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A study of Soviet railroad transport accomplishments. The government-operated railroads of the U.S.S.R. have shown what modern railroads can do under favorable conditions. They are technologically alert, have maintained high morale among their personnel, and have a remarkable record of cost reduction since 1950. Soviet rail passenger service, while not as impressive as the freight service, has handled most of the intercity passenger travel adequately for many years. This book, the sixth in the Brookings Transport Research Program series, analyzes the Soviet record and its implications for developing and developed countries. In describing Soviet railroading accomplishments, the author acknowledges the many differences between Soviet objectives and those of other nations, but commends to developing countries the energetic operating procedures and modern railroad equipment that have contributed to the Soviet achievement. He believes that industrially advanced countries can gain useful perspective on their own transport policy problems by reviewing Soviet experience. He challenges the conventional view of the relation between transport investment and general economic development by showing that heavy capital outlays for transport facilities need not precede the growth of agriculture and industry, but rather transport capacity can be expanded as the demand for it grows. The book also deals with the role of trucks, the problem of lack of roads, and the future of the passenger car in the Soviet Union.

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Its Lessons for Other Countries

Soviet Transport Experience: Its Lessons for Other Countries

Holland Hunter

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This volume, the sixth in the Brookings Transport Research Program series, analyzes the Soviet record and its implications for developing countries and for other industrially advanced countries. In describing Soviet railroading accomplishments, the author acknowledges the many differences between the objectives of the Soviet Union and those of other nations, but he commends to developing countries the energetic operating procedures and the technological potential of modern railroad equipment that have contributed to the Soviet achievement. He believes that industrially advanced countries can gain useful perspective on their own transport policy problems by reviewing Soviet experience. He challenges the conventional view of the relation between transport investment and general economic development by showing that heavy capital outlays for transport facilities need not precede the growth of agriculture and industry, but rather that transport capacity can be expanded as the demand for it grows. The book also deals

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with the role of trucks, the problem of "roadlessness," and the future of the passenger car in the Soviet Union.

Holland Hunter teaches economics at Haverford College. He is a coauthor (with Clair Wilcox and others) of *Economies of the World Today*, a contributor to an earlier Brookings book in the Transport Research Program series, *Transport Investment and Economic Development*, and the author of *Soviet Transportation Policy*.

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Foreword

ONLY A FEW COUNTRIES have a substantial history of formalized planning for economic development. Among these, the Soviet Union is particularly interesting to all who are concerned with the impact of transport investment on the development process. This interest has been focused on two aspects of Soviet transport policy: the effort to hold down transport investment to make existing investment serve more productively, and the conscious decision to minimize road investment relative to investment in rail and water transport. Both of these efforts were pursued within an overall economic planning framework that at various times encouraged the spread of economic growth to the outlying regions of the Soviet Union in order to achieve more uniform development throughout the country.

The Soviet approach to transport is of obvious interest to developing countries now faced with these same questions of regional equities, intermodal competition, and resource allocation. The Transport Research Program, financed by a grant from the United States Agency for International Development, was fortunate in being able to interest Holland Hunter of Haverford College in undertaking this study to show the relevance of Soviet experience. Professor Hunter is the author of *Soviet Transportation Policy* and a contributor to another Brookings book in the Transport Research Program series, *Transport Investment and Economic Development.*

Albert O. Hirschman, Alan S. Manne, and Ernest W. Williams, Jr., reviewed the manuscript, and Professor Hunter wishes to ac-

knowledge their detailed suggestions. He also is grateful for the assistance provided by officials of the Government of India Ministry of Railways, the Association of American Railroads, the American Trucking Associations, Inc., and his colleagues in the Transport Research Program. Appendix B was written in collaboration with Helen Manning Hunter, to whom the book is dedicated. Major research assistance was provided by Jill A. Lion. The manuscript was edited by Alice M. Carroll and the index prepared by Florence Robinson.

Portions of the material appeared in *New Directions in the Soviet Economy*, a 1966 study prepared for the Joint Economic Committee of the Congress, and in an article in the October 1965 issue of *Economic Development and Cultural Change*.

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Opinions expressed by the author are his own and do not necessarily represent the views of the Agency for International Development, or the trustees, officers, or other staff members of the Brookings Institution.

KERMIT GORDON
President

August 1967

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CHAPTER I

Issues Underlying Soviet Transport Development Policy

IN REVIEWING THE ROLE of the transport sector in Soviet economic development, one must recognize the crucial influence of several basic state policies. Different basic policies would have called for a different set of transport decisions and given rise to a different set of transport responses. Moreover, the implications of Soviet experience for other countries depend not only on the degree of similarity in their transport conditions but also on the extent to which Soviet basic policies are felt to form an appropriate model. This study thus begins with a brief review of three basic Soviet policy decisions—national self-sufficiency, dispersed development, and the primacy of industry—that have crucially influenced the Soviet transport record.

International Trade or Domestic Self-Sufficiency?

The railroad network inherited by the Bolsheviks in 1917 had been strongly shaped during the nineteenth century by Russia's foreign trade. A numerous set of grain-export lines had been built from Baltic seaports southeast into the grain-growing regions of central Russia, and another group of grain-export lines was built northward and eastward from the Black Sea into the grain-growing regions of the Ukraine and southern Russia.[1] Early Russian

[1] See Tigran Sergeevich Khachaturov, *Razmeshchenie transporta v kapitalisticheskikh stranakh i v SSSR* (1939), pp. 440-41. Place of publication of all Russian language titles is Moscow, unless otherwise noted.

economic development was significantly oriented toward the export of primary products to Europe; for example, an oil pipeline was built from Baku on the Caspian Sea westward across to Batumi on the Black Sea in 1904 to facilitate Soviet kerosene exports. There was also a large traditional flow of Soviet timber from north European Russia to Great Britain. Did the Bolsheviks wish to continue these extensive economic relations with the outside world?

Russian economic development before World War I had been strongly influenced by substantial foreign investments.[2] The iron and steel industry that grew up in the eastern Ukraine during and after the 1870's depended heavily on capital inflows from England and elsewhere. The petroleum industry grew under the stimulus of large French investments. In machinery and several other manufacturing sectors, German, Belgian, and other European investment loomed large. Toward the end of the prewar period, the share of native Russian investment in manufacturing capital was increasing, especially in the textile industry, but in the modern sector as a whole, foreign influence was still dominant. The intrusion of Western capitalism had, of course, first been welcomed by Lenin as preparing the way for a higher stage of development along Marxian lines,[3] but for many Russians it was galling to see foreigners organizing and benefiting from the new activities. To the Bolsheviks, moreover, dependence on foreign capital appeared very dangerous. As the theoretic notions of Bolshevism took shape after 1902, an autarkic theme clearly assumed major importance. By 1917, with the publication of Lenin's *Imperialism—The Highest Stage of Capitalism*, the Marxian distinction between exploiter and exploited had been given an international as well as a national dimension.[4] The major imperial powers exploited their colonies, just as Russian capitalists exploited their workers. The Bolshevik call for a domestic revolution to overthrow the oppressors at home was accompanied by a faith, on the international plane, that op-

[2] See Ol', Pavel Vasil'evich, *Inostrannye kapitaly v narodnom khoziaistve dovoennnoi Rossii* (Leningrad, 1925), *passim*, and Khachaturov, *op. cit.*, pp. 425-27.

[3] See V. I. Lenin's 1899 book, *The Development of Capitalism in Russia*, Vol. 3 of his *Collected Works* (in Russian; 4th ed., 1946), Chap. 1, especially pp. 45-47 *et passim*.

[4] See Vol. 22 of his *Collected Works* (4th ed.; 1948), pp. 263-64 *et passim*.

pressed nations would overthrow their imperialist oppressors and achieve their national independence.

When the new leaders of Russia were able to take stock and chart their course, after the turmoil of war and civil war subsided in 1920, this intellectual heritage quite naturally led to a strong emphasis on national self-sufficiency.[5] The Soviet government refused to accept responsibility for paying interest or repaying principal on the large outstanding Russian debt to France and other countries. Though there were tentative efforts to arrange a few minerals concessions, and in fact a few foreign mining specialists worked in the U.S.S.R. during the middle 1920's, the prewar era of massive Western participation in Russian industrialization had clearly come to an end. The basic economic objectives of the first Five Year Plan, published in 1929, centered on creating a self-sufficient and economically independent Soviet industrial base. For a few years there was a brief burst of plant and equipment imports, together with the primary product exports necessary to finance the imports, but the volume of both fell to a low level in the later 1930's. Even with the marked growth of Soviet imports and exports since 1954, foreign trade continues to produce only a small fraction of Soviet national income, and the Soviet economy remains unusually self-sufficient by world standards.

The Soviet policy of economic self-sufficiency had a number of important transport implications. It meant, for example, that rail lines built to open up new natural resources sites would be likely to carry raw materials to domestic production centers rather than freight to Russian ports for sale abroad. Because the inherited railway network had clearly been designed with the export trade in mind, the new domestically oriented commodity flows could be expected to require new, supplementary railway connections. Transport lines heavily engaged in foreign trade movements before World War I might fall into relative disuse, while new or formerly

[5] Soviet writers usually quote Lenin's "Draft Plan of Scientific and Technical Work" (written in April 1918 and published in March 1924), which called for a "plan for the reorganization of industry and the economic progress of Russia . . ." so that it could ". . . provide itself *independently* with *all* the chief items of raw materials and organize main branches of industry." See his *Collected Works*, Vol. 27 (4th ed.; 1950), p. 288.

minor internal links would be called on to carry heavy traffic generated by an inwardly focused pattern of industrial development.

Other transport modes also felt the impact of national autarky; obviously it constituted a blow to Russian maritime transport. The volume of Soviet foreign trade recovered slowly in the 1920's and remained small in the 1930's after a temporary boom in imports and exports during 1930-35.[6] But because much of Russia's sea trade had been carried in foreign ships before World War I, efforts were made under the five year plans to enhance economic independence by raising the Soviet merchant marine's share of the reduced traffic. At the same time, greater stress was placed on the purely domestic (coastal and intercoastal) role of the Soviet fleet, and this inward emphasis appears to have predominated.[7]

Though the Soviet drive for self-sufficiency made the prospects of the maritime component of Soviet freight transportation unfavorable, river transport could expect to benefit from economic inwardness. A linked system of internal waterways might well contribute to domestic industrial growth. To the extent, however, that Soviet rivers displayed the usual geographic tendency to run from the interior to the maritime edges of the continental land mass, and failed to link domestic centers of economic activity, they too might suffer from the new orientation of national economic policy.

Finally, Bolshevik autarky raised uncomfortable issues concerning the future of the easternmost parts of Soviet territory. Long before World War I, Russia had begun reaching toward the Pacific, and at the turn of the century the Trans-Siberian Railroad was built to link European Russia with Vladivostok. Would the new regime be as active here? Relations with China and Japan would clearly influence Soviet eastern development, and perhaps override the transport disadvantages of very long overland distances. Taken by itself, however, the policy of economic autarky would tend to isolate the Soviet Far East from its least-cost economic contacts. Fluctuating Soviet policies toward the Soviet Far East since

[6] For summary data, see Ministerstvo Vneshnei Torgovli SSSR, *Vneshniaia torgovlia SSSR v 1918-1940 gg.* (1960), pp. 14-16.

[7] For discussion of the difficult coverage problems surrounding maritime traffic data, see the appendix by George Novak in Ernest W. Williams, Jr., *Freight Transportation in the Soviet Union* (Princeton University Press, 1962), pp. 157-67.

the 1920's have in fact proved to be of continuing interest, though they cannot be reviewed here.

Development of the Periphery or the Old Centers?

A second major issue that shaped the evolution of Soviet transport concerned the role to be played by various parts of the country in the drive to build industrial power. Lenin had argued, in his tract on imperialism, that Russia too was an imperial power, whose colonies lay around the periphery of the land empire.[8] Party doctrine held that the imperial capital, Saint Petersburg, together with Moscow and a few other old centers, had been exploiting the provinces and the colonial periphery. Now, after *Der Tag*, what new course would be set? The question was of course closely related to ethnic frictions between the Slavic Great Russians and the many other ethnic minorities that had suffered real or fancied domination by Great Russians in the past. The leader most closely associated with this group of problems was J. V. Stalin, a non-Great Russian from the Caucasus whose political strength lay in the outlying regions. One might have expected, therefore, an interest in the development of peripheral regions to accompany Stalin's rise to sole authority.

Why had industry developed around Saint Petersburg on the Gulf of Finland, around Moscow in central European Russia, and in several other long-settled towns in central European Russia? In the making of textiles, the processing of food products, and the fabricating of many manufactured products, though raw materials

[8] Lenin explained in his preface that the tsarist censorship forced him to be Aesopian and use as examples incidents like the Japanese annexation of Korea, but that "the careful reader will easily substitute Russia for Japan, and Finland, Poland, Courland, the Ukraine, Khiva, Bokhara, Estonia, or other regions peopled by non-Great Russians, for Korea." In other tracts written just before and after this 1916 manuscript, he wrote of "Russia, where the oppressed nations account for no less than 57% of the population, or over 100 million, where they occupy mostly the border regions . . . ," and asserted that ". . . Russia set a world record for the oppression of nations with an imperialism that is much more crude, medieval, economically backwa d, and militarily bureaucratic." See his *Collected Works*, Vol. 22, pp. 176, 142, and 343-44.

and fuel were key inputs, their pull on the location of new enterprises was clearly outweighed by the pull of markets and a suitable labor force. The old centers could supply both customers and workers. Machinery and equipment imported from the West therefore tended to be set up in or near Saint Petersburg, for example, where workmen could be hired, other inputs secured, and the product sold. The required raw materials might also be imported from the West, or be brought to the old center from a domestic Russian resource site in the south or east. This was the geographic pattern of growth in the early decades of Russian industrialization.

A major theme in Russian history, running counter to the pull of the old cities, was the vision of fabulous wealth in the vast territories generally called "Siberia." The continental land mass stretching for three thousand miles eastward beyond the Urals, though forbidding in its cold northern climate, gave ample evidence of innumerable rich mineral deposits, dense forests, and mighty rivers. The imagination of Russian nineteenth century private and governmental entrepreneurs was fired by the potentialities for industrial development in those distant territories. The building of the Trans-Siberian Railroad around the turn of the century stimulated the opening up of coal fields, gold deposits, lumbering operations, tin and copper mines, and other natural resource extractive activities. In the 1920's, the Soviet regime had to decide on the extent to which the development of Siberia should be continued.

As Commissar for Nationalities, J. V. Stalin developed a policy for dealing with non-Great Russian minority groups under which each group was accorded a distinct geographic territory. The nation state formed under the Constitution of 1923 consisted of eleven "soviet socialist republics," ostensibly federated in a Union of Soviet Socialist Republics, and below them (mainly within the largest republic, the Russian Soviet Federated Socialist Republic), several dozen "autonomous soviet socialist republics," and "autonomous oblasts." The economic implications of this large, complex territorial structure are a matter of considerable interest. Each unit of course had its capital or administrative center, and the formal ground rules of the federal political structure appeared designed to permit or even induce regional efforts to obtain central support for

their rapid economic growth. In practice, however, under the slogan "national in form, Socialist in content," Moscow maintained firm control over the national pattern of development. Nevertheless, as we shall see, the presence of "localist tendencies" has been a matter of concern to the authorities for forty years.

The two major precepts of the location policy enunciated by the Soviet regime in the 1920's were (1) to locate industry more evenly, and (2) to move industry closer to sources of fuel and raw materials. Their relation to the factors we have been examining is readily apparent. A more uniform distribution of industrial activity throughout the numerous ethnic regions of the U.S.S.R. would act to redress the asserted inequity of the inherited pattern. Building new factories at or near the major sources of fuel and raw materials would open up the "fabulous wealth of Siberia" and unlock the full domestic production potential of the Soviet Union in a locationally efficient way.

Industrial location policy clearly had major implications for Soviet transport evolution. If industrial activity were located at or near fuel and raw material sites, the demand for freight transportation would be smaller than if industry expanded around the old centers in European Russia, hundreds of kilometers away from their raw materials supplies. Though this seemed a logical overall conclusion, development of new industrial centers in fact gave rise to huge freight traffic demands.

If industry were actually to be "located more evenly" in a fine-scale sense, responding to the promise implied in the political formalities of Soviet nationalities policy, the transport implications would be drastic. Scattered, decentralized, small-scale producing units would require a widespread transport network, and thus a large volume of new road or rail construction, and would generate a sprawling pattern of relatively light traffic flows. If, on the other hand, industrial growth were concentrated at a handful of major centers, in defiance of the call to "locate industry more evenly," less enlargement of the transport network would be required, and concentrated freight traffic flows on major trunk lines might be handled through methods enjoying economies of scale and meeting transport needs at low real costs.

Emphasis on Industry or Agriculture?

The most pervasive background policy issue shaping the development of Soviet transportation has been the question of industry versus agriculture. It lies at the heart of Soviet history.* Bitter struggles raged in the Communist Party during the 1920's over sectoral priorities, and the distinctively Stalinist answer that emerged at the close of the decade has shaped Soviet growth ever since. The dichotomy between industry and agriculture is closely bound up with similar dichotomies between the state and the consumer, between heavy and light industry, and between a drive for rapid industrialization and a program of gradual evolution. Soviet policy has obviously been directed decisively toward the rapid development of heavy industry with all its attendant consequences. The resulting relative neglect of household wants, agriculture, and light industry, and the associated costs imposed on the Russian people, have clearly not been primary ends but unfortunate byproducts of the stress on heavy industry. Although the complexities of these issues are not under review here, we must examine briefly the numerous implications for Soviet transport of these decisions on sectoral emphasis.

The focus on heavy industry meant, first of all, giving attention to freight traffic rather than passenger movement, except for transporting workers to their jobs and perhaps migrants to new areas. Most transport organizations throughout the world in fact devote the major part of their efforts to freight rather than passengers, but this tendency was heightened in the U.S.S.R. under the five year plans. If necessary, passenger trains were put on sidings to let freight trains go through. Thus, freight traffic, as well as freight-handling capacity, has grown far more rapidly than Soviet passenger traffic.

Within the freight category, the stress on heavy industry meant

*For a review of the issues see Nicolas Spulber, *Soviet Strategy for Economic Growth* (Indiana University Press, 1964), and its companion volume, *Foundations of Soviet Strategy for Economic Growth: Selected Soviet Essays, 1924-1930*, edited by Spulber and published simultaneously by Indiana.

that a narrow range of commodity groups, centering on mass industrial raw materials and fuel, would dominate the picture. The diverse and numerous commodity groups associated with light industry, processed agricultural products, and consumer goods, often shipped in less than carload lots and usually making up a major share of most railroads' problems, have played a minor role in Soviet transport experience. Shipments of this kind were by no means eliminated, but under Stalin they had low priority.

The decision to give secondary priority to agriculture had important implications for the growth of Soviet railroads. The inherited rail network already reached existing producing centers and required relatively modest expansion to meet the needs of a heavy industrial development program. However, the tsarist railway network lacked the abundant supply of feeder lines that had proliferated in the West before World War I. These feeder lines facilitated the gathering of agricultural produce, the distribution of consumer goods, and the decentralized development of light industry. In the U.S.S.R., since agriculture, consumer goods, and light industry were of secondary concern to the authorities, pressures to build feeder lines could be resisted.

Finally, the Soviet focus on heavy industry pointed toward reliance on rail transport and worked against the large-scale development of highways and automobile transport. In carrying coal or iron ore for long distances, trucks can only under very rare circumstances compete with railroads. For quick, door-to-door deliveries of high-valued consumer goods, over relatively short distances, the advantage is reversed, but demands of this kind have not been a major feature of Soviet economic development. The Soviet Union established its own truck and passenger automobile production facilities during the first Five Year Plan (the growth of motor vehicle transport is examined in some detail later in Chapters 5 and 6). Nevertheless, it should be clear at the outset that the road-versus-rail issue which bedevils so much Western discussion of transport problems was decisively settled in the Soviet Union by the very nature of the development drive decided on at the close of the 1920's.

CHAPTER II

Soviet Conditioning Factors

THE LESSONS TO BE DRAWN from the Soviet transport record turn largely on the way in which the transport sector has reacted to a number of conditioning factors which defined its problems and constrained its responses to the policy intentions set forth in the preceding chapter. These conditioning factors, outlined briefly in this chapter, include geographic and technological constraints as well as certain demographic aspects of Soviet history.

Climatic and Geographic Limitations

Most of the Soviet Union lies far up in the northern part of the northern hemisphere and, in addition, is cut off from the ameliorating influences of oceanic currents. Among the unfavorable consequences is a growing season in most parts of the country that is short by world standards. Almost half of Soviet territory (47 percent, according to a distinguished Soviet physical geographer)[1] is subject to permafrost, or permanently frozen subsoil. Where only a shallow layer of earth thaws each summer, not only is agriculture

[1] See S. P. Suslov, *Fizicheskaia geografiia SSSR, Zapadnaia Sibir', Vostochnaia Sibir', Dal'nii Vostok, Srednaia Aziia* (Leningrad-Moscow, 1947), pp. 140-63, especially pp. 140-43. A 1940 treatise had stated, "The area of permanent ground frost is approximately 10 million square kilometers, which is 47% of the area of the USSR." See S. S. Balzak *et al.* (eds.), *Economic Geography of the USSR*, trans. Chauncy D. Harris (Macmillan, 1949), p. 62. The same estimate is attributed to M. I. Sumgin in M. I. Davydova *et al.*, *Fizicheskaia geografiia SSSR* (1960), p. 99. For a review of current problems in developing the Soviet north, see the article by S. Slavin in *Planovoe Khoziaistvo*, 1966, No. 12, pp. 16-26. Place of publication of all Russian language titles is Moscow, unless otherwise noted.

difficult, but construction and maintenance of factories, homes, railroads, bridges, dams, and all the fixed capital of industrial activity are more difficult and expensive, sometimes prohibitively so. In seeking to take advantage of the "fabulous wealth of Siberia," the Russians have confronted major engineering and technical difficulties, comparable perhaps to those that have inhibited the development of Alaska. Alaska is not, however, 47 percent of the United States.

The northern location of the Soviet Union also means that her rivers and seas are frozen for periods ranging from three to nine months each year. Even Odessa, major Ukrainian port on the Black Sea, is closed an average of thirty-seven days each year.[2] The Black Sea is in the same latitude as the Great Lakes in North America, suggesting that Canada rather than the United States provides a relevant analog for Soviet geographic conditions. Oceanic amelioration is far more helpful for eastern Canada, however, than for western Russia. In both countries, intermittent freezing makes waterways less attractive for shippers, especially those who depend on year-round reliable transport service. This defect of Soviet internal waterways, as we shall see, has seriously hindered their development in recent decades. Developing economies of Asia, Africa, and Latin America that can take advantage of well-located river systems are likely to have transport opportunities open to them that have been foreclosed to the U.S.S.R. by its northern location.

The huge Soviet land mass has a maritime coastline of 37,000 kilometers, but its usefulness for transport purposes is severely limited. The seas are mainly peripheral to the central mass of Soviet territory, and, more serious, are separated from each other by massive intervening barriers. Save for a low-capacity canal connection, the White Sea in the north of European Russia and the Baltic Sea on which western Russia fronts are separated by the whole of the Scandinavian peninsula. The Baltic, in turn, is separated from the Black Sea below the Ukraine by the whole continent of Europe. Since 1952, a large canal has made possible movement between the

[2] For this and nineteen other shipping-season averages at various Soviet sea and river locations, see Holland Hunter, *Soviet Transportation Policy* (Harvard University Press, 1957), p. 13.

Black Sea and the Caspian Sea on the southern edge of European Russia, though not much traffic has so far been generated on this route. Far more discouraging is the enormous distance separating the Black Sea and the Soviet Pacific coast, involving a trip into the Mediterranean, through the Suez Canal, across the Indian Ocean, and past China, some 11,600 miles in all.[3] Traffic around the eastern and northern coastline of the U.S.S.R. has for thirty years been minute in spite of strenuous efforts by the Great Northern Sea Route Administration. During a precarious and irregular ten-week shipping season, convoys of a few dozen freighters can pass between the White Sea and the Pacific, but nothing approaching regular and dependable mass freight carrying capacity seems in prospect for this route.[4] Taken altogether, the limitations on Soviet maritime transportation, in relation to the domestic needs of the Soviet economy, are severe. Countries like Indonesia, Brazil, and even India are far more fortunate in their access to ocean shipping opportunities.

A number of large, long rivers traverse the Soviet land mass, and several have figured prominently in Russian history. Before World War I, the Volga River was a major traffic artery for the tsarist economy. Nevertheless, several geographic and climatic limitations have hampered the growth of Soviet river transport. The basic problem is that Soviet rivers do not directly link major centers of industrial production or consumption. Between the eastern Ukraine and Moscow, the Volga offers only a very circuitous connection.[5] Between the eastern Ukraine and the Leningrad region, no large-capacity all-water connection exists. The great rivers of Siberia flow northward and therefore fail to provide direct links

[3] A route distance of 18,687 kilometers between Odessa and Vladivostok is shown on the 1954 four-sheet map, *Soiuz Sovetskikh Sotsialisticheskikh Respublik*, issued by the Glavnoe Upravlenie Geodezii i Kartografii of the Ministerstvo Vnutrennykh Del' in Moscow.

[4] For historical background, see Terence Armstrong, *The Northern Sea Route* (Cambridge University Press, 1952), especially pp. 103-19. For more recent evaluation, see S. V. Slavin, *Promyshlennoe i transportnoe osvoenie severa SSSR* (1961), *passim*.

[5] For informed evaluation of this and other difficulties, see Robert N. Taaffe, "Volga River Transportation: Problems and Prospects," in Richard S. Thoman and Donald J. Patton, *Focus on Geographic Activity: A Collection of Original Studies* (McGraw-Hill, 1964), pp. 185-93.

with centers lying to the west in European Russia. The two great rivers of Soviet Central Asia unfortunately terminate in the Aral Sea, and thus fail to offer a through route to European Russia. Several rivers are useful for bringing timber to northern Soviet ports for export to Europe, though only during a relatively short ice-free season. Again it is clear that unfortunate accidents of geography and climate impair the potential of Soviet water transport, and that many underdeveloped countries—for example, Nigeria in West Africa—are far more fortunate in this respect.

The Soviet land mass is, however, highly favorable for low cost operation of railroads. The Ural Mountains, separating European from Asiatic Russia, present only a minor barrier to east-west rail lines, which can traverse low passes without difficulty. The great plain of European Russia extends in a narrowing band all the way from Poland east to the River Yenisei in Siberia before highlands and mountainous territory create railroad-building problems. The mountainous territory between Lake Baikal and the Amur Valley is indeed difficult, and so far only the Trans-Siberian crosses its southern edge. Between the Caspian Sea and the western edge of China, a lack of usable water in the deserts of Soviet Central Asia impeded the spread of steam railroads; now, however, diesel-electric locomotives operate freely up to the point where peripheral mountain ranges present serious barriers. The great Caucasian mountain range between the Caspian and Black seas can be skirted easily on the east and with more difficulty along the Black Sea coast; both connections are in place.

For most of the settled portions of Soviet territory, therefore, railroads offer a low cost means of moving heavy freight traffic. With the methods that have evolved in Soviet railroad practice, the real cost per ton-kilometer for moving fuel and industrial raw materials can be very low. But it remains true that where materials move over extremely long distances, the absolute cost per ton of delivered commodity will still be very high.

Several transport implications follow from these geographic considerations. By comparison with a hypothetical situation in which low cost river and sea transport, properly located, was available, one might expect the Soviet economy to require a high ratio of transport outlays to national income. While the real costs of

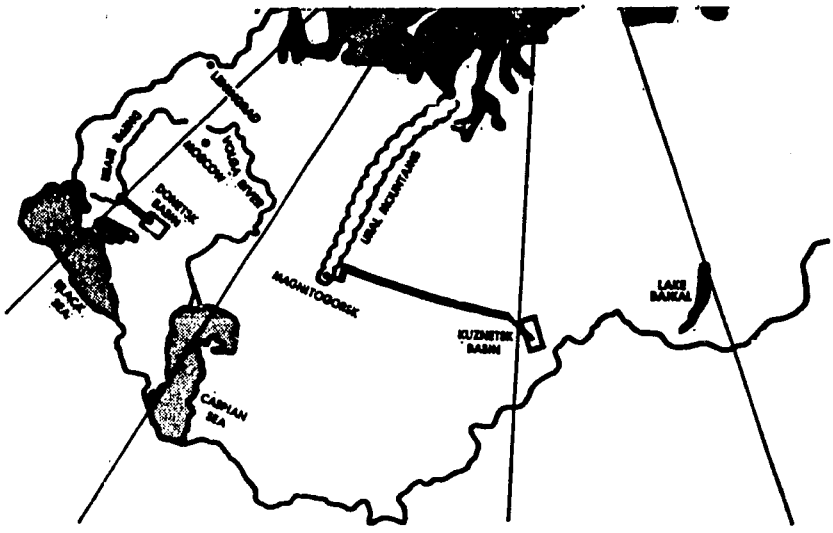
moving heavy freight across the Soviet Union would clearly be lower than, for example, moving them across the continent of Latin America with its formidable Andean barrier, low ton-kilometer costs might be offset by long average distances of movement. The key consideration would be the geographic density of economic activity, and in particular, the distance between points generating major traffic flows. Soviet geography gives ample ground for an expectation that the Soviet economy will display a relatively high ratio of transportation costs to total national income.

Dispersion of Resource Sites

In Figure 1, the major Soviet resource areas generating freight traffic are identified. In the west, the map shows the coal and iron complex of the eastern Ukraine, with iron ore in the great bend of the Dnepr River around Krivoi Rog and coking coal in the basin of the Donets River. The main east-west axis of the shuttle traffic in this region is about 350 miles long. In the center of the map one sees another axis, connecting the iron ore at Magnitogorsk in the southern Urals with coking coal in the Kuznetsk Basin of western Siberia, a transport distance of about 1,400 miles. Between the two centers is a lower quality coal field at Karaganda, and above Magnitogorsk diverse mineral deposits extend to the northern Urals. Several rich coal fields lie in central and eastern Siberia, far from existing centers of population and industry, but they are only beginning to form the basis for local industrial growth. In north European Russia, coal at Pechora and oil at Ukhta help to supply the needs of the Leningrad industrial region, moving several hundred kilometers to do so. Enumeration of other minor fuel and raw material resource sites would not alter the point that the Soviet economy depends on widely scattered sources of supply, far from each other and often far from major population centers.

Oil is perhaps an exception. In 1904, Russia was the largest producer of crude oil in the world. Rich oil fields at Maikop and Grozny on the northern slopes of the Caucasus Mountains came in during the 1890's, and an even richer series of strikes was made on the Apsheron Peninsula, jutting into the southwestern corner of

FIGURE 1. *Major Soviet Resource Sites and Freight Traffic Axes*



Source: Azimuthal equal-area base taken from Frank Lorimer, *Population of the Soviet Union: History and Prospects* (Geneva: League of Nations, 1946), Plate XVI, p. 152.

the Caspian Sea near the city of Baku. Much of the oil was refined into kerosene and shipped westward by pipeline to Batumi for export to Europe. The balance was available for domestic Russian consumption, and though the source of supply was on the southern edge of the economy, the Caspian Sea and the Volga River provided a low cost means of shipping crude oil and refined products into central Russia. During the 1930's, abundant new crude oil supplies were found in deep Devonian strata east of the middle Volga and west of the Ural Mountains. After World War II, and especially after Stalin died, crude oil production from this so-called second Baku territory increased very rapidly. It is conveniently located near the burgeoning industrial cities of the Volga Valley (Gorky, Kazan, Kuibyshev, Saratov, and Volgograd) and within a triangle formed by Moscow, the eastern Ukraine, and the Urals.

Since the early 1950's, large deposits of natural gas have been found in the western Ukraine, the north Caucasus, and Soviet Central Asia. Pipelines from these fields are rapidly making natural gas available to the large industrial cities lying to the north of them. As

the share of natural gas in total Soviet fuel consumption rises, the effect is to relieve demands on the railroads and in the long run on the whole transport sector itself.

The field and livestock products of the Soviet agricultural sector are grown in a huge, wedge-like territory whose long point extends to the east. The northern boundary of the wedge, running eastward from Leningrad across the Urals to the River Yenisei, is defined by the northern limit for growing cereal grains. The southern edge traditionally ran from the Black Sea eastward across the southern edge of the West Siberian Plain to the River Yenisei; lack of rainfall prevented crop growing below this line. In oases along the lower reaches of the Syr Darya and Amu Darya rivers, cotton is now grown on irrigated land. In the Fergana Valley and around Alma-Ata, under the beginnings of huge mountain ranges, melons and fruits are grown. In the fertile valleys below the Caucasus Mountains, many crops flourish, including grapes for wine.

This great wedge-shaped agricultural region, together with its southern appendages, occupies a huge territory, yet it excludes almost all the bleak northern and eastern regions of the country. Even within the wedge, population settlement reflecting previously known agricultural technology has been concentrated in the west, in European Russia where rainfall is adequate and the growing season sufficiently long. The Soviet regime has made determined efforts to extend wheat growing into southeastern European Russia across the Volga, and into north Kazakhstan and west Siberia, across the Urals. Grain growing is, however, precarious in these territories, as the last decade has shown. Strenuous efforts to grow corn and fodder crops, to increase the area of irrigated land, and even to alter the climate have not so far created an enlarged and secure agricultural base for the Soviet economy.[6]

The transport implications of Soviet natural resource geography are several. If the whole territory of the U.S.S.R. were like the eastern Ukraine, with fuels, industrial raw materials, and agricultural supplies all close together, the need for transportation would be

[6] For an evaluation of recent efforts, see Naum Jasny, *Khrushchev's Crop Policy* (Glasgow: George Outram & Co. [1965]), and W. A. Douglas Jackson and Paul E. Lydolph in Roy D. Laird (ed.), *Soviet Agricultural and Peasant Affairs* (University of Kansas Press, 1963), pp. 171-85 and 204-12.

relatively small, and intersectoral flows could generate output without much contribution from the transport sector. In actuality, Soviet fuel, mineral, and agricultural resource sites are widely separated from each other, by distances ranging up to 5,000 miles. The inevitable result is that, even if primary production facilities are located directly at resource sites, some important inputs almost surely have to be brought from far away. Soviet resource geography, in other words, necessitates large-scale movement of food, fuels, and raw materials over long distances.

Poor Location of Old Population Centers

The great cities of Russia appear to have grown up under the influences that are observable all over the world: on natural defensive sites, at the intersection of trade routes, or at transshipment points. Kiev on the Dnepr River, Moscow on a tributary of the upper Volga, and the other old cities of European Russia—all fit into this pattern. They were well located with respect to food supplies and existing forms of economic activity.

Leningrad was an exception. It originated somewhat artificially in 1703 when Peter the Great decided to open a "window on the West." The marshy site where the Neva River empties into the Gulf of Finland was made the capital of the Russian Empire. During the nineteenth century, it became a major port and manufacturing center, acting somewhat as an enclave of Western economic intrusion. Its coal came from Poland, its raw cotton from America via England, and its machinery from several European sources. The imperial capital was thus geographically peripheral in its economic relations with the Russian interior.

The transport needs that appeared when the industrial revolution modified Russian economic activity arose in considerable part because these old centers proved to be poorly located with respect to the new forms of production. It has already been noted that nineteenth century textile and manufacturing activity, using machinery imported from the West, was logically attracted to the old cities by markets and a labor force. Flax for linen came from close at hand, but for several decades cotton was imported from the

West. An iron industry, briefly stimulated by Peter the Great around 1700, rose again in the Urals during the latter part of the nineteenth century, not even connected by rail with European Russia until 1896. On the eve of World War I, south Russia was growing tempestuously, but Saint Petersburg, Moscow, and other old centers were still dominant. The Soviet regime thus faced the locational problem of designing a pattern of industrial growth that would bring the inherited pattern into better conformity with Russia's resource potential and would minimize the transport costs arising from the dispersion of resource sites and the mal-location of old population centers.

Regional Pattern of Industry in 1928

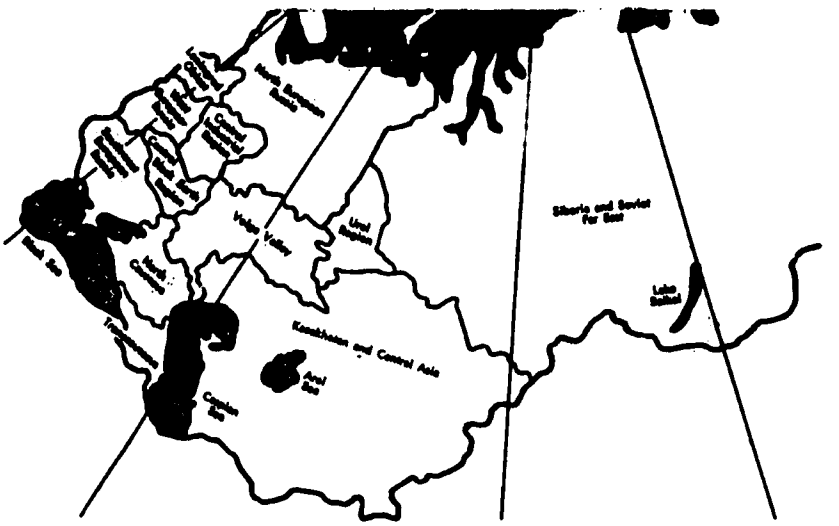
On the eve of the first Five Year Plan, the industrial sector of the Soviet economy had more than regained the not-inconsiderable size it had reached after half a century of prerevolutionary development. It was, however, as Table 1 shows, heavily concentrated in a few regions. Their location is indicated on the accompa-

TABLE 1. *Regional Pattern of Soviet Industrial Fixed Capital and Gross Output, 1928*[a]

Region	Share of Industrial Fixed Capital (Percent)	Share of Industrial Gross Output (Percent)	Average Capital-Output Ratio
Leningrad Oblast	11.13	12.52	0.85
West European Russia	2.42	2.67	0.87
Southwest European Russia	25.87	19.32	1.28
Central Industrial Region	30.23	39.69	0.73
Central Black Earth Region	1.82	1.95	0.89
North Caucasus	5.36	4.90	1.04
Transcaucasus	10.90	5.40	1.92
North European Russia	1.26	1.92	0.62
Volga Valley	3.10	3.56	0.83
Ural Region	4.16	3.60	1.10
Kazakhstan and Central Asia	2.08	3.12	0.64
Siberia and Soviet Far East	1.67	1.35	1.17
Total U.S.S.R.	100.00	100.00	0.95

[a] Derived from absolute data in Table A-1, App. A.

FIGURE 2. *Outline Sketch of Soviet Industrial Regions Designated in Tables 1–3 and A-1–A-4*



Source: Azimuthal equal-area base taken from Lorimer, *Population of the Soviet Union*, p. 152.

nying map (Figure 2). Lenin's strictures had some point. The Central Industrial Region around Moscow accounted for 30 percent of industrial fixed capital and 40 percent of gross industrial output in 1928. Southwest European Russia, mainly the eastern Ukraine, accounted for 26 percent of industrial fixed capital and 19 percent of gross industrial output. Textiles, machinery, and other finished goods figured heavily in the output of Moscow and the old towns of the Central Industrial Region. In the Ukraine, coal, iron and steel, and machinery were the principal outputs.

Industry was also concentrated in Leningrad Oblast, primarily in the renamed city of Saint Petersburg, accounting for more than a tenth of the capital plant and an eighth of the industrial output of the country. In the Transcaucasus, substantial capital was involved in the petroleum industry, though in 1928 this region's share of the country's industrial output lagged behind its capital share. In the North Caucasus, modest industrial development involving coal above Rostov, cement around Novorossisk, and other industry accounted for about 5 percent of the country's industrial assets and

output. On the eastern edge of European Russia, the Volga Valley accounted for some 3 percent of national industrial assets and output, while beyond it to the east the Ural Region accounted for roughly 4 percent of each. As Table 1 shows, all the other regions—including huge expanses of Siberia and the Soviet Far East—together held only about a tenth of the industrial sector's fixed capital and produced only a tenth of its gross industrial output.

This concentrated geographic pattern of industrial location, inherited from the tsarist era, evolved rationally out of the economic and political forces shaping prerevolutionary industrial development. Nevertheless, the peoples of the outlying regions had less than their proportionate share of industrial capital and output, while those in the old centers of European Russia had more than their share. In the first Five Year Plan, the Communist Party proposed to reduce these imbalances.

First Five Year Plan Intentions

The first plan stressed industrial growth, and investment in industrial fixed capital as the chief means of achieving it. Thus the allocation of investment funds by region was a central instrument of the regime's industrial location policies. Table 2 shows what the first plan intended. In general, the shares of Moscow, Leningrad, and the Caucasus in the country's industrial assets and output were to be reduced, while those of the Ural Region, Siberia, and nonindustrial areas generally were to be raised. The shift was to affect capital more than output for a reason that is important in our analysis.

The planners' intentions involved interesting details. It was expected, for example, that the Central Industrial Region would require only 15 percent of the gross capital additions during the period 1929-33 (though its 1928 share was 30 percent of the country's total) since it was thought that a very low incremental capital-output ratio (ICOR) would apply to this region. As a result, it was expected that while the region's share of industrial fixed capital would fall from 30 to 22 percent by 1933, its share of industrial output would still be 37 percent of the national total, only slightly reduced from its 40 percent share in 1928. Similar optimism was

TABLE 2. *First Five Year Plan Intentions for Soviet Industry, by Region, 1928–33*[a]

Region	During Period		In Terminal Year 1933		
	Share of Additional Fixed Capital (Percent)	Incremental Capital-Output Ratio	Share of Industrial Fixed Capital (Percent)	Share of Industrial Gross Output (Percent)	Average Capital-Output Ratio
Leningrad Oblast	5.23	0.33	7.89	11.43	0.54
West European Russia	2.69	0.57	2.57	3.02	0.67
Southwest European Russia	27.49	1.01	26.76	18.95	1.11
Central Industrial Region	15.38	0.29	22.09	37.42	0.46
Central Black Earth Region	2.84	1.18	2.38	1.77	1.06
North Caucasus	5.61	0.72	5.50	5.20	0.83
Transcaucasus	5.14	0.81	7.74	4.77	1.28
North European Russia	3.46	0.83	2.46	2.52	0.77
Volga Valley	5.44	0.97	4.38	3.75	0.92
Ural Region	14.17	1.65	9.65	5.06	1.50
Kazakhstan and Central Asia	5.67	1.05	4.05	3.50	0.91
Siberia and Soviet Far East	6.88	1.42	4.53	2.60	1.37
Total U.S.S.R.	100.00	0.69	100.00	100.00	0.79

[a] Derived from absolute data in Table A-1, App. A.

shown toward the Leningrad region. Both regions had displayed base period ratios of capital to output that were below the national average, indicating a product mix and an efficiency level conducive to efficient use of capital. By contrast, the 1928 average capital-output ratio (ACOR) in the Ukraine was above the national average. The first plan assigned more than a quarter of all additional fixed capital to Southwest European Russia during 1929-33, expecting that the region's share of industrial fixed capital would rise slightly as a result, and its output share remain about the same.

The Transcaucasus, where capital was not very productive in 1928, was assigned only 5 percent of expected capital additions (though in 1928 it held 11 percent of the national total), and its 1933 share of both capital and output was expected to fall compared to its 1928 share.

An exactly reversed policy is evident toward the Ural Region. The plan expected 14 percent of all capital additions to go here, though the region began with 4 percent of the country's total, with

the result that its 1933 share would be almost 10 percent. It was also expected, however, that a high incremental capital-output ratio would mean that the Ural Region's share of industrial output would rise only from 3.6 to 5 percent of the country's total. It is impressive to note that Soviet planners, twenty years before estimates of incremental capital-output ratios became fashionable in Western analysis of development problems, were evidently perfectly aware in practice of the difficulties to be anticipated in pioneer regions. An ICOR more than twice the national average was also anticipated for investment in Siberia and the Soviet Far East.

