outside the traditional kolkhoz and sovkhoz system. These specialized factory-like operations purchased their feed and other inputs from outside sources, to which they enjoyed priority access. In 1986 they accounted for about 20 percent of pork, 5 percent of beef and milk, and over 60 percent of poultry and egg production.

In the thirty-five years between 1950 and 1985, per capita meat and fat consumption increased some 135 percent, reaching sixty-one kilograms per year. During the same period, consumption of milk and dairy products climbed by nearly 88 percent, and egg consumption rose by an impressive 334 percent. Still, demand for these products far exceeded supply, and in the late 1980s their availability in state stores remained very limited.

Forestry

With a third of the world's forested area, the Soviet Union has long led all countries in the production of logs and sawn timber. Although Siberia and the Soviet Far East hold 75 percent of the country's total reserves, they accounted for only about 35 percent of timber output in the mid-1980s. The forests of the northern European part of the Russian Republic have supplied timber products to the major population centers for centuries, and the timber industry of the region is better organized and more efficient than that east of the Urals. In addition, the European pine and fir forests grow in denser stands and yield a generally superior

product than the vast forests of the east, where the less desirable larch predominates. With the construction of some of the world's largest wood-processing centers in eastern Siberia and the Soviet Far East, and with the opening of the Baykal-Amur Main Line in 1989, the timber industry of the eastern regions was greatly advanced (see The Baykal-Amur Main Line, ch. 14).

The Soviet timber industry, which in 1986 employed roughly 454,000 workers, has had a long history of low productivity and excessive waste. Because of inadequate processing capacity, output of wood pulp, newsprint, paper, cardboard, plywood, and other wood products was scandalously low, considering the size of the Soviet Union's timber resources and its perennial position as the world leader in roundwood and sawed timber production. By the mid-1980s, the country appeared to have made substantial progress in achieving greater balance in its wood products mix. In 1986, for example, the production of pulp (9 million tons) was nearly four times the 1960 output (2.3 million tons), paper production (6.2 million tons) was almost three times higher, and cardboard output (4.6 million tons) was roughly five times the 1960 level. Nevertheless, in 1986 the Soviet Union ranked only fourth in world paper and cardboard production, with only one-sixth the output of either the United States or Japan. A high percentage of the roundwood harvest was used in the form of unprocessed logs and firewood, which remained an important fuel in the countryside.

In addition to their wood products, the north European, Siberian, and Far Eastern forests are important for their animal resources. Fur exports have long been an important source of hard currency (see Glossary). Although trapping continued to be widely practiced in the 1980s, fur farming, set up soon after the Bolshevik Revolution, accounted for most of the country's production of mink, sable, fox, and other fine furs.

One of the significant accomplishments of Soviet forestry has been the successful effort to restore and maintain production through reforestation of areas where overfelling had occurred. In 1986 alone, restoration work on 2.2 million hectares was completed, which included planting trees on 986,000 hectares. In the same year, nearly 1.7 million hectares of trees that had been planted as seedlings reached commercial maturity. In addition, some 109,000 hectares of shelterbelts were planted along gullies, ravines, sand dunes, and pastureland. This policy of conservation, in place for several decades, helped fight wind erosion and preserved soil moisture.

Fishing

Fish has always been a prominent part of the Soviet diet. Until the mid-1950s, the bulk of the Soviet catch came from inland lakes,

rivers, and coastal waters. Thereafter, the Soviet Union launched an ambitious program to develop the world's largest oceangoing fishing fleet, which consisted of 4,222 ships in 1986. The Soviet Union became the world's second leading fish producer, trailing Japan by a small margin throughout the 1970s and 1980s. In 1986 Soviet production amounted to 11.4 million tons, most of which was caught in marine fisheries.

The Atlantic Ocean supplied 49.2 percent of the total catch in 1980, while the Pacific Ocean yielded 41.3 percent. The Caspian, Black, Azov, and Aral seas, suffering from lowered water levels, increased salinity, and pollution, became relatively less important fisheries in the 1970s and 1980s. Whereas Murmansk had been the one large fishing port before the expansion of the oceangoing fleet, by 1980 there were twenty-three such ports, the largest of which were Vladivostok, Nakhodka, Kaliningrad, Archangel, Klaipeda, Riga, Tallin, Sevastopol', and Kerch'. In 1982 more than 96 percent of the frozen fish, 45 percent of the canned fish, 60 percent of the fish preserve, and 94 percent of the fish meal delivered to market was processed at sea by large, modern factory ships.