These average and incremental capital-output ratios reflect situations in hundreds of enterprises producing many different forms of output under widely differing conditions, and the twelve highly aggregated regional figures defy simple interpretation. Exhaustively detailed historical analysis would no doubt yield an itemized explanation of the observed differences. Even without such analysis, it seems clear that old regions (except for the Ukraine) were expected to show industrial capital investment results more favorable than those obtainable in the new outlying regions. In spite of this, the planners channeled investments toward these outlying regions, especially the Urals. They were thus, in effect, carrying out Comrade Lenin's behest.

Actual Developments, 1928-34

Since large construction projects typically take longer to finish than is originally specified, it is reasonable to compare the situation at the end of 1934 with that projected by the first Five Year Plan for a date some fifteen months earlier. The government switched from a fiscal year beginning October 1 to a fiscal year beginning January 1 for 1931, so that officially the first plan period ended on December 31, 1932. Both 1932 and 1933 were years of extensive disorganization, and only with 1934 did the great transformation set in motion by the first plan take stable form.

Table 3 shows some of the structural characteristics of actual regional changes over the period 1928-34. For example, incremental capital-output ratios ranged from 0.77 for the Leningrad region to 2.24 for the Ural Region. Twenty-two percent of all the additional

TABLE 3. *Actual Developments in Soviet Industry, by Region, 1928–34*[a]

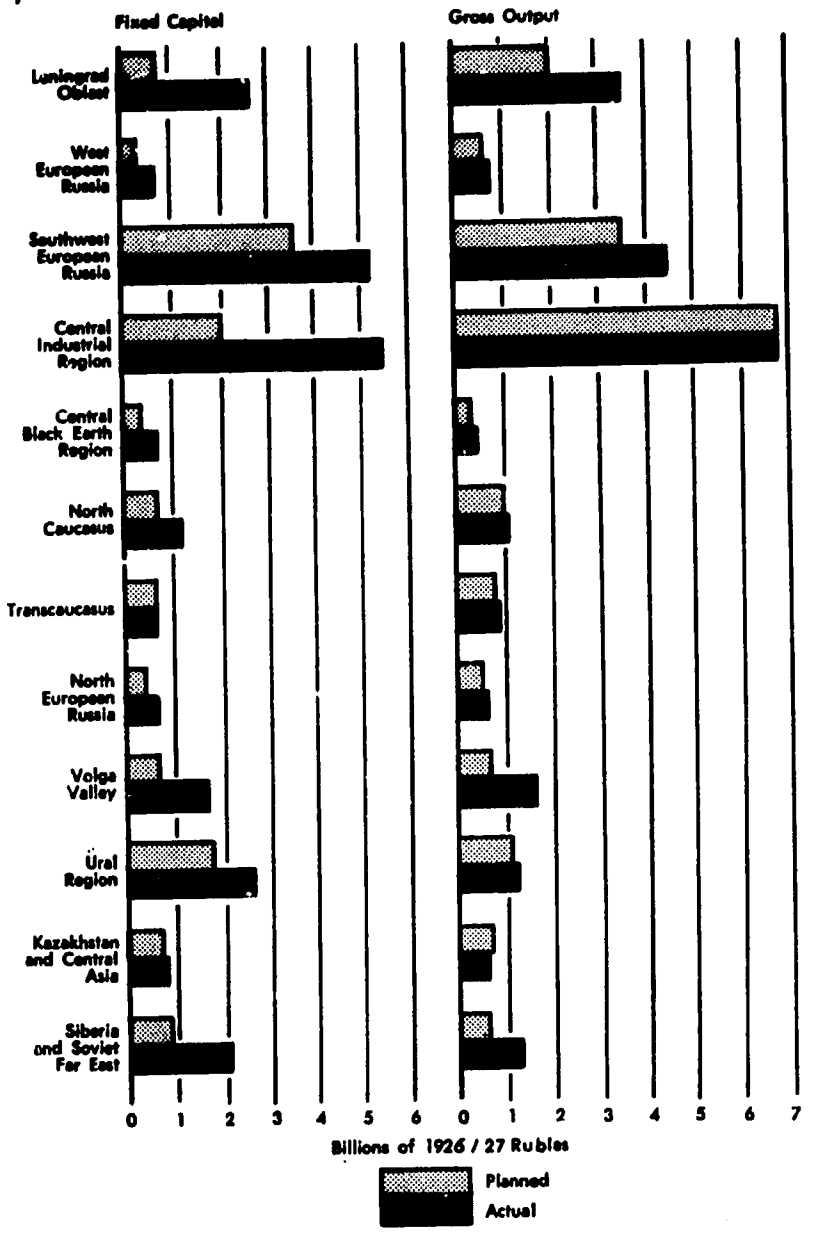
Region	During Period		In the Year 1934		
	Share of Additional Fixed Capital (Percent)	Incremental Capital-Output Ratio	Share of Industrial Fixed Capital (Percent)	Share of Industrial Gross Output (Percent)	Average Capital-Output Ratio
Leningrad Oblast	10.84	0.77	10.93	14.14	0.79
West European Russia	2.74	0.83	2.64	3.23	0.84
Southwest European Russia	21.12	1.18	22.56	19.15	1.21
Central Industrial Region	22.46	0.82	24.81	32.64	0.78
Central Black Earth Region	2.74	1.51	2.46	1.94	1.30
North Caucasus	4.71	1.08	4.91	4.73	1.07
Transcaucasus	2.83	0.79	5.27	4.32	1.25
North European Russia	2.88	1.13	2.39	2.45	1.00
Volga Valley	7.05	1.10	5.85	5.77	1.04
Ural Region	11.01	2.24	8.94	4.70	1.95
Kazakhstan and Central Asia	3.23	1.37	2.88	2.70	1.10
Siberia and Soviet Far East	8.39	1.59	6.36	4.23	1.54
Total U.S.S.R.	100.00	1.07	100.00	100.00	1.03

[a] Derived from absolute data in Table A-1, App. A.

fixed capital in the industrial sector went to the Central Industrial Region around Moscow; 21 percent to the Southwest region (mainly eastern Ukraine); 11 percent to the Leningrad region. Over half of the national total went to these three established areas. The Ural Region received 11 percent of all the additional industrial capital, the Volga Valley 7 percent, and Siberia 8 percent. The balance was distributed widely among the remaining regions of the country.

Comparisons between plan intentions and actual developments, region by region, are displayed in Figure 3 for increments of both fixed capital and gross output. It is immediately clear that the old Central Industrial Region obtained a great deal more capital than intended. Where the plan called for additional industrial fixed assets totaling 13 billion rubles for the whole country, the increment by the end of 1934 reached almost 25 billion rubles, and of the 12 billion excess, 3.5 billion showed up in the Central Industrial Region. This was almost three times the region's intended increment and put its percentage share 7 percentage points above its in-

Figure 3. *Planned Compared with Actual Soviet Regional Fixed Capital and Gross Output Increments, 1928-34*



Source: Tables A-2 and A-3, App. A.

tended level. Similarly, the Leningrad region was assigned three times as much industrial capital as the first plan had specified. The excess of 2 billion rubles put Leningrad's percentage share more than 5 percentage points above original intentions.

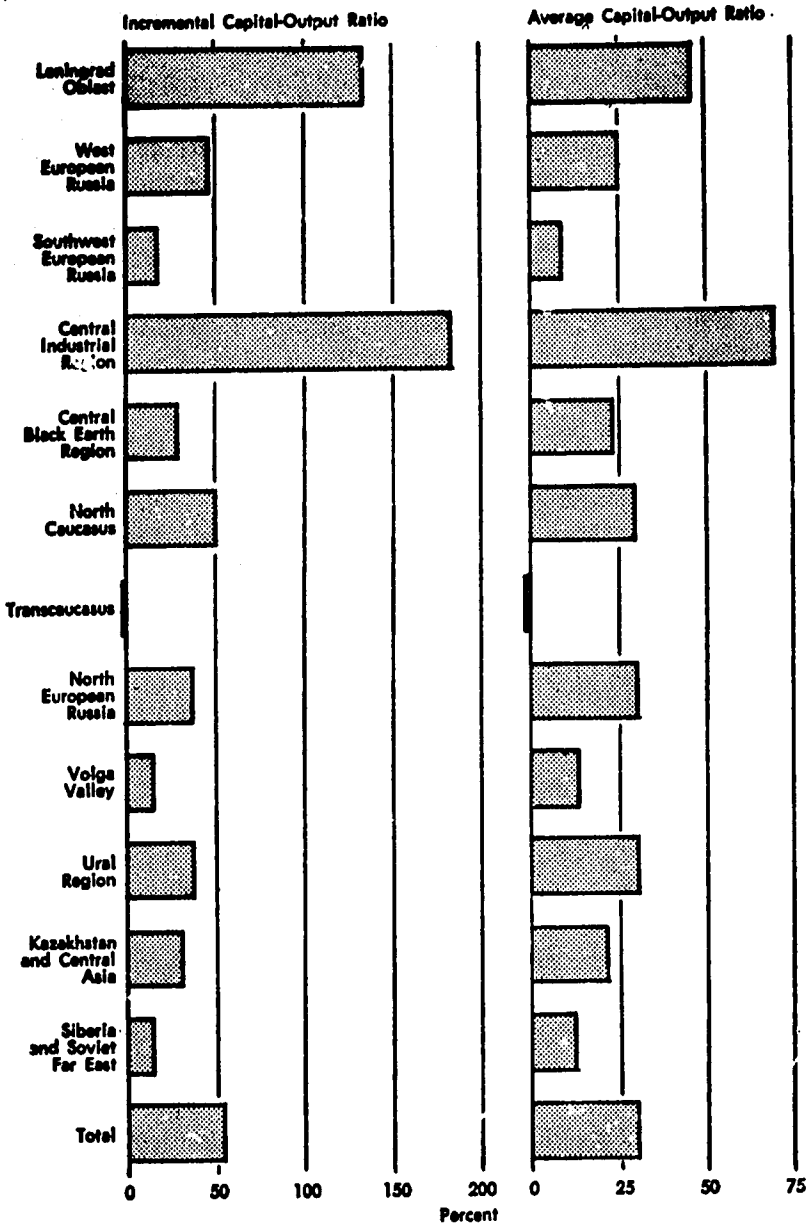
Only two other regions were given more than their intended share of investment: the Volga Valley and Siberia. Assignments to the Ukraine fell substantially short of plan intentions, relatively, and the Southwest region's share of the overall capital increment was more than 6 percentage points below its assigned share. The Ural Region failed to receive its intended share of new industrial capital, as did Kazakhstan and Central Asia.

The regional pattern of industrial output in 1934 also differed from what the first plan called for. The region around Moscow found its percentage share of gross industrial production almost 7 percentage points below its intended share, since the region's incremeneal capital-output ratio was so much higher than anticipated that the above-plan investment failed to yield above-plan output. The first plan called for the Central Industrial Region's share of national industrial output to fall from 40 percent to 37 percent; in fact it fell to 33 percent. This was, in a sense, a policy victory, though one obtained through the doubtful means of low capital productivity.

By contrast, the Leningrad region used its additional industrial capital far more effectively, producing 70 percent more output in 1934 than had been intended for 1933, and accounting for a share of the total national output increment 4 percentage points above its intended share. The consequence, however, was a failure to reduce the relative industrial strength of the country's former capital.

Discrepancies appear also in the above-plan growth of output in the Volga Valley and in Siberia. Both show more than twice their intended levels, putting their percentage shares 3 and 2 percentage points, respectively, above what the first plan called for. In the Ukraine, the shortfall of investment funds was offset by higher-than-plan capital productivity, so that the Southwest region's share of industrial output was not far from that intended by the plan. The performance of the remaining regions can be traced in the tables.

Figure 4. *Planned Compared with Actual Soviet Regional Incremental and Average Capital-Output Ratios, 1928-34, in Percentage Excesses of Actual Over Planned Ratios*



Source: Table A-4, App. A.

Regional discrepancies between planned and actual results are summarized in Figure 4 and in Table A-4 of Appendix A. The incremental capital-output ratios show a wide dispersion in the effectiveness of industrial capital increments from one region to another. For the country as a whole, the 1928-34 industrial ICOR was 55 percent above expectations. Around Moscow the ratio was 183 percent above the optimistically assumed plan level, and in Leningrad 133 percent, while in all other regions of the country the percentage excess was below the national average. It is clear, ex post, that the planners wildly overestimated the extent to which capital increments around these old centers could be made to yield additional output. Figure 4 shows that, in the course of carrying out the national industrial construction program, planned regional shares were markedly ignored. Moscow and Leningrad gained; the Ukraine suffered. Above-plan shares went to the Volga Valley and Siberia, while shortfalls are visible for the Transcaucasus, the Urals, and Kazakhstan. Deviations in output shares were less striking.

Finally, Figure 4 compares the average capital-output ratios (ACOR) actually observable in 1934 with those the first plan expected for 1933. For the Soviet industrial sector as a whole, the ratio was 30 percent above its intended level, indicating notable over-optimism in the first plan. Again, however, some regions performed far better than others. Around Moscow the 1934 ACOR was 70 percent above its intended level, and around Leningrad the excess was 46 percent. At the other extreme, the Transcaucasus region showed an ACOR 2 percent better than had been planned, and the Southwest region's ACOR was only 9 percent above the plan level. Apart from these striking discrepancies, most regions showed an excess of actual over intended ACOR fairly close to the national average.

These comparisons are alternative ways of illustrating from Soviet experience the uncertainties connected with forecasting the productivity of capital investments and the wide departures from plan that can occur even in a highly centralized economy. The four comparisons are, of course, not independent of each other. Still it can be said that above-plan industrial capital formation around Moscow and Leningrad was associated with below-plan capital

effectiveness, whereas results in the Ukraine took a reverse form. The Volga Valley and Siberian regions obtained above-plan capital increments and performed more effectively than had been expected. No decisive pattern of marked progress toward raising the relative standing of outlying regions had yet appeared.

Causes of Deviations from Plan

In seeking to account for these highly aggregated numerical results, we must recognize that they are made up of hundreds of individual instances, reflecting a multiplicity of forces at work. In all the varied industries making up the industrial sector, there were new construction projects, additions, and renovations of old facilities. Many accounts describe the delays, difficulties of coordination, uncertainties of supply, acts of God, and even sabotage that dogged these Gargantuan efforts. It is therefore not surprising that industrial capital increments were less productive than had been expected and that the regional pattern of events differed notably from what the plan had laid down. Quite to the contrary, the data show that planners to a considerable extent correctly foresaw the rank order of the regions' potentials and, with some notable exceptions, found the order of magnitude of their estimates confirmed by events.

The strongest factor causing above-plan industrial capital formation in the Central Industrial and Leningrad regions must have been their far greater attractiveness for the decision makers in production commissariats. In these regions, much social overhead capital was already available. Far less new workers' housing was typically required than would be for a new plant located in a backward region. Because of a relatively better climate and more amenities, a competent labor force could be more easily attracted and held at a site in old, settled territory than somewhere out on the frontier. Ancillary suppliers would be more accessible. Construction costs would probably be lower and building times shorter around the old centers. Enormous stress on speed was the hallmark of Stalinism and thus could scarcely fail to have an impact on industrial location decisions. Even Stalin's great stress on the "second iron and

steel base" in the Urals and western Siberia did not prevent a relative shortfall in the Urals' advance.

Along with these general forces, a number of specific factors influenced Soviet industrial development during 1923-34. A serious railroad freight traffic jam delayed shipments of all kinds of freight, especially during 1931-33. Its differential regional impact is hard to discern. The bottleneck was especially severe for building timber and may have delayed construction projects in southern regions of the country more than in the north. The above-plan buildup of industries in Siberia and the Soviet Far East reflects a crash program of industrial development north of Manchuria after that country was occupied by the Japanese in 1931. Relative shortfalls in industrial capital and output gains in Soviet Central Asia may reflect the low priority attached to cotton as a consumer good. The poor showing of the Transcaucasus region is bound up with relatively slow progress in the petroleum industry, whose crude oil base after several decades of exploitation was beginning to face rising costs.

The impressive showing of industry in the Volga Valley, where there was more capital growth than planned, and where capital productivity was higher than expected, deserves comment. The major cities of the region—Kuibyshev, Stalingrad, Saratov, and Kazan—were rapidly developing machinery and other industrial products. Though less attractive than the old centers farther west, the cities were nevertheless far more accessible than those scattered far beyond to the east. It became clear during World War II, a few years later, that the Volga Valley region had acquired decisive importance in the economy. Lack of local raw materials was clearly outweighed by other favorable factors.

Gradual Shift of Industry to East

During 1937 and 1938, the regime became aware of the real costs associated with its policy of concentrating large industrial plants in a few major locations, thus generating huge increments of freight traffic. In March 1939, when the third Five Year Plan covering the calendar years 1938-42 was approved, "gigantomania" was condemned, regional self-sufficiency was called for, and further expan-

sion of heavy industrial capacity in Moscow, Leningrad, Kiev, and several other old centers of European Russia was banned. Industrial officials had been responding to the attractiveness of old centers in their case-by-case decisions on locating new plant capacity, in spite of the associated increments of long-haul fuel and raw material imports these plants entailed. It was proving more difficult to move industry eastward than the Party had anticipated, but the authorities persisted.

The Nazi invasion caused evacuation and relocation of many industrial facilities to the east, and the war also stimulated emergency expansion of eastern industry. After the war, industrial capacity was gradually reestablished in territory that had been occupied, but the permanent effect of World War II has been to induce a substantial net shift of industry toward the east. Nonetheless, continued large scale growth of industry around Moscow and Leningrad, in other old centers of central European Russia, and in the Ukraine, to say nothing of expansion in the Baltic Republics, goes far to match and offset the absolute growth occurring in the Volga Valley cities, the Urals, Kazakhstan, Soviet Central Asia, and Siberia. Only very gradually is industry coming to be "more evenly located" over Soviet territory.

The clear transport implication of the old centers' persistent vigor is that massive flows of fuel and industrial raw materials to these centers from far distant primary resource locations will not soon disappear.

Helpful Demographic Trends

In marked contrast to underdeveloped countries today, the Soviet Union after 1929 experienced a reduced and rather modest rate of population growth. The reasons were several. Agricultural collectivization gravely disorganized village life and even led, in conjunction with poor harvests around 1932, to famines and starvation. Urban population growth by migration was extremely rapid, but severe housing shortages and the availability of free abortions in hospitals until 1936 greatly lowered the natural rate of population growth in Soviet cities. Thus the Soviet population

grew only from 147 million people in 1926 to 170 million in early 1939, at an average annual rate of 1.1 percent.

World War II had a tragic demographic impact on the U.S.S.R. Analysis of the 1959 census data, in relation to 1939 census data and other scattered evidence, indicates that the war cost the Russians something like 10 million military and 15 million civilian casualties during the course of the war, as well as a shortfall of 20 million people who were not born or who failed to survive infancy during the war and the first grim years of postwar recovery. In toto, had it not been for World War II—that is, had the 1959 Soviet population evolved in peacetime from its 1939 base—it would have been larger by some 45 million persons.[7]

The war also caused massive temporary geographic dislocations, with eastward migration of millions in 1941-42, followed in 1944-46 by a westward return of population on a scale not anticipated by the government. Moreover, several ethnic minorities in the Crimea, southeastern European Russia, and the Caucasus were forcibly moved eastward when their patriotism became suspect, as were large groups of people in western Poland, the Baltic Republics, and the region bordering Finland during and after the war. Their places were taken by Russians moving west.

As a result of slow growth and areal redistribution, the Soviet population now shows a markedly greater degree of dispersion than in 1926. Vivid contrasts remain, however, between the fairly heavily settled regions of European Russia and a few other major districts, on the one hand, and the vast desolate reaches of the north and east.[8]

Several transport implications of this demographic situation may be noted. First, by contrast with densely populated countries like India, the Soviet Union has been able to relegate passenger transportation to a secondary status and to focus on freight transportation in its growth programs. The Party's preference for industry

[7] See Warren W. Eason, "The Soviet Population Today," *Foreign Affairs*, Vol. 37 (July 1959), pp. 598-606.

[8] For an analysis of long-run trends using carefully standardized geographic regions, see Robert A. Lewis and J. William Leasure, "Regional Population Changes in Russia and the USSR Since 1851," *Slavic Review*, Vol. 25, No. 4 (December 1966), pp. 663-68.

over agriculture was also made more feasible by the slow growth of the population, again in marked contrast to the situation confronting many poor countries today. The neglect of agriculture, in turn, eased somewhat the problems of the transport sector, since transport authorities could concentrate on moving mass industrial raw materials without having to extend the rail and/or road network to handle major increments of farm population and production.

Technological Options of the 1920's

The Soviet transport record reflects basic decisions taken in the middle and late 1920's when many of the technological alternatives now available to developing countries were not at hand or had not yet proved themselves. Transport facilities being long lived, these decisions have shaped developments ever since and have inhibited prompt adoption of recent innovations. Hindsight should not, however, be misused to find fault with Soviet decisions taken forty years ago in the light of the prospects offered by the then contemporary technology.

The first Five Year Plan was formulated at a time when steam railroads were still dominant for land transport everywhere. Ample scope for modernization of the inherited Russian railway plant suggested that steam railroads had great unexploited potential for serving the Soviet economy. Traditional belief in the transport effectiveness of river and sea carriers persisted, but pipelines, intercity highway transport, and air transport did not appear capable of assuming much of the prospective freight burden.

Petroleum pipelines were well known in the 1920's, and 1,100 kilometers had already been built in Russia before the revolution. After 1928, however, the network of pipelines was only modestly expanded until the middle 1950's. The key consideration appears to have been the absence of geographically concentrated consumption demands for petroleum products. The regime's emphasis on coal as the chief energy source for industrial development restricted potential users of petroleum products to the Air Force, the

machine tractor stations in agriculture, and the construction and industrial enterprises using trucks. Their demands shared the common characteristic of being geographically scattered, so that delivery by rail tank car must have appeared logical. The cost advantages of pipelines over rail tank cars only become overwhelming when the diameter of the pipeline grows large, especially if, in addition, steel pipe-making capacity is a bottleneck.

The Soviet regime laid tremendous stress on electrification as the key to rapid modernization. Lenin said, in a famous phrase, "Communism equals Soviets plus electrification."[9] The first national development plan to be formulated was the Goelro Plan of 1920 for the electrification of Russia. It included grandiose projects for electrifying many thousands of kilometers of railroad. In practice, however, Soviet officials between 1928 and 1940 prudently refrained from electrifying more than some 900 miles of railroad line where special conditions called for it. After the death of Stalin and the retirement of Kaganovich, railroad electrification gathered speed; it is now having a revolutionary impact on Soviet rail transport (described in Chapter 4).

Transport planners in the late 1920's saw a promising role for freight-carrying motor vehicles, especially for short-haul pickup and delivery work in industrial districts and around construction sites, and for bringing farm products to railroad stations. Intercity highway trucking, which was only beginning to develop in the West, was not even considered as a competitor to rail transport in the U.S.S.R. The automobile would replace the horse and wagon in local cartage, or the horse and carriage for high-priority urban passenger movement.

In Russia, as elsewhere, railways displaced river freight carriers for many commodity movements, and though Soviet authorities systematically sought to reverse this trend, Soviet internal waterways proved unable to handle a major share of the freight traffic

[9] See his *Sochinenia*, Vol. 31 of his *Collected Works* (4th ed.; 1950), p. 392, and E. H. Carr, *The Bolshevik Revolution, 1917-23* (London: Macmillan, 1952), II, 373. On the priority accorded electrification see my "Priorities and Shortfalls in Prewar Soviet Planning," in Jane Degras (ed.), *Soviet Planning: Essays in Honour of Naum Jasny* (Oxford: Basil Blackwell, 1964), pp. 1-31.

that arose during the five year plans. The technological transformation of river traffic that came with the introduction of tugs pushing coupled barges still lay in the future.

Soviet transport planners gave some attention also to development of an aviation industry. There was a good deal of publicity for the use of aircraft in the north, supplying arctic weather stations, assisting in the opening of the Great Northern Sea Route, providing winter communications with distant mining settlements in eastern Siberia, and conducting medical errands of mercy. Still, in terms of freight ton-kilometers moved, Soviet civil aviation as projected in the late 1920's, and as it has actually developed to date, understandably plays an extremely small role in freight transport.

The technological perspective available to Soviet decision makers in the late 1920's had several transport implications. First, it was clear that for low cost movement of mass fuels and industrial raw materials under Soviet conditions, the railroads were still the undisputed champion. With the other carriers unable to offer comparable service, and without the cost-reducing innovations that have recently developed for transshipment operations, it was also clear that joint shipments involving two or more carriers would not play much of a role.

Far more technological options are open to countries making basic decisions about transport development in the 1960's than were available to the Russians forty years ago. In selecting an optimum combination of transport modes, currently developing countries will necessarily get the benefit of lower ratios of transport outlay to national product than the technological horizons of the 1920's afforded.

CHAPTER III

Soviet Transportation Outcomes

INTERACTION BETWEEN the Soviet policies outlined in Chapter 1 and the conditioning factors sketched in Chapter 2 has generated a record of experience in the transport sector of the Soviet economy that deserves thoughtful attention. Later chapters examine in detail Soviet railroad operating practices, the role of trucks, and problems raised by the passenger automobile. This chapter provides a broad account of a series of outcomes resulting from these detailed developments. The framework provides perspective and suggests points where a reader may wish to examine later details with some care.

Growth of Output and Freight Traffic

The transport sector's contribution to economic development can be measured by comparing growth rates in total output and in freight traffic. As we have seen, Soviet authorities hoped that output (especially industrial production) could be expanded with a less-than-proportionate growth in freight traffic. Since 1928, however, this hope has not been achieved. Table 4 presents some summary evidence. Two measures of aggregate output are compared with an index for the metric ton-kilometers of freight traffic carried by the five major Soviet domestic transport modes. The Gross National Product indexes are independent Western estimates constructed out of Soviet statistical fragments to fit within an accepted national accounts framework.

From 1928 to 1940, Soviet freight traffic grew 2.2 times as rapidly as Gross National Product. There was a fourfold growth in

TABLE 4. *Indexes of Soviet GNP, National Income, and Domestic Freight Traffic, 1928, 1937, 1940, 1950–65*

Year	Real GNP[a]	Official National Income[b]	Freight Traffic[c]
	1928 = 100		
1928	100	100	100
1937	153	386	366
1940	186	513	409
	1950 = 100		
1950	100	100	100
1951	109	112	113
1952	119	125	124
1953	125	136	133
1954	130	153	144
1955	144	171	163
1956	152	191	180
1957	161	203	208
1958	174	229	220
1959	183	246	242
1960	192	265	257
1961	204	283	270
1962	214	299	285
1963	220	311	304
1964	237	339	326
1965	247	359	348

[a] The three prewar indexes for real GNP are derived from the careful estimates, at ruble factor cost of 1937, presented by Abram Bergson in his *The Real National Income of Soviet Russia Since 1928* (Harvard University Press, 1961), p. 128, but with the modified 1928 figure he gives in Abram Bergson and Simon Kuznets (eds.), *Economic Trends in the Soviet Union* (Harvard University Press, 1963), p. 36. The postwar GNP index links together his annual estimates for 1950–55 from *Real National Income*, p. 303, and for 1958 from *Trends*, p. 36, with estimates for 1957–65 by Stanley H. Cohn reported in U.S. Congress, Joint Economic Committee, *New Directions in the Soviet Economy* (Government Printing Office, 1966), p. 104. 1956 is interpolated as a geometric mean between 1955 and 1957.

[b] The indexes for national income are the official Soviet series, here taken from Tsentral'noe statisticheskoe upravlenie, *Narodnoe khozyaistvo SSSR v 1958 g.* (1959), p. 95, for 1928–40 and 1950–57. The 1958–64 indexes are from *Narodnoe . . . v 1964 g.* (1966), p. 575, and the 1965 figure is from *Pravda*, Feb. 3, 1966, p. 2.

[c] The prewar traffic index is from Holland Hunter, *Soviet Transportation Policy* (Harvard University Press, 1957), p. 329, and the 1950–65 values are derived from the aggregate domestic metric ton-kilometer estimates in column 6 of Table 4 in *New Directions*, p. 576.

physical freight traffic compared with somewhat less than a doubling of GNP in real terms.

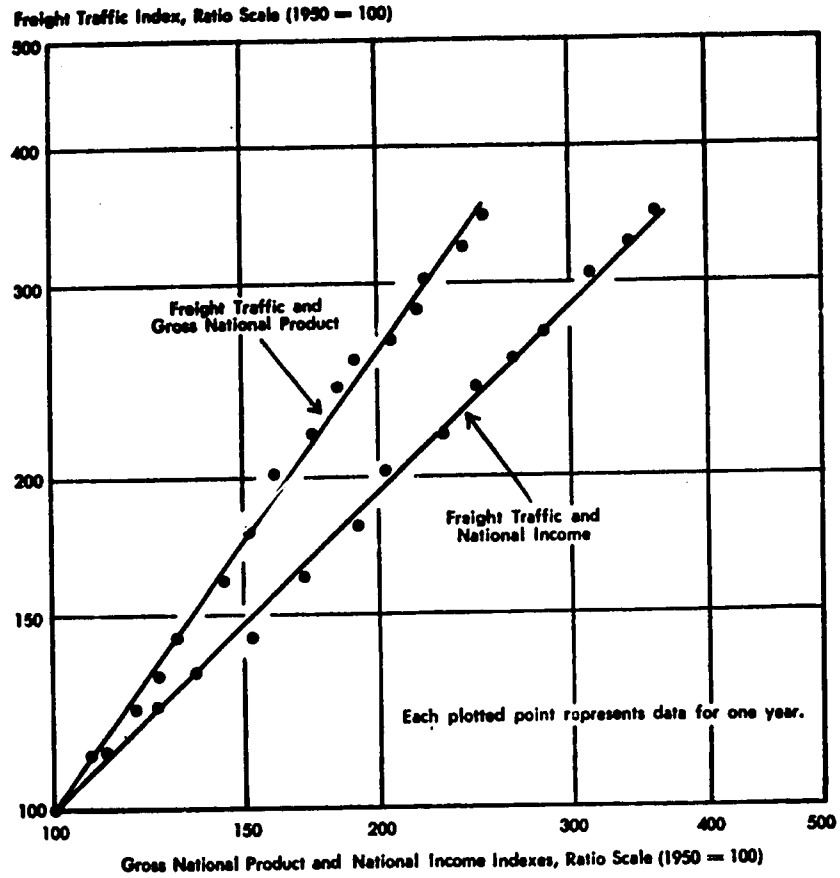
A very different relationship existed between freight traffic and the official series for national income. The latter purportedly rose from an index of 100 in 1928 to an index of 513 in 1940. By implication, the growth rate of freight traffic was only four-fifths the growth rate of national income. However, with estimates for the three series covering only three benchmark years of the thirteen-year prewar period, we cannot be sure that stable relationships existed, much less speculate about their causes.

The Soviet data for 1950-65 permit somewhat more secure evaluation. As the two scatters in Figure 5 make clear, domestic freight traffic over this sixteen-year period has, according to both measures, been very closely associated with total output. Again, it appears that Soviet freight traffic has been growing more rapidly than total output. A least-squares line fitted to the logarithms of the freight traffic and GNP indexes shows that a 10 percent rise in GNP was associated with a 14.06 percent rise in aggregate traffic. Alternatively, one could say that the elasticity of freight traffic with respect to changes in GNP was 1.41. The average percentage deviation (without regard for sign) of actual values around this relationship was 4.1 percent.

Comparison of Soviet freight traffic growth with the official national income index indicates that they grew at very nearly the same rate. A least-squares line fitted to the logarithms of the indexes shows that a 10 percent rise in official national income was associated with a 9.77 percent rise in domestic freight traffic. The elasticity of freight traffic with respect to national income changes was 0.98. Actual traffic levels lay within plus or minus 3.0 percent of this relationship.

Incidentally, as one would expect, there proves to be a very close relationship between the official Soviet national income index and the Bergson-Cohn index for Soviet GNP. A least-squares line fitted to the logarithms indicates that a 10 percent rise in official national income over this period has been associated with a 6.93 percent rise in Bergson-Cohn GNP, with an average absolute deviation around this relationship of only 2.5 percent. Large aggre-

FIGURE 5. *Relation of Soviet Aggregate Domestic Freight Traffic to Gross National Product and to National Income, 1950-65*



Source: Table 4.

gates of this kind tend to move in parallel fashion, even when they are very differently estimated. To the extent that this relationship can be expected to persist in the near future, it provides a crude but convenient device for suggesting the Bergson-Cohn equivalent of any projected Soviet target for official national income.

It is interesting to compare United States with Soviet experience. Table 5 and Figure 6 present some U.S. data roughly comparable with the Soviet data. A decisive contrast immediately emerges. United States output growth since 1929 has been associated with less-than-proportionate growth in the physical volume of

TABLE 5. ***United States Gross National Product and Aggregate Freight Traffic, 1947–63***[a]

(In billions of dollars at 1958 prices and billions of short ton-miles)

Year	Gross National Product		Freight Traffic	
	Dollars	Index	Ton-Miles[b]	Index
1947	309.9	100.0	1,267	100.0
1948	323.7	104.5	1,296	102.3
1949	324.1	104.6	1,161	91.6
1950	355.3	114.6	1,327	104.7
1951	383.4	123.7	1,460	115.2
1952	395.1	127.5	1,420	112.1
1953	412.8	133.2	1,496	118.1
1954	407.0	131.3	1,514	119.5
1955	438.0	141.3	1,577	124.5
1956	446.1	143.9	1,651	130.3
1957	452.5	146.0	1,500	118.4
1958	447.3	144.3	1,498	118.2
1959	475.9	153.6	1,597	126.0
1960	487.8	157.4	1,625	128.3
1961	497.3	160.5	1,628	128.4
1962	530.0	171.0	1,688	133.2
1963	550.0	177.5	1,758	138.8

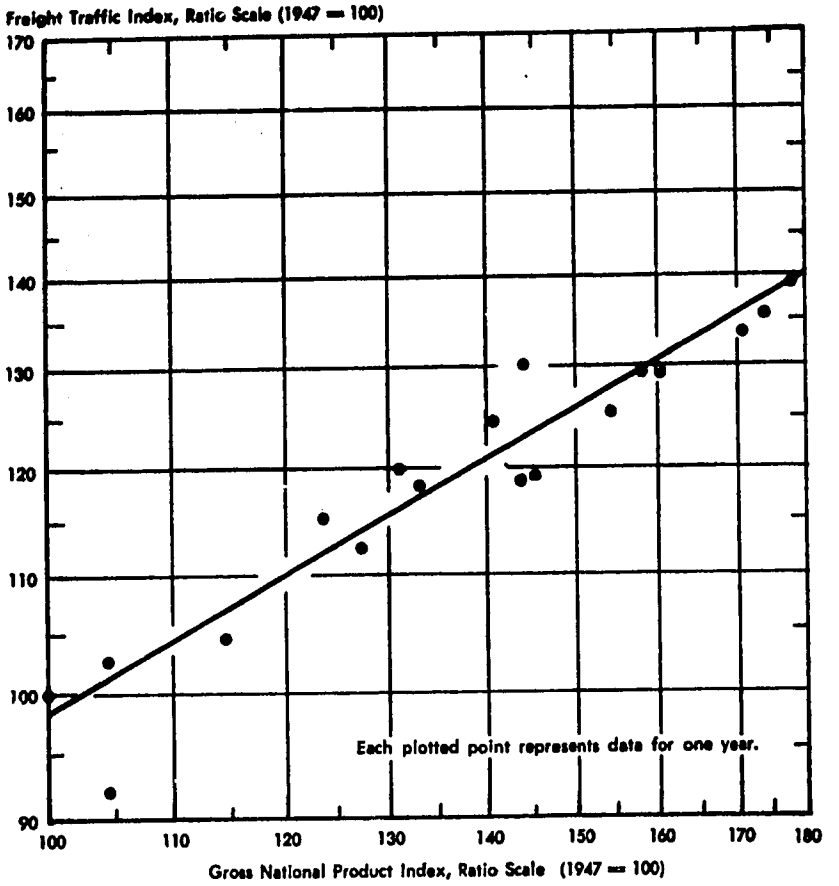
[a] The GNP estimates are those of the U.S. Department of Commerce, Office of Business Economics, in *Economic Report of the President*, January 1966, p. 210. The series for aggregate freight traffic covers intercoastal and coastwise maritime ton-miles as well as rail, motor, pipeline, inland water, and air ton-miles. For 1947–57, the maritime estimates are from Ernest W. Williams, Jr., *Freight Transportation in the Soviet Union* (Princeton University Press, 1962), p. 18. For 1958–63, the maritime estimates are from U.S. Interstate Commerce Commission, *Transport Economics*, July 1965, p. 1. ICC estimates for all other traffic are here transcribed from U.S. Department of Commerce, *Statistical Abstract of the United States: 1955* (Government Printing Office), p. 558; . . . *1962*, p. 570; and . . . *1965*, p. 559. The help of Robert K. Wismer in assembling the data and making the indexes is gratefully acknowledged.

[b] Short ton.

domestic freight traffic. Some years ago, a comparison of American freight traffic with "real material product" (GNP in constant dollars with services output deducted) showed that over the period from 1929 through 1956, traffic grew from an index value of 100 in 1929 to 312 in 1956, while real material product was rising from 100 to 369.[1]

[1] See my analysis in Joseph J. Spengler (ed.), *Natural Resources and Economic Growth* (Resources for the Future, 1961), pp. 135-38.

FIGURE 6. *Relation of U.S. Aggregate Domestic Freight Traffic to Gross National Product, 1947-63*



Source: Table 5.

The present comparison, covering the period 1947-63 and relating United States domestic freight traffic to the entire Gross National Product in constant dollars, shows that a 78 percent rise in GNP was associated with a 39 percent rise in domestic freight traffic. A least-squares line fitted to the logarithms yields an elasticity of traffic with respect to output changes of 0.616, with average absolute percentage deviations amounting to 3.1 percent. A least-squares line fitted to the absolute values of each variable displayed average percentage deviations of 3.1 percent with an elasticity of 0.612 at the means.

This important contrast between Soviet and American experience deserves more thorough analysis than can be attempted here. Clearly the tendency toward greater traffic growth in the U.S.S.R., relative to output growth, than is observable in the United States constitutes a relative handicap to Soviet growth. What explanatory factors might plausibly be adduced to account for the contrast? While attempts have been made to standardize the coverage of each measure for both countries, it is important to note that we are not here forced to estimate the absolute ton-miles or ton-kilometers associated with a dollar or ruble of GNP, but are merely comparing their internal relative rates of growth.[2] Only drastic widening or shrinking of coverage over time in one or more of the traffic and output series could decisively alter the contrasting experience the estimates disclose.

Differences in coverage and compilation method underlie the sharp contrasts between official Soviet national income estimates and the Bergson-Cohn GNP estimates, but the details need not be recounted here.[3] The official measure of Soviet national income does, however, exclude services from total output as not being part of "material production," which suggests that services output should be omitted from the United States GNP aggregate to increase its comparability with the official Soviet series. However, though the growth of services output has been more rapid in the United States since 1929 than the growth of the rest of the GNP, the dispersion in growth rates is not enough to affect significantly the elasticities we have been examining.

It might be thought that the relatively modest growth of United States aggregate freight traffic relates only to commercial or common-carrier traffic, and that rapidly expanding freight traffic in private trucks has been excluded. This, however, is not so. The underlying freight motor vehicle series cover all truck traffic, in privately owned as well as commercial trucks. Local traffic is excluded from United States estimates, but included in aggregate Soviet traffic. Yet exclusion of all Soviet motor vehicle freight traffic, which now

[2] Comparability and coverage problems relating to Soviet and United States freight traffic statistics are thoroughly reviewed in Williams, *Freight Transportation in the Soviet Union*, especially pp. 1-25 and 33-39.

[3] The definitive discussion is, of course, Professor Bergson's *Real National Income*, *passim*.

accounts for 6 percent of total Soviet domestic freight traffic, likewise would not significantly alter our results.

The disparity between Soviet and United States relative growth rates in freight traffic would be somewhat reduced if traffic were measured in value terms. There has been a substantial improvement in the quality of United States freight traffic service as reflected in higher speeds, more door-to-door service, less onerous crating requirements, etc. Estimation of value weights would need to focus especially on truck traffic and here, unfortunately, available revenue data cover only about a third of the traffic.[4] For the Soviet Union, Norman M. Kaplan has constructed a number of output indexes for the transport and communications sector. His index for aggregate freight traffic with 1955 value weights rises from 100 in 1928 to 406 in 1940 (scarcely different from the 409 index value for physical ton-kilometers), and from 100 in 1950 to 378 in 1963 (roughly 24 percent above the index value of 304 for physical ton-kilometers in 1963).[5] The quality of Soviet railroad freight service has improved substantially since 1928, but not to a degree equaling American qualitative gains from the shift to truck transport.

Among the background forces that appear to have generated more-than-proportionate Soviet freight traffic growth, three stand out. Soviet economic activity, especially its freight-generating heavy industrial activity, has expanded since 1928 in widely scattered locations; the effect has been increased dispersion leading to marked increases in interregional freight traffic. The discussion in earlier chapters of Soviet economic geography and Soviet regional development policies has identified the forces that seem to have produced this outcome. By contrast, there may have been a tendency in the United States over the last three or four decades for major regions to meet their resource needs from closer at hand than was once the case.

A somewhat related contrast probably arises out of Soviet stress on heavy industrial output and the primary activities supplying it.

[4] See the informative table and discussion in American Trucking Associations, *American Trucking Trends, 1965* (Washington: American Trucking Associations, Inc., 1965), p. 9.

[5] See his *Soviet Transport and Communications: Output Indexes, 1928-1962* (RM-4264-PR; RAND Corp., 1964), and especially p. 7 of its Supplement (1965).

As these forms of output have increased their share of Soviet Gross National Product, they have no doubt stimulated directly a rise in ton-kilometers of freight traffic that has outdistanced their contribution in value terms to GNP. United States experience in recent decades has been almost the opposite of this; primary production has accounted for a steadily decreasing share of total value added, even in material production taken by itself.

Finally, the American shift from coal to oil and natural gas as energy sources has clearly acted to lower the transport-output ratio in the United States, while the shift still has far to go in the Soviet economy. In another decade or so, Soviet use of "second Baku" petroleum, well-located natural gas deposits, and high-capacity long-distance electric power transmission lines should contribute substantially to bringing down the high transport-output ratio that has revealed itself in the first half century of Soviet economic growth.

Current Pattern of Soviet Traffic Flows

Soviet efforts to carry out Lenin's injunctions have, of course, produced massive changes all over the U.S.S.R., but as previous chapters have indicated, powerful counterforces have conspired to thwart radical shifts in the spatial organization of Soviet economic activity. Maps of Soviet population concentrations, the location of Soviet agricultural and industrial production, and even the transport network display a structure closely related to that of pre-1917 Russia. Nevertheless, Soviet growth has brought important changes reflecting both an internal eastward movement and altered economic relations with the outside world.

In spite of all efforts to locate industry more evenly, bring the backward regions up to parity with the center, and move industry closer to the sources of fuel and raw materials, Moscow and Leningrad remain far and away the largest centers of Soviet industry. The eastern Ukraine, too, has grown greatly in spite of having been overrun and wrecked in World War II. Table 6 presents summary data showing the percentage shares of eight large Soviet regions in industrial production and population on the eve of the first Five

TABLE 6. *Regional Shares in Soviet Industrial Production, 1928 and 1960, and Population, 1926 and 1959*

(Percent)

Region	Industrial Production[a]		Population[b]	
	1928	1960[c]	1926	1959
Northwest RSFSR[d] and Belorus SSR	16.1	11.6	11.2	9.8
Central RSFSR	41.6	22.1	20.1	16.8
Ukrainian SSR	19.1	22.2	23.8	20.9
Volga Valley and Caucasus	13.9	17.6	21.7	21.0
Subtotal "West"	90.7	73.5	76.8	68.5
Urals	4.1	10.8	7.4	9.3
Kazakh SSR	0.0	2.7	3.9	4.7
Soviet Central Asia	2.9	3.5	4.7	6.8
Siberia and Soviet Far East	1.4	9.5	7.2	10.7
Subtotal "East"	9.3	26.5	23.2	31.5
Total U.S.S.R.	100.0	100.0	100.0	100.0

[a] The 1928 estimates are derived from 1927/28 ruble data in Gosplan SSSR, *Piatiletnii plan narodno-khozi-aistvennogo stroitel'stva SSSR* (5d ed.; 1930), Vol. 3, p. 584. The 1960 estimates are derived from ruble data assembled by Paul K. Cook in U.S. Congress, Joint Economic Committee, *Dimensions of Soviet Economic Power* (Government Printing Office, 1962), pp. 704–31. The approximate matching and aggregation of regions was carried out by Alan Abouchar, using IA.G. Feigin, *Razmeshchenie proizvodstva pri kapitalizme i sotsializme* (2d ed.; 1958), pp. 407–408 *et passim*.

[b] The population shares are derived from absolute Soviet data regionally classified by Robert A. Lewis and J. William Leasure; see their "Regional Population Changes in Russia and the USSR Since 1851," *Slavic Review*, Vol. 25, No. 4 (December 1966), pp. 663–68.

[c] For greater comparability with 1927/28, industrial production in the three Baltic and the Moldavian SSR has been excluded here, though output in the annexed parts of the Ukrainian SSR, Belorus SSR, and RSFSR could not be deducted. The actual 1960 share of the present "west" was of course larger than that shown above.

[d] RSFSR is the Soviet abbreviation for the Russian Soviet Federa ted Socialist Republic.

Year Plan, and at the close of the 1950's. The share of the "west," or roughly speaking European Russia, in both population and industrial production has declined over this period, while that of the "east" has correspondingly grown. Where the west accounted for 91 percent of industrial output and 77 percent of the population before the five year plans began, its industrial output share in 1960 had fallen to 74 percent and it accounted for 69 percent of the population. The east, by contrast, raised its share of industrial produc-

tion from 9 percent to 27 percent, while its population grew from 23 percent to 32 percent of the Soviet total. Comparison of output and population shares for individual regions shows plausible contrasts between those with above-average and others with below-average per capita industrial production capabilities.

The old mining and industrial towns of the Urals, together with a number of new centers in the Urals, northern Kazakhstan, and western Siberia, have risen dramatically to form an industrial complex that now has reached very large absolute dimensions. Had the old centers of European Russia remained at their prerevolutionary level, Stalin's "second iron and steel base" would by now dominate the economy. There would have been a decisive shift in the direction called for by Party doctrine. From this point of view, it could be argued that the regime's early geographic promises should be reinterpreted in absolute rather than relative terms. Industrialization has indeed been extended to peripheral regions and impressive absolute gains have been achieved. As a result, large new traffic flows have developed. What has not been achieved, however, is any absolute decline in interregional freight traffic of the kind promised or implied by early Soviet regional specialists.

Between the old centers of European Russia and the eastern Ukraine on the one hand, and the Urals-western Siberia complex on the other, major traffic flows of a roughly triangular pattern have emerged. The old river cities on the Volga have become large industrial cities favored by relative propinquity to markets and fuel, though not to mineral ores. The strengthening and expansion of railroad trunk lines linking the several foci of this Soviet economic heartland has developed logically and predictably out of tendencies already under way and clearly visible half a century ago.

An element of disillusionment with Soviet promises is perhaps justified by the relatively modest and recent economic development of eastern Siberia and the Soviet Far East. The difficulties faced have of course been formidable. Siberia's "fabulous riches" lie in very forbidding territory. High extraction and transport costs do have an inexorable logic. National defense induced hasty development efforts in Soviet maritime territory on the eve of World War II, and defense considerations have not ceased to suggest con-

tinued development of the east, but in purely economic terms, the sparse development of Soviet eastern territory, especially in the north, is a credit to Bolshevik common sense in the face of received doctrine.

The long-settled regions in the west of European Russia were somewhat slighted in the 1928-40 period, but since World War II, and with the addition of territory acquired in 1939-45, this part of the Soviet Union has progressed rapidly, especially in industry. Again, the locational effect has been to dampen the impact of an eastward movement on the center of gravity of the whole economy. Similarly, the European north has grown more since the late 1940's than the early planners anticipated, perhaps because the nearby old centers of northwest and central European Russia have exerted a more powerful pull than had been expected.

Use of river and sea carriers has continued to be urged by Soviet policy makers, and the volume of traffic has increased greatly since World War II. Recent technological progress has aided internal waterway movements all over the world, and Soviet practice has incorporated these improvements. Large tows are now pushed on Soviet rivers wherever possible. Nevertheless, difficulties continue to interfere with the growth of Soviet river and maritime freight traffic.

On the Volga, for example, two huge dams have created "artificial seas" north of Volgograd and Kuibyshev, extending as much as 370 miles in length and ten miles in width. These long, narrow lakes are, however, very shallow, so that cross winds during rather frequent windstorms raise choppy waves. As a consequence, southbound rafts of logs chained within a circle, a prominent feature of Volga traffic for many decades, are no longer feasible. Tow barges lose up to 20 percent of their time waiting for windstorms to subside.[6] Some river vessels have proved unusable and new designs have been required. The shallow lakes have lengthened the average frozen period on the Volga by about 10 percent, adding twelve days or so to a four-month period of ice cover.

[6] See Robert N. Taaffe, "Volga River Transportation: Problems and Prospects," in Richard S. Thoman and Donald J. Patton, *Focus on Geographic Activity: A Collection of Original Studies* (McGraw-Hill, 1964), pp. 191-92.

Maritime traffic in the Caspian Sea, traditionally dominated by northbound petroleum movements from Baku and Makhachkala to Astrakhan, has been dislocated by steadily worsening conditions at the roadstead below Astrakhan. Since the early 1930's, the level of the Caspian has fallen by some 3 meters, and at the shallow northern end, transshipment from sea vessels to river vessels has moved south from Astrakhan in the Volga Delta to a point now some 50 kilometers away. Here again, windstorms create waves that make transshipment precarious.

The Volga-Don Canal, completed in 1952, provides a link enabling water freight movements between the Urals and eastern Ukraine. Southbound timber traffic and miscellaneous northbound traffic have reached substantial levels, though not fulfilling planners' hopes. The shipping season generally runs from April to November, and shippers who value dependable year-round service remain reluctant to use the internal waterway system. Railroads in this territory urge their clients to make maximum use of the rivers, but shippers continue to display what one railroad official some years ago ruefully called "hydrophobia."

What little information is available indicates that the volume of freight traffic on the Great Northern Sea Route across the top of the Soviet Union is still very small. Icebreakers using atomic power lead caravans of up to a dozen vessels through the ice fields during a ten-week shipping season each year, carrying supplies to outposts along the northern coast and bringing out, presumably, valuable minerals. It has been explicitly recognized by careful Soviet scholars, however, that development of Siberia will rest mainly on use of the Trans-Siberian Railroad and the main north-flowing rivers, rather than on the Great Northern Sea Route.

While the massive traffic flows generated by Soviet economic activity are now predominantly internally oriented, a large growth of Soviet foreign trade with Eastern Europe and other parts of the world has had a perceptible impact on Soviet freight traffic patterns, restoring in part a prerevolutionary dimension, and adding new channels. Once again, there is a large Black Sea traffic leading to and from the Danube, and partly to the Mediterranean and beyond. Baltic Sea traffic to and from Poland and other European

trading partners has now reached levels that surpass the sea trade of prerevolutionary days.

Heavy railroad freight traffic involving iron ore and coking coal, with a return flow of machinery, equipment, and consumer goods, is channeled largely through Chop, in the southwest, and Brest, on the Polish frontier. Since 1964, a large-diameter pipeline for crude and refined petroleum products has provided an export channel from the Soviet Union to her Eastern European neighbors.

Though Soviet trade with China in recent years has fallen off drastically from the high levels reached at the end of the 1950's, new links have been added to eastern Soviet traffic patterns. The old Chinese Eastern Railway across Manchuria passed into Chinese hands in 1955. A new, more direct connection between the U.S.S.R. and Peking, across the Mongolian People's Republic, came into operation in 1956. As part of a notable building program within China, the railroad network was extended northwestward during the 1950's to Lanchow and westward across Sinkiang, eventually to be linked at the Soviet-Chinese frontier with a branch line completed by the Russians in 1960. The branch connects the border station of Druzhba with Aktogai on the Turkestan-Siberia line, 547 kilometers north of Alma-Ata. Construction work west of Urumchi evidently has proceeded slowly, if at all, in recent years, in part, no doubt, because the reduced volume of Soviet-Chinese trade is not pressing on existing transport capacity to move it.[7]

Foregone Transport Alternatives

Evaluation of Soviet transport policies necessarily involves, either implicitly or explicitly, comparing actual policies with foregone alternatives. If the Soviet record is to suggest lessons for other countries now making choices among competing alternatives in the transport sphere, the available Soviet alternatives over the period we are studying need to be specified. Otherwise the relevance and transferability of Soviet experience for other economies cannot be determined.

[7] See Victor D. Lippit, "Development of Transportation in Communist China," *China Quarterly*, July-September 1963, pp. 101-19, especially p. 118.

Diversion of Resources to Roads and Automobiles

As will be shown in Chapters 5 and 6, Soviet authorities until recently have deliberately restricted the flow of resources to road-building and passenger automobile production. What would have been the result for the U.S.S.R. if something like the American or recent West European path had been followed? Huge amounts of steel, machine tool capacity, rubber, and glass would have been deflected from heavy industry and national defense into passenger automobiles, and steel, cement, asphalt, gravel, stone, and other construction materials would have been diverted into highway construction. Gasoline and other petroleum products would have been required on a much larger scale than was in fact required by the Soviet economy. The resulting gains in consumer welfare would have been obtained at the expense of a slower rate of growth for all those activities from which inputs were diverted. Presumably these would have been the heavy industrial activities that have speeded Soviet industrial and military growth.

Appraisal of the prewar Soviet decision depends heavily on one's judgment of interwar international relations. If the Nazi invasion of the Soviet Union in 1941 is assumed to have been unavoidable, Stalin's grim and clumsy efforts, from 1934 on, to withstand the blow deserve serious consideration. On the other hand, if a peaceful environment for Soviet policies in the 1930's is assumed, a welfare-oriented judgment would appear far more persuasive.

Stalin warned at the Seventeenth Party Congress in January 1934 that the international economic crisis, coupled with the rise of Germany and Japan, meant that "things are heading for a new war."[8] In a situation of "hostile capitalist encirclement," as defined by Stalin, it is hard to see how large-scale passenger automobile production could have been justified. The case for trucks and military vehicles was, of course, stronger, and by 1941 Soviet capacity

[8] The translated text appears in his *Problems of Leninism* (Moscow, 1947), p. 460. For similar references, see the speeches of Molotov, Kaganovich, and Voroshilov in Kommunisticheskaia partiia Sovetskogo soiuza. 17. S"ezd, Moscow, 1934, *XVII s"ezd Vsesoiuznoi kommunisticheskoi partii (b), 26 IAnvaria-10 Fevralia 1934 g., Stenograficheskii otchet* (1934). Place of publication of all Russian language titles is Moscow, unless otherwise noted.

in these items was by no means negligible. As for highways, their relative absence seriously hampered the Nazi invaders, who depended heavily on overland movement of troops and supplies. The nineteenth century Russian decision to have a railroad gauge 3½ inches wider than the West European gauge is thought to have been made partially as a defensive effort to deter a Western invader; perhaps a similar rationale in the 1930's underlay the observed failure to develop a system of paved roads in western European Russia.

The prewar reluctance of Soviet policy makers to increase the flow of resources into highway building and passenger automobile production has persisted until very recently. Evidently an unswerving belief in plowing resources back into the further growth of heavy industry has continued to motivate Party leaders. Under the nuclear stalemate, invasion on land was not being alleged as a danger. Sheer policy inertia may well have been more important.

Soviet inattention to roadbuilding has been fully consistent with the low priority accorded the agricultural sector. Had major efforts been made to lower costs and raise productivity in agriculture, extension of the rural road network and a large-scale paving program would unquestionably have been part of the drive. In Western Europe and North America, investment in farm-to-market roads has been a major element of agricultural progress for two hundred years. The vehicles encouraged would not, of course, have been passenger automobiles, at least initially, but rather trucks. In practice, the distinction is blurred because rural trucks carry people as well as farm supplies and produce; many trucks are, in effect, joint-product vehicles. An improved road system would have reduced agricultural costs in many ways: (1) harvest losses would have been reduced as less grain was spilled on bumpy roads; (2) delivered costs for farm produce would have been cut as travel time from farm to market was reduced, and as vehicle expenses were lowered; (3) faster delivery would have reduced spoilage of perishables; (4) faster and more dependable delivery of supplies for agriculture would have improved field and livestock operations; and (5) increased mobility would have raised morale in the farm population. One can plausibly suppose that efforts in this direction might well have more than paid for themselves through resulting benefits of this kind. At long last, there are now signs of Soviet

movement in this direction. Soviet experience provides no positive evidence that inattention to rural roads permits a net release of resources with high payoffs elsewhere; on the contrary, it suggests that other countries, facing rapidly rising needs for agricultural output, should investigate carefully the merits of a far more extensive rural road program than the Soviet Union has yet carried out.

Early Shift from Coal to Oil and Gas

The Soviet decision to base its industrial growth on coal for steam power and electricity, with petroleum conserved primarily for military aviation, along with trucks and farm tractors, placed very heavy demands on the transport sector. Thirty percent of all railroad ton-kilometers of freight traffic from 1928 to 1953 were used simply to carry coal. An equivalent volume of heat energy could have been supplied through petroleum and natural gas with about half as many ton-kilometers of freight traffic. The change away from coal was well underway in the United States during the 1930's. It swept across Western Europe after 1945. It has only struck the Soviet economy in the last decade. Should Soviet authorities have been more alert and initiated the switch earlier?

The issue turns on the assured availability of ample domestic petroleum supplies, and before the fields of the "second Baku" area began to come in after 1935, the old Caucasian and Baku fields could well have been deemed an insecure base. Vigorous exploration for new petroleum deposits had been under way since 1929, spurred on by the Party, but it was not until the Eighteenth Congress, in March 1939, that recent promising strikes appeared to justify a directive calling for vastly increased crude oil production in the second Baku area. L. M. Kaganovich, then the head of the People's Commissariat for Heavy Industry, called for raising output from the 1938 level of less than 2 million tons to 10 million by 1942, and a leading analyst observed, in 1939, that "there is no doubt that with proper organization of prospecting work this task of the Commissar will be overfulfilled."[9] The Nazi invasion of course in-

[9] S. F. Fedorov, *Neftianye mestorozhdeniia Sovetskogo Soiuza* (2d ed.; Moscow-Leningrad, 1939), p. 529. For extremely interesting indications of the shift in his perspective since the first edition in 1935, see pp. 4, 5-6, 432-33, 526-31.

terrupted this growth, and it was not until 1948 or 1949 that Ural-Volga fields reached an output level of 10 million tons. Meanwhile the impact of World War II on the old Caucasian fields had been disastrous; their output has never regained the prewar level. Nevertheless, by 1948 or so it must have been clear that ample domestic reserves of petroleum were assured, and the implication is that Stalin's stubbornness inhibited change. Shortly after his death, a sharp debate broke out in the technical journals in several fields, including railroads, and in 1955 a decision by the Central Committee of the Communist Party brought a clear new policy line. One of the accusations against Kaganovich as Minister of Railroads, when he was ousted along with Malenkov and Molotov in June 1957, was that he had held out too long against a switch from steam locomotives to electric and diesel-electric motive power. Soviet industry and railroads in the 1960's are moving rapidly to substitute oil and gas as energy sources in many of the applications that have proved themselves in Western practice.

If the change had been launched ten or even twenty years earlier, the result might have been a net release of resources from fuel production and transportation to other uses. The change would have required major amounts of re-equipping in fuel-using sectors, along with investments in oil and gas production and refining, but simultaneously huge flows of inputs into coal mining, railroad transportation, and steam power generation would have been saved. On balance, the economy would have gained.

It is, however, unfair to bring hindsight to bear on Soviet decisions made in the 1930's and middle 1940's when the economic superiority of oil and gas over coal was not yet so decisively established. Soviet technological caution is understandable. The fact remains, nonetheless, that Soviet economic policy makers in this case did not prove notably alert, and that the transport sector would have benefited substantially if the shift away from coal had begun earlier.

Decentralized Pattern of Industrial Expansion

How would demands on the Soviet transport sector have differed if, instead of building very large industrial installations in

a handful of major centers, the U.S.S.R. had built smaller plants, scattered in a decentralized pattern more widely over Soviet territory? The question is not an easy one to answer. Total unit costs of production would have been higher in a set of smaller plants than in the giant plants the Soviets actually built, though experience indicates that the difference would not have been nearly as great as was supposed at the time. Perhaps larger total capital outlays would have been incurred under a decentralized small-plant program than were required for the actual Soviet program. On the other hand, the record suggests that in many industries output increases would have been obtained more promptly under a small-plant program than proved possible under the program of "gigantomania."[10]

The effect on the transport sector would probably have been unfavorable. Freight traffic in fuel and raw materials would have been less focused on a handful of interregional trunk lines, where line-haul economies could be obtained. Traffic in intermediate and fabricated products would have originated and terminated at many more locations, requiring a more scattered and complex pattern of operations. Internal railroad unit costs would have been raised as a result. Moreover, a more extensive betterment program would have been necessary. The transport crisis of the early 1930's would have been less easily surmounted, and the transport sector might have remained a bottleneck hampering industrial development longer than it did.

Decisive Industrial Shift Away from Old Centers

In the actual course of Soviet industrial expansion, the alternative of a thoroughgoing locational shift away from the old centers and out to the sources of fuel and raw materials (mainly in the east) was not seized. What would have been the result if this alternative had not been foregone?

One can deduce, first of all, that Soviet industrial output in 1940 would have been smaller than it was, but that industrial capacity

[10] This view is fully consistent with the conclusions reached in a major new study by David Granick; see his *Soviet Metal-Fabrication and Economic Development* (University of Wisconsin Press, 1967), especially pp. 15-16, 38-40, and 48-50.

would have been better located in relation to the coming Nazi invasion. Less wherewithal would have been at hand, but capacity to survive would have been improved. If invasion seemed certain in 1934, the eastward movement should have been more decisive in the following six years. If, however, military planners at that time assumed that the western frontier could be successfully defended, industrial expansion in the Ukraine and around Leningrad could have been rationalized on the grounds that it would yield output more quickly than eastern expansion would.[11]

Eastern expansion required much more social overhead capital, in the form of workers' dwellings and all the facilities that surround factory installations, than did expansion around existing centers in the west. Use of construction inputs to meet these needs would have cut into the growth of heavy industrial capital plant and equipment itself. Moreover, there was an understandable lack of enthusiasm among officials and workers at the thought of moving to inhospitable sites in distant regions. It took the spur of wartime evacuation and resettlement to send millions of Russians to the Urals, western Siberia, Kazakhstan, and Soviet Central Asia.

On the other hand, it might have been expected that a decisive movement of industry toward the east would have reduced the volume of freight traffic associated with any given level of industrial production. Heavy industry around Moscow and Leningrad drew its coal and raw material needs from the eastern Ukraine, several hundred kilometers away. It was hoped that new industrial capacity located in the Urals, in western Siberia, and in other underdeveloped districts with rich resource deposits could use weight-losing inputs on the spot, shipping only the much lighter fabricated output back to the old centers of European Russia for final consumption. However, the Ural-Kuznetsk Kombinat, or

[11] Compare the following judgment by Evgenii Davidovich Khanukov in his *Transport i razmeshchenie proizvodstva* (1956), pp. 108-109: "Along with this, the fact of capitalist encirclement of the U.S.S.R. dictated the necessity not only of assuring full economic independence of the U.S.S.R. from the capitalist world in the shortest possible time, but also the broad development of industry, first of all heavy industry, in the interior, especially in the Eastern regions of the country, which corresponded also with the task of rationally locating industry closer to rich sources of raw materials and fuel. The development of machine building in the old regions of the country greatly facilitated the subsequent successful fulfillment of this task."

"second iron and steel base of the U.S.S.R.," generated a tremendous volume of coal and ore traffic because of the fourteen-hundred mile distance between the two ends of the shuttle. Desperate efforts to use low-grade iron ore near the Kuznetsk Basin and low-grade coking coal near Magnitogorsk reduced the demands on the railroads, but raised real production costs in steel plants at each end.[12]

Growth of industrial output in the Volga Valley led to substantial coal imports from the Kuznetsk Basin, some two thousand miles away. In general, Soviet experience seems to have demonstrated that an effort to "move production closer to fuel and raw material sources," when these sources are widely separated from each other and from old population centers, will not only bring no absolute fall in the volume of freight traffic, but cause freight traffic to grow even more rapidly than output.

[12] For details, see Mills Gardner Clark, *The Economics of Soviet Steel* (Harvard University Press, 1957), pp. 130-36, 178-83, and 216-28.

CHAPTER IV

Soviet Railroad Operating Achievements

THE FRAMEWORK OF POLICY issues and historical developments set forth in the preceding chapters has provided general perspective on Soviet transport experience. At the heart of this record stand the railroads, a central institution of the Soviet economy that deserves worldwide respect. In this chapter we review the remarkable performance record of this railroad system.

The railroads have made a substantial contribution to Soviet growth. Russian railroad building before 1917 had created an extensive railroad system; it accounted for a larger fraction of the national capital stock when the five year plans began than did any other nonagricultural sector of the economy. Making intensive use of this inheritance, the railroads since 1928 have served heavy industry and the rest of the economy in a very impressive way. They have, moreover, continued their first-rate performance even in recent years when many other sectors of the economy have faltered. There is genuine analytic excitement in seeking to discover how these results have been obtained and in reflecting on their implications.

The experience of Soviet railroads suggests many lessons, principally positive ones, that will repay the thoughtful attention of transport policy makers and operating officials throughout the world of developing economies. The chief lesson, of course, is that railroads can be tremendously productive. Another is that continuity of use is the key to high productivity. The relationship can, in fact, be statistically measured. The consequence in reduced railroad costs makes up an important lesson in itself. The import of

these findings will be noted at the end of this chapter, with India used as a concrete illustration of potential carry-over.

Prewar Modernization Campaign

When the Stalinist era of five year plans began at the end of 1928, the railroads were called on for a major effort. They had snapped back rapidly with the rest of the economy over the preceding eight years and were handling more traffic than they had before the revolution. Much of their plant and equipment was antiquated, but by Western European standards there still appeared to be unutilized slack in the system.

The first Five Year Plan laid down ambitious output targets and large building programs for all sectors of the economy, including the railroads, but it became clear after a year or so that heavy industrial targets were to be pursued tenaciously, while other goals, like those for consumer goods, were to be largely deferred to the future. In this spectrum the railroads fell near the middle. Their capital needs were fended off with admonitions that they should get more out of their existing facilities. Their traffic responsibilities rose faster than the plan anticipated, but warnings of impending disaster from the head of the railroad commissariat were ignored.[1]

For the first two years, substantial increments of freight and passenger traffic were handled without much of an increase in railroad facilities. Bad-order locomotives and cars were repaired and placed in service and a many-sided betterment program was launched, but initial successes reflected mainly the taking up of slack. Most railroad operating averages improved.

But eminent engineering specialists and leading railroad officials were expounding at this time what came to be excoriated by the Party as "a theory of limits."[2] Scientific computations were used to demonstrate the upper boundary of freight-carrying capacity beyond which the existing system could not go. Authorities cited Eu-

[1] See Holland Hunter, *Soviet Transportation Policy* (Harvard University Press, 1957), pp. 54-56.

[2] See J. N. Westwood, *A History of Russian Railways* (London: George Allen and Unwin, 1964), pp. 234-37.

ropean examples of sound practice that could not be violated. Respected academicians proved that the railroads were doing their best. If further traffic were to be carried, the clear implication was that a proportionate increase in railroad plant and equipment would be required.

From 1931 through 1933, however, capital funds and imports and construction materials were concentrated on heavy industrial projects, while all but a few railroad projects held secondary priority. In spite of exhortations and administrative reorganizations, the railroads fell progressively behind in handling added traffic, so that backlogs of unshipped freight developed and passenger travel became chaotic. Railroad men and Party officials referred to the railroads as a bottleneck, holding back the advance of the whole economy.

Finally, in 1934, priorities were shifted toward the railroads and within two years they were able to work off their backlogs and eliminate the freight traffic bottleneck. With the benefit of hindsight, it is clear that the railroad modernization program was too long delayed. Beyond this, however, the contents of the Soviet railroad modernization program, and its relation to railroad performance, deserve our brief scrutiny.

One relatively quick and inexpensive step had been taken in 1930 and 1931: automatic brakes and automatic couplings began to be installed on the old European-style two-axle freight cars, long before they could be replaced by large four-axle cars. Air pressure hose was fitted to enough cars so that those with automatic brakes could be spotted through a freight train and used to control its movement.

Programs for designing and building large numbers of new, more powerful locomotives and freight cars came to fruition from 1934 on.[2] Line facilities on heavily burdened main routes were upgraded. Block signaling replaced train staff methods where traffic was very heavy. Projects were launched to double-track key

[2] See Boris Pavlovich Orlov, *Razvitie transporta SSSR, 1917-1962: istoriko-ekonomicheskii ocherk* (Izdat. Akad. Nauk SSSR, 1963), pp. 171-81. This thorough and scholarly study gives detailed footnote references to Transportation Ministry archival sources and other primary evidence not previously cited in Soviet transport literature, and presents a more well-rounded analysis than used to be possible. Place of publication of all Russian language titles is Moscow, unless otherwise noted.

routes. Though it was not a major aspect of the whole program, construction of new lines to establish some new key connections also played a role. Most of the publicity went to the so-called Turksib (Turkestan-Siberia) Line, built through Kazakhstan to bring west Siberian wheat into Central Asia and release land for cotton growing. In practice, the Turksib was less important than a trunk line put together to carry Donetsk Basin coal to Moscow, some regional links built for the Ural-Kuznetsk Kombinat, and some connections between the eastern Ukraine and Leningrad.

The modernization program was accompanied by a strenuous drive to improve the utilization of railroad plant and equipment. All the operating averages that measure railroad efficiency the world over came under sharp scrutiny for potential improvement. Could the average number of kilometers per day run by freight locomotives be increased? Could the number of days required for a freight car trip be reduced? How about the average weight and speed of freight trains? Were the "limits" described by orthodox railroad spokesmen in fact insurmountable?

These questions proved not to be rhetorical. Under the flamboyant leadership of Lazar Moiseevich Kaganovich, Soviet railroad men in 1934-36 demonstrated that operating averages could be pushed to new heights. The human side of the drive focused on firing the enthusiasm and initiative of the people themselves to augment the effect of modernized equipment. Kaganovich deliberately enlisted railway men from top to bottom in a series of meetings to assemble suggestions for improving the work. He systematically stimulated innovators to try new approaches and gave widespread publicity to their successes. When Petr Krivonos drove his old Series E freight locomotive, pulling an extra-heavy train, at above normal speeds by raising the boiler pressure beyond accepted limits, he was made a national hero. Men and women who found ways to make up trains more quickly, or unload cars more quickly, or repair locomotives more quickly, were given the publicity other societies reserve for their athletes and movie stars. An observer might have found the campaign slightly ludicrous, but it moved the freight.

During these years the railroad operating labor force grew considerably. In addition, it suffered substantial turnover, like that

affecting industry, as fresh recruits to the nonagricultural labor force "flitted" from job to job. Many thousands of men and women had to be trained for disciplined railroad work and fired with the enthusiasm necessary for these new efforts. The general atmosphere was propitious. Food rationing ended in December 1935; a new constitution was proclaimed, and for a while things went very well indeed.

The railroad labor force underwent substantial retraining, both on the job and in special night schools. The Party called for a drive in 1936 to give at least 500,000 railroad workers a special course of training in handling the new equipment that was becoming available. By the end of the year, almost 620,000 railroad workers had passed the examination, and in 1937 another 320,000 had completed it. Beyond this, another 303,000 learned new skills and raised their qualifications. In all, roughly 1,200,000 railroad men and women were given some systematic technical education.[4] A network of railroad trade schools and technical institutes was also expanded to provide a continuing supply of trained labor.

After 1936, however, the widening purges cast a pall over the operation of the economy. The railroads were especially hard hit.[5] An increasing shift of resources into military end-products also cut into the railroads' progress.

Though this is not the place for a detailed account, Soviet railroads made a vital contribution to Russian victory in World War II. Western anticipations of transport collapse were proved incorrect, as it was demonstrated that the strenuous efforts of the preceding decade had provided the basis for Soviet survival. Extensive destruction of railroad facilities began to be made up even before the war's end; by 1948, the 1940 level of freight traffic had been exceeded, and by 1950 many operating averages had been brought back to their prewar level.

[4] See Orlov, *op. cit.*, p. 211.

[5] Orlov writes (*op. cit.*, p. 224): "Under the circumstances of the cult of personality of Stalin, a majority of the heads of railroads and of their political sections, and many of the leading officials in the NKPS [People's Commissariat for Means of Communication], were pulled off their jobs and arrested. This repression heavily affected transport work." In their analytic account of the purge as they saw it from prison cells, F. Beck and W. Godin report that railroad officials were among those most likely to be arrested; see their *Russian Purge and the Extraction of Confession* (Viking Press, 1951), pp. 26-27, 70-71, and 109-11.

This first era of Soviet railroading thus brought out clearly the impressive potential in traditional steam railroads when intensively used. Soviet railroad men had responded to grim pressure by finding new ways to handle enormous increments of freight traffic. New facilities were combined with new methods to produce operating effectiveness never before achieved. One can dissent from the economy's scale of priorities and from Stalin's methods, but given these imposed conditions, Soviet railroad men must be admired for their performance.

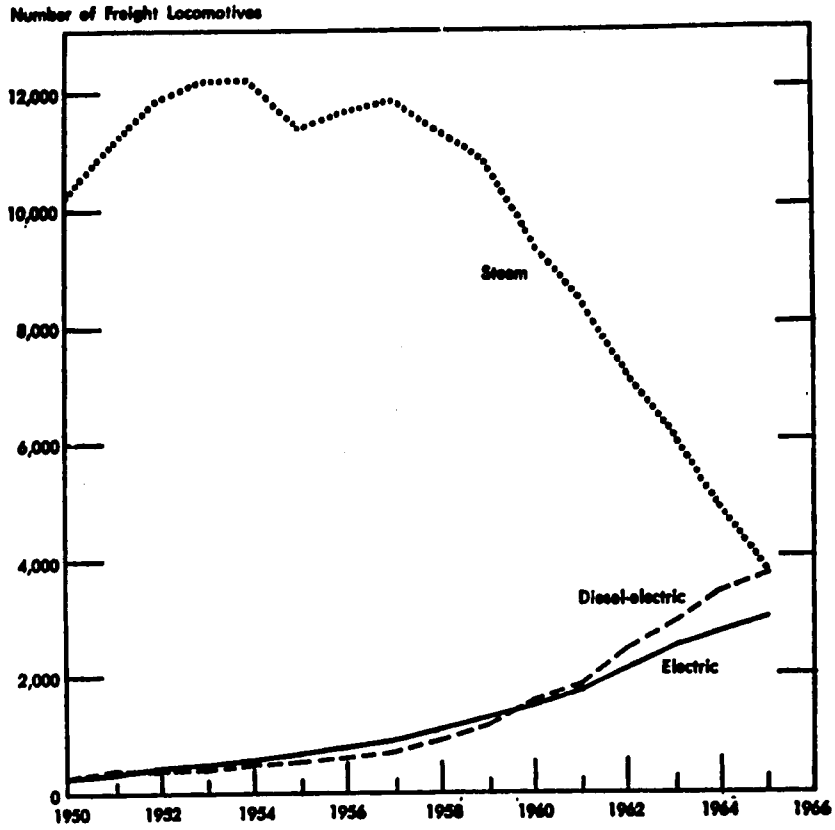
Railroad Technological Revolution Since 1950

In 1950, Soviet railroads carried just over 600 billion ton-kilometers of freight traffic and appeared to be straining the upper limit of the possible in doing so. Fifteen years later, they carried more than three times as much traffic, with only a modest increase in the length of the network, very little rise in the operating labor force, and no increase at all in the number of locomotives. How was this done? Had these results been predicted in 1950, a rational observer would have had to judge them impossible. The answer—improvements in technology—is fashionably obvious nowadays, but this dramatic case study is nonetheless impressive. It is instructive to examine its main features.

Much of the secret lies in the motive power revolution. In 1950, steam locomotives moved 95 percent of the freight ton-kilometers handled. Electric traction had long been on the Soviet agenda; Lenin had called in 1920 for a vast electrification program that included railroads along with other parts of the economy. The first Five Year Plan listed several thousand kilometers of line slated for electrification, and the long lists continued in the second and third plans, but the total in 1950 was only 3,042 kilometers. Technological prudence had restrained responsible officials from switching the source of horsepower in the middle of a steam economy.

But Soviet freight traffic densities were reaching a level that clearly justified the heavy initial outlays for railroad electrification, and the American example of a rapid change to diesel-electric traction indicated still another alternative. By the time Stalin died,

FIGURE 7. *Number of Soviet Freight Locomotives in Active Service, by Type, 1950-65*



Source: Table D-4, App. D.

railroad technical specialists were apparently beginning to chafe. Kaganovich, however, no longer young, in May 1954 stubbornly stressed his continued confidence in the steam locomotive, and it was not until 1955 that the Central Committee of the Party laid down a new line. Since then, as Figure 7 shows, the number of straight electric and diesel-electric locomotives has grown very rapidly. They now handle over 90 percent of all freight traffic. Steam locomotives, while still numerous, are relegated to branch-line service, switching, and some passenger movement.

The advantages of electric and diesel motive power are numerous. These locomotives are far more continuously available for

work than steam locomotives can be. They require much less servicing. Distances between stops can be far longer than with steam power. In addition, electric and diesel-electric locomotives can be built to pull heavy, fast trains without requiring the heavy track structure and bridges that an equally powerful steam locomotive would require. In these comparisons, relative fuel costs play a minor role. Everywhere in the world, the steam locomotive is being displaced. Soviet experience since 1950 thus conforms to a universal trend. The motive power revolution has a great deal to do with explaining recent Soviet railroad successes.

Other forms of modernization have also contributed. The freight car fleet has been substantially upgraded in the course of its continued growth, though by present American standards Soviet cars are still of the previous generation. In main line service, practically all Soviet freight cars are now four-axle cars with automatic brakes and couplings. Most of them are of 50-ton capacity and many have roller bearings. Extra-large cars, and specialized types, are rare. Two-axle units have not all been retired. Nevertheless, the capacity of the freight car fleet has slightly more than doubled since 1950.

Recent technological progress has raised Soviet railroad line capacity notably. Modern signaling has been extended to most of the trunk line routes. Freight classification yards have been rebuilt. Humps have been installed, pneumatic retarders are at work, yard radio communications are employed, and closed-circuit television, too, is in evidence.

Displacement of steam traction has forced the relocation of division points, turnaround depots, and repair facilities. The reorganized lines have lower operating costs. Large-scale efforts are under way to lengthen sidings and passing tracks to accommodate the longer trains that are possible with the new motive power.

Soviet railway men and women have developed the art of train scheduling to a remarkable degree. The average headway between trains running the same direction on a few of the busiest routes is said to be as low as ten minutes. This suggests remarkable discipline at the marshaling yards that assemble trains for main line movement and deal with arrivals. The extent of track occupancy on the Soviet railroad system now far exceeds American experience (see Table 9, page 74).

Train weights and speeds have risen steadily throughout the

postwar period (see Table 11, page 76); the effect has been to facilitate the mass movement of line haul traffic and raise the annual output of a hard-pressed system. The average turnaround time for freight cars, already impressively low in 1950, has been brought still lower, though the rate of decline has slowed down in recent years and turnaround time is probably reaching a lower limit. The 1950 figure was 7.5 days; in 1966 it was 5.3 days.

In all these ways, Soviet railroads have continued to take advantage of the potential that lies in modern railroads for moving heavy freight traffic. Confronted with inexorably growing demands for the movement of fuels and raw materials over long distances, Soviet railroads have regularly overfulfilled their targets without receiving in full the additional capital planned for them. They have continued to uncover new "internal reserves" in spite of appearing stretched to the limit. An outside observer might ask whether all the freight should, in fact, be moved, or whether its composition is optimal, or its geographic pattern ideal, but once again, given the demands placed on them, it is hard to deny the impressive performance of Soviet railroads.

Implications of a Soviet Railroad Production Function

The foregoing discussion has given a sweeping historical account of the way Soviet railroads have managed to carry the enlarged freight traffic that has accompanied Soviet industrial expansion. The principal technical and institutional changes involved have been described. But additional insight into the quantitative relations among all these changes is provided in more systematic form through analysis of a historical railroad production function fitted to the Soviet data. The statistical details are set forth in Appendix B. Here the chief implications of the exercise are reviewed.

First of all, it should be said that multiple regression analysis provides straightforward confirmation of several overriding and obvious features of the record: from 1928 through 1940, and again from 1950 through 1964, freight traffic output increased far more than did the inputs of labor and capital, however measured. In the production of freight traffic services, Soviet railroads displayed

substantially increasing returns to scale. Economists have long cited railroading as an activity subject to increasing returns, and similar findings have been made for Western railway systems.[6]

Soviet railroads have increased their traffic output in part by making use of substantially enlarged input supplies. Capital plant and equipment and the railroad labor force have grown notably since 1928. But traffic gains have far exceeded the rise in input flows, since two other kinds of change have been at work. The technology embodied in Soviet railroad equipment and in the Soviet railroad labor force has improved greatly in quality. Locomotives, freight cars, signaling facilities, yard facilities, and all the other forms of capital used in railroading have been modernized over the last forty years.

Beyond this, however, a third category of change has amplified the effects of enlarged input flows and improvements in railroad technology. Soviet railroad men have developed numerous ways of greatly intensifying the use of their plant and equipment. Utilization factors have been raised far above conventional Western levels. Through making more continuous use of locomotives, freight cars, and line capacity, the annual volume of freight traffic carried by the system has been additionally expanded.

Intensive utilization, technological progress, and growth in input flows have acted jointly to produce Soviet railroad successes. The changes have reinforced each other in a reciprocal way. An attempt at statistical decomposition should not be taken to imply that these changes could in practice be isolated for separate introduction. Nevertheless, multiple regression analysis is capable, under favorable statistical conditions, of showing the relative importance of contributing factors, and that is the information developed in Appendix B.

It is shown there that the introduction of a measure for the intensity with which freight cars have been used provides a statistically significant clue to the results Soviet railroads have achieved. Similarly significant findings were obtained with a term measuring the intensity with which line capacity has been used. Though the

[6] See George H. Borts, "Increasing Returns in the Railway Industry," *Journal of Political Economy*, Vol. 62, No. 4 (August 1954), pp. 316-33, and the literature there cited.

evidence is crude, it indicates that the technological progress that came to be embodied in Soviet railroad capital and labor can be given statistical expression through the introduction of a utilization measure as a separate explanatory variable.

In addition, the statistical production function in several forms reveals deviations from the general historical trend which appear to reflect the helpful or harmful impact on railroad performance of general forces at work in the surrounding economy. The crisis brought on by agricultural collectivization after 1929, the "good times" that prevailed for a while in the middle 1930's, the deteriorating performance resulting from the widespread purges of the late 1930's, and the subnormal conditions that existed just before and after Stalin's death in 1953—all these leave a statistical mark on the Soviet railroad record, with something of a time lag.

Soviet railroad technological progress has been used to intensify the utilization of railroad capital plant and equipment and thus to enable Soviet railroads to handle a manyfold increase in freight traffic. Technological progress on American railroads has been used quite differently. Without fitting an aggregate production function to American data, it is clear from the general record that American railroads, not confronted with a massive growth in the demands for their services, have used the opportunities opened up by technological progress primarily to reduce their inputs of labor. In the last thirty or forty years, labor productivity has risen greatly on both railroad systems, but the Soviet gain has primarily occurred through a rise in the output numerator, while the American gain has come through a fall in the labor denominator. On both systems, capital productivity also has risen, and even without an attempt at precise measurement it seems clear that Soviet railroad capital productivity has shown larger proportionate gains over this period than would be found for American railroad capital.

The technological progress embodied in Soviet railroad capital, consciously employed to further the continuous use of railroad equipment, has permitted the Soviet economy to economize in making additions to the railroad capital stock. The intent has been to raise the ratio of output to capital in this sector, that is, to raise capital productivity or lower the capital-output ratio. By contrast, the technological progress embodied in American railroad capital,

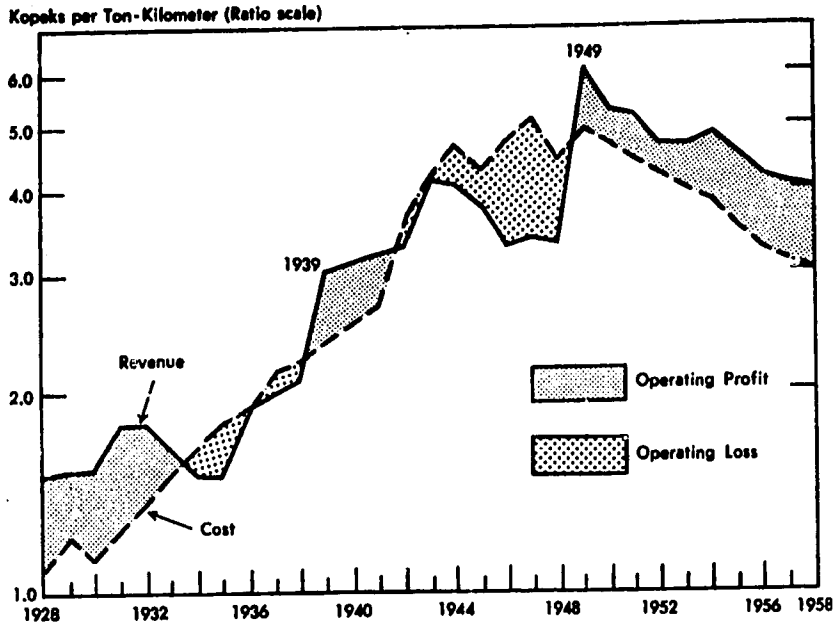
heavily directed toward reducing operating costs, has enabled the American economy to obtain railroad freight services with a far smaller outlay on railroad labor than would otherwise have been necessary. The primary focus of American railroad management has been on raising the ratio of output to labor, that is, railroad labor productivity. In each case the broad policies pursued are understandable and appear economically rational.

But intrasectoral rationality is not enough. From an overall point of view, rational resource management requires attention not only to the cost minimizing efforts of each sector individually, but to their joint interaction. The more continuous use of railroad capital plant and equipment that has played such a large role in explaining Soviet railroad successes has one serious economic drawback; it raises costs for freight shippers and receivers. Freight arrivals and departures at night, over weekends, and on holidays require the railroads' clients (unless they themselves happen to be on a continuous, three-shift basis) to bear extra expenses. Similarly, the handling of large consignments, arriving and departing intermittently, raises storage costs for a railroad client. In all these respects, the relatively low level of utilization that characterizes American railroad plant and equipment may be seen as a direct measure of the nonimposition of such expenses on American shippers and receivers. The point should not, however, be overstated; the American railroad record over the last four decades shows many periods when slack utilization has gone far beyond what could be justified on this basis.