Because of the worldwide trend of claiming 200-mile territorial waters, total fish production fell after 1977. The open Pacific was viewed as a promising fishery to offset reduced production in coastal waters, which had been yielding up to 60 percent of the Soviet catch. Inland fisheries also began to receive more attention, and fish farming was promoted as ponds were established close to urban centers. Between 1961 and 1980, the production of fresh fish by such enterprises increased by over 8.8 times, reaching 158,300 tons. The Eleventh Five-Year Plan called for pond fish production to be tripled.

The Twelfth Five-Year Plan, 1986–90

Following the disappointing performance of Soviet agriculture during the Eleventh Five-Year Plan, the Twelfth Five-Year Plan got off to a promising start, with larger than expected grain harvests and improved labor productivity. Nevertheless, Western analysts viewed as unrealistic most of the Twelfth Five-Year Plan production targets—both those set forth in the Food Program of 1982 and those subsequently revised downward.

According to the document *Basic Directions for the Economic and Social Development of the USSR for 1986–1990 and for the Period to the Year 2000,* the Soviet Union would significantly increase production of all agricultural commodities. The ambitious 1990 production target ranges laid out in this document called for increases over the average annual output of the Eleventh Five-Year Plan. The

Fishing boats in the port of Listvyanka, Lake Baykal, Russian Republic
Courtesy Jimmy Pritchard

target ranges for agricultural commodities were as follows: grain from 38.7 to 41.4 percent; sugar beets from 20.6 to 24.5 percent; sunflower seeds from 48.9 to 50.9 percent; potatoes from 14.9 to 17.4 percent; vegetables from 36.9 to 43.7 percent; fruits, berries, and grapes from 40.4 to 51.6 percent; raw cotton from 9.5 to 13.1 percent; meat from 10.7 to 29.4 percent; milk from 12.1 to 16.3 percent; and eggs from 7.5 to 10.2 percent. The 1990 goals for the fishing industry ranged from 4.4 to 4.6 million tons of fish food products and about 3 billion cans of fish preserve. The forestry industry was tasked with increasing the production of pulp by 15 to 18 percent, of paper by 11 to 15 percent, and of fiberboard by 17 to 20 percent. As in all sectors of the economy, conservation of raw materials and reduction of waste in transportation and storage of commodities were to be emphasized more than in any previous period.

Although grain harvests were excellent in 1986 and 1987, output fell to only 195 million tons in 1988, forcing the Soviet Union to import more than 36 million tons that year. The 1988 harvest of potatoes, other vegetables, and fruits also declined as compared with the previous two years. As a result, the availability of food products throughout the country worsened, and in mid-1989 many Western observers believed a severe shortage and possibly famine

were impending. Clearly the Twelfth Five-Year Plan's goals for agriculture would not be attained, a severe setback for Gorbachev's *perestroika* efforts.

* * *

An invaluable source of statistical data on the agro-industrial complex is the 1987 publication *Narodnoe khoziaistvo SSSR za 70 let,* compiled by the Soviet Union's Gosudarstvennyi komitet po statistike. *USSR Situation and Outlook Report,* published annually by the United States Department of Agriculture's Economic Research Service, presents a concise overview of recent Soviet agricultural performance. D. Gale Johnson and Karen McConnell Brooks's *Prospects for Soviet Agriculture in the 1980s* examines Soviet agricultural efficiency in light of policy and natural and climatic factors. *The Soviet Rural Economy,* edited by Robert C. Stuart, presents several highly pertinent essays on Soviet agriculture, including Michael L. Wyzan's "The Kolkhoz and the Sovkhoz," Valentin Litvin's "Agro-Industrial Complexes," and Everett M. Jacobs's "Soviet Agricultural Management and Planning and the 1982 Administrative Reforms." Two other important anthologies are *Agricultural Policies in the USSR and Eastern Europe,* edited by Ronald A. Francisco, Betty A. Laird, and Roy D. Laird, and *Soviet Agricultural and Peasant Affairs,* edited by Roy D. Laird. Paul E. Lydolph's classic *Geography of the USSR* provides a comprehensive description of Soviet agricultural resources, including forestry and fishing. The evolution of current policy is traced by Karl-Eugen Waedekin in numerous *Radio Liberty Research Bulletin* reports, including "The Private Agricultural Sector in the 1980s," "'Contract' and 'Normless' Labor on Soviet Farms," and "What Is New about Brigades in Soviet Agriculture?" Zhores A. Medvedev's *Soviet Agriculture* and Valentin Litvin's *The Soviet Agro-Industrial Complex* provide highly detailed descriptions of the organization and functioning of Soviet agriculture. (For further information and complete citations, see Bibliography.)