Cost and Revenue Trends

Soviet railroads began the plan era in a profitable condition, and were able to maintain it for several years. The rapid growth of freight and passenger traffic increased revenues more than it raised expenditures. However, rate concessions on heavy industrial inputs, and the post-1932 decline in passenger traffic, hurt railroad revenues while their operating costs were rising. From 1934 through 1938, freight operations ran at a loss. Net income from passenger operations and other sources prevented an overall rail-

FIGURE 8. *Average Soviet Railroad Freight Revenue and Cost, 1928-58*



Source: Table D-7, App. D.

road deficit, but the steady upward trend in railroads' unit operating cost in freight operations gave much concern to the authorities. The average internal cost to the railroads of moving a ton of freight one kilometer rose from a little over one kopek in the late 1920's to about 2.4 kopeks in the late 1930's, that is, it doubled.

Railroad costs were pushed up by the rise in money wage rates that plagued the whole economy and by a sharp rise in material costs, especially in 1936.[7]

In 1939 a sharp rise in the national schedule of freight rates relieved Soviet railroad financial stringency. Average realized revenue per freight ton-kilometer rose 50 percent in one year, from 2.09 kopeks in 1938 to 3.01 kopeks in 1939 The profitability of freight operations continued through 1941, but the severe dislocations of the war led to large operating freight deficits for seven years thereafter. As Figure 8 shows, unit costs in rail freight operations re-

[7] For fuller discussion see Hunter, *op. cit.*, pp. 202-207.

TABLE 7. *Soviet Railroad Payments into, and Receipts from, the State Budget, Selected Years, 1940–62*[a]
(In millions of rubles)

Item	1940	1950	1955	1960	1962
Railroad profits paid to U.S.S.R. budget	301	388	1,629	2,394	2,817
Budget grants to the railroads	449	1,011	942	824	730
Balance of rail contribution	−148	−623	687	1,570	2,087

[a] Source: I. V. Ivliev, *Finansy i finansirovanie zhel. transporta* (1963), p. 21.

mained far above unit revenues until 1949, when again the rate structure was sharply raised, by almost 100 percent. The average realized unit revenue in 1949 was 79 percent above its 1948 level.

After 1949, Soviet railroad freight operating costs steadily declined as growing traffic and improved equipment permitted continuous efficiency gains. Freight operations became highly profitable. There was no longer any need for passenger net income to offset freight deficits. In fact, freight rates themselves could be lowered, as they were on several occasions after 1949.

The fall in unit operating costs for Soviet railroad freight operations has permitted the authorities to choose between two alternative opportunities. On one hand, if freight rates had remained unchanged while costs fell, huge balances of net income would have accrued to the railroads. On the other hand, if freight rates had been brought down as fast and as far as unit operating costs fell, shippers and receivers would have obtained the full benefit of lower rail transport costs. Soviet practice has favored a mixed solution. The average realized unit revenue for Soviet railroad freight fell from 6.01 to 4.04 kopeks over the period 1949-58, cutting clients' costs, *ceteris paribus*, by one-third. At the same time, as Table 7 shows, railroad profits swelled enormously.

Should savings in rail transport costs be passed on to shippers and receivers, or should the net income that accrues if rates are not reduced be siphoned into the central government budget, for assignment on capital account according to national policy? From a

Soviet point of view, each alternative has advantages and disadvantages. Rate cuts help distant shippers, like those in outlying regions the Party has long sought to favor. Projects considered desirable on political and social grounds are made more economically viable by the fall in rail transport costs and are thus more able to manage without subsidy.

On the other hand, where rail costs fall below the revenues generated by a stable set of freight rates, a very convenient source of funds that can be relatively painlessly extracted to finance capital development is available for tapping. Transfer of the profits into the central budget is formally analogous to the impact of the turnover tax and general profits tax that have long been used to finance the restructuring of the Soviet economy under Party auspices.

If the decision had rested with Soviet railroads themselves, their profits would most likely have been spent to assure timely carrying out of their planned capital investment and even perhaps for adding to railroad fixed capital beyond planned targets. In the historical context of Soviet policies as they have been sketched in earlier chapters, we should not be surprised that this path has not been taken. A railroad partisan might still, however, register a sense of outrage, especially if the profits siphoned off from railroads were being used to finance the expansion of river, sea, and road carriers.

Implications for Developing Countries

The strongest railway system in the world of developing economies is clearly that of India. In some respects it has recently been out-performing the railway systems of the United States and several European economies. Precisely because of its strength, and the large tasks that confront it, the Indian railway system provides an informative illustration of the potential carry-over from Soviet railroad experience. What are the lessons of Soviet railroading for a country like India? What would be the quantitative impact on Indian railway operations if Soviet methods were used? What qualifications should be attached to these implications, in view of various noncomparabilities between the U.S.S.R. and India? These are the questions to which this section is addressed.

Lessons for Indian Railways

For the last quarter of a century, Indian railways have carried heavy burdens with distinction. This long-established system, with old equipment but first-rate leadership, made a major contribution in the years 1939-45. During India's planned growth since 1950, railways have played a central role in the economy's progress. Through both increased efficiency and added capital, the railway system has more than doubled its freight traffic output during the first three plan periods.

But capital investment for the railways has taken a major share of India's public outlays on development. The railways have been voracious consumers of foreign exchange. Anything that might lighten further railway capital requirements would release scarce resources for the agricultural sector or for other urgent needs of the economy. It is thus important to ask what Soviet experience suggests about the potential of Indian railways.

Clearly the major lesson of Soviet railroad experience is that railways are not obsolete. They have tremendous potential for carrying the heavy freight traffic on which an industrial economy depends. A country with a first-class railway system has inherited an extremely valuable base for its economic growth. Railway difficulties in some mature economies should not be sweepingly misinterpreted to imply that the railroad era has ended.

Another general lesson that emerges from comparison of Soviet railroad operating averages with those of Western railroads is that Western utilization patterns can readily be improved on. Western railroad practice has been stodgy. Chronic underutilization has permitted slack standards. Concern for the safety of employees has meant cautious procedures. In a process requiring strict discipline, the rule book has tended, over the decades, to hold back intensive methods. Featherbedding has hurt productivity. For all these reasons, some good and some bad, American and European railroads lack a tradition of intensive equipment utilization. The dimensions of the contrast will be indicated below in a few simple comparisons.

Perhaps the most important lesson of Soviet railroad experience

TABLE 8. *Freight Traffic Densities on Indian Broad-Gauge, Soviet, and Three United States Railways, Selected Years, 1928–65*[a]

(In thousands of net metric ton-kilometers per route kilometer)

Year[b]	Indian Broad-Gauge Railways	Soviet Railways	Three United States Railways
1928	—	1,215	—
1929	—	1,467	—
1930	—	1,738	—
1931	—	1,896	—
1932	—	2,075	—
1933	—	2,065	—
1934	—	2,472	—
1935	—	3,079	—
1936	—	3,820	—
1937	—	4,179	—
1938	—	4,363	—
1939	—	4,431	—
1940	—	4,344	—
1950	1,503	5,169	—
1951	1,616	5,773	—
1952	1,584	6,274	—
1953	1,607	6,692	—
1954	1,742	7,133	4,569
1955	1,948	8,057	5,740
1956	2,138	8,940	6,219
1957	2,411	10,020	6,141
1958	2,459	10,670	4,860
1959	2,618	11,570	4,888
1960	2,774	12,020	4,897
1961	2,829	12,410	4,759
1962	3,099	12,740	5,125
1963	3,252	13,650	5,460
1964	3,187	14,370	—
1965	3,431	15,000	—

[a] Source: For Indian broad-gauge and the three U.S. railways, Table D-8, App. D. For Soviet railways, Tables D-1 and D-3, App. D.

[b] The Indian data cover a fiscal year ending March 31 of the following calendar year.

is that changes in methods and in men can greatly multiply the effectiveness of changes in equipment. Railway capital can be enlarged and modernized so that increased traffic can be handled. These gains can be greatly augmented, however, if equipment modernization is accompanied by imaginative, systematic reorganization of railway operations. As we have seen, Soviet railroads have achieved important breakthroughs in this sphere.

A few statistical comparisons will illustrate the point. Readily available data for the broad-gauge portion of the Indian railway system can be compared with Soviet data. Additional contrast is provided through examination of data for three large U.S. railways which, taken together, make a network of about the same length as Indian broad-gauge railways. Table 8 shows the Indian record from 1950 through 1965 and compares it with the Soviet and U.S. records for selected years.[8] It shows that in overall freight traffic density, Indian railroads have moved through a range similar to that traversed by Soviet railroads before World War II, but that greatly intensified freight traffic densities would be technically feasible if they were called for. Even the underemployed facilities of the three American railroads shown here display freight traffic densities substantially above current Indian broad-gauge levels.

Another revealing indicator of railway operating methods is the number of trains per day handled on an average stretch of line. Table 9 shows that the average daily frequency of Indian broad-gauge freight trains rose from 8.4 in 1950 to 12.7 in 1963. By contrast, the three United States railroads had an average frequency of freight trains varying from 7.5 daily in 1961 to 10.4 per day in 1956. Clearly Indian railways have moved rapidly to outperform American railways in this respect.

Table 9 shows that Soviet railways began in 1928 with a network average per route kilometer of about 8 daily freight trains, but had pushed the figure up in the late 1930's to over 17 per day. Between 1950 and 1963, Soviet railways increased their freight train fre-

[8] Railroad terminology differs from one country to another and (with apologies to all non-Americans) I have used U.S. terms in these comparisons. "Goods wagons" become "freight cars," and "engines" become "locomotives." On the other hand, U.S. short tons of 2,000 pounds are converted to metric tons (Indian railways changed over to the metric system in 1960), and data in miles are converted to kilometers.

TABLE 9. *Daily Freight Train Frequencies on Indian Broad-Gauge, Soviet, and Three United States Railways, Selected Years, 1928–64*[a]

Year[b]	Indian Broad-Gauge Railways	Soviet Railways	Three United States Railways
1928	—	8.2	—
1929	—	9.5	—
1930	—	9.7	—
1931	—	10.2	—
1932	—	11.0	—
1933	—	11.1	—
1934	—	12.9	—
1935	—	14.9	—
1936	—	16.3	—
1937	—	17.4	—
1938	—	17.6	—
1939	—	17.8	—
1940	—	17.1	—
1950	8.4	17.7	—
1951	8.9	19.2	—
1952	9.0	20.3	—
1953	8.9	20.8	—
1954	9.3	21.1	8.5
1955	9.9	22.2	10.0
1956	10.3	23.6	10.4
1957	10.7	25.6	9.9
1958	10.8	26.3	8.1
1959	11.3	27.6	8.1
1960	11.5	28.0	7.9
1961	11.7	28.3	7.5
1962	12.1	28.9	7.9
1963	12.7	29.7	8.1
1964	12.4	31.0	—

[a] Source: For Indian broad-gauge and three U.S. railways, Table D-8, App. D. For Soviet railways, Tables D-3 and D-5, App. D. Daily train frequency is the ratio of total annual freight train-kilometers (divided by 365) to average annual route kilometrage.

[b] The Indian data cover a fiscal year ending March 31 of the following calendar year.

quency from 18 up to 30 per day, more than twice the recent Indian level. As a systemwide average, sustained over months and years, this degree of Soviet track occupancy is most impressive. It reflects strong efforts to keep engines and wagons continuously on line and

TABLE 10. *Indian Freight Train Averages on Broad-Gauge Railways, 1950–65*[a]

Year[b]	Average Gross Weight (Metric tons)	Average Net Weight (Metric tons)	Average Speed[c] (Kilometers per hour)	Gross Metric Ton-Kilometers per Freight Train Locomotive-Hour
1950	933	489	17.4	16,409
1951	—	496	17.2	—
1952	—	479	16.7	—
1953	—	492	16.4	—
1954	—	510	16.3	—
1955	1,006	537	15.9	16,034
1956	1,047	565	15.5	16,229
1957	1,106	613	15.0	16,590
1958	1,130	623	15.2	17,176
1959	1,156	631	15.8	18,716
1960	1,192	656	16.1	19,640
1961	1,196	657	15.7	19,171
1962	1,254	699	15.4	19,730
1963	1,267	701	15.5	20,052
1964	1,275	700	15.9	20,726
1965	1,323	725	16.4	22,252

[a] These data come from two annual publications of the Ministry of Railways, Government of India: *Report by the Railway Board on Indian Railways* (cited hereafter as *Report*), and *Indian Railways* (cited hereafter as *IR*). For 1950, 1955, and 1960–65, all figures are from *IR 1965–66*, p. 46. The net weight and average speed figures for 1951–54 and 1956–59 are from *IR 1960–61*, pp. 52 and XLVIII. The 1959 figures in columns 1 and 4 are from *Report . . . for 1960–61*, Vol. 2, pp. 259 and 319. The 1956–58 gross weights (excluding locomotive) are derived in relation to 1955–59 data for gross weights including the locomotive; column 4 estimates result as the product of column 1 times column 3.

[b] Data cover a fiscal year ending March 31 of the following calendar year.

[c] Includes stops.

in motion, together with disciplined control of train makeup and train movements. It also reflects efforts to maintain an even flow of traffic by spreading seasonal peaks out, and continuing work on holidays, weekends, and at night.

Another dimension of railway performance is measured through examining the average weight and speed of freight trains. Table 10 shows that the net weight of Indian freight trains rose from almost 500 to 725 tons over the 1950-65 period, while gross train weight (including the weight of cars and caboose, but excluding the weight of locomotive and tender) rose from 933 to 1,323 tons. Av-

TABLE 11. *Soviet Railway Freight Train Averages, 1928–40 and 1950–66*[a]

Year	Average Gross Weight (Metric tons)	Average Net Weight (Metric tons)	Average Speed[b] (Kilometers per hour)	Gross Metric Ton-Kilometers per Freight Train Locomotive-Hour
1928	817	420	14.1	11,520
1929	854	443	13.3	11,360
1930	937	523	12.2	11,430
1931	967	549	13.2	12,760
1932	966	543	14.3	13,810
1933	959	533	13.8	13,260
1934	994	555	14.7	14,560
1935	1,035	590	15.7	16,250
1936	1,160	661	18.3	21,230
1937	1,200	682	19.6	23,520
1938	1,262	703	19.1	24,100
1939	1,296	711	19.3	25,010
1940	1,301	727	20.3	26,410
1950	1,430	815	20.1	28,740
1951	1,478	839	22.0	32.520
1952	1,521	859	23.3	35,440
1953	1,579	894	23.5	37,110
1954	1,660	936	22.9	38,010
1955	1,758	1,002	24.7	43,420
1956	1,831	1,052	24.8	45,410
1957	1,887	1,089	25.6	48,310
1958	1,972	1,126	26.6	52,460
1959	2,037	1,167	27.2	55,410
1960	2,099	1,201	28.3	59,400
1961	2,141	1,223	29.7	63,590
1962	2,199	1,249	30.7	67,510
1963	2,267	1,280	31.8	72,090
1964	2,315	1,300	32.9	76,160
1965	2,368	1,332	33.6	79,560
1966	2,406	1,348	33.7	81,080

[a] Data for 1928–40 compiled from Soviet sources in Hunter, *op. cit.*, Table 73, p. 399, revised (for 1937 and 1940) by data in Tsentral'noe Statisticheskoe Upravlenie (hereafter referred to as TsSU), *Transport i sviaz' SSSR: statisticheskii sbornik* (1967), which also gives the 1950–66 data on pp. 112 and 114. Column 4 is column 1 times column 3.

[b] Includes stops.

erage speed, however, declined somewhat from 17.4 kilometers per hour to 16.4. Multiplying gross weight by average speed yields a combined indicator of train performance; in gross ton-kilometers per freight train-hour, Indian railways showed a 36 percent improvement from 1950 to 1965.

Table 11 shows that the average Soviet freight train in 1928 was both lighter and slower than the Indian train of 1950. By the end of the 1930's, however, Soviet train weights and speeds had risen to approximately the 1965 Indian level. Moreover, while Indian freight trains have not raised their speeds in recent years, Soviet trains have steadily gone beyond their prewar peak of 20 kilometers an hour and now move at an average speed above 30 kilometers an hour. The combined result of heavier trains and higher speeds has brought Soviet gross ton-kilometers per train-hour to a level three and a half times the 1965 Indian level.

United States railway practice has long favored heavy trains, and the postwar spread of diesel-electric traction has raised average train weights and speeds. Both measures are substantially higher in the U.S. than on Indian railways, especially for the three U.S. railroads examined here, as shown in Table 12. United States freight trains are relatively infrequent, but heavy and fast when they appear.

Factors Accounting for Performance Differences

There are many reasons for the differences shown in the preceding tables. The measures themselves may not have precisely identical definitions and coverage, though I have tried to make them as comparable as possible. Close inspection will show, however, that even substantial differences in definition and coverage could hardly eliminate the contrasts we have noted.

A more fundamental basis for these differences lies in the age and nature of the capital plant and equipment employed. Soviet railways in the late 1930's and U.S. railways in the middle 1940's used steam power and old equipment to carry massive freight traffic. Now a series of innovations in motive power, signaling, etc., has brought new capacity to these systems. Accomplishments to date in Indian railway modernization should facilitate Indian

TABLE 12. *Freight Train Averages on Three United States Railways, 1954–63*[a]

Year	Average Gross Weight (Metric tons)	Average Net Weight (Metric tons)	Average Speed[b] (Kilometers per hour)	Gross Metric Ton-Kilometers per Freight Train Locomotive-Hour
1954	3,004	1,472	29.3	87,867
1955	3,133	1,581	28.4	89,079
1956	3,201	1,640	28.2	90,401
1957	3,331	1,696	28.5	95,061
1958	3,324	1,642	29.1	96,737
1959	3,333	1,653	28.7	95,762
1960	3,402	1,690	28.1	95,613
1961	3,505	1,739	28.4	99,454
1962	3,587	1,771	28.9	103,692
1963	3,734	1,859	28.6	106,767

[a] Data for the Pennsylvania, the Chesapeake and Ohio, and the Norfolk and Western railroads are from U.S. Interstate Commerce Commission, *Transport Statistics in the United States*, annual volumes, Part I. Column 4 is 1.45998 times Item 590, "Gross ton-miles of freight train cars, contents, and cabooses," over Item 598, "Freight train-hours in road freight service." Column 1 is 0.90719 times Item 590 over Item 532, "Total freight train miles." Column 2 is 0.90719 times Item 609, "Net ton-miles of revenue and non-revenue freight," over Item 532. Column 3 is 1.609344 times Item 532 over Item 598.

[b] Includes stops.

achievement of the earlier Soviet and U.S. levels of equipment use. Further modernization could then mean further gains.

Still another factor underlying these differences relates to the nature of the demands placed on the railways: the commodity composition of their freight traffic, its seasonal variation, the extent of passenger traffic, the geographic pattern of shipments, the terrain involved, and similar characteristics. Averages comparing large railway networks may be misleading. Detailed examination of actual local situations should underlie sound comparative judgments.

Many considerations suggest caution in drawing conclusions from these comparisons. It has been suggested at several earlier points in this study that national purposes have an important bearing on transport policies. Indian railways have always had far larger responsibilities for passenger movement than have Soviet railroads. India's population is more than twice as large as Russia's, and regional population densities are far greater. This makes In-

dian railway problems a great deal more complicated than those Soviet railroad officials have faced. Similarly, India's development plans accord greater relative attention to agriculture and the output of consumer goods than has been true of Soviet plans. The result is a composition of railway freight traffic that tends to hold down Indian railway operating averages in comparisons like those made above. Government in India is less centralized than in the U.S.S.R., and the power to compel changes is certainly less Draconian in India than it was in the Soviet Union under Stalin thirty years ago. In these respects and others, therefore, the differences in railway operating averages reflect human differences in the two societies that are not subject to railroad control.

Beyond this, however, the record of Soviet progress can nevertheless serve as a beacon demonstrating the technological potential of modern railroad equipment when it is augmented by energetic operating procedures. Tenderness toward human beings need not require an undemanding attitude toward scarce capital equipment. Rejection of Stalin's methods need not excuse an unnecessary degree of idleness in the use of motive power, rolling stock, and line capacity. Modern methods permit intensive equipment utilization without excessive human pressure.

Still further optimism is in order when one reflects on the more ample technological opportunities open to Indian railways at the present time. Major innovations in motive power, communications equipment, freight handling methods, and the whole range of railroad shipment processes contain a potential that runs far beyond what was available to Soviet railroad authorities a generation ago. Seized with imaginative enthusiasm, and combined with alert, energetic procedures throughout the railway organization, these technological improvements can generate impressive gains in transport effectiveness. That is the overall lesson of Soviet railroad experience.

CHAPTER V

The Role of Trucks in Soviet Freight Transport

THE ROLE OF FREIGHT-CARRYING motor vehicles, or trucks, in the Soviet economy is confined almost entirely to providing short-haul mobility for industrial, agricultural, construction, and commercial activity. The tonnage of truck shipments is very large, but the average length of a trip is only seven or eight miles. The "automobilization" of Russia that was called for in the 1920's and set in motion thereafter has gone far to replace horse-drawn carts and wagons with trucks, which now total some 3 million units. The major trends in this transformation are described briefly in this chapter, together with a few of the policy issues that have arisen in this field.

It should be stressed immediately that the "road or rail" problem assumes a very unusual form in the Soviet Union. The authorities have been concerned for many years to shift short-haul traffic, especially around major industrial centers, *from* railroads *to* trucks. The volume of short-haul rail traffic is still, however, very large. The railroads, hard pressed to handle an ever growing volume of long-distance heavy industrial traffic, have never expressed any objection to the transfer of commodity shipments from railroads to trucks. As we shall see, the chief limitation on the growth of Soviet truck traffic has been inadequate growth in the number of trucks and their carrying capacity.

In Appendix C, annual Soviet data for truck production, imports, and exports since 1928 are employed, together with other

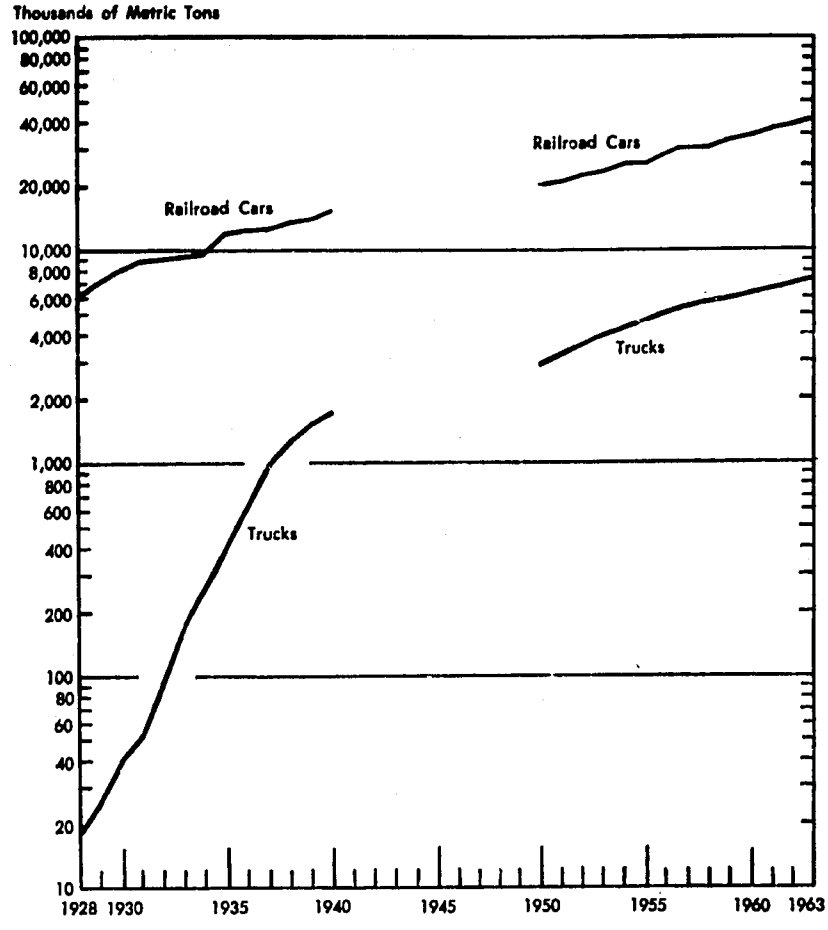
evidence, to develop time series estimates for the total stock of trucks and their presence in various sectors of the economy. The data are not firm, but they show clear trends and relative dimensions that emerge unmistakably from within a substantial margin of imprecision. It is these trends and dimensions that illustrate Soviet transport policy in action.

Trends in Truck Numbers

The freight-carrying capacity of the national stock of trucks in the U.S.S.R. has grown very rapidly since 1928, though it is of course far overshadowed by the aggregate carrying capacity of railroad freight cars. Figure 9 indicates the dimensions involved. Rapid growth from 1928 to 1940 gave the Soviet economy 1.7 million tons of truck capacity by 1940. Meanwhile, however, the capacity of the railroad freight car fleet had risen from 6.0 to 15.4 million tons. From 1950 through 1963, Soviet truck capacity rose from 2.9 million to 7.3 million tons, passing the level at which the railroads began in 1928. Again, however, slow steady growth in the railroad freight car stock brought its aggregate capacity up from 20.3 million tons in 1950 to 40.2 million in 1963. Soviet railroads still dispose of more than five times the freight-carrying capacity available in trucks.

Freight-carrying motor vehicles are owned and operated by many kinds of Soviet enterprises. Figure 10 indicates the trends since 1950 in the number of trucks at work in agriculture, the number operated by common-carrier trucking organizations, and the balance held by all other organizations. While common-carrier trucking has grown extremely rapidly and the number of trucks in agriculture has expanded steadily, the balance available for other uses has grown very slowly since the early 1950's. Trucks for common-carrier transport units have come from the fleets of other organizations as well as from new production, though annual details are not available. There is now considerable tension and rivalry for new trucks, as evidenced by a recent issue of the main Soviet auto-

FIGURE 9. *Total Freight-Carrying Capacity of Soviet Trucks and Railroad Freight Cars, 1928-40 and 1950-63*



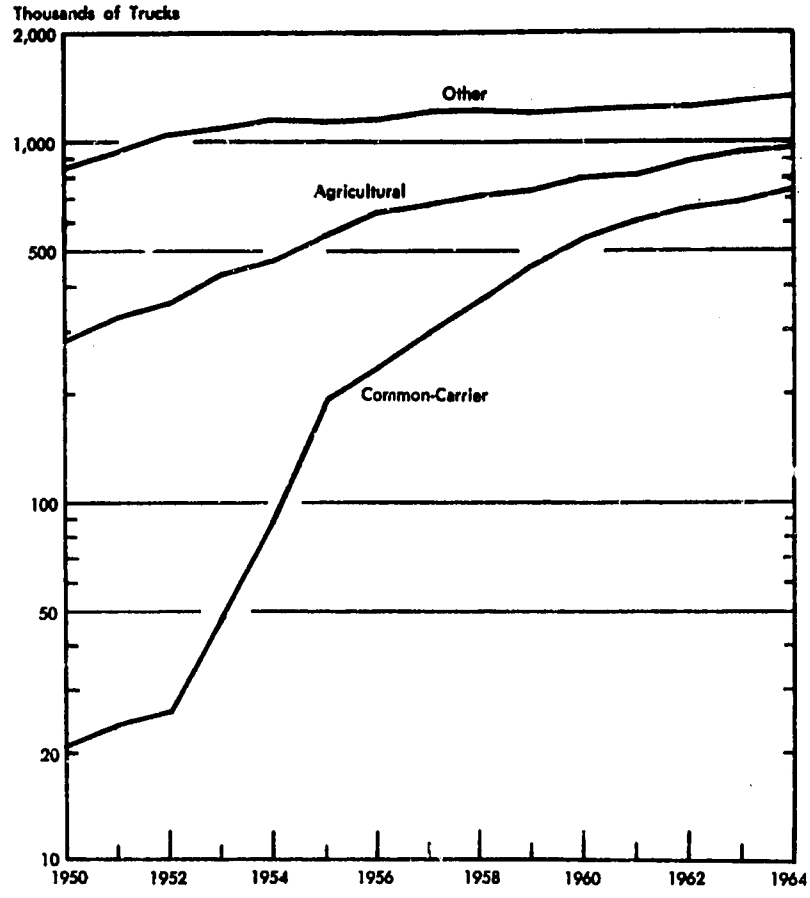
Source: Table C-11, App. C.

motive journal which warned that "in 1966 the deliveries of new trucks to common-carrier truck operators will be smaller than in 1965 because of an increase in their deliveries to agriculture. Some operators will not even be able to replace the trucks that are retired in accordance with very rigid norms for depreciation."[1]

The freight traffic carried by trucks has increased manyfold over the last twenty years, as the number of trucks has grown and the

[1] See *Avtomobil'nyi transport*, 1966, No. 3, p. 2.

FIGURE 10. *Estimated Number of Common-Carrier, Agricultural, and Other Trucks in the Soviet Union, 1950-64*

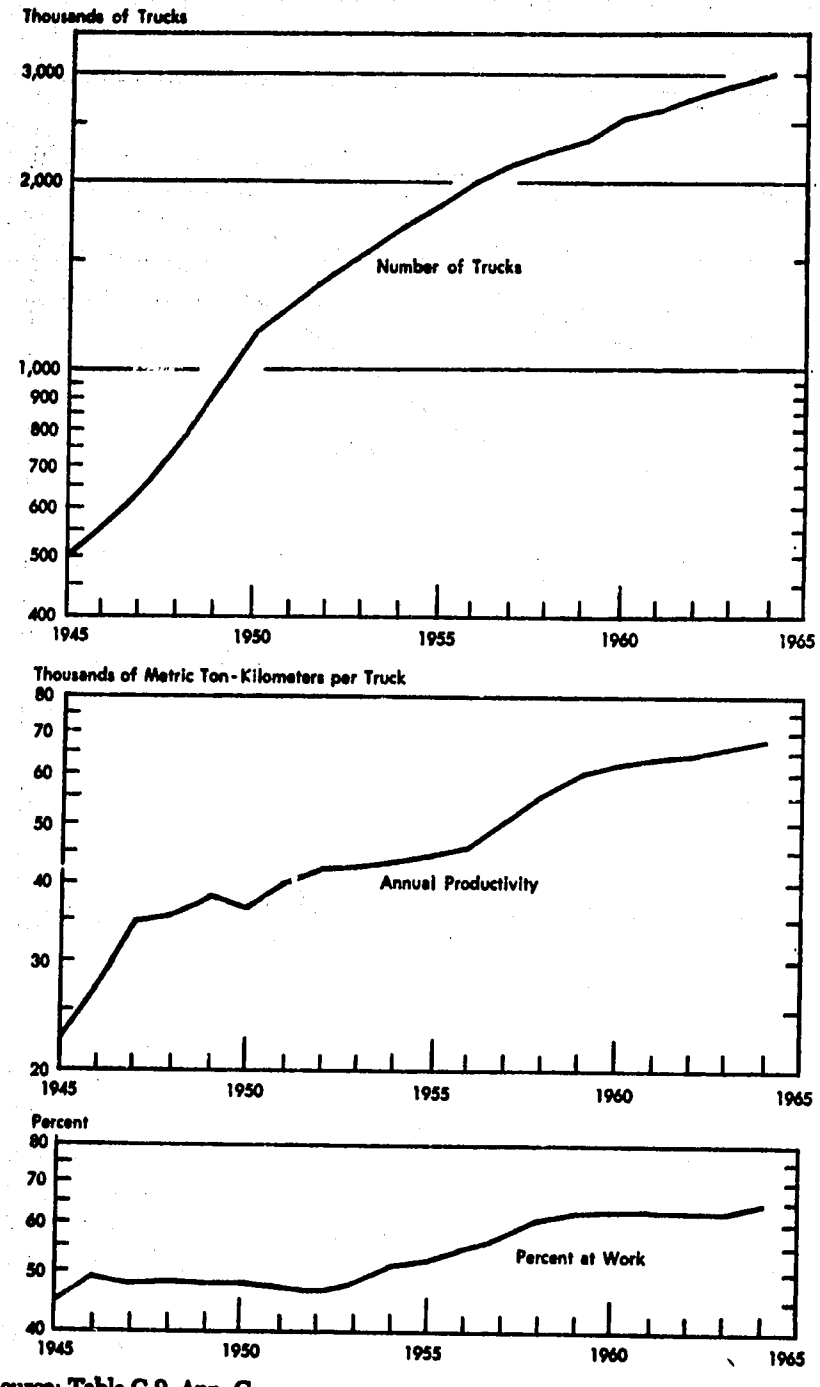


Source: Table C-8, App. C.

effectiveness of their use has improved. Figure 11 shows several trends at work. From 1945 through 1953, less than half the trucking fleet was in operation; the percentage at work varied from 45.0 to 49.0. From 1954 to 1959, repair and maintenance conditions improved steadily, bringing the average percentage of the fleet at work to more than 62 percent. This level persisted through 1963, and 1964 saw a 2-point gain, though more than a third of Soviet trucks, on the average, remain out of service.

Improvements in the organization of truck use, together with

FIGURE 11. *Number of Soviet Trucks, Percent at Work, and Annual Productivity, 1945-64*



Source: Table C-9, App. C.

modest gains in truck design and size, have led to notable gains in the annual ton-kilometers of freight carried by the average active truck. Annual gains from 1947 to 1956 raised the average truck's output from 35,000 to 45,000 ton-kilometers per year. During 1957-59, sharp gains brought this figure to 60,000 ton-kilometers; since then it has slowly risen to 68,000 ton-kilometers per truck in 1964.

The contribution of these performance improvements to the Soviet truck fleet's output has been outweighed, however, by a steady increase in the number of trucks, as Figure 11 shows clearly. It also shows that the rate of growth in the national fleet of trucks has steadily declined. The very high growth rate during postwar reconstruction dropped sharply after 1950 and (except for 1960) the annual growth rate has drifted downward ever since.

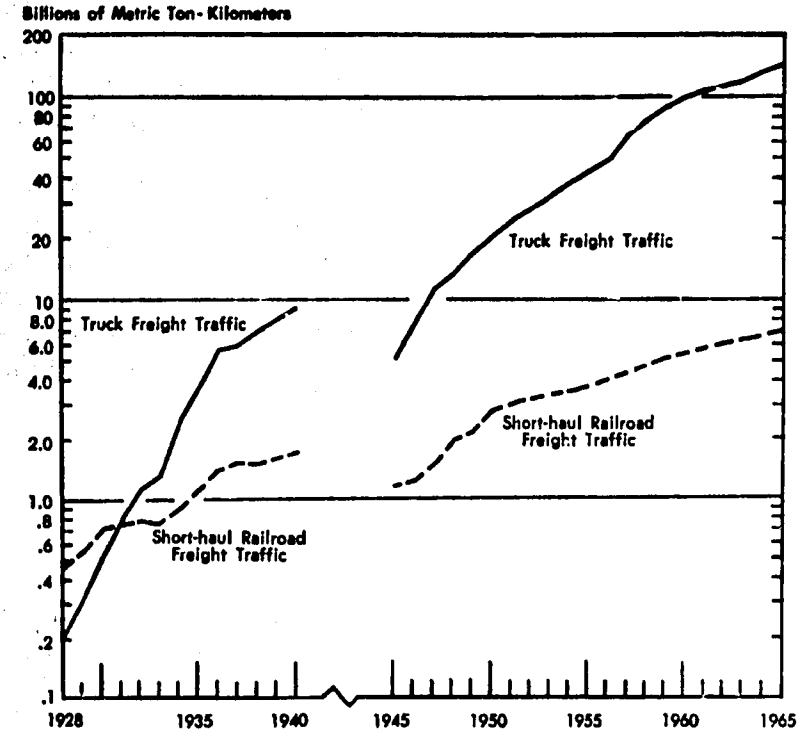
Growth of Truck Freight Traffic

In Figure 12 the growth of truck freight traffic since 1928 is displayed. From 1928 to 1936 the infant industry raised its output from 200 million to 5.5 billion ton-kilometers of annual movement. From 1936 through 1940, the growth rate fell off sharply, reflecting the strains imposed on the economy by the purges. After rapid postwar recovery, a strong growth rate persisted from 1947 through 1956 and even speeded up in 1957-58. Since 1959, however, truck traffic has grown more slowly, presumably in response to the reduced growth rates that have characterized the economy generally.

Traffic growth has been almost fully due to growth in the number of tons shipped; the average length of haul for Soviet truck shipment has increased very slowly. Postwar recovery during 1945-48 produced slightly longer hauls, but with industrial recovery the prewar pattern of extremely short hauls reestablished itself, and even the appearance in recent years of a very small volume of intercity movement has not brought the average haul outside a local cartage range.

Comparison of this short-haul Soviet truck traffic with the volume of short-haul railroad traffic is instructive. Figure 12 presents

FIGURE 12. *Total Soviet Motor Vehicle and Short-haul Railroad Freight Traffic, 1928-40 and 1945-65*



Source: Table C-10, App. C.

crude estimates for the annual volume of railroad freight ton-kilometers generated by shipments made for distances up to 50 kilometers. Around 1930 this short-haul railroad traffic, with an average length of haul around 24 kilometers, was larger than the traffic carried by the infant trucking industry, but by 1940 the Soviet trucking fleet was already carrying six times as much short-haul traffic (defined this way) as the railroads were handling. In the postwar period, railroad short-haul traffic has continued to grow steadily, from something like 1.17 billion ton-kilometers in 1945 to 7 billion in 1965, but truck freight over the same period has risen from 5 billion to 143 billion ton-kilometers. It is clear that the Soviet trucking industry has now reached a scale of operations that would permit it to take over this railroad short-haul freight if the

TABLE 13. *Soviet Motor Vehicle Freight Shipments in 1958, by Sector and Owning Organization*[a]

(In millions of metric tons)

Owning Organization	Sector Served					
	Industry	Agriculture	Construction	Trade	Unspecified	Total
Common carrier truckers	372.6	157.7	529.0	81.7	—	1,141.0
Regional economic councils	1,972.2	—	882.0	—	—	2,854.2
Collective farms	—	952.2	—	—	—	952.2
State farms and repair technical stations	—	536.0	—	—	—	536.0
Transport construction enterprises	—	—	250.1	—	—	250.1
Fuel and power construction enterprises	—	—	234.7	—	—	234.7
Local Soviet organs	107.8	—	109.6	—	—	217.4
Construction ministries	—	—	133.5	—	—	133.5
Grain procurement ministries	—	41.1	—	—	—	41.1
Trade ministries and cooperatives	—	—	—	134.1	—	134.1
Unspecified	—	—	—	—	7.3	7.3
Total tons shipped	2,452.6	1,660.0	2,138.9	215.8	7.3	6,474.6
Millions of metric ton-kilometers carried	24,036	20,458	26,603	5,052	652	76,801

[a] Derived from Igor Aleksandrovich Verkhovskii, *Statistika avtomobil'nogo transporta* (1963), p. 78.

shift were required. Twenty years ago, or before World War II, this would not have been practicable.

The highly varied activities of the Soviet trucking industry make up a normal pattern of assistance to the major sectors of the economy. Industry, agriculture, construction, and trade are the major sectors that use trucks for freight shipments. Some 35 percent of all truck freight ton-kilometers involve the construction industry. Another 31 percent relate to shipments for industry. Agriculture accounts for 27 percent of the traffic, and retail trade the other 7 percent. Shipment data for 1958, set forth in Table 13, illustrate the pattern of truck use.

Less than a fifth of this traffic is handled by common-carrier trucking organizations. Most of the shipments in 1958 were carried in trucks owned by nontrucking organizations. In industry and construction, the regional economic councils that supervised industrial and construction activity in the U.S.S.R. from 1957 through 1964 handled a great deal of truck traffic with the trucks assigned to enterprises under their administration. In agriculture, most ship-

ments were made in trucks owned by collective farms and state farms.

Operating Problems in Truck Freight Shipments

The major organizational issue in Soviet trucking since 1951 has concerned the optimum pattern of administrative control. Soviet authorities are convinced that large truck fleets operating on a common-carrier basis have lower costs and are more productive than small scattered groups of trucks operated by nontrucking enterprises. They have therefore sought to corral a large fraction of the trucks owned and operated by nontransport enterprises into centralized fleets, available for use by many organizations in a given district. The purpose has been to increase the rate of utilization of trucks which otherwise would stand idle a large part of the time. As we saw above, the number of common-carrier trucks has indeed grown very rapidly since 1951. One can readily surmise, however, that truck users prefer to have their own trucks. Ready availability minimizes lost time. Direct control increases reliability and promotes firm scheduling. These are significant advantages for enterprises hard pressed to meet the demands placed on them. The cost of having partially idle trucks on hand can easily be outweighed by gains in all these other respects. I suspect that if large numbers of trucks were available for purchase, and nontrucking enterprises were free to buy them, large purchases would prove to be advantageous.

Another major problem is the coordination of road-rail shipments. Believing as they do that state ownership of all means of transport necessarily promotes their joint use, Soviet authorities have made steady efforts for thirty years to encourage and facilitate joint truck-rail shipments. The railroads have been eager to divest themselves of short-haul shipments, especially around major industrial centers, which they can handle only at relatively high costs. Movements from one plant siding to another in a congested railroad switching district tie up locomotives, line capacity, and railroad manpower in a bothersome way. Where carload lots of raw material or large-dimension items are involved, rail movement may

still be indicated. Prompt movement of small shipments, on the other hand, even though both shipper and receiver may have a railroad siding, is likely to be more expeditious by truck. The difficulty appears to be that Soviet trucking organizations lack the initiative and carrying capacity to take over all this traffic. In the absence of initiative from below, pressure from above is regularly brought to bear on all concerned. The desirability of shifting short-haul railroad traffic to trucks was pointed out before World War II by Lazar M. Kaganovich when he was the chief spokesman for the railroads. The Minister of Railroads has regularly mentioned the matter ever since. N. S. Khrushchev spoke sternly about the problem in 1957, and as recently as April 1966 the present Minister of Railroads, B. P. Beshchev, speaking at the Twenty-third Congress of the Party, called once more for further efforts to shift railroad short-haul traffic to trucks. He complained, moreover, that trucks were now frequently carrying shipments "for hundreds and even thousands of kilometers, as a result of which the state bears non-negligible costs." Later the chief of the Party Central Committee's transport and communication section wrote:

> Significant losses in automotive transport are caused by excessively long hauls of mass freight which is much more economically handled by rail or water. And such shipments are growing. Not infrequently trucks carry freight for up to a thousand kilometers, which is extremely unprofitable for the State. In 1965, intercity shipments by the RSFSR Truck and Road Ministry were 21.4 million tons, with an average haul of 163 kilometers. In the last five years, long-haul shipments have increased 2.8-fold.[2]

Joint shipments for long-distance movement take place whenever trucks deliver freight from a shipper to a railroad station or from a station to its final destination. These are ordinarily, however, distinctly separate movements on two different shipping documents. There is as yet very little truly joint movement under a single bill of lading. The Soviet economy makes practically no use to date of tractor-trailer combinations and so far has no trailer-on-flat-car traffic. Generally, road-rail coordination results from nondu-

[2] See the Twenty-third Congress Proceedings, translated in *Current Digest of the Soviet Press* (hereafter cited as *CDSP*), Vol. 18, No. 21 (June 15, 1966), p. 29, and *Ekonomicheskaia Gazeta*, 1966, No. 31 (August), p. 12.

plication. Long distance movement, as we have seen, is still overwhelmingly by rail. In outlying regions, like the forbidding territory in the far northeast above the Sea of Okhotsk, trucks may carry freight and people for several hundred kilometers, for example, between Magadan and the Kolyma gold fields. Occasionally an enterprising collective farm may send a truck full of produce overland to a distant city.

The problem of rate making has received relatively little attention in the Soviet Union. Because truck shipment costs in the U.S.S.R., like trucking costs everywhere, are much higher for long distance bulk movements than those of rail, pipeline, or water carriers, Soviet freight rates for truck shipments are generally far above those charged by the other carriers. On small shipments over short distances, total charges to the shipper, including transfer costs, may still be lower with truck service. Most trucking, as we have seen, is short-haul. But where convenience, speed of delivery, readiness of access, or other factors appear to justify the payment of high trucking charges for longer shipments, the demand for truck services appears to be growing.

From the beginning, Soviet policy has sought to establish trucking freight rates that will fully cover the operating costs of truck-operating agencies, including the cost of the trucks amortized to cover their service lives. The total sums spent on truck shipments now amount to about half the economy's total outlay on freight transport services. Prices for truck fuel, like those for gasoline, have long been deliberately kept high as part of an economywide high-price policy to discourage nonmilitary use of petroleum products. The tax revenues received have gone into general state budgets without being segregated and designated for road maintenance or construction. A tax of 2 percent on the operating income of motor vehicle transport organizations is specifically allocated to road maintenance and construction. In general, however, Soviet policy has attempted to hold trucking freight rates down to the level of truck operators' costs, and to reduce these costs. There has been no major effort to finance road construction through levying user charges that would take advantage of the great potential demand for road services.

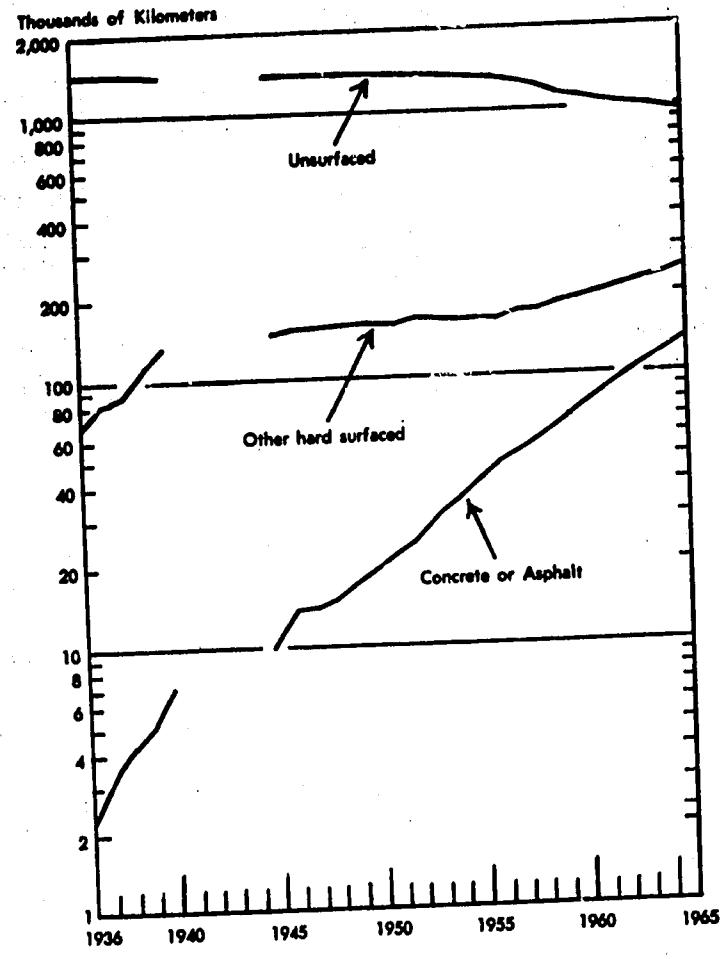
The Russian Problem of "Roadlessness"

In Russian history the problem of "roadlessness" is an old theme. For several weeks during the spring and again in the fall, rains make most roads impassable. Thousands of villages are cut off from the outside world. Rural Russia becomes a sea of mud. This general condition, long familiar in many other parts of the world, has not yet been fundamentally changed in rural areas of the U.S.S.R. In addition, large parts of Soviet territory are afflicted with extremely difficult winter transport conditions. Heavy snow drifts frequently block the roads in many areas. Permafrost conditions and poorly drained soil, as in Northern Canada, produce heaving and buckling of road surfaces as a result of freezing and thawing. These difficulties plague road maintenance in most parts of the country.

It has long been alleged that large portions of Russia suffered from a lack of road building materials, though the evidence is inconclusive. Even the black earth steppe regions of European Russia seem to contain fairly frequent gravel deposits and places where stone can be quarried. The average length of haul for railroad ballast is only 300 kilometers. Soviet cement plants are now widely scattered throughout the populated territory. Whatever the case in earlier times, the present ample availability of petroleum and its by-products should assist Soviet road builders from now on in developing various types of asphalt surfacing.

Ambitious programs for bringing an end to "roadlessness" have been on the Soviet agenda ever since the mid-1920's, but higher-priority objectives have kept accomplishments in this field far below intentions. Figure 13 shows how the total lengths of concrete and asphalt, other hard-surfaced roads, and unsurfaced roads have changed since 1936. The total length of all roads under local, regional, or national administration has not increased at all during the Soviet era, since construction of new roads has been more than offset by administrative abandonment of responsibility for maintenance of minor local roads. There has been slow growth in the

FIGURE 13. *Roads in the Soviet Union, by Type of Surface, 1936-40 and 1945-65*



Source: Table C-12, App. C.

length of roads with some form of hard surface, and within this, rapid and sustained growth in the small segment of the system that is paved with concrete or asphalt. Starting from practically nothing in 1928, the length of paved road reached 4,400 miles (mainly in and around Soviet cities) by 1940. Since 1945 it has more or less doubled every six years, and by the end of 1965 the national total had reached 82,000 miles. This was the mileage of concrete and asphalt

highway in the United States about 1920.[3] While the growth of paved road in the Soviet Union has been rapid, there is clearly a vast job still to be done.

If the total length of Soviet roads is compared with the total area of the country, an exceedingly low ratio results, but it is a misleading one. Three-quarters of the population lives in one-quarter of Soviet territory. Forty-seven percent of the U.S.S.R. is subject to permafrost. Millions of square kilometers of arctic tundra, Siberian tiaga, and mountainous territory in the far northeast are unlikely to be settled, at least in the next half century or so. These regions have very little need for roads. The need for new road construction is therefore far smaller than might otherwise appear to be the case. Even in old settled territory, though many additional roads will eventually be desirable, one can surmise that all the key mileage already exists. The present task consists, mainly, in improving the surfaces of existing roads, bringing them to all-weather standards, and thus reducing the costs of moving freight and passengers along them. Perhaps interregional highways that bypass old towns and cities will prove desirable even before old roads become congested, but this prospect too lies a good many years in the future.

Additional detail on types of road surface in the U.S.S.R. and on levels of administrative responsibility for road maintenance are displayed in Table 14, showing the situation in 1960. It tells a melancholy tale. The bleakness of the story stands out more starkly by contrast with the situation in the United States. Table 15 presents American data for 1963, converted into kilometers, and consolidated Soviet data for 1960. Classification of administrative levels and surface types for comparability is not easy, but broad categories bring out several important differences. The total length of roads in the United States under all forms of public authority was 5.8 million kilometers; in the U.S.S.R. it was 1.4 million. Of this total, 3.2 percent was paved with concrete in the United States; in the U.S.S.R., 0.3 percent. More than a third of the U.S. total was paved with asphalt, compared with less than 2 percent in the

[3] The first national breakdown reports 25,523 miles of paved and 87,609 miles of macadam (that is, asphalt) roads on January 1, 1922. See U.S. Department of Commerce, *Statistical Abstract of the United States, 1923* (Washington, 1924), p. 373.

TABLE 14. *Soviet Roads, by Type of Surface, Under Various Administrative Levels of Control, 1960*[a]
(In kilometers)

Type of Road	National	Republic	Regional	Local	Total
Hard-surfaced					
Concrete	2,490	140	250	100	2,980
Asphalt	13,270	5,060	1,870	1,120	21,320
Oiled gravel or crushed stone	26,780	18,350	4,690	3,010	52,830
Nonoiled crushed stone or slag	2,220	6,210	6,170	12,130	26,730
Bridges	3,890	12,380	11,120	15,930	43,320
Nonoiled gravel	12,870	29,890	19,000	61,900	123,660
Total	61,520	72,030	43,100	94,190	270,840
Unsurfaced					
Graded dirt	990	24,640	41,660	264,240	331,530
Improved dirt	5,360	25,630	18,950	120,460	170,430
Natural dirt	1,780	18,700	13,870	536,500	570,850
Other	—	820	1,730	19,350	21,900
Total	8,130	69,820	76,210	940,550	1,094,710
Total all administered roads	69,650	141,850	119,310	1,034,740	1,365,550

[a] Taken, with retotaling and correction of one misprinting, from Verkhovskii, *Statistika avtomobil'nogo transporta*, p. 267.

U.S.S.R. One-quarter of U.S. roads were still unsurfaced in 1963, but—within a much smaller absolute total—four-fifths of Soviet roads in 1960 remained unsurfaced.

There appears to be formal similarity between Soviet and United States allocation of road administration responsibility among national, regional, and local levels. If one considers the oblast within the R.S.F.S.R. (Russian Soviet Federated Socialist Republic), together with the constituent republic outside the R.S.F.S.R., as an administratively intermediate unit like the states in the United States, and if one combines United States local and county levels to match the Soviet "local" category, the percentages indicated in Table 15 result. Roughly three-quarters of the administrative control over roads in each country lies at the local level. About 20 percent rests at an intermediate level, and only 5 percent or less of the road system in each country is under exclusively national control.

TABLE 15. *Roads in the Soviet Union (1960) and the United States (1963), by Type of Surface and Level of Administrative Responsibility*[a]

Item	Kilometers		Percentages	
	Soviet Union	United States	Soviet Union	United States
Type of Surface				
Concrete	3,543	183,101	0.3	3.2
Asphalt	25,392	2,016,648	1.9	34.6
Other Surfaced	241,905	2,133,341	17.7	36.6
Unsurfaced	1,094,710	1,492,225	80.1	25.6
Total	1,365,550	5,825,315	100.0	100.0
Level of Administration				
National	69,650	195,368	5.1	3.4
Regional	261,160	1,185,452	19.1	20.3
Local	1,034,740	4,444,495	75.8	76.3
Total	1,365,550	5,825,315	100.0	100.0

[a] Soviet data are from Verkhovskii, *Statistika avtomobil'nogo transporta*, p. 267. The U.S. figures are consolidated and converted to kilometers from data in U.S. Department of Commerce, Bureau of Public Roads, *Highway Statistics 1963* (Government Printing Office, 1965), p. 117.

The financing of Soviet road construction and maintenance is, roughly speaking, a somewhat similar three-level affair. Perhaps a fifth of the funds allocated to road maintenance and construction comes through the national budget; these funds go mainly to roads of national importance. Roads of intermediate importance are maintained and built with funds allocated through budgets of the constituent republics. Most of these funds come from the 2 percent tax levied on trucking agencies. The vast bulk of the maintenance, however, and even some of the new construction, is paid for in kind through the contributions in kind required of rural people. Such local road maintenance obligations have of course been important in United States rural areas down to quite recent times. In the U.S.S.R. a detailed decree of 1936 called for six days of labor annually from collective farm members (12 days from a few persecuted individual peasants), together with their teams and equipment. In November 1958, regulations were changed to extend the obligations to all nonfarm enterprises outside cities, but also permitted organizations to substitute money payments for contribu-

tions of equipment or labor services in kind. New road construction is sometimes carried out as a "people's project," in which volunteers from a whole region are organized during an off season for a crash program to build a particular new road.

Three hundred years of American experience attest both to the great importance of roads for economic development and to the practical feasibility of enlisting local efforts for their construction. Where tangible benefits reach the local resident as a direct result of his efforts, and where tradition fortifies expectations, voluntary contribution of labor and equipment has proved to be an effective means of building and maintaining roads.

The persistence of Russian "roadlessness" may well reflect inadequate incentives for the rural population to build and maintain good roads. Certainly until 1953 the Soviet regime slighted the agricultural sector of the economy and all those who lived in it. It was part and parcel of Stalinist policy to restrict the incentives that might have called forth vigorous efforts from the rural population in road maintenance and construction.

Now that Soviet authorities are putting major stress on improving the agricultural sector, it seems clear that greatly increased attention should be given to the improvement of existing roads and the construction of new farm-to-market roads. Contributions in kind, of both manpower and equipment, may still be useful if the rural public is persuaded that the benefits will accrue to them. If road construction agencies with adequate equipment are locally available, and able to take on the assignment, the gain in quality of construction and maintenance would perhaps justify the levying of local assessments.

For surfacing interregional roads, full-time construction efforts by the already-existing road construction agencies could be greatly expanded. But whoever does the work, the point is that more road building is needed. The chief planner of the automobile production ministry, discussing prospects for the industry under the new Five Year Plan, pointed out that "operation of trucks on poor roads lowers their average speed and productivity by 35-45%, raises fuel consumption by 20-40%, and reduces the mileage for major repairs and the length of tire life by 40-50%, which at present costs

the government almost 2.5 billion rubles a year."[4] Logic suggests that if additional outlays on road improvement are offset by equivalent reductions in these costs, the net expenditure imposed on the economy would be zero.

Yet the first outlines of the new Five Year Plan have not shown sufficient appreciation of what needs to be done for Russian roads, and a few persons are concerned. U.S.S.R. Supreme Soviet Deputy V. Klauson, writing in *Izvestia* in July 1966, noted that the length of paved roads was slated to rise by "only 17% to 18%. This is not enough."[5] He called for substantially increased allocations to road construction and maintenance, arguing that this would reduce large current losses, which he painted in even stronger colors than the automotive planner had. Will the authorities respond?

[4] See S. Matveev, in *Planovoe Khoziaistvo*, 1966, No. 7, p. 30.

[5] See the translated condensed text in *CDSP*, Vol. 18, No. 30 (Aug. 17, 1966), pp. 31-32.

CHAPTER VI

Passenger Transport in the Soviet Union

THOUGH SOVIET POLICY since 1928 has focused mainly on moving goods rather than people, Soviet railroads and other passenger carriers have performed impressively in meeting the need for passenger transportation. In this chapter, their performance as suppliers of intercity and urban transport services is briefly described. Most of the chapter, however, deals with the automobile. Until recently, the passenger automobile has not figured significantly in Soviet passenger transport, but its proper role is becoming a major issue in Soviet society. Now that the U.S.S.R. is entering the age of the passenger automobile, its policy makers confront all the great problems and opportunities that Western experience has made familiar. There is thus considerable interest in examining Soviet practice and intentions toward the passenger car.

Role of the Major Passenger Carriers

Table 16 shows how the major carriers have shared in providing intercity passenger service since 1928. At the beginning of the plan era, the railroads accounted for 93 percent of all intercity passenger-kilometers. Their share in 1965 was still 66 percent, but the absolute level of railroad intercity passenger traffic appears to be reaching a peak. Three decades ago, when motor vehicle transport was in its infancy and civil air transport was just being born, river and sea vessels accounted for most of the nonrail passenger car-

TABLE 16. *Intercity Passenger Traffic in the Soviet Union, by Carrier, Selected Years, 1928–65*[a]

Year	Billions of Passenger-Kilometers					Population (Millions)	Annual Passenger-Kilometers Per Capita
	Railroad	Autobus	Water	Air	Total		
1928	20.7	—	2.4	—	23.1	—	—
1932	66.9	—	5.5	—	72.4	—	—
1937	69.5	—	4.1	0.1	73.7	—	—
1940	73.3	—	4.7	0.2	78.2	194.1	403
1950	66.8	1.4	3.9	1.2	73.3	178.5	411
1951	73.4		4.1			181.6	—
1952	79.6	1.9	4.2	1.7	87.4	184.8	473
1953	89.4	2.6	4.8	—	—	188.0	—
1954	98.9	3.2	4.9	—	—	191.0	—
1955	109.1	5.5	5.1	2.8	122.5	194.4	630
1956	109.9	7.2	4.9	3.1	125.1	197.9	632
1957	118.7	9.7	5.2	4.1	137.1	201.4	681
1958	121.6	12.3	5.4	6.4	145.7	204.9	711
1959	126.0	14.7	5.5	9.1	155.3	208.8	744
1960	130.1	17.6	5.6	12.1	165.4	212.3	779
1961	134.3	19.3	5.7	16.4	175.7	216.2	813
1962	145.2	23.1	5.9	20.3	194.5	219.8	885
1963	145.2	26.8	6.1	25.3	203.4	223.2	911
1964	144.9	29.4	6.0	30.9	211.2	226.4	933
1965	150.0	33.3	6.4	33.1	227.8	229.3	993

[a] Sources: The traffic data are compiled by subtracting intercity traffic from total traffic figures presented in Tsentral'noe Statisticheskoe Upravlenie (referred to hereafter as TsSU), *Transport i sviaz' SSSR: statisticheskii sbornik* (1957), pp. 12, 41, 175, for the pre-1950 data, and *ibid.* (1967), pp. 28, 105, and 255 for the 1950–65 figures. The population data are from TsSU, *Narodnoe khoziaistvo SSSR v 1965 g.* (1966), p. 7, and the figures in column 7 are ratios of column 5 over column 6.

riage. Recently, however, intercity bus transport has grown very rapidly; its share of all public transport has risen from 2 percent in 1950 to 15 percent in 1965. River and sea carriers, by contrast, have seen their share of passenger traffic fall from 5 percent to less than 3 percent; here, too, the volume appears to be leveling off. Intercity air passenger traffic has grown very rapidly from 1.2 billion pas-

senger-kilometers in 1950 to 38.1 billion in 1965. Aircraft now account for a larger volume of intercity passenger-kilometers than buses do.

It will be noted that intercity movement by passenger automobile is not covered in Table 16. Its present very modest level is not yet estimated by Soviet statisticians. Passenger travel in trucks is likewise excluded, as is all urban passenger movement.

In general, the public transport system has managed to supply a slowly growing population with its approved travel requirements, though Soviet citizens enjoy a far smaller annual volume of travel than prevails in Western Europe or North America. Overcrowded and slow services in the prewar period have gradually given way in recent years to services that are usually fairly efficient, up to date, and comfortable. The authorities have not so far found it necessary to increase markedly the allocation of resources to intercity passenger travel, even though complaints about inadequate service and stock appear from time to time in the Soviet press.

On the basis of this experience, Soviet authorities have anticipated that buses will handle an increasing volume of short and intermediate passenger trips around and between Soviet cities, especially where rail service is sparse or nonexistent. River and sea passenger travel is increasingly a matter of recreation, on holidays and vacations, rather than a regular means of commutation or business or migratory movement. Soviet planners expect long distance passenger travel to be handled primarily by Aeroflot, the nationwide civil air service. In the official vision, the Soviet Union will thus leap over the whole era of irrational congestion produced in the West by the private passenger automobile. After looking briefly at the urban transport picture, we shall need to examine this vision with some care.

Urban passenger traffic in the U.S.S.R. has grown rapidly since 1928, reflecting the rapid growth of the urban population. During the prewar period, commutation railroad passenger traffic accounted for some 40-48 percent of urban passenger-kilometers, though after 1932 the role of other urban carriers expanded at the expense of the railroads.[1] Since 1950, the volume of Soviet urban

[1] See Holland Hunter, *Soviet Transportation Policy* (Harvard University Press, 1957), pp. 186 and 361.

TABLE 17. *Urban Passenger Traffic in the Soviet Union, by Carrier, 1950–65*[a]

Year	Millions of Passengers Carried						Urban Population (Millions)	Annual Trips per Urbanite
	Autobus	Tramway	Trolley-Bus	Commutation Railroad	Subway	Five-Carrier Total		
1950	1,001	5,157	945	955	629	8,687	69.4	125
1951	—	—	—	1,101	—	—	73.0	—
1952	1,774	5,612	1,229	1,218	739	10,572	76.8	138
1953	2,289	—	—	1,275	—	—	80.2	—
1954	3,082	—	—	1,338	—	—	83.6	—
1955	4,294	6,367	1,858	1,392	937	14,848	86.3	172
1956	5,201	6,416	2,082	1,414	996	16,109	88.2	183
1957	6,476	6,812	2,392	1,506	1,015	18,201	91.4	199
1958	7,931	7,195	2,672	1,583	1,068	20,449	95.6	214
1959	9,113	7,450	2,805	1,635	1,093	22,096	100.0	220
1960	10,634	7,842	3,055	1,713	1,148	24,392	103.8	235
1961	11,113	7,780	3,159	1,726	1,233	24,991	106.3	231
1962	12,651	7,957	3,353	1,791	1,301	27,033	111.8	242
1963	14,360	7,990	3,580	1,891	1,441	29,262	115.1	254
1964	15,969	8,221	3,947	2,001	1,569	31,707	118.5	268
1965	17,517	8,239	4,293	2,049	1,652	33,750	121.7	277

[a] Compiled from TsSU, *Transporti sviaz' SSSR* (1957), pp. 41, 184; *Narkhoz '58*, p. 588; *Narkhoz '59*, pp. 495, 529; *Narkhoz '60*, pp. 538, 565, 573; *Narkhoz '62*, pp. 385, 415, 421; *Narkhoz '64*, pp. 437, 493, and 499; and *Narkhoz '65*, pp. 7, 492, 503, and 509. Column 8 is column 6 over column 7.

passenger traffic, measured by the number of passengers carried, has grown almost fourfold. Though the urban population has grown by 75 percent, annual trips per urban resident have more than doubled. Before the war and up to the early 1950's, the principal nonrail urban carrier was the streetcar; in 1950, it still carried 59 percent of the urban passengers. By 1965, however, streetcars were accounting for only 24 percent of the urban passenger trips. The shift was to autobuses, whose share rose from 12 percent in 1950 to 52 percent in 1965. The share of rail commutation traffic by 1965 had fallen to 6 percent of urban passenger trips (though the fraction would be somewhat higher as a share of passenger-kilometers, since rail commutation trips are perhaps four times as long as nonrail urban trips).

The data of Table 17 exclude urban movement in taxis and passenger automobiles, as well as movement by motorcycle, bicycle, and on foot. Though the indicated annual number of trips per

urban resident is therefore understated, the data nevertheless accurately convey a sense of the restricted mobility enjoyed by the average Soviet urban citizen. By comparison with the people of Tokyo, London, or New York, the Russian city-dweller is still relatively confined in his movements.

The most dramatic early development in Soviet urban transport was the building of the Moscow subway in the 1930's. It was one of the key symbols of Soviet modernization, employed to sustain and encourage the Russian people during a stern era of belt tightening. Lazar Moiseevich Kaganovich and Nikita Sergeevich Khrushchev were among the young Stalinist leaders who came to prominence with its construction. The emphasis in the subway was on beauty. Each station was conceived as representing one part of the country, or as a display of one form of building material. When the subway opened on May 15, 1935, it was 11.4 kilometers (7 miles) long, and by the end of 1938 it had been extended to a route distance of 26.5 kilometers (16.5 miles).[2]

Postwar construction has now brought the Moscow subway to a total route length of over 100 kilometers; it currently carries about a billion passengers per year. A 10.8-kilometer subway was opened in Leningrad in 1955, and a 6-kilometer subway line began service in Kiev in November 1960.[3] In spite of this continued subway construction, the share of national urban passenger traffic handled by subways has fallen from 7 percent in 1950 to 5 percent in 1965. Both traffic growth outside the three subway cities and spreading travel patterns within these cities themselves must account for this relative decline.

The Passenger Car Situation in 1928

When the era of five year plans began in 1928, there were in the U.S.S.R. something over 16,000 motor vehicles, of which 7,500 were passenger cars, 7,900 trucks, and 1,100 buses. Even at that time, the Soviet Union was distinguished among all the countries

[2] For further details, see Hunter, *op. cit.*, p. 187.

[3] See *Pravda Ukrainy*, Nov. 5, 1960, trans. in *Current Digest of the Soviet Press* (hereafter cited as *CDSP*), Vol. 12, No. 45 (Dec. 7, 1960), p. 29.

of the world by the fact that its trucks and buses outnumbered its passenger cars. The government published a careful study in 1929 placing its automobile situation in an international context and, among other things, presenting a table for world motor vehicle ownership at the beginning of 1928, covering 39 countries. In all but the U.S.S.R., passenger automobiles outnumbered trucks.

On the eve of World War I, Russia had had 7,300 passenger cars and over 1,500 trucks, but by 1922 the number of passenger cars had fallen to 5,600 while almost 5,000 of the trucks and special vehicles that had been imported for wartime needs remained. The new regime added little to the passenger car stock thereafter, but even during the recovery period it imported almost 3,000 trucks and other special purpose vehicles like fire engines.

It is thus evident that, from the start, the Soviet regime saw motor vehicles primarily in functional terms. This view, as we shall see, was to prevail for the next thirty years.

Along with electrification, tractorization, and other glamorous visions for the rapid industrialization of the U.S.S.R., "automobilization" achieved a considerable amount of publicity.[4] The term did not refer, of course, to the self-organizing of individuals, but to the spread of automobiles throughout the Soviet economy. Moreover, it did not focus on passenger cars for the general public, but (as noted in Chapter 5) on the substitution of trucks for horses and carts in agriculture and in local cartage around cities and industrial centers.[5]

The early planners also presented ambitious programs for the paving of existing roads and for expansion of the road network. As we have seen, the problem of "roadlessness" had plagued Russia for centuries. Spring and fall rains made the typical dirt road im-

[4] The mood of the day is illustrated by Stalin's November 7, 1929, speech, "Year of the Great Change," in the following passage: "We are becoming a country of metal, a country of automobilization, a country of tractorization. And when we put the U.S.S.R. in an automobile and the peasant on a tractor—then let the worthy capitalists who boast of their 'civilization' try to catch up with us. Then we shall see which countries can be 'defined' as backward and which as advanced." *Voprosy leninizma* (1933), p. 441. Place of publication of all Russian language titles is Moscow, unless otherwise noted.

[5] For details, from a prolific writer on this topic, see N. Osinskii (Valerian Valerianovich Obolenski), *Avtomobilizatsia SSSR: statei, ocherki, rechi, 1927-1929* (1930). See also M. L. Sorokin, *Za avtomobilizatsiiu SSSR* (1928).

passable and isolated thousands of localities for several weeks each year. The strongly pronounced seasonal pattern of Russian economic life, with its winter low and frantic summer peak, reflected in no small part the lack of an all-weather highway system.

Road building related mainly, however, to the life of villages and towns, that is, to the agricultural sector of the economy, since mining and manufacturing centers were in general linked together by the railroad network. Thus expansion of the road system was closely tied to the fate of Soviet agriculture, and as we have seen, agriculture under Stalin had very low priority. It is not surprising, then, that investments in road building during the plan era have been modest.

Automobile Production under Five Year Plans

As will be shown shortly, the stock of passenger cars in the U.S.S.R. rose from 7,500 at the end of 1928 to 100,000 at the end of 1940. The absolute growth was modest, though it represented a fifteenfold expansion. Most of the additional cars were domestically produced, at a Ford-built plant in Gorky, at a large plant in Moscow, or in one of a few other small, special-purpose factories. All but a few were owned by state or Party organizations, and used by responsible officials in furtherance of their work. Cars were not in general available for purchase by private citizens, few of whom in any case would have been able to afford them. This spartan approach to the passenger automobile necessarily continued through the difficult years of war and postwar recovery into the mid-1950's. By this time, the Soviet stock of passenger automobiles had reached about half a million for a population of almost 200 million. The 1955 registrations of passenger automobiles in the United States totaled 52 million for a population of 165 million.

The thousands of passenger automobiles that were produced in the U.S.S.R. after 1930 became valued perquisites attached to the upper positions in Soviet and Party organizations. Plant managers, district Party secretaries, heads of research institutes, etc., had cars and chauffeurs assigned to them for the performance of their official duties. Occasional criticism arose if the officials (or their wives) used such cars for personal errands, but it would seem that

the authorities considered cars to be devices deliberately employed as inducements and rewards for service.

The post-Stalin opening up of Soviet contact with the West brought the problem of the passenger automobile increasingly to the attention of Soviet leaders. Early Soviet visitors to Western Europe and the United States were staggered by the number of cars they saw. Some suspected deliberately engineered plots to fool them about the number of cars "the workers" owned. Were their hosts setting up "Potemkin villages" at the places they visited?

By the fall of 1959, when N. S. Khrushchev visited the United States, Soviet authorities were ready to try a new approach. The need for it evidently crystallized in Khrushchev's mind as a result of what he saw on his trip. Near the end of the visit, when he was leaving San Francisco, Mayor Christopher escorted him to the airport by way of the great, handsome San Francisco Freeway. They were bucking the incoming morning rush hour traffic. Khrushchev apparently watched the stream of individual cars go by, generally with one passenger per car, and finally exclaimed that it was irrational. Mayor Christopher evidently conceded diplomatically that large numbers of private cars had indeed created large traffic problems in our big cities. The experience seems to have made a profound impression on Khrushchev.

In early October, when Khrushchev stopped in Vladivostok after a conference in Peking, his long rambling speech to the assembled citizens of the city included the following passage:

> Americans have now begun to point out more often that they have far more automobiles than the Soviet Union. America really does have a lot of cars. But it is not at all our aim to compete with the Americans in the production of large numbers of automobiles. We are developing and will continue to develop automobile production, but not the way the Americans are doing it.
>
> We will turn out a lot of cars, but not now. We want to establish a system for the use of automobiles that will differ from the one in capitalist countries, where people reason on the principle: "The car may be lousy, but it's my own." We will make more rational use of automobiles than the Americans do. We will develop public taxi pools on an ever broader scale; people will get cars from them for necessary trips. Why should a man have to worry about where to park his car, why should he have to bother with it? Such a system will meet

people's needs better and accord with the interests of society as a whole and of each citizen individually.[6]

The phrase "taxi pool" does not accurately convey the meaning of the new proposal. In practice it proved to be a car-rental scheme, in which each major city would have a small fleet of rental vehicles, available from an agency of the municipality itself (no "No. 2's" in the U.S.S.R.). As we shall see, the scheme has not worked well.

Khrushchev's efforts to contain the pressures for more passenger automobiles now appear to have been publicly repudiated by his successors. The U.S.S.R. has finally, for better or worse, stepped across the threshold of the automobile age, and for the rest of this chapter we shall discuss the resulting problems and prospects. To begin with, how many cars do the Russians have?

Current Stock of Automobiles

Soviet data on domestic production, exports, and imports of passenger automobiles permit estimation of the total national stock and its changes over the period from 1928 to 1964, given various assumptions about probable rates of attrition. Table 18 presents four alternative estimates applying straight-line depreciation rates which assume that Soviet passenger cars last 30, 25, 20, or 15 years. They imply that, by the end of 1964, there were somewhere between 880,000 and 1,240,000 passenger cars in the U.S.S.R. For a country of 233 million people, this is a very small stock of passenger vehicles. The ratio of total population to total automobile registrations in the United States is now about 2.7 to 1. In West Germany, France, and the United Kingdom, the ratio is about 6 to 1; in Italy, about 9 to 1; and in Japan, about 14 to 1.[7] The Soviet ratio is at present more than 200 to 1. Even this limited stock of Soviet passenger automobiles is mainly in the hands of state organizations rather than private citizens. Something like a fifth of the existing

[6] See *Pravda*, Oct. 8, 1959, trans. in *CDSP*, Vol. 11, No. 40 (Nov. 4, 1959), p. 3.

[7] These ratios reflect one-year updating of the figures for the end of 1964 presented in U.S. Department of Commerce, Business and Defense Services Administration, *World Motor Vehicle Production and Registration, 1964-65* (Government Printing Office, January 1966), p. 4.

stock is out of service, awaiting repairs. Thus, there are approximately 500 people for every car in unrestricted, private use in the U.S.S.R.

In this respect, therefore, the difference between automobile availability in Soviet and American societies is not on the order of one to ten, but something under one to a hundred. It requires a drastic wrench of the understanding to appreciate the contrast. A casual Western visitor to the Soviet Union is unlikely to appreciate the magnitude of this disparity. In Moscow and other cities on the Intourist circuit, one rides in cars and sees many cars on the streets. Somehow their relative scarcity is not made vivid, though one does notice that they are outnumbered by trucks. Presumably in the vast stretches of the hinterland, and in smaller cities and towns seldom visited by Westerners, the paucity of passenger automobiles would be more apparent.

The present nationwide stock of about one million passenger automobiles has not been growing rapidly, as the estimates of Table 18 make clear. Annual production has recently reached 200,000

TABLE 18. *Estimated Stocks of Passenger Automobiles in the Soviet Union, Selected Years, 1928–64, Under Alternative Assumed Rates of Attrition*[a]
(In thousands of automobiles)

Year	Attrition Rate			
	3.3%	4.0%	5.0%	6.7%
1928	7.5	7.5	7.5	7.5
1940	117.6	113.8	108.1	98.6
1945	100.0	100.0	100.0	100.0
1950	225.3	220.8	214.4	203.7
1955	543.7	526.1	500.9	459.0
1960	887.8	842.0	776.6	667.6
1961	969.0	915.5	839.1	718.3
1962	1,056.5	994.4	905.8	771.8
1963	1,151.0	1,079.5	977.3	828.6
1964	1,244.1	1,162.2	1,045.1	880.7

[a] Derived by applying indicated attrition rates to the annual number of passenger motor vehicles produced in the U.S.S.R., plus imports minus exports.

units, of which some 40,000 are exported, primarily to East European countries. Taking account of normal depreciation, net additions to the national stock are currently in the neighborhood of 75,000 units a year. Compared with growth rates in Western Europe and Japan, to say nothing of North America, this is an exceedingly modest level of growth. The Soviet Union, as the second industrial power of the world, has obviously been pursuing a radically restrictive policy toward the passenger automobile.

The slender stock of passenger automobiles is supported by an equally underdeveloped supporting base of paved roads, filling stations, and garages. The main streets of cities are paved, but even in Moscow the back streets can be very hard to navigate. Major interregional highways are hard-surfaced and often paved, though year-round maintenance in so northern a territory presents many problems. A *Pravda* story in the fall of 1963 indicated that the total number of filling stations for the entire country was around fifteen or sixteen hundred.[8] Servicing and repair facilities are even more scarce.

The rare possessor of a private automobile therefore faces many frustrations. Garages work under plans that make them reluctant to take on minor servicing jobs, since major overhauls and replacements contribute more effectively to plan fulfilment. Complaints indicate that spare parts are frequently not available. Filling stations sometimes do not have supplies of gasoline, or they observe limited hours of business. All of this reflects the low priority that has been assigned by the authorities to the private passenger automobile in the Soviet economy. For example, six years ago in Frunze, a regional capital of 250,000 people, there were fourteen hundred individual cars and fifteen hundred motorcycles, but only a single filling station! Car owners obtained gasoline illegally from truck drivers or through other devious channels.[9] A few years earlier, in a novel celebrating postwar progress, part of the story involved a happy vacation trip on the newly paved highway from Moscow south all the way to the Crimea. Dramatic tension was provided intermittently as the vacationers faced a recurring crisis. It was not whether the next motel would have an empty room, with or without swimming pool, but whether the filling station said

[8] *CDSP*, Vol. 15, No. 36 (Oct. 2, 1963), p. 24.
[9] *CDSP*, Vol. 12, No. 16 (May 18, 1960), pp. 24-25.

to be in the next city would have any gas! Gas is gratefully purchased in the U.S.S.R., even without trading stamps.

Illegal transactions in gas led the authorities in July 1965 to initiate a system under which gas was sold *only* for "trading stamps" (that is, special coupons) issued for cash at government offices. New coupons were to be issued only if the mileage shown on the purchaser's car mileage indicator was consistent with his previous records and gas purchases. The scheme was designed to thwart illegal gas purchases, from truck drivers mainly; but a March 1966 Moscow news story indicated that attempts to enforce it had led to much red tape and confusion. The drive had been criticized from the start as unworkable, and the final blow came from the police official charged with enforcing the regulations: he suggested that a better approach would be to provide filling stations wherever car owners need them, keep the stations open night and day, and control truck gasoline supplies more carefully.[10]

Problems with State-Owned Cars

This coupon episode illustrates the pressures that come into play when 233 million people live in a largely industrial society that makes use of only about 1 million passenger cars, of which less than half are owned by individuals. The effort to introduce municipal car rental services in 1959-60 gave rise to another response, illustrated in what can be called the "Krasnoyarsk incident." In this provincial district of Siberia, some enterprising municipal authorities decided in the spring of 1960 to develop car-rental services in several cities of their territory. They did not simply purchase new automobiles. Instead, they sought to round up the passenger cars owned by various factories, offices, trusts, and other government institutions. "It was decided, on the basis of a territory executive committee decree, to set up centralized common-carrier units in place of the small separate garages of individual offices, factories, and trusts. The intention was to assemble all the cars from the latter and to operate them from two new garages, one holding 150,

[10] See P. Koriagin, "Strange Procedure," *Izvestia*, July 8, 1965, trans. in *CDSP*, Vol. 17, No. 27 (July 28, 1965), p. 33; Colonel L. Kuznetsov, "Are Coupons Necessary?" *Vechernaia Moskva*, March 10, 1966, p. 2; and *The Washington Post*, March 11, 1966, Sec. A, p. 17.

the other 130 cars. The savings would be substantial. The Moskvich or Volga car that once stood idle in front of a director's office would be able to serve both its former individual owner and also several additional persons entitled to the use of a car in the performance of their duties."[11]

The officials of these organizations reacted with both imagination and initiative. As soon as the order was issued, requests came in to exempt cars as "special vehicles." "On the streets of Krasnoyarsk, Abakan, Norilsk, and other cities, dozens of passenger cars have started to appear with the most diverse emblems and signs, from the blue cross of the veterinary service to a neatly painted line reading 'Culinary Products Delivery.' There were 'mobile emergency repair cars,' 'operational-emergency-technical cars,' and still other special purpose cars."[12] After three months, 107 cars had been turned in, but 166 had obtained exemptions.

What did the "Krasnoyarsk incident" show? Clearly government officials had found that the cars assigned to them were convenient and useful for both official and personal trips. They were reluctant to turn them in to a municipal pool. The centralized fleet would perhaps have made more continuous use of each car, cutting costs, spreading overhead, and eliminating waste and duplication. But the officials who had tasted the delights of a personal car were reluctant to give their cars up.

Problems with Privately Operated Passenger Cars

Another important phenomenon arises under Soviet conditions, reflecting the chronic shortages of various consumer goods and services that have plagued the Soviet economy for many years. Soviet citizens sometimes use their cars to produce what the regime calls "unearned income." We have it on the authority of the Minister of Internal Affairs of the principal Soviet republic that, where the state fails to provide adequate supplies of consumer goods and services, private citizens tend to move in to fill the vacuum.[13] An en-

[11] *Sovetskaia Rossiia*, April 3, 1960, trans. in *CDSP*, Vol. 12, No. 14 (May 4, 1960), pp. 24-25.

[12] *Ibid.*

[13] V. I. Tikunov in *Izvestia*, April 13, 1962, trans. in *CDSP*, Vol. 14, No. 15 (May 9, 1962), p. 23.

terprising individual can use his car, for example, to bring fresh fruit or vegetables to cities where, at uncontrolled prices in farmers' markets or at street-corner stands, they command a substantial premium over their cost in producing areas. By the canons of Adam Smith, this function of relieving shortages and reducing price discrepancies is an honorable contribution to the general welfare. In the Soviet Union, however, such activities are considered antisocial, and those who engage in them are termed "parasites," getting "unearned income" from their "capitalist" activities. Privately owned automobiles figure prominently in the lurid accounts of the evil doings of such "speculators" brought to trial under a campaign that has been going on since 1960.

Even more modest means of transportation can offend the authorities. In May 1962, *Izvestia* reported the case of a forty-seven year old schoolteacher, in a country district near the Caspian Sea, who gave up school teaching in favor of growing vegetables and fruit. Over seven years he built himself a brick house and planted a large vegetable garden, thirty-two fruit trees, two hundred and thirty-six grape plants, and sixteen hundred tomato plants. He bought a motor and installed a watering system. He built a hothouse. He bought a motorboat to carry the vegetables to a nearby city and beyond. His neighbors "expressed indignation and asked that the machinations of the swindler be looked into. Finally, criminal action was instituted against the inveterate money-chaser. The court decided to exile Stepanov from the province, and to confiscate the house, the hothouse, and the motorboat."[14]

Problems with Rental Cars

If the authorities tend to frown on privately owned cars, citizens appear to have their doubts about rented cars. Municipal car-rental fleets have not proven attractive under the regulations laid down by Soviet municipalities. The Soviet citizen who wants a car for a summer vacation trip or a weekend jaunt faces a number of deterrents. Perhaps most important, Soviet legal authorities appear to feel that accidents will be minimized if insurance against personal liability is *not* made available. The renter of a municipal car

[14] *Izvestia*, May 26, 1962, trans. in *CDSP*, Vol. 14, No. 21 (June 20, 1962), p. 23.

is liable for anything that happens to it, as well as for any damage it may cause to other persons or property. He must also bear the cost of any repairs it may require, and if a breakdown keeps the car out beyond the time he has contracted for, he is charged one and a half times the regular rate for additional days of rental. He cannot reserve a car more than one hour in advance; thus, if demand proves to be heavy on a particular day, he cannot be sure that a car will be available. In mid-1963, the capital city of Moscow had 868 cars for rent, but only 632 of them were in good enough repair to be rented, that is, 27 percent were out of order.[15] In addition, the would-be renter must have a driver's license (hard to qualify for) and sometimes must get certification from his employer as to his eligibility for the privilege of renting a car. These barriers, together with all the headaches involved in obtaining gas and repairs, provide a sufficient explanation for the difficulties that have confronted municipal car-rental organizations for several years.[16]

In Moscow at least, the combined traffic of trucks, buses, and passenger automobiles has already begun to create traffic control problems. As early as 1959, pedestrian underpasses were being built in congested downtown crossings. Later, many streets were converted to one-way traffic, and a limited-access belt highway 92 kilometers long was built around the city. In 1965 a six-lane artery connecting the Kremlin with the Ministry of Foreign Affairs was put through a fine old neighborhood near the Arbat, requiring demolition of more than a hundred stately homes.[17] An April 1966 decree has now called for an elaborate schedule of staggered work hours to distribute peak load morning and evening traffic more evenly.[18]

The familiar problem of unsightly highway signs has also made

[15] Donald D. Barry, "Russians and Their Cars," *Survey*, No. 57 (October 1965), p. 106, citing an article by A. Gudimov in *Ekonomicheskaia Gazeta*, Aug. 24, 1963, p. 40.

[16] For further discussion, see Zigurds L. Zile, "Law and the Distribution of Consumer Goods in the Soviet Union," *University of Illinois Law Forum*, Spring 1964, pp. 257-61; and the article by Donald D. Barry and Carole Barner Barry, "Happiness Is Driving Your Own Moskvich," *New York Times Sunday Magazine*, April 10, 1966, pp. 16 ff.

[17] See *New York Times*, Nov. 14, 1965, sec. I, p. 15.

[18] See *Izvestia*, March 6, 1966, trans. in *CDSP*, Vol. 18, No. 10 (March 30, 1966), p. 28.

its appearance, but in a most unusual form. Recently an *Izvestia* staff correspondent wrote from Kemerovo in the center of the Kuznetsk Basin, the west Siberian coal region, complaining that large lurid signs were frightening travelers. They were not, of course, commercial advertisements. The posters were designed to warn against driving dangers, at railroad grade crossings or sharp turns, and also to caution against drunken driving. The correspondent went on:

> The road was smooth and paved with asphalt. Workers' settlements flashed by, and we passed gay throngs of green birches. But we had lost our taste for the beauties of nature. The kaleidoscope of horrors continued to unfold with inexorable consistency. There are about two dozen grade crossings on the Kemerovo-Novokuznetsk highway. At each one of them steam or electric locomotives crushed motor vehicles of the most varied types. On the posters of the Chief Motor Vehicle Inspection Service, people's volunteers extracted red-nosed drunken drivers from the front seats of cars and heavy "diesels" nudged their low-powered brethren off the road. The artists did not stint on the colors, they laid them on as heavy as possible.[19]

Current Forces at Work

A major factor shaping the official approach to the automobile problem is ideology. There is a faith that life can and should be "organized." There is a widespread conviction that rational arrangements can be selected "scientifically." From such a standpoint it is easy to criticize, as being obviously irrational, the Western "solution" of unrestrained proliferation of passenger cars. The Soviet regime hopes to develop a different answer. Moreover, this government vision of a rational technical solution is part of a larger political and psychological vision of what has come to be called "full communism." Under full communism, as Marx wrote in 1875, "Society will inscribe upon its banners: 'From each according to his ability, to each according to his needs.'" Soviet theorists have gradually developed the view that these needs should be inter-

[19] P. Voroshilov in *Izvestia*, May 28, 1966, trans. in *CDSP*, Vol. 18, No. 21 (June 15, 1966), p. 45.

preted as "the *rational* needs of a *cultured* man." In the official view, comic books and chewing gum are not needed by a cultured man, and will therefore not be part of full communism. According to the "scientific" criteria of the authorities, senseless proliferation, unnecessary duplication, garish ostentation, and selfish display are not rational, so they, too, will be absent, even when that great day of abundance arrives.

These matters have been carefully considered by Soviet theorists in connection with the revised Party program that was adopted in 1961. It is recognized, for example, that summer cottages, private automobiles, and private truck gardens are still necessary among the incentives that motivate Soviet citizens. Society's ruling slogan is still: "From each according to his ability, to each according to his work." Great reliance is still placed on what Khrushchev used to call "the principle of material interestedness." As long as inducements are necessary to call forth initiative and diligence, responsible theoreticians caution against premature suppression of rewards for hard work.

But the future is seen in rosier terms. There will be state parks, state summer resorts, and state-provided vacation facilities that will remove any need for private dachas. Abundant supplies of food will remove any need for personal gardens. In the same way, municipal car-rental services will meet any personal needs for passenger automobiles. Thus, as one enthusiastic doctor of philosophy argued in September 1960:

> When the public forms of satisfying needs, both in terms of quantity and especially of quality of service, reveal their advantages, people will begin voluntarily to give up their dachas. . . . When all the necessary material and spiritual prerequisites are created, there will no longer be an economic necessity for a number of items of personal property (personal dachas, automobiles, personal savings, etc.). The spiritual prerequisites include a comprehensively developed social awareness: a developed sense of collectivism, and the disappearance of all traces of a private-property psychology and survivals of egoism and individualism.[20]

[20] Ts. Stepanyan in *Oktyabr*, 1960, No. 9, trans. in *CDSP*, Vol. 12, No. 42 (Nov. 16, 1960), pp. 19-20.

This passage is a typical product of the cast of mind that visualizes a rational, organized future.

Actually, of course, present-day Soviet life is quite normal. Ten years ago, when I visited the Academy of Sciences Institute for Complex Transportation Problems, its vice-director twitted me about the traffic jams he had seen in New York City when he served on a United Nations technical committee. I replied diplomatically (I thought) that Moscow's broad avenues would perhaps permit them to avoid such congestion. "Oh no," he said, cheerfully, "We will soon have traffic jams, too!" One could not avoid the conclusion that international stature requires traffic jams in one's capital city. After the interview, this elderly, distinguished academician (now deceased) walked out of the Institute with me in order to point out, proudly, his own personal car parked in the street nearby. Here was a major analyst of rational transportation showing clear evidence of both the international and the individual status conferred by the passenger automobile.

As a perquisite for the elite, the passenger automobile has long commanded wistful interest among Soviet citizens. Under Stalin and Khrushchev, however, a latent popular desire for cars remained submerged. Occasionally it would find oblique expression, as when the late, courageous academician V. S. Nemchinov, criticizing the output targets set forth in the draft Seven Year Plan, wrote in early 1959 that "personal mobility is an important component of a high standard of living."[21] It would not be surprising if the Soviet man in the street showed the same weakness for having his own car that has proved so powerful in North America, Western Europe, and Japan. Experience in high-income societies shows that consumers, left to themselves, put automobile outlays ahead of health, education, and culture, to the distress of academics and planners alike. Western experience demonstrates conclusively the enormous strength of the urge to own a car, if this urge is given free rein.

The great dilemma that now confronts Soviet policy makers has arisen because the post-Khrushchevian leadership appears to have abandoned his attempt to suppress the individual passenger auto-

[21] *Kommunist*, 1959, No. 1, p. 87.

mobile. Soviet passenger car production is slated to rise from the 1965 level of 201,000 units to some 800,000 by 1970. Most of the new production is to come from facilities to be built under the technical supervision of Fiat engineers from Italy and Renault engineers from France. This departure from long-standing Soviet practice evidently reflects not only a recognition of popular demand for more passenger cars, but also a judgment that European technical experience can supply proven designs for production facilities to turn out a tested product more quickly and cheaply than could Soviet resources alone. Soviet attempts since 1959 to design and build a new small car, the Zaporozhets, have been plagued with difficulties.[22] The government is in effect reverting to the demonstrably successful procedures followed in the early 1930's, when many facilities were founded with the technological assistance of Western blueprints and engineers.

The new leadership also appears to have ceded ground on the matter of individual cars for responsible government and Party officials. Speaking at a March 19, 1965, meeting of the U.S.S.R. State Planning Committee, A. N. Kosygin referred to the drive that was illustrated above by the "Krasnoyarsk incident" as an example of the arbitrary, subjectivist policies imposed from above by Khrushchev. He said:

> You know how insistently the idea was imposed that there is no need in our country for expanded development of the production of passenger cars. Everyone, apparently, should travel only in buses. Everything was done to deprive the directors, even of large enterprises and economic organizations, of the right to use automobile transport. Is this correct? Indeed, the result was that many directors were obliged to make illegal use of trucks for official trips. The result is an apparent saving in transport expenses, but in fact the state suffered a loss.[23]

One notes that what appeals to Kosygin, here, is the sheer productive effectiveness of the passenger automobile in helping officials accomplish their work, not its capacity to satisfy the consumption

[22] For details, see Barry in *Survey*, pp. 100-101.

[23] *Planovoe Khoziaistvo*, 1965, No. 4, trans. in *CDSP*, Vol. 17, No. 18 (May 26, 1965), p. 18.

desires of the general Soviet public. As he said in the same passage, "Even such an apparently minor problem cannot be approached without evaluating the economic effectiveness of the measure proposed." One can guess that in Krasnoyarsk Province and elsewhere throughout the country, both specially marked passenger automobiles and centrally operated motor pools have quietly been abandoned.

If the convenience and effectiveness of individual passenger cars for officials is given expanded official sanction, there is likely to be increased spillover into unofficial use of these automobiles. The plant director (or his wife) is likely to find that personal errands can be combined with official trips and that off-hours use of the car is irresistible. It will be exceedingly difficult to confine the use of these cars to official business purposes. As the number of such cars grows, however, it seems inevitable that they will multiply rather than diminish the demand for cars coming from millions of citizens at intermediate levels in Soviet institutions. The plain fact is that cars *are* very convenient!

The role of the passenger automobile as a symbol of personal status is muted in Soviet society. Where cars are so rare, the individual owner who flaunts his possession is easily accused of selfishness. His neighbors can heckle him in a Comrades' Court. Officially manipulated public opinion can conspire with petty motives of envy to create a hostile climate around a blatant car owner. Perhaps in the future this stern atmosphere will be relaxed. There seems, however, absolutely no prospect that Soviet consumers will ever be confronted with the strident advertising appeals to power and prestige that lure Western automobile buyers into dealers' showrooms.

The passenger automobile can play an important role as an instrument of courtship. In the West, cars have provided unchaperoned privacy for boys and girls, or men and women. In the Soviet Union, where the urban population faces extremely crowded living conditions, this function of the automobile may well have special importance. Soviet young people frequently have to defer marriage until they can find a room to share, and married couples generally limit their families because of the housing shortage. Under

these conditions, more cars are likely to mean more lovers' lanes. If the Soviet people could choose between more apartments and more passenger automobiles, which would they prefer?

The inputs required for apartment houses and motor vehicles are, of course, not the same. But over time, generalized labor and capital resources can be channeled in one direction or the other. During the last decade, the Soviet government has clearly focused on increasing urban housing. Overcrowding has been reduced, but vast needs remain. It seems most unlikely that any society, faced with a choice between adequate living quarters and more numerous passenger cars, would give priority to automobiles. It is inconceivable, in any case, that the present Soviet regime would countenance such a choice.

Some Western observers have pointed out that Soviet passenger automobiles, priced far above their internal domestic money cost, provide a useful means for mopping up excess purchasing power in the hands of Soviet citizens. There is ample evidence that hundreds of thousands of Russians, given a chance, will cast enthusiastic ruble votes for automobiles. Soviet producers of clothes, shoes, washing machines, television sets, and similar commodities have grown more responsive to consumer demand; perhaps a broader responsiveness will extend to the public's desire for passenger cars. If Soviet resources were invested in response to prospective rates of return, rapid expansion of automobile production would certainly occur. But if Soviet consumers could bid for more housing, my guess is that their ruble votes would run heavily in this direction, too. Unfortunately, most urban residential construction is financed through government channels that do not respond directly to popular demand. The rent charged for Soviet urban dwelling space scarcely covers its maintenance, and new housing cannot be freely bid for in the market place.

Soviet Urban Growth Problems

Problems of organizing a satisfactory urban environment have long received Soviet attention. As part of the initial drive to build industry in outlying regions, move production closer to raw mate-

rials, and raise backward regions up closer to parity with the old centers, a Party resolution of June 1931 sought to forbid further industrial expansion in Moscow, Leningrad, and other centers.[24] A general plan for rebuilding Moscow was confirmed in 1935; one of its main features was an attempt to limit the growth of the city's population and to ban the construction of new factories. Urban growth in Moscow and elsewhere nevertheless continued, and the Eighteenth Party Congress in 1939 found it necessary to refer again, in its resolution on the third Five Year Plan, to the need to enforce the decisions of the Party and government prohibiting the building of new factories in Moscow and Leningrad. "This prohibition should be extended to Kiev, Kharkov, Rostov-on-Don, Gorky, and Sverdlovsk."[25] After the great blows of World War II were made good, rapid urban growth was resumed, in Moscow and the old centers of European Russia as well as in new cities. When the U.S.S.R. Council of Ministers in 1966 approved a set of principles to underlie a new general plan for the development of Moscow, they found it necessary once again to prohibit the building of new industrial enterprises and even the expansion of old ones.[26] As a leading Soviet architect, B. Svetlichny, recently wrote in a thoughtful review of the problem, "The cities keep growing despite our city-planning theories, which long ago declared verbal war against giant cities, and despite the bans on building new industries in them."[27]

The approach to this problem in the current Five Year Plan stresses the building of new factories primarily in medium-sized and small cities, with new construction in large cities limited principally to service enterprises. The policy is intended to halt at long last the expansion of heavy industrial installations in old centers,

[24] See *Kommunisticheskaia partiia Sovetskogo Soiuza v rezoliutsiiakh i reshentiakh s"ezdov, konferentsii i plenumov Tsk* (7th ed.; 1953), Vol. 2, pp. 656-69, especially p. 666.

[25] See the English translation of the Eighteenth Congress proceedings, published under the title *The Land of Socialism Today and Tomorrow* (Moscow: Foreign Languages Publishing House, 1939), p. 433.

[26] See the remarks of V. F. Promyslov, in *Izvestia*, Oct. 5, 1966, trans. in *CDSP*, Vol. 18, No. 40 (Oct. 26, 1966), pp. 35-36, and the preceding announcement in *Izvestia*, Sept. 18, 1966, trans. in *CDSP*, Vol. 18, No. 38 (Oct. 12, 1966), pp. 35-36.

[27] His article appeared in the journal *Oktyabr*, 1966, No. 10, trans. in *CDSP*, Vol. 18, No. 48 (Dec. 21, 1966), pp. 11-17.

thus limiting the congestion and pollution problems that have begun to cause concern in the Soviet Union. An additional, major motive relates to employment. The Party's plan directive refers to the aim of improving the utilization of labor resources, both male and female, as a criterion for locating new plants. There are evidently pockets of underemployed labor in many small cities, especially in European Russia, and the hope is to bring industry to these people. If successful, the policy would check their tendency to migrate to large cities where they create a need for additional housing and other social overhead capital.

The mayor of Moscow said recently, in discussing the principles for Moscow's new general plan, "The chief problem is providing the population with well-appointed living quarters." To this end, it is vital that further growth in the city's population be halted and that land uses that compete with housing be controlled. Continuation of the vast housing program of the last decade would then permit the development (by 1980 in planners' eyes) of a really model modern city. But the outward spread of apartment house complexes has already shown that important transport problems are intimately associated with the attempt to make this vision a reality.

The capital's transit facilities are now handling eleven million passenger trips a day, and the mayor foresees a 50 percent increase "in the near future." Most of the traffic, as we saw above, is handled by subways, autobuses, trolley buses, and streetcars. For the future, it is intended to double the length of the subway system from 160 to 320 kilometers and integrate the system with suburban electric railroads. Trolley buses and large-size autobuses are looked to also. In addition, however, the mayor now speaks of "launching large scale work on the construction of new belt highways." He said proudly at the Twenty-third Congress that there were already 75,000 families in Moscow with their own passenger automobiles, and predicted that their number would increase several fold by the end of the current plan. These new cars, together with burgeoning truck traffic, will surely require additional traffic capacity passing through central Moscow and joining it with the edges of the city.

Already these pressures, long familiar in the West, are causing distress among sensitive Moscovites. Svetlichny points out that

though many underground crosswalks for pedestrians have been built in recent years, "vehicles, especially trucks, have been the winners, of course. What about the people? I would hardly be mistaken if I said that Moscovites would be glad to return to the 'good old times' when they could cross the street without descending and ascending steep underground stairways. It is a fact, after all, that in many cases pedestrian traffic has grown more inconvenient. In addition, the crosswalks are still too few, and one must often make a detour of nearly a kilometer to cross the street." Another writer, commenting on a recent meeting where plans for rebuilding the old center of Moscow were discussed, complained passionately against the replacement of historic buildings with skyscrapers and freeways.[28]

Soviet planners hope to hold down the need for added urban transport capacity through designing and building "microboroughs," visualized as relatively self-contained units of from 4,000 to 18,000 people. The unit would combine residences, workplaces, shopping facilities, and recreation areas into a single harmonious complex. Its residents would clearly have a greatly reduced need for travel to other parts of a large urban area.[29] In Moscow's expansion to date, however, the great need for housing has made it very difficult to achieve the microborough ideal. Apartments are ready for occupancy before ancillary facilities are in place. Pressure develops for taller apartment houses, closer together, and with smaller recreation areas than in architects' models. It is still necessary, moreover, for occupants of these new quarters to travel long distances to and from their jobs, since there is as yet no close coordination between place of work and place of residence. Thus the microborough approach has not yet been able to demonstrate any capacity to check the growing demand for urban transit services.

Moscow's new apartment complexes are not only short of retail trade facilities, but appear to have made woefully inadequate provision for the passenger automobile. At present, of course, the need is slight, and the rare owner of an automobile can park it some-

[28] See Oleg Volkov, "What Should Moscow Be Like?" *Literaturnaia Gazeta*, Dec. 17, 1966, p. 2; summarized in *CDSP*, Vol. 19, No. 3 (Feb. 8, 1967), p. 36.

[29] See B. Michael Frolic, "The Soviet City," *The Town Planning Review*, Vol. 34, No. 4 (Jan. 1964), pp. 285-306, and the items listed in his bibliography.

where near his apartment, probably outside rather than in a garage, though this means he may not be able to get much use out of it during the winter. What seems clear to a Western visitor, nonetheless, is the prospect of a tragic denouement if personal cars become widespread.

Both automobile production and housing construction give rise to broad problems of interrelated needs in organizing a complete urban environment. Neither the U.S.S.R. State Planning Committee nor the short-run, purely competitive private market analyzed in Western textbooks can easily specify a fully coordinated response to such joint needs, involving all the ancillary facilities required for modern urban life. All countries now, whether rich or poor, face problems of urban planning, and none has yet developed a fully satisfactory way of solving them. Citizens want contradictory things: pleasant living quarters in the midst of highly civilized surroundings, and prompt, convenient movement between home and job.[30]

At present there appears to be considerable danger that the Soviet Union faces a long-run prospect of uncoordinated expansion in the number of automobiles and the density of urban settlement. Men have long had faith that a planned economy could use foresight to build an environment with consistent and harmonious features. Perhaps it is appropriate to end this chapter with the hope that it is not too late for Soviet planners to develop a compromise solution that will fit the automobile into a decent urban future.

[30] For lucid, informed analyses of the current United States situation, see Wilfred Owen, *The Metropolitan Transportation Problem* (rev. ed.; Brookings Institution, 1966), and J. R. Meyer, J. F. Kain, and M. Wohl, *The Urban Transportation Problem* (Harvard University Press, 1965).

CHAPTER VII

Implications of Soviet Transport Experience for Other Countries

THOUGH DIVERSITY DEFIES generalization, Soviet transport experience has a number of important implications for the numerous nations of the world now intent on improving their economic performance. Causal connections among forces at work are clearly displayed in the Soviet record. The transport consequences of economic policy choices stand out clearly in Soviet economic history. Thus in spite of qualifications and complications that severely restrict easy generalizations, those concerned with economic development elsewhere can learn much from Soviet experience. The incomplete evidence and imperfect analysis of the preceding chapters are drawn on in this final chapter to suggest a number of lessons for other countries.

Transport—Precondition or Concomitant?

Countries in early stages of economic development can learn from Soviet experience one lesson of fundamental importance: transport investment is a concomitant of, not a precondition for, economic development. Such countries need not accept the orthodox view, based on a misreading of nineteenth century experience in the United States, that large-scale expensive transport facilities must be laid down before agriculture and industry can begin to grow. Transport capacity can be expanded as the demand for it grows, rather than being provided in advance. Soviet experience

demonstrates that the transport sector can be made to serve an industrial development program without itself becoming the largest single claimant for capital plant and equipment.[1]

The Soviet regime, of course, inherited an economy that was already well launched in the industrialization process. Modernization of the Russian economy had proceeded rapidly for more than half a century before the revolutions of 1917. Extensive railroad building had been a major feature of this growth, proceeding hand-in-hand with the development of industry and agriculture. In the stock of capital plant and equipment inherited by the Bolsheviks, the fixed assets of the transport sector were substantially larger than those of the industrial sector, and were exceeded only by those in agriculture.[2] A major portion of the road to modernization had been traversed before Soviet authorities assumed control. But many countries today, like India and several Latin American economies, are similarly endowed with a substantial transport plant, together with non-negligible capacities in agriculture and industry. For them, the implications of Soviet experience lie in how the middle portion of the road to modernization can be traversed.

Soviet stress on heavy industry has made transport a handmaiden of industrial expansion rather than a prime mover. Intensive use of inherited transport plant, together with crucially necessary additions, has enabled Soviet authorities to make transport a secondary sector of the economy. The outcome of this policy can be seen in the data of Table 19, where capital outlays in the transport sector and in the whole economy are compared, from period to period over the whole course of Soviet experience. The official Soviet ruble data are said to be in "comparable" prices, that is, to involve a constant set of price weights, but the details have never been published. There are also unexplained issues relating to many matters of definition and coverage that have not yet been thoroughly discussed by Soviet statistical authorities. Nevertheless, the figures assembled in Table 19 can be read as crude indicators of

[1] See Holland Hunter, "Transport in Soviet and Chinese Development," *Economic Development and Cultural Change*, October 1965, pp. 71-84.

[2] See Holland Hunter, *Soviet Transportation Policy* (Harvard University Press, 1957), Table 77, p. 411.

TABLE 19. *Soviet Investment Outlays in the Transport Sector and the National Economy, by Periods, 1918–65*[a]

(In millions of rubles and, in parentheses, percent of outlay in the whole economy)

Period	Transport Sector			Whole Economy
	Railroads	Other Modes	Total	
Jan. 1, 1918–Sept. 30, 1928	319 (19.1)	79 (4.7)	398 (23.8)	1,674 (100)
Oct. 1, 1928–Dec. 31, 1932	738 (11.0)	510 (7.6)	1,248 (18.6)	6,716 (100)
Jan. 1, 1933–Dec. 31, 1937	1,735 (11.5)	1,510 (9.9)	3,245 (21.4)	15,170 (100)
Jan. 1, 1938–June 30, 1941	1,827 (12.1)	1,250 (8.3)	3,077 (20.4)	15,101 (100)
July 1, 1941–Dec. 31, 1945	1,957 (13.5)	656 (4.5)	2,613 (18.0)	14,548 (100)
Jan. 1, 1946–Dec. 31, 1950	3,155 (9.0)	1,790 (5.2)	4,945 (14.2)	34,875 (100)
Jan. 1, 1951–Dec. 31, 1955	3,868 (5.8)	2,952 (4.4)	6,820 (10.2)	67,187 (100)
Jan. 1, 1956–Dec. 31, 1960	5,112 (4.2)	7,226 (5.9)	12,338 (10.1)	122,018 (100)
Jan. 1, 1961–Dec. 31, 1965	7,121 (3.8)	13,742 (7.4)	20,863 (11.2)	186,719 (100)

[a] Assembled from absolute data in TsSU, *Narkhoz '61*, pp. 542–43, for 1918–58, 1959, and 1961; *Narkhoz '63*, p. 454, for 1962–63; and *Narkhoz '65*, p. 533, for 1958, 1960, and 1964–65. Ruble data are in so-called comparable prices.

Soviet policy in action. The broad trends they show are not likely to be altered by the statistical refinements that might emerge from an independent investigation.[3]

[3] Intensive study of Soviet capital investment and stock trends has been conducted by Professor Norman Kaplan; see his chapter in Abram Bergson and Simon Kuznets (eds.), *Economic Trends in the Soviet Union* (Harvard University Press, 1963), and a larger forthcoming work. Another major analysis is that of Raymond P. Powell and Richard R. Moorsteen, *The Soviet Capital Stock, 1928-1962* (Harvard University Press, 1966). The aggregate series developed in both these studies

During the first decade of civil war, restoration, and recovery, the transport sector of the Soviet economy received almost 25 percent of all state and cooperative capital investment, with railroads receiving 19 percent and other modes of transport receiving another 5 percent of average annual outlays during these years. The dominant role of railroads in capital investment, which had characterized tsarist industrialization for several decades and which had made railroad capital so large a proportion of the total capital stock, persisted until the first Five Year Plan began. From 1929 on, a sharp policy change is apparent. The transport share of annual capital investment was cut back perceptibly to vary between 19 percent and 21 percent of all state and cooperative investment during the 1930's. The railroad share was cut back far more drastically to between 11 percent and 12 percent. Investment in the capital stock of other transport modes increased to between 8 percent and 10 percent annually during the second Five Year Plan. The minor carriers received almost as much investment as the railroads did. During World War II, investment in the minor carriers was sharply curtailed, but attention to the railroads understandably increased.

Over the two decades of postwar experience, the Soviet policy of stringency in transport investment has paid off dramatically. Even during the fourth Five Year Plan, dominated by postwar reconstruction, the transport sector received only 14 percent of all investment, and the railroad share dropped to 9 percent. In the last fifteen years, the transport sector's share has only been 10 percent or 11 percent of total state and cooperative investment, and the railroad share has been brought down below 4 percent. It was shown in Chapter 3 that during the 1950-65 period the domestic freight traffic carried by the Soviet transport sector grew very rapidly, more rapidly than the Gross National Product; in other words, that the ratio of traffic to output has been rising. That Soviet authorities have been able to cut the transport sector's share of investment in the face of rapidly growing traffic demands is a great tribute to the performance of Soviet carriers, and primarily to the

are not presented in sectoral breakdowns permitting analysis of the transport sector's share of Soviet investment and capital over this period. When sectoral trends are clearer, the tentative judgments offered here can be made more definitive.

railroads, for they have accounted for the great bulk of the freight traffic increments measured in physical terms. The recent sharp rise in the investment share of other transport modes reflects substantial Soviet outlays on maritime carriers, primarily for nondomestic traffic, together with increased attention to motor vehicles and domestic waterways improvements. During the last decade, these other transport modes have been receiving more annual investment than have the railroads.

The lesson here is not that transportation is unimportant for economic development. Interregional movement of goods and people is of course vital for the whole process of producing and exchanging resources effectively. The question is one of timing and proportions. Even to the extent that a particular transport link is a prerequisite for a specific mining, manufacturing, or agricultural project, Soviet practice exemplifies the rule that a transport investment need not precede the "directly productive activity" very much in time, and need not outweigh it heavily in financial dimensions. Specific counter examples can of course be cited from all over the world. Nevertheless, the Western concept of infrastructure as a necessary precursor of economic expansion does not square well with Soviet experience. In World War II, U.S. civilians were asked, "Is this trip necessary?" On a grander and more fundamental scale, perhaps development planners, in the light of this experience, should regularly ask: "Is this transport project necessary?"

The Railroad Potential

Another lesson of Soviet experience, relevant to the situation in a great many less developed countries, concerns the tremendous potential of railroads for carrying mass freight traffic. The prestige of railroads in most Western countries has fallen seriously in recent decades because of dissatisfaction with the passenger service they offer in comparison with that of automobiles and aircraft. The general public may have an impression that railroads are obsolete. Nothing could be further from the truth. Soviet railroads have shown conclusively what modern railroads can do under favorable conditions.

Established railroad systems in some countries, like Argentina, have displayed administrative difficulties that have hurt the reputation of railroads generally. Government ownership or control has led to high costs, sluggish leadership, poor morale, and deteriorating service. Again, Soviet railroads provide vivid proof that these conditions are not inevitable. The government-operated railroads of the U.S.S.R. are technologically alert, maintain high morale among their personnel, and have a remarkable record of cost reduction since 1950. Soviet railroad passenger service, while not as impressive as the freight service, has handled most of the intercity passenger travel in adequate fashion for many years. The lesson for less developed countries with existing railroad systems is clearly that the railroads should not be lightly cast aside. Their potential for contributing to economic development should be carefully weighed. A delegation sent to the U.S.S.R. to examine Soviet railroad operating methods might return with fresh ideas for rejuvenating a rundown railway system at home.

The railroad potential that has been realized in Soviet experience is closely associated with the intensive utilization of plant and equipment that characterizes Soviet railroad freight operations. American railroads are not intensively used, because the American railroad network has been overbuilt for at least half a century. Almost all the present system remains a national asset, but if railroad building were to begin all over again under present conditions, the system would surely never proliferate as it had by 1920. Except for occasional periods and selected portions of the network, American railroads have not generally been forced to use equipment intensively in the Soviet manner. There is thus some reason to imagine that American advisors on transport development have not generally tended to visualize intensive use of railroads as a feasible alternative. Since the extent of the need for transport plant and equipment depends on how it is used, there is reason to suppose that Western advisors on development programs in less developed economies have, by employing undemanding standards for equipment use, tended to overstate the need for added transport capacity.

Motion per se may be pointless, but if traffic needs to be moved, continuity of equipment use is the key to effectiveness. State policy

has forced Soviet railroads to make extremely intensive use of motive power, rolling stock, and line capacity. The railroads have long sought to organize traffic flows so that loaded trains will be in motion night and day, in both directions, throughout each week over all seasons of the year. Their ideal is never, of course, completely achieved. The productive operations of shippers and receivers cannot and should not be fully bent to the railroads' purposes. But wherever traffic is growing and resources are scarce, continuous use of transport capacity remains a powerful principle for reasonable application.

Adapting to Unique Environments

Another lesson of Soviet transport experience is that it reflects unique geographic circumstances. To the extent that Soviet transport policies reflect sensible adaptation to conditions in the Soviet Union, the implication for other countries is not that identical decisions should be reached, but that optimum solutions require sensitive adaptation to each country's unique geographic and climatic situation.

Chapters 2 and 3 have shown the constraints on Soviet transport evolution imposed by her northern location and geographic structure. The northern position of the U.S.S.R. means long freezing periods for her rivers and seas, seriously handicapping their continuous use for year-round shipping operations. The poor location of Soviet rivers and seas in relation to the major interregional traffic needs of the economy constitutes a second handicap to their use. Railroads, by contrast, are favored by the vast extent of relatively level plains in the occupied portions of Soviet territory. It has thus been geography, rather than the laws of historical materialism or Marxism-Leninism, that has shaped Soviet choice of carriers and Soviet transport evolution. The point is not made tendentiously, but only to reinforce common-sense observation. If Soviet experience had unfolded in a different geographic setting, there is every reason to suppose that the Soviet transport sector would have adapted itself differently.

Imitation elsewhere of specific Soviet modal choices would

therefore only be appropriate under roughly identical circumstances. The thrust of the argument here is that optimum transport development policy needs to reflect sensitive evaluation of geographic and climatic factors. In practice, the analysis of Chapters 2 and 3 has suggested that Stalin's faith in canals and internal waterway transport went too far.

Clearly the precept counseling adaptability to geographic environment suggests that countries like Indonesia, Nigeria, and Brazil are enabled by their geographic situation to make far greater use of water transport than the U.S.S.R. has. As a group of islands, Indonesia clearly must depend on maritime transport to move heavy freight traffic back and forth among its major divisions. The well-located river systems of Nigeria and Brazil, not subject to freezing and relatively free from seasonal flood conditions, would appear capable of playing a substantial role in the transport development of these economies. Elsewhere in Latin America, plains regions clearly favor the use of railroads, though the great barrier of the Andes seriously limits the feasibility of transcontinental rail connections.[4] Where water carriers or pipelines cannot serve, railroads have an unchallengeable ability to move mass freight over long distances at low cost. Perhaps sharp changes in elevation, as in eastern Colombia or western Uganda, are better traversed by highway than by railroad, but with mild gradients and adequate traffic, the railroad cost advantages are decisive.

The Impact of National Purposes

Previous chapters have stressed the influence of Soviet purposes on the evolution of the transport sector. A less developed country whose national purposes are less focused on heavy industry and national defense than were those of the U.S.S.R. after 1928 is not likely to imitate Soviet transport policies. If light industry and consumer goods production rank high among national priorities, widespread highway building and use of motor vehicles for prompt

[4] For analysis of prospective coastal maritime connections in South America, see Robert T. Brown, *Transport and the Economic Integration of South America* (Brookings Institution, 1966).

door-to-door service is likely to spring up far more rapidly than it has in the Soviet Union. Small-scale producers, receiving and shipping small consignments, generate the kind of traffic that trucks can handle more expeditiously than railroads.

Where modernization of the agricultural sector has high priority, rural road building must receive far greater attention than it has in the U.S.S.R. Farm-to-market connections require an adequate highway system, even if a railroad network handles large interregional traffic in agricultural output. The lesson of Soviet inattention to rural roads is precisely that it has hampered the development of Soviet agriculture.

In less developed countries with dense populations, if development programs are sensitive to popular demands, passenger transportation will make greater claims on transport capacity than it has in the Soviet Union. As was noted in Chapter 4, Indian railroads face far more serious problems in this respect than have confronted Soviet railroads since the early 1930's. In India and elsewhere, heavy passenger traffic demands are likely to call for substantial investment in highways, buses, and urban passenger transport facilities, as well as in railroad and air passenger traffic capacity. Even with its relatively low population density and modest rate of population growth, the U.S.S.R. has had to devote substantial resources to expansion of passenger transport capacity; in many developing countries, strong demands for passenger service will compel relatively greater attention.

Difficulties of Industrial Relocation

Another relation between national purposes and economic evolution is illustrated by Soviet experience in seeking to bring outlying regions of the country closer to parity with established centers. The absolute gains that have been achieved in previously backward portions of Soviet territory have been very large indeed. At the same time, equally massive increments of investment and output have occurred in old settled regions. As a result, the net shift in the share of national economic activity attributable to peripheral parts of the country has been more modest than early Soviet plans

intended. It has also taken far longer to bring about these net shifts than the planners anticipated.

Two lessons for other countries are implied by this aspect of Soviet economic experience. The first is that decisive shifts in the regional structure of economic activity are likely to require decades rather than years for their accomplishment. Powerful forces attract capital and labor to established centers, which are likely to grow even if national policy seeks to prevent it. A strong case can in fact be made against deliberate efforts to channel investment toward an economy's backward regions, if larger immediate output gains will result from placing the resources in established districts. The argument is that immediate output gains will cumulatively raise the sum total of resources available and that, after a decade or so, ample funds will be available to finance the rapid advance of backward regions previously slighted.[5]

The slow appearance in the U.S.S.R. of a net regional shift away from old centers can perhaps be interpreted as reflecting an implicit recognition by "middle-management" decision makers of the inexorable logic contained in this argument. The elements of what could be called a "springboard policy," using expanded industrial capacity around Moscow, in the eastern Ukraine, and around Leningrad as the basis for a later leap to the east, is perhaps discernible in the Soviet record, though it was not clearly articulated at the time in contemporary policy discussion.

A related lesson of Soviet experience is that hopes of reducing the relative demands of a developing economy for freight transport service, through fostering regional self-sufficiency and holding down the growth of interregional freight traffic, are not likely to be realized if the economy's basic resources are widely separated from each other. No other country in the world faces the resource dispersion problem on quite the Soviet scale, but perhaps the general implication for development planners everywhere is that it will be hard to prevent development, which links together the previously

[5] See Louis Lefeber's papers, "Economic Development and Regional Growth," in Gary Fromm (ed.), *Transport Investment and Economic Development* (Brookings Institution, 1965), pp. 106-22, and "Regional Allocation of Resources in India," in P. N. Rosenstein-Rodan (ed.), *Pricing and Fiscal Policies* (M.I.T. Press, 1964), pp. 18-29.

separate regions of an economy, from giving rise to more than proportionate increases in heavy freight traffic.

Enlarged Transport Options

Soviet transport experience has mainly been shaped by policy decisions reached in the late 1920's when transport technology offered far fewer modal alternatives than are available today. It has been argued at several points that criticism of Soviet policy with the benefit of hindsight is unfair. Decisions reflecting impeccable evaluation of existing alternatives can nevertheless be gradually outmoded as a result of technological progress. The lesson for later decision makers in other places is surely that the full range of current transport technological options should be carefully examined, and not that earlier experience should be mechanically imitated. Transport planners in developing countries today should note a number of such potential departures from previous Soviet experience.

Modern technology has developed in the direction of facilitating joint use of several transport modes, improving the flexibility, diversity, and capacity for decentralization of a growing economy. The key to joint shipments is the universal container. It is a remarkably flexible transport instrument, capable of being shifted rapidly from a highway truck to a railroad flatcar, a river barge, the hold of a cargo ship, or even a large aircraft. Containers can be lifted or rolled from one mode to another far more quickly and cheaply than cargo handled by older transshipment methods. Losses from pilferage can be greatly reduced with sealed containers, and they are more easily protected against moisture.

Where intensive use of transport capacity led Soviet authorities in the past to concentrate heavily on the railroads, less developed countries today can make use of modern containers for joint shipments relying on several modes if they are available under favorable conditions. A skeletal rail system can be jointly used with highway, water, and perhaps air carriers to obtain lower costs and greater flexibility than could have been attained under earlier technological conditions.

Soviet transport authorities have been prompt to adapt jet aircraft for civil air passenger and freight applications, and have provided glamorous summer vacation excursion opportunities with hydrofoil passenger ships on the Volga and the Black Sea. In the main, however, the Soviet regime has been traditional and conservative in its transport technology choices. There has even been a stubborn faith in the potentialities of canals. Stalin completed the Volga-Don Canal in 1952, some 250 years after Peter the Great proposed the project. He may have reflected a kind of totalitarian time-lag at work. Political leaders driving to catch up with rival industrial nations seem to imitate the technological history of their predecessors. It is perhaps a political form of the biological principle that ontogeny repeats phylogeny.

Developments since World War II in the technology of river transport provide another instance of transport options open to less developed countries with good internal waterways. The pushing of numerous barges cabled together has proved to be far cheaper than earlier methods, greatly facilitating the low-cost movement of materials like sand and gravel, crude oil, and coal. Diesel pushers are now employed in the U.S.S.R., but as we have seen, a number of unfortunate geographic disabilities have impaired their effectiveness. Soviet experience confirms, on the other hand, the great effectiveness of pipelines for the large-scale movement of petroleum and natural gas, already amply demonstrated in North America, the Middle East, and Europe.

The immense transport contribution that can be made by trucks, buses, and passenger cars toward the rapid and flexible movement of people and goods is clearly more evident today than it was forty years ago when basic Soviet transport decisions were being made. The Soviet Union developed its own motor vehicle industry as quickly as seemed feasible, but is only now entering the automobile age in earnest. Does modern technology add decisively to the advantages of road transport by comparison with rail, water, or pipeline carriage? In many cases it probably does. If promising but limited resources are being developed on a modest scale, for example, trucks using temporary roads may be substantially more economical than rail transport which will be left stranded after a few years. Small ore deposits, gravel pits, or limited timber stands ex-

emplify this kind of situation. Feeder roads in place of branch rail lines with very light traffic may show decisive cost advantages now, especially with modern road building methods and with the use of containers.

The drift of modern technology suggests still another lesson that is obliquely related to Soviet experience. Over the last century, a number of major technological trends have acted to reduce the tons of raw material input that must be shipped per unit (in value terms) of final output. Fuel consumption has grown more efficient. Construction materials are stronger and lighter. Products of field and forest are more fully consumed. A hundred years ago, or even fifty years ago, mass movement of heavy freight traffic was clearly an essential element of industrial growth. Soviet authorities greatly expanded their coal-using heavy industrial base, drawing on widely separated coal and ore deposits, following this tradition. Now, however, the shift from coal to oil and gas as fuels, the substitution of electric power transmission for coal movements, the greater use of agglomeration and beneficiation of ores, the on-site processing of timber, and similar developments in other industrial sectors permit the Soviet economy to lighten its relative demands on the transport sector. Of course the immense traffic capabilities that Soviet railroads have developed will not stand idle in the future. Economies in input use will permit larger final output. The lesson for other countries, and particularly for transport planners in less developed countries, is that a judicious combination of modern technological methods for fuel and primary input processing, combined with Soviet railroad operating methods, holds the prospect of doubly substantial savings in resources that might otherwise be channeled into expansion of transport capital plant and equipment.

Lessons for Highly Developed Economies

Though the lessons of Soviet transport experience relate mainly to the problems of less developed countries, the record we have been examining has a number of interesting implications for highly developed economies. They too should be conscious of the close

connection between national purposes and an appropriate set of transport policies. Soviet experience shows how, under unique circumstances, the transport sector can contribute impressively to rapid industrial growth. In the framework of Soviet economic geography and Bolshevik economic policy, Soviet railroads have proved admirably fitted for carrying huge volumes of coal, iron ore, petroleum, timber, and the other basic raw materials needed by heavy industry, itself concentrated in a handful of major centers. Transport capacity expansion has been held down and the investment resources thereby released have been available for other uses. It has been argued above, however, that this Soviet solution has developed in response to distinctively Soviet purposes, which are not likely to be relevant to the situation of other developed economies.

In a consumer-oriented economy, producing a widely diversified range of final goods and services, with a geographically decentralized pattern of industrial location, the Soviet approach to transport economizing would prove to be a substantial handicap. Where shipments on a relatively small scale must be moved promptly among a large number of decentralized shipping and receiving points, the distinctive features of Soviet railroading cease to be advantageous. The high degree of track occupancy and relatively continuous use of rolling stock that keeps Soviet rail costs low would be far harder to achieve. Its costs would probably outweigh its benefits.

Frugality in providing transport services limits the options open to shippers, receivers, and travelers. The carriers themselves are able to concentrate freight traffic on main routes, schedule traffic movements in ways that promote their internal efficiency, and confine themselves to the forms of service that permit high degrees of equipment utilization. This Soviet approach clearly lays costs on transport users, however, and in an economy where these costs are important, the Soviet approach is not likely to have great appeal. Public convenience is greatly facilitated by ample transport capacity, in pursuit of both convenience and efficiency.

Soviet transport authorities are justly proud of their achievements. They are also convinced that state ownership of all the major transport modes gives the U.S.S.R. an inherent advantage in

achieving intermodal cooperation within a unified transport system. The record indicates, to me at least, a different conclusion. Comparison of Soviet transport experience in intermodal cooperation with developments in the United States and Europe suggests that technology, not "state ownership," is proving to be the key to progress in this sphere. Containerization of freight shipments is now stimulating a rapid expansion of joint shipments involving two or more modes. Transshipment costs are reduced, delivery times are speeded up, pilferage and damage costs are lowered, and intermodal paper work is facilitated through the use of containers. Though containers have been used in the U.S.S.R. since the middle 1930's on a small scale, recent developments in North America and Western Europe have gone far beyond Soviet attainments.

Similarly, intermodal difficulties in keeping track of joint shipments, allocating traffic revenues, coordinating schedules, and otherwise arranging for prompt and flexible service reflect "departmental barriers" in the Soviet Union, fully comparable to the difficulties caused by intermodal rivalry in a market economy. Here, too, technological progress in information processing, telecommunications, etc., has contributed effectively to intermodal cooperation in the West, to a greater extent than in the U.S.S.R. Current plans suggest that the Soviet Union will rapidly catch up in the use of these devices, but it is hard to see that state ownership by itself makes any additional contribution.

Now that the Soviet Union has joined the ranks of the developed economies, there may be some lessons for its present and future policies that arise out of its own past transport experience. What can the U.S.S.R. itself learn from this record? Three inferences would appear to flow from the evidence and arguments of this study. The first is that past neglect of transport hurt the Soviet agricultural sector, and that its healthy development now will require substantial rural road building and other investments to improve rural transport conditions. The second is that the new, more diversified, and more consumer-oriented policies of the regime will make it necessary to raise the transport sector's share of national investment outlays, especially by comparison with the stringency of the last decade or so. Finally, Soviet difficulties in dealing with the pas-

senger automobile, and current Soviet intentions for enlarging its role, indicate a lack of appreciation for the complexities and dangers that modern urban society confronts in this area. One might well hope that new answers will emerge from Soviet approaches; as yet, the challenge remains to be met.

APPENDIX A

Regional Data for Soviet Industrial Investment and Output, 1928-34

This appendix presents the absolute data that underlie the regional discussion in Chapter 2. Sources, coverage problems, and adjustments are discussed. Analysis is confined to the six-year period 1928-34 chiefly because of serious difficulties in adjusting for changes in Soviet regional boundaries. With substantial additional work, it should be possible to extend the analysis from 1934 to 1937, 1940, and even the postwar era.

Soviet statistics for the industrial sector in this period are relatively abundant, though they involve serious problems of coverage and definition. For present purposes, use is made of ruble data in the first Five Year Plan and in a 1936 statistical handbook. The first Five Year Plan gives base year actual figures for 1927/28 and terminal-year targets for 1932/33, covering both industrial fixed assets and gross industrial output in each of 27 regions. By 1934, regional subdivisions had been considerably reorganized, but it has proved possible to match new regions with old, especially since regions are here grouped into twelve large areas.

The base year values are in rubles "at 1926/27 prices." Plan targets for 1932/33 are similarly presented in rubles at "1926/27 prices." In comparing actual with intended results, data for 1934, purportedly in the same "1926/27 prices," are employed. Adjustments of the gross output series proved both necessary and possible; the fixed asset series, however, stands as taken from the sources.

The national total for industrial fixed assets was put, in the first Five Year Plan, at 10,706 million rubles as of October 1, 1928, using "1926/27 prices." The coverage is stated as: "basic funds of state industry planned by VSNKH, at full replacement costs." A smaller total of 7,081 million rubles shows their "real value taking account of depreciation," and both

series are shown for each region on October 1, 1928 and as projected for October 1, 1933. The text of the first plan properly focuses attention on the smaller, depreciated asset series. However, the regionally subdivided industrial asset data in the 1936 handbook appear to involve the larger coverage. The coverage is stated as: "productive basic funds for large-scale industry on January 1, 1935," and the national total of 35,391 million rubles is shown as part of a continuous annual series from 1928 through 1934 with a figure for the end of 1928 of 10,262 million rubles. On this slender evidence, I assume that no drastic revaluations have influenced this asset series.

The 1927/28 data and 1932/33 targets in the first Five Year Plan for gross industrial production are presented with the same institutional coverage as the fixed asset series. The national total for 1927/28 is given as 11,244 million rubles. However, the 1936 statistical handbook presents a continuous annual series for calendar years 1928 through 1934 in which the 1928 figure is 16,860 million rubles at "1926/27 prices." Clearly the 1936 handbook estimate involves either an extension of coverage to enterprises not covered in the first plan figures, or a substantial upward revaluation of the base period data. In either case the effect is to show a lower rate of growth in industrial output than would be implied by comparing the 1936 handbook's figures for 1934 with the first plan's figure for 1928. To compare the actual 1934 regional output figures with the targets for 1933 in the first Five Year Plan, I have reduced the reported 1934 data through multiplying them by 0.6669, the ratio between 11,244 and 16,860, after making two other adjustments.

One small adjustment is required for coal production, the value of which in 1934 was about 2 percent of total industrial output. As Nancy Nimitz has shown, output from new mines came to be valued at increasingly higher prices after 1932 and the resulting distortion differed among regions. Without changing the national ruble total for 1934 coal output, I have applied her adjustments[1] to revalue certain regional output figures as follows:

Region	Net Change (Thousands of rubles)
Southwest European Russia	22,161
Central Industrial Region	−25,830
North Caucasus	2,194
Transcaucasus	1,326
Ural Region	− 4,442
Kazakhstan and Central Asia	−20,193
Siberia and Soviet Far East	24,784

[1] See Nancy Nimitz, *A Dollar Index of Soviet Coal Output, 1927/28-1937* (RM-1042; RAND Corp., 1953), pp. 30-31 and 57.

TABLE A-1. *Soviet Industrial Capital Stock and Output, by Region, 1928, Plan 1933, and Actual 1934*[a]
(In millions of 1926/27 rubles)

Region	Initial Value, 1928		Planned Value, 1933		Actual Value, 1934	
	Capital Stock	Output	Capital Stock	Output	Capital Stock	Output
Leningrad Oblast	1,191	1,408	1,870	3,440	3,867	4,866
West European Russia	259	299	608	911	935	1,111
Southwest European Russia	2,770	2,172	6,343	5,708	7,983	6,590
Central Industrial Region	3,236	4,463	5,235	11,262	8,780	11,236
Central Black Earth Region	195	220	564	533	872	669
North Caucasus	574	551	1,303	1,562	1,736	1,628
Transcaucasus	1,167	607	1,835	1,434	1,867	1,488
North European Russia	135	217	584	758	845	844
Volga Valley	332	400	1,039	1,126	2,072	1,985
Ural Region	445	404	2,287	1,522	3,163	1,618
Kazakhstan and Central Asia	223	350	960	1,054	1,020	930
Siberia and Soviet Far East	179	153	1,073	784	2,251	1,457
Total U.S.S.R.	10,706	11,244	23,701	30,089	35,391	34,422

[a] Compiled from data for 27 regions in Gosplan SSSR, *Piatiletnii plan narodno-khoziaistvennogo stroitel'stva SSSR* (3d ed.; 1930), Vol. 3, pp. 582–84, and for 41 regions in Tsentral'noe Upravlenie Narodnogo-Khoziaistvennogo Ucheta, *Sotsialisticheskoe stroitel'stvo SSSR* (1936), pp. 57–58. Place of publication of all Russian language titles is Moscow, unless otherwise noted.

The output of machinery, accounting in 1934 for some 20 percent of total gross industrial output, is here adjusted on the basis of Moorsteen's careful work.[2] His price index for 1934, using fixed weights of 1927/28, shows a modest decline from the initial 1927-28 level, reflecting production cost decreases in the categories of machinery whose output had grown very rapidly. Fortunately the 1936 handbook subdivides its 1934 regional output figures by product category. I have multiplied the machinery ruble figures by 1.0769, the ratio of 70 to 65, Moorsteen's 1928 and 1934 index numbers with 1937 equal to 100.

In the case of petroleum, as of coal, the ratio of 1934 to 1928 output in ruble terms was so close to the ratio of 1934 to 1928 output in metric tons

[2] See Richard Moorsteen, *Prices and Production of Machinery in the Soviet Union* (Harvard University Press, 1962), p. 72.

as to indicate no major price changes. According to the 1936 statistical handbook, the ruble value of the petroleum industry's 1932 output was 96 percent greater than its 1928 value, while its physical output in metric tons rose 111 percent for petroleum alone, and 118 percent for petroleum and natural gas together. After 1932, however, prices of refined petroleum products were sharply raised through the imposition of steep turnover taxes. In comparing 1934 with 1928, I suggest that the unadjusted 1934 ruble data will not convey a distorted impression.

For the period we are considering, official industrial prices remain almost unchanged, according to a careful independent reconstruction. "The rise in Soviet basic industrial prices for the entire period 1928-1950 occurred almost entirely in the period 1933-41 and in the year 1949. Prior to 1933, prices actually tended to decline, but only to a very limited extent. . . . The price increase between 1933 and 1941 is in good part attributable to a major price reform which the government instituted in the spring of 1936 . . . we have been referring to our over-all indexes in-

TABLE A-2. *Discrepancies in Soviet Regional Fixed Capital Increments, 1928–Plan 1933 and 1928–Actual 1934*[a]

Region	Millions of 1926/27 Rubles			Percentage Excess	Discrepancy in Percentage Share
	Planned 1928–33	Actual 1928–34	Excess		
Leningrad Oblast	679	2,676	1,997	294	+5.61
West European Russia	349	676	327	94	+0.05
Southwest European Russia	3,573	5,213	1,640	46	−6.37
Central Industrial Region	1,999	5,544	3,545	177	+7.08
Central Black Earth Region	369	677	308	83	−0.10
North Caucasus	729	1,162	433	59	−0.90
Transcaucasus	688	700	32	5	−2.31
North European Russia	449	710	261	58	−0.58
Volga Valley	707	1,740	1,033	146	+1.61
Ural Region	1,842	2,718	876	48	−3.16
Kazakhstan and Central Asia	737	797	60	8	−2.44
Siberia and Soviet Far East	894	2,072	1,178	132	+1.51
Total U.S.S.R.	12,995	24,685	11,690	90	0

[a] Source: Table A-1.

TABLE A-3. *Discrepancies in Soviet Regional Gross Output Increments, 1928–Plan 1933 and 1928–Actual 1934*[a]

Region	Millions of 1926/27 Rubles			Percentage Excess	Discrepancy in Percentage Share
	Planned 1928–33	Actual 1928–34	Excess		
Leningrad Oblast	2,032	3,458	1,426	70	+4.14
West European Russia	612	812	200	33	+0.25
Southwest European Russia	3,531	4,418	887	25	+0.32
Central Industrial Region	6,799	6,773	−26	−0.4	−6.86
Central Black Earth Region	313	449	136	43	+0.28
North Caucasus	1,011	1,077	66	7	−0.71
Transcaucasus	827	881	54	7	−0.59
North European Russia	541	627	86	16	−0.17
Volga Valley	726	1,585	859	118	+2.99
Ural Region	1,118	1,214	96	9	−0.69
Kazakhstan and Central Asia	704	580	−124	−18	−1.24
Siberia and Soviet Far East	631	1,304	673	107	+2.28
Total U.S.S.R.	18,845	23,178	4,333	23	0

[a] Source: Table A-1.

clusive of petroleum products. Exclusive of oil, basic industrial prices are nearly stable from 1928 to 1935. . . ."[3]

It may some day be possible to reconstruct these regional data for both industrial assets and industrial output using 1934 weights instead of 1928 weights. The change in weights would surely influence the extent and pattern of regional shifts over this period, though it is hard, a priori, to predict the direction of the alterations. Meanwhile, the available data, using base period weights, are instructive, especially since we are comparing plans necessarily made in terms of base period weights with results actually achieved. The absolute data are presented in Table A-1. Derived figures, comparing planned changes with actual developments and calculating various discrepancies, are presented in Tables A-

[3] See Abram Bergson, Roman Bernaut, and Lynn Turgeon, "Prices of Basic Industrial Products in the U.S.S.R., 1938-50," *Journal of Political Economy*, Vol. 64 (August 1956), pp. 325-26.

TABLE A-4. *Discrepancies in Soviet Capital and Output Results, by Region, Plan 1933 and Actual 1934*[a]

Region	Percentage Excess of Actual Over Planned ICOR[b]	Actual Minus Planned Percentage Share		Percentage Excess of Actual Over Planned ACOR[c]
		Fixed Capital	Gross Output	
Leningrad Oblast	133	+3.04	+2.71	46
West European Russia	46	+0.07	+0.21	25
Southwest European Russia	17	−4.20	+0.20	9
Central Industrial Region	183	+2.72	−4.79	70
Central Black Earth Region	28	+0.08	+0.17	23
North Caucasus	50	−0.59	−0.47	29
Transcaucasus	−2	−2.47	−0.45	−2
North European Russia	36	−0.07	−0.07	30
Volga Valley	13	+1.47	+2.02	13
Ural Region	36	−0.71	−0.36	30
Kazakhstan and Central Asia	30	−1.17	−0.80	21
Siberia and Soviet Far East	12	+1.83	+1.63	12
Total U.S.S.R.	55	—	—	30

[a] Source: Tables 2 and 3, Chap. 2.
[b] Incremental capital-output ratio.
[c] Average capital-output ratio.

2, A-3, and A-4. These are the data that underlie Tables 1-3, Figures 3 and 4, and the associated discussion in Chapter 2.

APPENDIX B

A Historical Soviet Railroad Production Function

BY HOLLAND AND HELEN M. HUNTER*

Since 1928, Soviet railroads have greatly increased their output of services, both freight and passenger. The increases have been obtained through a large variety of measures, and it is important in understanding the Soviet record to estimate the relative contribution made by each of the major factors involved. This is the purpose of the present appendix.

The reader familiar with current Western econometric literature on production functions will recognize that the usual approach to industry production functions[1] is not followed here. A cross-section approach is not possible because most of the systematic data on Soviet railroads are published only on a national basis. The profit-maximizing or cost-minimizing assumptions that permit the use of input prices or factor shares for estimating purposes do not fit the Soviet institutional framework. Thus the pioneer work on railroad production and cost functions by Borts, Klein, and Meyer *et al.* cannot be drawn on.[2]

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[1] See the thorough review article by A. A. Walters, "Production and Cost Functions," *Econometrica*, Vol. 31, No. 1-2 (January-April 1963), pp. 1-66, including an extensive bibliography. The monograph by Marc Nerlove, *Estimation and Identification of Cobb-Douglas Production Functions* (Rand-McNally, 1965), provides an analytic survey.

[2] See George H. Borts, "Production Relations in the Railway Industry," *Econometrica*, Vol. 20, No. 1 (January 1952), pp. 71-79; "Increasing Returns in the Railway Industry," *Journal of Political Economy*, Vol. 62, No. 4 (August 1954), pp. 316-33; "The Estimation of Rail Cost Functions," *Econometrica*, Vol. 28, No. 1 (January 1960), pp. 108-31; Lawrence R. Klein, *A Textbook of Econometrics* (Row, Peterson, 1953), pp. 226-36; and John R. Meyer *et al.*, *The Economics of Competition in the Transportation Industries* (Harvard University Press, 1964), especially Appendices B and C, pp. 277-347.

The search for a feasible approach led up some false, or at least uninformative, paths. The first involved attempts to attach "augmenting factors" to individual railroad inputs, in imitation of the Solow-Denison approach to an aggregate production function, to see if the quality gains that came with technological progress could be divided up and assigned to the major inputs. The second involved attempts to measure the separate contributions of railroad motive power, rolling stock [illegible] facilities in producing freight traffic output. Neither approach proved to be manageable with the Soviet data available. However, the introduction of a utilization measure as a separate variable *did* yield significant and interpretable results. After brief discussion of the analytic difficulties confronted, these results are presented below.

An initial problem arose in selecting the units in which to measure outputs and inputs. In railroading, both are very diverse. Ordinarily economists would seek to aggregate the various inputs and outputs under a few major heads and use their money values as a common denominator. In a market economy, given several fairly plausible assumptions, there is a theoretical rationale for this procedure. Essentially it argues that marginal rates of substitution between pairs of inputs on a physical production surface can be approximated by ratios between the prices of these inputs, since the ratios in which inputs are used will be such as to minimize the cost of producing a given output. But in Soviet experience, the choice of input combinations has not depended on their prices, and the prices assigned to factors of production have been somewhat arbitrary. This suggests, therefore, that physical measures of Soviet railroad relationships may be more meaningful than the usual money measures. At the same time we should remind ourselves that highly aggregated physical composites are still very heterogeneous and therefore subject to index-number difficulties. Moreover, it will be shown in due course that a series assembled from Soviet ruble data on railroad total fixed assets seems to record the contribution of railroad capital in much the same way that a physical measure does.

The services produced by railroads take the form mainly of passenger-miles and freight ton-miles. Here the focus is on freight traffic as being fundamental in economic development, though the influence of passenger traffic is briefly examined. Output measured in metric ton-kilometers of freight carried per time period has the dimensions of weight, distance, and speed; they should ideally be separately measured, since users of freight service are not in general willing to exchange tons for kilometers, say, or distance for speed. At present, however, statistical decomposition of these traffic dimensions does not seem possible.

A related difficulty arises because, assuming demand in excess of supply as has generally been true in the U.S.S.R., an increase in the speed of movement permits an increase in the annual total of ton-kilometers carried. Ton-kilometers per year, divided by (365 times 24), equals ton-kilometers per hour. With higher speeds, the weight and/or distance carried can be raised. Thus higher speed, a qualitative improvement in railroad service from the customer's point of view, shows up quantitatively as an increase in traffic output.

There are major dimensional dilemmas relating to the measurement of inputs. The services of both locomotives and freight cars can be measured in flow terms as well as stock terms; that is, annual locomotive-kilometers run in freight service and annual freight car-kilometers run can be used as alternatives to the number of locomotives and cars owned or in active service. And where output is clearly a flow of services, it would seem logical that inputs, too, should be measured as flows. A difficulty arises, however, because freight ton-kilometers, train-kilometers, locomotive-kilometers, and car-kilometers all move very closely together. The quotient of annual net ton-kilometers of freight carried over annual freight car-kilometers run, for example, is simply the average net load per car (loaded only or loaded-plus-empty, depending on which series is used in the denominator). These ratios (tons per car, tons per train, cars per train, etc.) change rather slowly and steadily on a large railroad system. Thus if the services of railroad capital equipment are measured in flow terms with a distance dimension, and the measure of railroad output contains this same distance dimension, very nearly the same thing appears on both sides of the equation, and distance run cannot "explain" distance run.

However, if railroad capital inputs are measured in stock form, there will still be difficulties, because as Klein points out: "For the stock variables to be meaningful input factors, we implicitly assume a constant rate of capacity utilization."[8] Since it is clear that the rate of capital utilization on Soviet railroads has changed substantially, the use of a stock measure for railroad capital by itself it not likely to be adequate. For this reason, explicit measures of capital utilization should be introduced in an attempt to measure the separate influence of this variable. The railroad industry is unusual in generating direct physical measures of the intensity of equipment use. It is worth noting that combining the stock of an input and the rate at which it is used in a logarithmic equation (in which the independent variables are multiplied together) has

[8] See Lawrence R. Klein, *An Introduction to Econometrics* (Prentice-Hall, 1962), p. 85.

the effect of decomposing the flow of input services into two parts: the stock and its rate of use. Total car-kilometers run annually by a given stock of freight cars, for example, are equivalent to the product of the car stock multiplied by the annual car-kilometers traveled by the average car. The latter is a measure of the rate of utilization of freight cars. It will be seen below that in the Soviet case these two components of the flow of car services both changed markedly and importantly, in different ways in different years.

The motivation for attempting to distinguish the separate contributions of motive power, rolling stock, and line facilities to Soviet railroad expansion lies in the potential lessons for others concerned with raising the capacity of a railroad system in the process of economic development. Investment could be channeled toward each form of capital plant and equipment in proportion to its effectiveness in raising freight traffic output. Though these three types of railroad capital operate jointly rather than singly, the question of optimum proportions is important. Unfortunately, however, statistical difficulties had the effect of masking the separate roles of these inputs, and recourse was therefore had to two other ways of measuring the services of total railroad capital.

The measurement of "technological progress" causes additional complications. To a considerable extent, increases in a utilization variable are likely to reflect technological progress. One can, for example, run more trains per day on a given stretch of track if the signaling system is improved. Thus the utilization variable will reflect, in part, quality improvements in the capital stock. It will also, however, reflect improvements in efficiency of management, the morale of the labor force, or helpful changes in the composition of the work being performed. One separate way to estimate technological change is to introduce a trend factor, a variable consisting simply of the number of years elapsed since the initial year. A positive coefficient for such a trend variable would suggest that there has been some systematic increase in output over and above what can be accounted for by quantitative input increases and more intensive factor utilization.

Statistical production functions traditionally employ a small number of independent variables in an attempt to account for changes in output as the dependent variable. A linear equation is usually fitted to the logarithms of the independent variables. This implies that the causal relationship is multiplicative rather than additive, that output is the weighted product of the causal variables, instead of their weighted sum. The weights are the estimated coefficients of the variables, and when the equation is written in nonlogarithmic form, the weights appear as expo-

nents. Where the individual exponents have values less than one, the individual inputs will display diminishing returns, while if the sum of the exponents exceeds one, the process as a whole will display increasing returns to scale. Such a form seems appropriate to railroading.

When one shifts from these methodological issues to the actual data, it turns out that Soviet sources contain a good deal of usable information (a detailed account of its compilation is provided in Table D-6, Appendix D). However, while the output and labor force data are directly available, and the trackage series contains only a small element of estimation, the locomotive and freight car series had to be derived through a number of indirect steps (explained in Table D-6, Appendix D). Possible error is thus introduced, as well as artificial smoothing which weakens the regression approach. Figures are assembled for the thirteen prewar years from 1928 through 1940 and for fourteen postwar years from 1950 through 1963.

The following checklist shows the variables that were tried out in this investigation, the symbols assigned to them, and their precise dimensions:

O = output of freight traffic, measured in metric ton-kilometers ("operating" rather than "tariff").

O' = estimated output.

P = passenger traffic, measured in passenger-kilometers of suburban and long-distance carriage.

M = motive power input, measured either as the annual total of principal locomotive-kilometers run in freight service or as the aggregate metric tons of tractive effort available in the Soviet freight locomotive stock.

C = freight car input, measured either as the annual total of freight car-kilometers run in freight service, both empty and loaded, or as the aggregate metric tons of carrying capacity in the Soviet freight car fleet.

T = total trackage of railway line, measured in kilometers, including first main track (route mileage), second tracks, and all additional track operated by the railroads, but excluding noncommon-carrier trackage.

L = the average annual number of men and women in the "operating" portion of the railroad labor force, that is, exluding workers engaged in construction, capital repairs, loading-and-unloading, and a few other nonoperating occupations. Manhour data are not available.

$A(t)$ = a trend term recording the average annual percentage rate of growth in traffic output that is not accounted for by other independent variables.

TK = annual freight train-kilometers per route-kilometer, a use-factor variable reflecting the average intensity with which line facilities are used in each year.

CK = average freight car-kilometers per active car-day, an alternative use-factor variable reflecting the average intensity with which rolling stock is used in each year.

K = railroad fixed assets, measured in rubles, roughly adjusted to a constant price level.

Other variables, such as fuel input or a separate series for activity in classification and marshaling yards, might well be studied, but as less information on them is available and as the small number of observations limits the number of variables that can be significantly considered, no other variables were tested.

Experiment demonstrated, in fact, that not all these variables could be simultaneously employed, because of excessive multicollinearity among the three series for capital plant and equipment when used along with railroad labor to explain freight traffic output. Table B-1 shows the simple correlation coefficients that were obtained by regressing stock measures of Soviet railroad motive power, freight cars, total track, and operating labor on railroad freight ton-kilometers. When data are as closely correlated as these are, the estimation of the separate influence of individual inputs becomes extremely difficult. As one would expect, the use of *flow* measures for motive power and car input leads to simple correlation coefficients that are scarcely different from one.

The individual coefficients in a multiple regression equation show the

TABLE B-1. *Simple Correlation Coefficients Among Stock Measures of Soviet Railroad Motive Power, Freight Cars, Total Track, Operating Labor, and Traffic Output, 1928–40 and 1950–63*

Stock Measure	Motive Power	Freight Cars	Total Track	Operating Labor	Traffic Output
Motive power	1.000	—	—	—	—
Freight cars	0.985	1.000	—	—	—
Total track	0.991	0.988	1.000	—	—
Operating labor	0.993	0.977	0.988	1.000	—
Traffic output	0.986	0.996	0.982	0.975	1.000

isolated effect of each variable on the dependent variable, after the effect of the other independent variables has been accounted for. Though the combined influence of all variables together may still be accurately predicted in cases like this, the individual variables are too closely interrelated to permit their individual impacts to be revealed.

Under these conditions, a possible remedy may be to use one of the closely related variables as a proxy to represent the group: in the present case, to use one of the three railroad plant and equipment series to represent all railroad capital. Statistical experiment showed that the stock of freight cars, when combined with railroad labor and a utilization measure as explanatory variables, gave meaningful results. Neither motive power nor total track yielded reasonable or significant statistical outcomes; they were therefore abandoned. At the same time a Soviet series for the ruble value of all railroad capital was retained as an aggregate measure of the capital stock, since it appeared to explain the role of capital in much the same way that the freight car series did.

In sum, the results presented below relate the freight traffic growth that has been achieved by Soviet railroads to four major explanatory variables: railroad capital (measured either in money or in physical form), the rate of capital utilization (measured in one of two ways), the input of railroad labor, and a trend factor intended to reflect "technological progress."

Results with Aggregate Ruble Capital Stock Measures

Estimates and residuals of a traditional production function fitted by least squares to the logarithms of absolute values for railroad fixed assets, measured in rubles, and the railroad labor force are shown in Figure B-1. The equation is as follows:

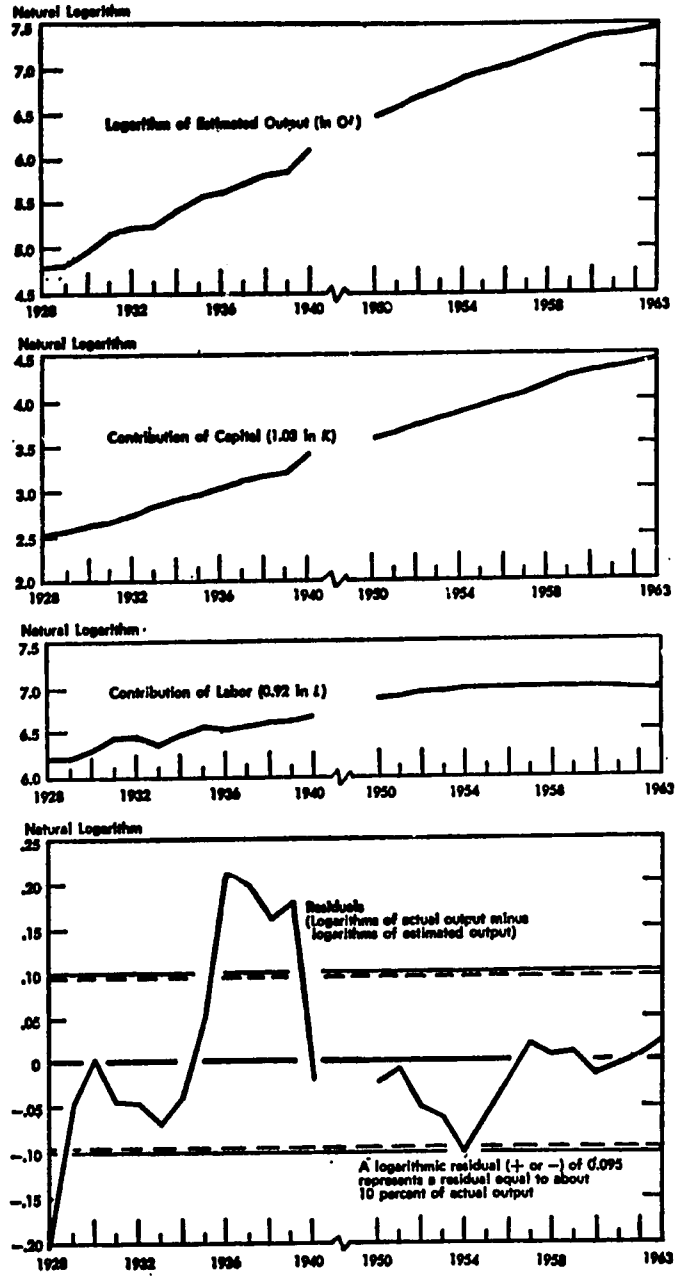
$$\ln O' = \underset{(1.3)}{-3.94} + \underset{(0.11)}{1.03} \ln K + \underset{(0.23)}{0.92} \ln L \qquad (1)$$

$$R = 0.995 \quad S = 0.096$$

The figures shown in parentheses are the standard errors of the coefficients—a measure of their expected variability from sample to sample. These standard errors are not directly a part of the estimating equation, but if the coefficients above them are more than two or three times as large, a nonaccidental relationship is indicated. R is the coefficient of multiple correlation. It is the square root of the ratio between the variation in output over time that can be attributed (according to this equa-

Figure B-1. *Results of Fitting Equation (1), 1928-63*

Equation (1): $\ln O' = -3.94 + 1.03 \ln K + 0.92 \ln L$



tion) to the independent variables, and the total variation in output. That is, it represents the proportion of total variation in output (O) "explained" by the equation. S is the standard error of estimate, a kind of average of the residuals (the difference between actual and estimated output).

In nonlogarithmic form, this equation would be

$$O' = 0.19K^{1.03}L^{0.92} \tag{1a}$$

The sum of the coefficients of capital and labor is almost equal to 2, indicating strong increasing returns to scale in railroad freight traffic production. Equal proportionate increases in both inputs have historically produced almost twice as large a proportionate increase in output.

All of the coefficients of the equation are significant, in the sense that they are too large to be the result of random association of variables. The equation thus supports the common-sense assumption that changes in railroad traffic output have been systematically related to changes in labor input and the services of railroad capital.

It should be noted that, because the relationship assumed here is multiplicative rather than additive, logarithms of the estimates and residuals are graphed in Figure B-1 instead of absolute values. It is difficult for the eye to comprehend multiplicative relationships graphically, but in using logarithms the process of multiplication becomes additive and it is relatively easy to see how the logarithmic changes in the independent variables add up to the total change in the dependent variable. The reader should remember, however, that what look like equal absolute changes are really equal relative changes.

Comparing the residuals graphed in Figure B-1 with those obtained from the following equations shows that the year-by-year estimates derived from equation (1) are a poor fit. They differ much more substantially from actual output (as we shall see) than do estimates obtained from equations (2) through (6). This is probably because no term is included here to represent the rate of utilization of the capital stock. In equation (2) such a term has been added to the value of capital stock and labor. Figure B-2 shows the results.

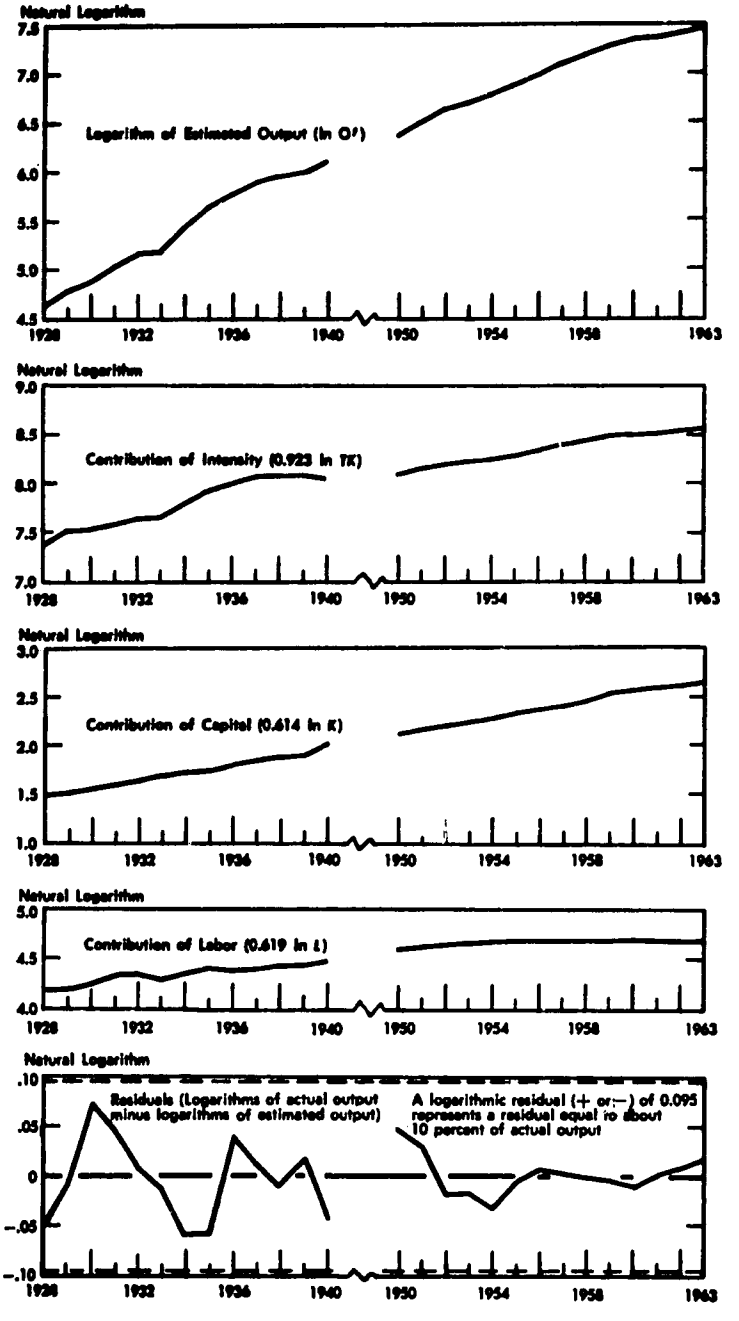
$$\ln O' = \underset{(0.62)}{-8.45} + \underset{(0.05)}{0.61} \ln K + \underset{(0.09)}{0.62} \ln L + \underset{(0.08)}{0.92} \ln TK \tag{2}$$

$$R = 0.999 \quad S = 0.036$$

The meanings of K and L are the same as in equation (1). TK is a

FIGURE B-2. *Results of Fitting Equation (2), 1928-63*

Equation (2): $\ln O' = -8.449 + 0.614 \ln K + 0.619 \ln L + 0.923 \ln TK$



measure of the intensity with which the railroad network is being used, specifically, total annual freight train-kilometers divided by the average route length of the network that year. Again the coefficients sum to more than one, indicating increasing returns to scale. This formulation gives a much better fit than equation (1), as can be seen from the smaller residuals. The time pattern of the residuals is similar in all the equations presented here: its probable meaning is discussed below.

Increases in the rate of network utilization seem to have played a major role in increasing traffic output after 1934 and again after 1955. Increases in the stock of capital seem to have contributed fairly steadily throughout the period. Labor increases seem to have been important in the early 1930's, but not since then. A constant labor force since the early 1950's has evidently been able to produce a steadily growing volume of traffic output using a growing and more efficient capital stock. These same conclusions are supported by equations (3), (5), and (6).

Another possible measure of capital utilization focuses on the use of freight cars, measured as car-kilometers per car-day. This is the annual total of freight car-kilometers run, divided by the average daily number of freight cars in active service. In equation (3) this utilization variable takes the place of TK in equation (2).

$$\ln O' = \underset{(0.81)}{-6.34} + \underset{(0.09)}{0.55} \ln K + \underset{(0.13)}{0.71} \ln L + \underset{(0.15)}{1.1} \ln CK \qquad (3)$$

$$R = 0.998 \quad S = 0.055$$

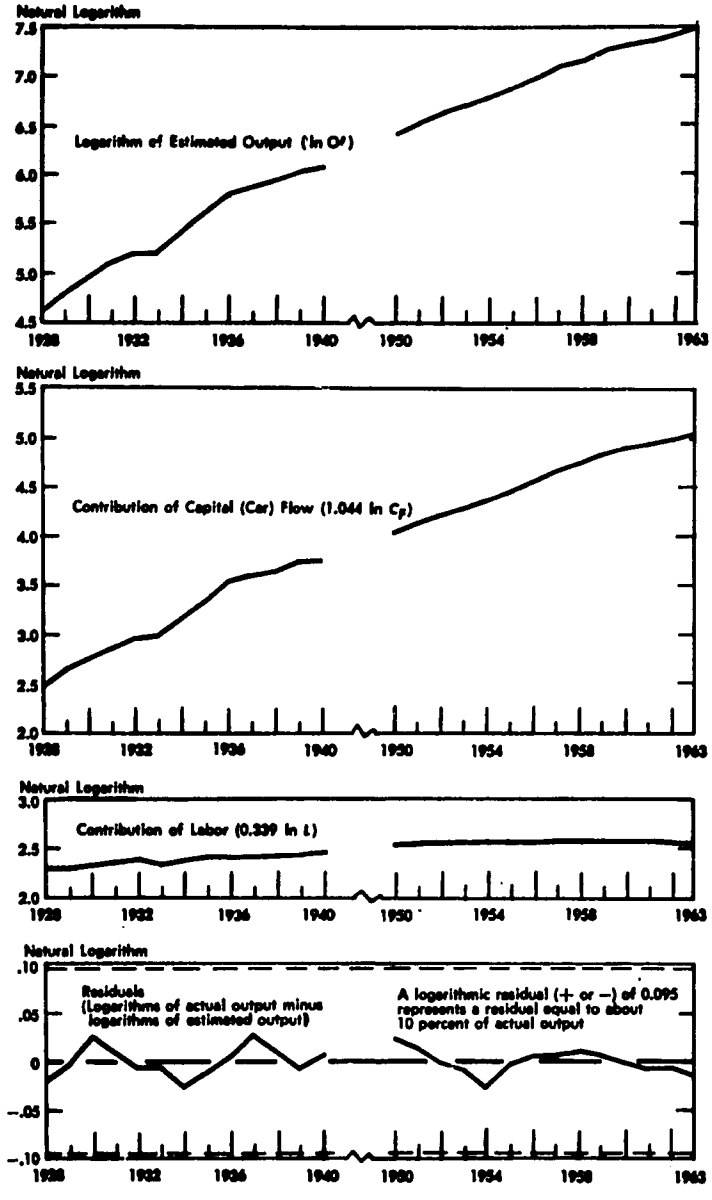
The estimates made from this equation are very similar to those from equation (2), except that the residuals are larger. The reason for this is not obvious, since the estimated effects of network utilization and car utilization look much alike. Perhaps network use reflects more accurately than car use the contribution of all the forms of railroad plant and equipment taken together.

Results Using Freight Cars to Represent Total Railroad Capital

It was explained above that freight car capacity seems to be the best variable to use to represent a physical measure of the railroad capital stock. Its use permits one interesting variation on the usual production function. This is shown in equation (4). Here, output has been expressed as a function of the *flow* of capital services (that is, total car kilometers run per year, indicated by C_F) together with labor.

Figure B-3. *Results of Fitting Equation (4), 1928-63*

Equation (4): $\ln O' = -0.156 + 1.044 \ln C_p + 0.338 \ln L$



$$\ln O' = \underset{(0.22)}{-0.16} + \underset{(0.01)}{1.04} \ln C_F + \underset{(0.04)}{0.34} \ln L \qquad (4)$$
$$R = 0.999 \quad S = 0.014$$

As Figure B-3 shows, this equation gives the best fit, that is, the lowest residuals, of any of the equations presented here, but it does not follow that this is the most meaningful or useful formulation. The close fit and high correlation actually reflect the dimensional similarity between car-kilometers and ton-kilometers (the measure used for railroad freight traffic output). We are almost regressing output against itself, and must therefore necessarily expect a very close fit.

It will be noted that the sum of the coefficients of the independent variables in this case is lower than in all the other equations, being about 1.4 compared to about 2.0. This reflects the fact that car-kilometers have increased more rapidly than has the stock of cars or the stock of other capital equipment, precisely because of intensified car utilization.

Equation (5) is a reformulation of equation (4). It uses both the stock of freight cars (C_S) to represent capital stock, and the rate of car use (CK). A plausible (but poorly fitting) equation can also be obtained using only car stock and labor, but this is subject to the conceptual problems already noted. Logically the product of car stock and car utilization should be the flow of car services that was measured in equation (4) as C_F.

$$\ln O' = \underset{(0.66)}{-3.17} + \underset{(0.07)}{0.85} \ln C_S + \underset{(0.10)}{0.25} \ln L + \underset{(0.09)}{1.03} \ln CK \qquad (5)$$
$$R = 0.999 \quad S = 0.025$$

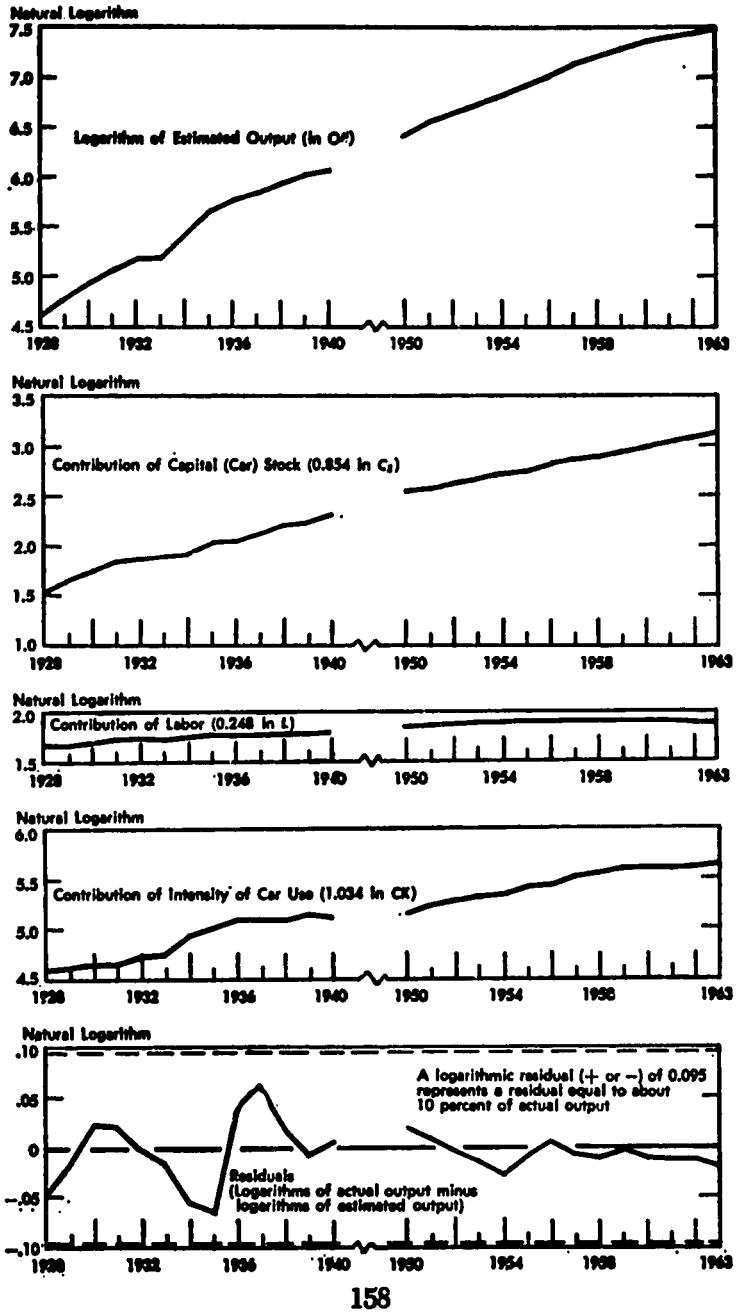
It is interesting to compare the estimates obtained in equations (4) and (5)—graphed in Figures B-3 and B-4. The increases in the flow of car services from 1928 to 1933, for example, were evidently the result principally of increases in the stock of cars. From 1933 through 1936, however, the rate of utilization became more important. In recent years, on the other hand, both variables have contributed to the increasing flow of car services, with car stock adding slightly more than car utilization.

The sum of the coefficients of equation (5) is again around 2.0, indicating that neither utilization nor stock increased individually as rapidly as output did, on a proportionate basis.

In equation (6), network utilization was substituted for car utilization, with car stock again representing capital stock.

FIGURE B-4. *Results of Fitting Equation (5), 1928-63*

Equation (5): $\ln O' = -3.175 + 0.854 \ln C_s + 0.248 \ln L + 1.034 \ln CK$



$$\ln O' = \underset{(0.71)}{-5.4} + \underset{(0.06)}{0.89} \ln C_S + \underset{(0.09)}{0.24} \ln L + \underset{(0.07)}{0.84} \ln TK \qquad (6)$$
$$R = 0.999 \quad S = 0.030$$

The resulting equation does not give as good a fit as equation (5) did, but both (5) and (6), like (2) and (3), seem to provide a plausible picture of the basic forces at work. Most of the residuals are below 5 percent of actual output, and none is as great as 10 percent of the actual level of output in any year.

Other Factors Affecting Output—The Pattern of the Residuals

Scrutiny of the graphs discloses a similarity of the residuals attached to all of the equations. First, actual output was lower in 1934 than might have been expected from these equations, and (in all but one case) also lower in 1933 and 1935. Conversely, it was higher than expected in 1936, 1937, and (again with one exception) in 1938. The low performance in 1933-35 is fully consistent with what we know of this period. The economy was emerging from a great crisis brought on by collectivization of agriculture, and the railroads were overwhelmed with freight traffic backlogs. For some reason these railroad performance residuals show up with a two-year lag. By the same token, the high achievements of 1936-38 evidently reflect, with perhaps a one-year lag, the improved general economic conditions of the mid-1930's and the greater attention given to the railroads. These factors evidently led to increases in efficiency not measured completely by our independent variables. It should be emphasized that these forces also probably worked on the independent variables themselves (for example, when Stalin "turned his attention to transportation," in 1934 the rate of utilization of railroad capital rose). What the residuals show is an influence going beyond this, involving elements of morale and efficiency not measured elsewhere in our equations.

A similar low level of achievement, given the size of the independent variables, appears to have occurred in the years around 1954. Output was lower than expected in 1953 and 1954 (for all the equations), and in 1955 for all but one of them. Again the pattern is consistent with what we know about the period; Stalin's death disrupted the functioning of the economy, and if our data reflect a time lag, they perhaps also show the influence of poor morale in the period just preceding his death. In all the equations, the residuals reflect marked improvement in the situation by 1956.

The three equations (4), (5), and (6) that use freight cars as a proxy

for the railroads' physical stock all have residuals indicating that railroad output since 1960 (and in one case since 1957) has fallen short of what it should have been, given the level of the car stock, their rate of utilization, and the size of the railroad labor force. In the equations using a ruble measure of railroad capital, however, recent performance appears to have been, if anything, better than might have been expected. The difference may be explained by the much greater weight given to labor in the equations using a ruble measure of capital. In recent years the railroad labor force has been constant or has even declined. Thus a formulation that gives heavy weight to labor tends to produce lower output estimates for recent years than will a formulation assigning relatively greater weight to the other inputs.

On balance it may be more sensible to assign relatively small weights to changes in the railroad labor force as an influence changing input, since Western experience indicates that the kind of technological progress Soviet railroads have been experiencing greatly increases the productivity of railroad labor. Because they weight labor heavily, the estimates using a ruble measure of railroad capital imply, in effect, that the recent lack of growth in Soviet railroad labor has been a restraining influence on railroad traffic growth. This seems unrealistic. There is little reason to think that additions to the Soviet railroad labor force could not have been made if they had been needed. It appears, therefore, that the picture presented by equations (4), (5), and (6) comes closer to the true situation, and that performance has been falling behind capability, as estimated by these equations.

In any case, the consistent pattern of the residuals for most of the period covered and their compatibility with the known course of events both strengthen the assumption that these equations do represent broadly the basic causal factors that have been at work.

Use of a Trend Variable to Reflect Technological Progress

The rate of utilization of capital stock is, as suggested earlier, a variable that probably reflects in part the influence of technological progress. To see whether there had been any systematic increases in freight traffic output going beyond what could be explained by the variables already tested, a trend factor was added to equations (2), (3), (5), and (6)—which appear to be the best formulations of the Soviet railroad production function. This was intended to change equation (6), for example, from:

$$O' = aC_S^b L^c TK^d,$$

to

$$O' = aC_S^b L^c TK^d (m)^t,$$

where m is a constant and t is the number of years. For example, m might be 1.07, indicating a 7 percent increase in each year.

If such a term were significant and the coefficients of the other variables seemed reasonable, we might conclude that traffic output rose over time for reasons other than those measured by C_S, L, and TK. The t term had to be adjusted to allow for omission of the years 1941 through 1947, when the Soviet economy was badly disrupted by the Nazi invasion and its aftermath, and the years 1948-49 for which some of the data were lacking. Values were assigned to t on the assumption that the economy in 1950 had achieved about the same level of performance as might have existed in 1943 if World War II had not intervened.

The introduction of a trend term did not produce satisfactory statistical results. In the case of equations (2), (3), and (5), the coefficient of the trend variable turned out to be either negative or insignificant or both, or to make some other coefficient (like the one for capital stock) become negative. A plausible equation did result from adding a trend variable to equation (6), but the trend term was not clearly significant.

$$\ln O' = \underset{(0.80)}{-5.63} + \underset{(0.23)}{0.49} \ln C_S + \underset{(0.14)}{0.41} \ln L + \underset{(0.08)}{0.82} \ln TK + \underset{(0.012)}{0.022t}$$

$$R = 0.999 \quad S = 0.034 \tag{6a}$$

The antilogarithm of 0.022 is 1.022, indicating a 2.2 percent average annual rise in freight traffic output attributable to "technological progress."

The way in which addition of the trend variable changes the other input coefficients does not appear especially meaningful. It has the principal effect of decreasing the importance of changes in railroad capital and increasing the importance of changes in the railroad labor force. The utilization factor is unaffected.

On balance, considering all the equations, these results do not support the hypothesis that there has been an element of technological progress at work going beyond the gains that are embodied in the utilization variable. Alternatively, technological progress may not have occurred in a trend-like fashion.

The Effect of Passenger Travel

When Lawrence Klein made a cross-section analysis of American railroad data for 1936, he introduced passenger traffic as an independent variable, competing for the use of railroad capital and labor, and obtained a satisfactory negative coefficient for it. Soviet railroads since 1928, and especially since 1950, have seen relatively modest growth of passenger traffic, which in any case is not permitted to encumber freight traffic operations on major interregional trunk lines. Moreover, in the present investigation, the motive power and car input series are confined to the freight fleet. Nevertheless, it is worth asking whether increases in Soviet railroad passenger traffic have taken place at the expense of freight traffic. Statistically, such an effect might be expected to display itself as a negative coefficient for passenger-kilometers carried if such a term is added to equations (2) and (3) or (5) and (6). This would occur if, in years when there is a large increase in passenger traffic, there tended to be an appreciably smaller increase in freight traffic than might otherwise have been expected. The statistical results gave no support to this possibility. In every case, the coefficient of passenger traffic turned out to be small but positive. Except in the case of equation (3), it also turned out to be insignificant. In this context, the positive coefficient merely reflects the time-series fact that freight and passenger traffic on Soviet railroads have usually grown simultaneously.

Conclusions

The four equations—(2), (3), (5), and (6)— in which ton-kilometer freight traffic output is specified as a function of the railroad capital stock, its rate of utilization, and the railroad labor force give plausible estimates for what appear to be the broad determinants of the level of freight traffic carried by Soviet railroads. The equations differ in the way in which they measure the inputs, but all appear to lead to the following conclusions:

1. Soviet railroad traffic growth has been strongly influenced by both capital stock increases and improved rates of capital utilization. Their estimated relative importance depends on which versions of capital stock and capital utilization are used, but the results summarized in Table B-2 suggest strongly that the rate of utilization has played a major

TABLE B-2. *Alternative Estimates of Capital and Labor Contributions to Increased Freight Traffic Output, Soviet Railroads, 1928–40 and 1950–63*
(In logarithmic shares)

Factor Responsible for Increase	Variables in Equation[a]				
	Equation (2): K, L, TK	Equation (3): K, L, CK	Equation (5): C_S, L, CK	Equation (6): C_S, L, TK	Equation (6a): C_S, L, TK, t
1928–40					
All equation variables	1.49	1.36	1.45	1.57	1.51
Increased capital stock	0.52	0.47	0.81	0.84	0.47
Rate of utilization	0.68	0.55	0.52	0.61	0.60
Labor	0.29	0.34	0.12	0.12	0.17
Trend	—	—	—	—	0.27
1950–63					
All equation variables	1.09	1.09	1.10	1.08	1.10
Increased capital stock	0.53	0.41	0.59	0.61	0.34
Rate of utilization	0.48	0.49	0.49	0.43	0.42
Labor	0.08	0.19	0.02	0.04	0.05
Trend	—	—	—	—	0.29

[a] K = capital stock; L = labor; TK = intensity of track use; CK = intensity of car use; C_s = capital car stock; = trend.

role. This is true even in equation (6a) where a trend factor for technological progress was added.

2. Changes in the size of the railroad force have been much less important than capital stock and its utilization in explaining railroad freight traffic growth, especially over the last fifteen years. This reflects the increasing productivity of labor making use of modern railroad capital.

3. The pattern of the residuals (actual output minus estimated output) over time strongly suggests that influences in the surrounding political environment also affected the efficiency of railroad operations, if one defines efficiency as performance at the levels implied by long-run relationships with the level of railroad capital, its utilization, and railroad labor input.

4. Changes in the variables employed in equations (2), (3), (5), and (6) appear to incorporate the influence of technological progress on Soviet railroad performance. At least there seems to be no further significant rise in output over time beyond what these variables "ex-

plain." The utilization variable evidently incorporates technological progress with other intangible gains in the efficiency of railroad performance.

5. Variations in Soviet passenger traffic since 1928 do not seem to have had a statistically perceptible effect on the growth of freight traffic. As noted in Chapter 4, the fact that Soviet railroads were relatively free of a passenger traffic burden has been of non-negligible assistance to the railroads in handling growing freight traffic.

APPENDIX C

The Stock of Soviet Trucks and Their Performance

The total number of freight-carrying motor vehicles available in the Soviet economy has not been regularly reported in Soviet publications. There are, however, other fragments of information which, taken together, permit estimation of the total Soviet truck stock during the 1928-40 period and for the period since 1950. The available data, the methods used to combine them, the statistical results, and some of their immediate implications are set forth in this appendix.

The total stock on hand at the end of 1928 can be fairly well determined from a statistical publication of the Central Administration of Local Transport of the People's Commissariat of Means of Communication.[1] On the basis of a nationwide motor vehicle census carried out in 1928, it gives a figure for the beginning of the year of 7,859 trucks, of which 1,342 were special vehicles (fire engines, ambulances, etc.). Production of 740 units during the year, together with imports of 1,075 units, indicates a year-end total of 9,674 units, for December 31, 1928.

Annual production figures for subsequent years can be obtained from the Central Statistical Administration handbook, *Promyshlennost' SSSR*.[2] The production figures report trucks, passenger cars, and buses separately; comparison with the *Socialist Construction*[3] volumes of the mid-1930's shows that the *Promyshlennost'* truck series includes special

[1] Tsentral'noe Upravlenie Mestnogo Transporta, *Avtotransport SSSR* (1929), especially pp. 16, 18, and 25. Place of publication of all Russian language titles is Moscow, unless otherwise noted.

[2] Tsentral'noe Statisticheskoe Upravlenie (hereafter referred to as TsSU), *Promyshlennost' SSSR* (1964).

[3] Tsentral'noe Upravlenie Narodnogo-Khoziaistvennogo Ucheta Gosplana SSSR, *Sotsialisticheskoe Stroitel'stvo* SSSR, 1934, 1935, 1936.

Table C-1. *Number of New Trucks Available Annually in the Soviet Union, 1929–40 and 1945–65*[a]

Year	Production	Imports	Sum	Exports	Net New Availability
1929	1,471	2,361	3,832	0	3,832
1930	4,019	4,739	8,758	0	8,758
1931	3,915	2,563	6,478	0	6,478
1932	23,748	618	24,346	0	24,346
1933	39,101	97	39,198	0	39,198
1934	54,572	139	54,711	274	54,437
1935	76,854	29	76,883	734	76,149
1936	131,546	85	131,631	1.815	129,816
1937	180,339	17	180,356	3,392	176,964
1938	182,373	54	182,427	6,848	175,579
1939	178,769	7	178,776	447	178,329
1940	135,958	38	135,996	1,208	134,788
1945	68,548	—	—	—	68,548[b]
1946	94,572	—	—	—	94,572[b]
1947	121,248	—	—	—	121,248[b]
1948	173,908	—	—	—	173,908[b]
1949	226,854	—	—	—	226,854[b]
1950	294,402	—	—	—	294,402[b]
1951	229,777	—	—	—	229,777[b]
1952	243,465	—	—	—	243,465[b]
1953	270,667	—	—	—	270,667[b]
1954	300,613	—	—	—	300,613[b]
1955	328,047	30	328,077	22,900	305,200
1956	356,415	238	356,653	15,000	341,700
1957	369,504	1,201	370,705	11,900	358,800
1958	374,900	2,804	377,704	30,600	347,100
1959	351,373	3,167	354,540	24,400	330,100
1960	362,008	3,574	365,582	25,300	340,300
1961	381,617	2,435	384,052	20,200	363,900
1962	382,355	3,210	385,565	22,800	362,800
1963	382,220	3,316	385,536	24,200	361,300
1964	(385,946)	3,080	389,026	22,600	366,400
1965	379,600	3,089	382,689	16,000	366,700

[a] Sources: Production figures from TsSU, *Promyshlennost' SSSR*, p. 278. Import and export figures from MVT, *Vneshniaia torgovlia SSSR za 1918–1940 gg.*, pp. 127, 161, 191–92, 307, 340–41, 374–75, and 405; . . . *za 1955–1959 god* (1961), pp. 34–35 and 80–81; . . . *za 1959–1963 god* (1965), pp. 37 and 67; . . . *za 1964 god* (1965), pp. 25–26 and 42; . . . *za 1965 god* (1966), pp. 26–27 and 43.

[b] Exports and imports for 1945–54 have not been reported but, except for certain early postwar "imports," must have been very small.

vehicles like fire engines and ambulances, but excludes motorcycles. Annual data for imports and exports, treating all these items separately, are available for 1929-40 in the Ministry of Foreign Trade (MVT) volume on Soviet foreign trade in the 1928-40 period.[4] Detailed import and export data for 1945-54 are not presently available to be combined with production data, but the absolute volume of this trade during most of this period must have been very small. Export and import figures for 1955-64 are available from later volumes in the foreign trade series.

The stock on hand at the end of 1940 was drastically modified by the impact of World War II. Production had already been cut back somewhat after 1939, and may well have been shut down completely after June 1941, in order to free capacity for military production. A good many vehicles may have been added to the fleet in connection with the territory incorporated in the U.S.S.R. during 1940. During 1942-45, the U.S.S.R. received some 375,883 trucks (excluding jeeps and motorcycles) from the United States under Lend-Lease.[5] A wartime Soviet report on Allied aid up through April 30, 1944, indicated that out of 10,100,000 tons dispatched, 8,796,000 tons were received, for an average loss of 13 percent.[6] The percentage loss thereafter must have been much lower, so perhaps a 10 percent loss rate should be applied to the whole period. If one then assumes that half of the domestic stock plus Lend-Lease arrivals survived to the end of 1945, and that some 88,000 were acquired as "trophies" in Eastern Europe and Manchuria, a 1945 end-of-year figure of 500,000 vehicles (including modest 1945 production) is indicated.

The annual figures for production, imports, and exports assembled from these various sources are presented in Table C-1, together with the resulting series for annual net new availability of trucks in the Soviet economy.

Though the total national stock is not reported, Soviet statistical handbooks do report the total number held in the agricultural sector, together with figures for annual numbers made available to agriculture. Deduction of annual deliveries from year-end stocks yields a number that (on the assumption that no new trucks delivered during the year are lost) should approximate the number carried forward from the previous year. It will fall short of the previous year-end reported stock by the number

[4] Ministerstvo Vneshnei Torgovli (hereafter referred to as MVT), *Vneshniaia torgovlia SSSR za 1918-1940 gg.* (1960).

[5] United States Foreign Economic Administration, *21st Report to Congress on Lend-Lease Operations* (Government Printing Office, 1946), p. 25.

[6] See *Gudok*, June 11, 1944, p. 1.

TABLE C-2. *Annual Net Stock Changes and Implied Scrappage of Trucks in Soviet Agriculture, 1953–65*[a]
(In thousands of trucks)

Year	End-of-Year Reported Stock	Delivered During Year	Net Old Stock	Implied Scrappage	Implied Attrition (Percent)
1953	424	68.9	—	—	—
1954	465	115.6	349.4	74.6	17.6
1955	544	110.6	433.4	31.6	6.8
1956	631	114.2	516.8	27.2	5.0
1957	660	125.3	534.7	96.3	15.3
1958	700	102.1	597.9	62.1	9.4
1959	729	76.3	652.7	47.3	6.8
1960	778	66.1	711.9	17.1	2.3
1961	796	69.7	726.3	51.7	6.6
1962	875	82.6	792.4	3.6	0.5
1963	922	68.8	853.2	21.8	2.5
1964	954	63.0	891.0	31.0	3.4
1965	982	70.2	911.8	42.2	4.4

[a] Columns 1 and 2 are from TsSU, *Sel'skoe khoziaistvo SSSR* (1960), pp. 418, 419; *Narkhoz '66*, pp. 324, 329; *Narkhoz '64*, pp. 380, 389; and *Narkhoz '65*, pp. 395, 404. Column 3 is column 1 minus column 2. Column 4 is column 3 deducted from the preceding year's stock in column 1, and column 5 is the ratio of these two figures.

scrapped during the year. Table C-2 presents the Soviet figures for end-of-year stock and for annual deliveries from 1953 through 1965, together with the implied number of trucks scrapped and the implied percentage rate of scrappage. The implied attrition column shows that, of the trucks on hand in the agricultural sector at the end of a year, anywhere from 17.6 percent down to 0.5 percent have been scrapped during the following year. The rate varies widely. In 1954 and 1957, when the authorities were giving high priority to agricultural improvement and large numbers of trucks were being delivered to agriculture, about one-sixth of the old trucks were retired. In recent years, on the other hand, the scrappage rate has fallen to a much lower level. The drop is visible after 1959, and may be related to the fact that large numbers of trucks were shifted in 1958 from the machine tractor stations to the collective farms.

Readily available data for the United States permit computation of similar rates covering all U.S. truck registrations as shown in Table C-3, and for selected year models, as shown in Table C-4. The first tabulation indicates that from 1930 through 1952 the ratio of trucks scrapped an-

TABLE C-3. *Truck Registrations and Scrappage in the United States, 1929–52*[a]

(In thousands of trucks)

Year	Registrations	Scrappage	Attrition (Percent)
1929	3,408	—	—
1930	3,519	344	10.1
1931	3,490	398	11.3
1932	3,257	237	6.8
1933	3,246	229	7.0
1934	3,430	309	9.5
1935	3,676	310	9.0
1936	4,001	402	10.0
1937	4,249	356	8.9
1938	4,210	304	7.2
1939	4,407	387	9.2
1940	4,590	513	11.6
1941	4,859	375	8.2
1942	4,608	62	1.3
1943	4,480	62	1.3
1944	4,513	62	1.4
1945	4,835	62	1.4
1946	5,726	215	4.4
1947	6,513	433	6.6
1948	7,210	494	7.6
1949	7,693	534	7.4
1950	8,239	589	7.7
1951	8,623	651	7.9
1952	8,817	700	8.1

[a] The end-of-year registrations of privately owned trucks (excluding buses) are from Automobile Manufacturers Association, *Motor Truck Facts, 1965* (Detroit: Automobile Manufacturers Association, n.d.), p. 17. The AMA's scrappage estimates (excluding buses) are from their *Motor Truck Facts, 1953*, p. 27. The attrition percentages are ratios of scrappage figures to the preceding end-of-year registrations.

nually to the total number registered at the end of the preceding year varied from as little as 1.3 percent in the early 1940's during World War II to a high of 11.3 percent in the depression year of 1931, and another high of 11.6 percent in 1940. The average during 1930-41 was 9.1 percent per year, while the average during 1948-52 was 7.7 percent. Table C-4 shows how the total registrations of a given year model, as of July 1 in the year after it was launched, have suffered attrition over the next 18

years. There were, for example, 923,000 trucks of the 1955 year model registered on July 1, 1956, and the number registered a year later was 919,000, indicating attrition of 4,000 trucks or 0.4 percent of the base year figure. To take another example, of the 552,000 units of the 1940 year model registered on July 1, 1941, some 9.2 percent or 51,000 were retired during 1954, the 14th year of this model's life. As a recession year, 1954 shows up as a year of large retirement in each of the first four models in Table C-4. Apart from this tendency for large attrition in bad years, there is some indication that recent-year models suffer less attrition than did earlier models. Evidently American trucks are becoming more durable.

In estimating the stocks of Soviet trucks during 1928-40, it is possible to use the data of Table C-1, together with the initial stock and two Soviet benchmarks, to yield annual stock estimates that can then be used to generate implied scrappage rates as a check on their consistency and plausibility. The exercise is laid out in Table C-5. The estimates of end-

TABLE C-4. *Annual Truck Attrition Rates in the United States for Five Selected Year Models, 1940-55*[a]

(In percentages)

Year of Use	Year Model				
	1940	1941	1948	1951	1955
2d	—	—	0.1	0.9	0.4
3d	—	—	1.2	2.0[b]	0.5
4th	—	—	1.7	1.3	0.7
5th	—	—	3.6	2.1	3.3
6th	—	0.3	5.4[b]	3.4	3.1
7th	2.4	3.9	3.5	2.1	2.6
8th	3.6	4.6	4.4	1.6	4.3
9th	5.6	6.0	6.2	4.6	4.4
10th	5.6	7.3	4.9	4.7	—
11th	8.5	8.1	3.8	4.4	—
12th	8.3	8.5	6.1	5.4	—
13th	8.5	9.1[b]	5.5	4.9	—
14th	9.2[b]	6.4	4.8	—	—
15th	6.5	7.1	4.6	—	—
16th	6.9	5.5	—	—	—
17th	5.1	4.6	—	—	—
18th	4.0	2.9	—	—	—

[a] Derived from absolute data for July 1 registrations in Automobile Manufacturers Association, *Motor Truck Facts, 1947*, p. 20; *1949*, p. 15; *1961*, p. 23; *1966*, p. 21.

[b] Attrition rate in 1954, a recession year.

TABLE C-5. *Estimated Number of Trucks in the Soviet Union, 1928–40*

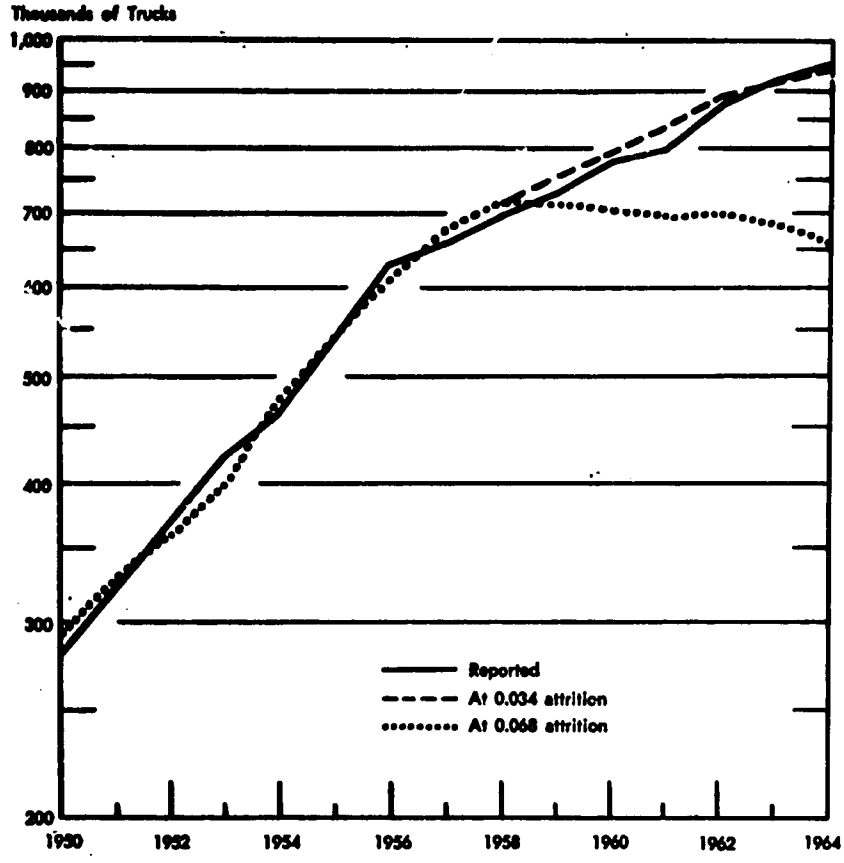
Year	End-of-Year Estimated Stock	Additions During Year	Net Old Stock	Implied Scrappage	Implied Attrition (Percent)
1928	9,000	—	—	—	—
1929	12,270	3,823	8,447	553	6.1
1930	20,310	8,756	11,554	716	5.8
1931	25,540	6,466	19,074	1,236	6.1
1932	48,818	24,335	24,483	1,057	4.1
1933	84,290	39,181	45,109	3,709	7.6
1934	133,490	54,366	79,124	5,166	6.1
1935	201,760	76,151	125,609	7,881	5.9
1936	320,200	129,781	190,419	11,341	5.6
1937	479,570	176,976	302,594	17,606	5.5
1938	630,400	175,877	454,523	25,047	5.2
1939	766,880	178,379	588,501	41,899	6.6
1940	850,000	134,809	715,191	51,689	6.7

of-year stock reflect application of a constant attrition rate of 5.9 percent applied year by year to each successive annual addition. The 5.9 percent rate was chosen because it generates a 1937 figure slightly above the 475,000 figure for the end of 1937, and slightly below the 635,000 figure for the end of 1938, given by I. Prokhorov, in *Planovoe Khoziaistvo.*[7] The implied attrition rate, as a fraction of last year's stock aggregated over all model years, ran between 5 and 7 percent in 1932 and 1933.

Experiment showed that application of a constant attrition rate of 6.8 percent, starting with the stock of trucks on hand in Soviet agriculture at the end of 1945 and accepting the Soviet series for numbers delivered to agriculture thereafter, reproduced the Soviet-reported end-of-year stocks in agriculture quite faithfully up through 1958. Thereafter, however, if the 6.8 percent rate had continued in conjunction with the reduced flow of trucks to agriculture, the sector's total stock would have begun to decline, as indicated by the dotted line of Figure C-1. As we saw above, a markedly lower scrappage rate began to be used. Use of a 3.4 percent attrition rate, applied to the computed 1958 stock of 705,000 trucks plus subsequent deliveries, leads to later stocks close to those officially reported.

[7] (1939), No. 10, p. 73.

FIGURE C-1. *Trucks in Soviet Agriculture at End of Year, 1950-64*



In the absence of other clues, an attrition rate of 6.8 percent may be a good first approximation to the true rate applicable to all Soviet trucks in the postwar period. It seems best, however, to assume that the stretch-out of service lives in agriculture after 1958 has not been matched in other sectors of the economy. On this assumption the excess numbers left in agriculture, beyond what would be there if the 6.8 percent rate had continued, should be added to the estimated national total under a 6.8 percent rate, to yield a composite total. The resulting estimates are presented in Table C-6, which shows separately the number in the agricultural sector and outside agriculture.

A number of important implications flow from these estimates. First, it is clear that attrition rates for Soviet trucks are lower than those ob-

TABLE C-6. *Estimated Number of Agricultural and Nonagricultural Trucks in the Soviet Union, 1928–40 and 1945–64*

Year	Agricultural	Nonagricultural	Total
1928	700	8,300	9,000
1929	—	—	12,270
1930	—	—	20,310
1931	—	—	25,540
1932	14,200	34,618	48,818
1933	26,629	57,661	84,290
1934	40,338	93,152	133,490
1935	69,658	132,102	201,760
1936	—	—	320,200
1937	146,000	333,570	479,570
1938	—	—	630,400
1939	195,800	571,080	766,880
1940	228,000	622,000	850,000
1945	62,000	438,000	500,000
1946	103,000	458,000	561,000
1947	130,000	511,000	641,000
1948	171,000	596,000	767,000
1949	222,000	711,000	933,000
1950	283,000	868,000	1,151,000
1951	327,000	958,000	1,285,000
1952	357,000	1,060,000	1,417,000
1953	424,000	1,136,000	1,560,000
1954	465,000	1,249,000	1,714,000
1955	544,000	1,309,000	1,853,000
1956	631,000	1,376,000	2,007,000
1957	660,000	1,496,000	2,156,000
1958	700,000	1,568,000	2,268,000
1959	729,000	1,633,000	2,362,000
1960	778,000	1,751,000	2,529,000
1961	796,000	1,845,000	2,641,000
1962	875,000	1,911,000	2,786,000
1963	922,000	1,984,000	2,906,000
1964	954,000	2,061,000	3,015,000

TABLE C-7. *Average Age of All Trucks in the Soviet Union and the United States, 1928–40 and 1945–64*

Year	Soviet Trucks	U.S. Trucks	Year	Soviet Trucks	U.S. Trucks
1928	5.5	—	1948	5.3	7.8
1929	4.8	—	1949	5.0	—
1930	3.7	—	1950	4.7	—
1931	3.8	—	1951	4.8	6.6
1932	2.9	—	1952	4.9	6.6
1933	2.5	—	1953	5.0	—
1934	2.5	—	1954	5.0	6.6
1935	2.5	—	1955	5.1	6.7
1936	2.5	—	1956	5.0	6.8
1937	2.5	—	1957	5.0	—
1938	2.8	—	1958	5.0	7.2
1939	3.1	—	1959	5.0	7.5
1940	3.6	5.8	1960	5.3	7.7
1945	5.5	7.6	1961	5.3	7.9
1946	5.6	8.7	1962	5.3	8.0
1947	5.5	8.1	1963	5.4	8.1
			1964	5.4	8.1

TABLE C-8. *Estimated Number of Soviet Common-Carrier, Agricultural, and Other Trucks, 1950–64*[a]
(In thousands of trucks)

Year	Common-Carrier	Agricultural	Other
1950	21	283	847
1951	24	327	934
1952	26	357	1,034
1953	48	424	1,068
1954	89	465	1,160
1955	190	544	1,119
1956	235	631	1,141
1957	295	660	1,201
1958	362	700	1,206
1959	450	729	1,183
1960	536	778	1,215
1961	602	796	1,243
1962	649	875	1,262
1963	683	922	1,301
1964	717	954	1,344

[a] The number of common-carrier trucks is derived by assuming an average capacity of 2.5 metric tons, applied to the quotient of common-carrier truck tons originated over the reported average tons originated per ton of truck capacity. See Tsentral'noe statisticheskoe upravlenie (referred to hereafter as TsSU), *Transport i sviaz' SSSR* (1957), p. 165; *Narkhoz '58*, p. 576; *Narkhoz '62*, p. 406; and *Narkhoz '64*, p. 485. Data for 1951 and 1954 are interpolated. The number of agricultural trucks is from Table C-6 and the number of "other" trucks is obtained by subtraction from the estimated series for all trucks in Table C-6.

TABLE C-9. *Number of Soviet Trucks, Percent at Work, and Annual Output per Truck, 1945–64*[a]

Year	(1) Estimated Stock (Thousands)	(2) Average Percent at Work	(3) Number of Active Trucks (Thousands)	(4) Ton-Kilometers Carried (Millions)	(5) Ton-Kilometers per Active Truck
1945	500	45.0	225	5,000	22,200
1946	561	49.0	275	7,500	27,300
1947	641	47.8	306	10,600	34,600
1948	767	48.6	373	13,300	35,700
1949	933	47.9	447	17,000	38,000
1950	1,151	48.0	552	20,121	36,500
1951	1,285	47.0	604	24,100	39,900
1952	1,417	46.2	655	27,569	42,100
1953	1,560	47.6	743	31,400	42,300
1954	1,714	50.7	869	37,500	43,200
1955	1,853	52.0	964	42,550	44,100
1956	2,007	54.4	1,092	49,792	45,600
1957	2,156	56.9	1,227	61,700	50,300
1958	2,268	60.8	1,379	76,801	55,700
1959	2,362	62.2	1,469	87,598	59,600
1960	2,529	62.6	1,596	98,520	61,700
1961	2,641	62.9	1,661	105,673	63,600
1962	2,786	62.8	1,750	111,896	63,900
1963	2,906	62.6	1,819	119,723	65,800
1964	3,015	64.8	1,954	132,115	67,600

[a] The estimates in column 1 are taken from Table C-6. Columns 2 and 4 are transcribed from TsSU, *Transport i sviaz' SSSR* (1957), pp. 157–59; *Narkhoz '59*, pp. 511, 514; *Narkhoz '62*, pp. 406, 408; and *Narkhoz '64*, pp. 484–85. Column 3 is column 1 times column 2, and column 5 is column 4 divided by column 3.

servable for American trucks on an overall basis. The fact does not explain itself. Differences in quality of construction, intensity of use, quality of maintenance, extent of repair, quality of roads, quality of fuel, and direction of administrative policy may all be significant explanatory factors. Secondly, it is clear that actual scrappage rates are usually far below those recommended in recent years by Soviet financial and economic specialists, who since 1963 have recommended that most trucks (those in the two- to four-ton classes) be depreciated over 5 years, with service lives extending up to 10 or 12 years for large and specialized vehicles. Only in years like 1954 and 1957 have rates like this been ob-

Table C-10. *Total Soviet Truck Freight Traffic and Railroad Short-haul Freight Traffic, 1928–40 and 1945–66*

Year	Trucks[a]			Railroad Short-haul Metric Ton-Kilometers[b] (Billions)
	Metric Ton-Kilometers (Billions)	Average Haul (Kilometers)	Metric Tons Originated (Millions)	
1928	0.2	10.0	20.0	0.45
1929	0.3	10.4	29.0	0.54
1930	0.5	10.4	48.0	0.69
1931	0.8	10.5	76.0	0.74
1932	1.1	10.7	100.0	0.77
1933	1.3	10.0	133.0	0.77
1934	2.4	10.3	233.0	0.91
1935	3.5	10.2	343.1	1.12
1936	5.5	10.2	539.2	1.39
1937	5.9	10.4	569.1	1.49
1938	6.8	10.5	642.7	1.49
1939	7.9	9.6	826.8	1.59
1940	8.896	10.4	858.6	1.71
1945	5.0	12.0	420.0	1.17
1946	7.5	12.3	610.0	1.37
1947	10.6	13.2	803.5	1.52
1948	13.3	12.2	1,092.4	1.97
1949	17.0	11.5	1,481.3	2.39
1950	20.121	10.8	1,859.2	2.77
1951	24.1	10.7	2,252.3	2.96
1952	27.569	10.4	2,652.8	3.16
1953	31.4	10.4	3,002.7	3.32
1954	37.5	11.4	3,305.9	3.43
1955	42.550	11.4	3,730.0	3.65
1956	49.792	11.9	4,200.9	3.95
1957	61.7	11.8	5,216.4	4.28
1958	76.801	11.9	6,474.4	4.66
1959	87.598	11.8	7,398.6	5.08
1960	98.520	11.6	8,492.7	5.43
1961	105.673	11.8	8,922.6	5.72
1962	111.896	12.3	9,122.1	5.98
1963	119.723	12.7	9,444.4	6.22
1964	132.115	12.9	10,240.3	6.59
1965	143.083	13.4	10,746.0	6.96
1966	154.0	13.3	11,579.0	7.15

[a] Sources: For 1928–40 and 1945–56, TsSU, *Transport i sviaz' SSSR* (1957), pp. 155–61. For 1952, *Narkhoz '56*, pp. 406–407. For 1957–66, TsSU, *Transport i sviaz' SSSR* (1967), pp. 225 and 228–29. The average haul is the ratio of column 1 to column 3.

[b] Derived from benchmark data for the percent of rail tons originated and ton-kilometers that moved for distances up to 50 kilometers, in 1935, 1940, 1945, 1950, 1954, and 1955, indicating an average length of haul around 24 kilometers and an average share of tons originated of about 12 percent. See Tsentral'noe upravlenie narodnogo-khozialstvennogo ucheta, *Sotsialisticheskoe stroitel'stvo SSSR* (1936), p. 425; I. V. Kochetov, *Zheleznodorozhnaia statistika* (1953), p. 30; E. D. Khanukov, *Transport i razmeshchenie proizvodstva* (1956), p. 123; and IU. I. Koldomasov, *Ekonomicheskie sviazi v ed. odnom khoziaistve SSSR* (1963), p. 40.

TABLE C-11. *Freight-Carrying Capacity of Soviet Trucks and Railroad Freight Cars, 1928–40 and 1950–64*[a]
(In thousands of metric tons)

Year	Trucks	Freight Cars	Year	Trucks	Freight Cars
1928	18	6,002	1950	2,880	20,292
1929	25	7,028	1951	3,210	21,140
1930	41	7,864	1952	3,540	22,344
1931	51	8,737	1953	3,900	23,357
1932	96	9,032	1954	4,290	25,180
1933	169	9,333	1955	4,630	25,646
1934	267	9,623	1956	5,020	28,174
1935	404	10,930	1957	5,390	29,796
1936	640	11,232	1958	5,670	30,626
1937	959	12,270	1959	5,900	32,919
1938	1,260	13,600	1960	6,320	34,484
1939	1,530	14,149	1961	6,600	36,683
1940	1,700	15,383	1962	6,970	38,315
			1963	7,270	40,215
			1964	7,540	

[a] The truck series is derived from my estimated total in Table C-6 multiplied by an average capacity per truck of 2.0 tons in 1928–40 and 2.5 tons in 1950–65. The railroad freight car series is from column 4 of Table D-6, App. D.

served. Recent scrappage rates in Soviet agriculture imply that a truck would be on hand for 30 years, not necessarily always in operable condition.

Recent levels of Soviet truck production, together with the indicated attrition rates, mean that the average age of Soviet trucks in use is increasing. Table C-7 presents annual figures for the average age of all trucks, both in the U.S.S.R. and in the United States, for 1928-40 and for 1945-64. During the 1930's the average age of Soviet trucks fell from an assumed initial level of 5.5 years to 2.5 years until the end of the decade when it rose to around 3.6 years. Beginning again in 1945 at an assumed level of 5.5 years, the average age of Soviet trucks fell to 4.7 years by 1950 and remained around 5 years through 1959, but since then it has risen to about 5.4 years. Meanwhile, in the United States, a truck stock with an average age over 8 years in the middle 1940's saw a decline to 6.6 years in the early 1950's but a subsequent rise to more than 8 years by 1964. Long service lives are the other side of the coin when rates of attrition are low. High scrappage rates tend to bring low average ages.

TABLE C-12. *Roads in the Soviet Union, by Type of Surface, 1928–40 and 1945–65*[a]
(In kilometers)

Year	Hard-Surfaced		Unsurfaced	Total
	Concrete or Asphalt	Other		
1928	—	32,000	1,420,100	1,452,100
1929	—	—	—	—
1930	—	—	—	—
1931	—	—	—	—
1932	500	44,000	1,449,200	1,493,700
1933	—	—	—	—
1934	—	—	—	—
1935	—	—	—	—
1936	2,200	69,100	1,428,700	1,500,000
1937	3,200	80,700	1,418,100	1,502,000
1938	4,200	88,700	1,421,800	1,514,700
1939	5,000	113,200	1,406,100	1,524,300
1940	7,100	136,300	1,387,800	1,531,200
1945	10,200	145,100	1,373,800	1,529,100
1946	13,400	151,200	1,376,700	1,541,300
1947	13,800	151,700	1,380,900	1,546,400
1948	14,800	152,900	1,379,900	1,547,600
1949	16,900	155,800	1,376,800	1,549,500
1950	19,200	158,100	1,373,100	1,550,400
1951	22,000	165,100	1,361,800	1,548,900
1952	25,800	164,700	1,355,100	1,545,600
1953	30,300	163,900	1,340,900	1,535,100
1954	35,300	165,500	1,310,700	1,511,500
1955	41,100	165,700	1,298,600	1,505,400
1956	47,100	167,400	1,291,500	1,506,000
1957	52,000	173,700	1,237,000	1,462,700
1958	58,500	177,400	1,206,700	1,442,600
1959	66,600	184,400	1,119,200	1,370,200
1960	77,100	193,700	1,094,800	1,365,600
1961	87,100	202,800	1,046,300	1,336,200
1962	97,300	213,700	1,025,400	1,336,400
1963	107,700	222,700	1,001,600	1,332,000
1964	118,500	233,200	988,600	1,340,300
1965	132,300	246,700	984,500	1,363,500

[a] Derived by rearrangement from data in TsSU, *Transport i sviaz' SSSR* (1957), p. 195 (for 1928–56); *Narkhoz '58*, p. 573 (for 1957–58); *Narkhoz '62*, pp. 405–407 (for 1959–62); *Narkhoz '64*, p. 48[illegible] (for 1963–64); and *Narkhoz '65*, p. 493 (for 1965).

Cost and productivity characteristics would need to be known, of course, in order to evaluate these trends.

A further implication of the recent Soviet truck estimates is that prompt retirement of overage trucks, without stepped up production, would mean smaller total national stocks.

These estimates, combined with various published Soviet series, lead to further rough estimates of truck numbers and performance in certain subdivisions of the national fleet, as set forth in Tables C-8 and C-9. Finally, Tables C-10, C-11, and C-12 present the data underlying Figures 9, 12, and 13 in Chapter 5.

APPENDIX D

Data on Railroad Performance

The tables assembled in this appendix present time series covering a few major aspects of the Soviet railroad record. Details of coverage and estimation are discussed in notes accompanying each table. It may be well to begin, however, with a brief note on the reliability of Soviet statistics.

Serious students of the Soviet economy have found Soviet data usable, though often incomplete, ambiguous, and misleading. Aggregate national income and product estimates have been painstakingly constructed through assembly and adjustment of Soviet data by Professor Bergson.[1] Statistics relating to industrial production have been carefully evaluated by Professor Grossman.[2]

Soviet railroad records have been reviewed for their accuracy and comparability with U.S. railroad data by Professor Williams.[3] Soviet explanations of reporting procedures will be found in standard textbooks by Professors Kochetov and IAkubov.[4]

Soviet data reliability varies widely, depending on many factors, so that generalizations are not helpful. Skepticism toward conclusions resting on small changes or on detailed relationships is entirely in order. As used in this study, however, the records of the Soviet transport sector display large changes in dimension that would not be substantially modified by any plausible corrections or adjustments. They are thus put forward as firm bases for the conclusions to which our analysis has led.

[1] See Abram Bergson, *The Real National Income of Soviet Russia Since 1928* (Harvard University Press, 1961), pp. 1-6, for some introductory perspective.

[2] See Gregory Grossman, *Soviet Statistics of Physical Output of Industrial Commodities: Their Compilation and Quality* (Princeton University Press, 1960), pp. 123-34, for summary observations.

[3] See Ernest W. Williams, Jr., *Freight Transportation in the Soviet Union* (Princeton University Press, 1962), especially pp. 33-39 for traffic measures and pp. 98-132 on operating data. Figures on locomotive use are discussed on pp. 106-11.

[4] See Ivan Vasil'evich Kochetov, *Zheleznodorozhnaia statistika* (2d ed.; 1953), especially pp. 116-19 and 126-27 for locomotive use; and Lev Sergeevich IAkubov, *Osnovy zheleznodorozhnoi statistiki* (2d rev. ed.; 1959), where locomotive use is discussed on pp. 176-83. Place of publication of all Russian language titles is Moscow, unless otherwise noted.

TABLE D-1. *Soviet Railroad Freight Traffic, 1928–66*[a]

Year	Metric Ton-Kilometers	Average Haul	Metric Tons Originated
	(Millions)	(Kilometers)	(Thousands)
1928	93,389	598	156,237
1929	112,950	602	187,626
1930	133,918	561	238,732
1931	152,129	589	258,283
1932	169,270	632	267,906
1933	169,485	632	268,075
1934	205,746	649	317,075
1935	258,066	664	388,583
1936	323,381	669	483,179
1937	354,839	686	517,849
	(Billions)		(Millions)
1938	370.5	718	516.3
1939	392.0	708	553.6
1940[b]	409.0	705	580.0
1940[c]	415.0	700	592.6
1941	386.4	732	528.0
1942	217.7	786	277.2
1943	238.6	804	296.6
1944	281.1	789	356.2
1945	314.0	794	395.3
1946	335.0	740	452.6
1947	350.5	714	491.1
1948	446.0	720	619.8
1949	523.3	712	735.3
1950	602.3	722	834.3
1951	677.3	745	909.2
1952	741.3	744	997.0
1953	798.0	748	1,067.4
1954	856.8	757	1,131.4
1955	970.9	766	1,267.0
1956	1,079.1	787	1,371.0
1957	1,212.8	815	1,487.7
1958	1,302.0	805	1,616.9
1959	1,429.5	810	1,763.8
1960	1,504.3	798	1,884.9
1961	1,566.6	788	1,987.6
1962	1,646.3	793	2,077.4
1963	1,749.4	811	2 158.0
1964	1,854.1	810	2,288.8
1965	1,950.2	807	2,415.3
1966	2,016.0	812	2,481.9

[a] The 1928–40 data are assembled from Soviet sources in Holland Hunter, *Soviet Transportation Policy* (Harvard University Press, 1957), p. 331. The revised estimates for 1921–44 are derived from annual percent increases given by Boris Pavlovich Orlov in his *Razvitiia transporta SSSR: 1917–1966* (1963), pp. 276, 285, 292, and 297, based on railroad ministry archival material; they show traffic levels about 5 percent below my previous estimates using less direct clues.

Data for 1945–66 appear in the TsSU (Tsentral'noe statisticheskoe upravlenie) statistical handbook: *Transport i sviaz' SSSR* (1967), p. 97. The average haul in each year is the ratio of ton-kilometers over tons originated.

[b] Excluding traffic in the regions acquired during 1940.

[c] Including traffic for all of 1940 in the regions acquired during 1939, and for approximately July–December in the regions acquired during 1940.

TABLE D-2. *Soviet Railroad Passenger Traffic, 1928–40 and 1945–66*[a]

Year	Passenger-Kilometers	Average Trip	Passengers Carried
	(Millions)	(Kilometers)	(Thousands)
1928	24,484	84	291,118
1929	32,004	88	365,230
1930	51,777	93	557,704
1931	61,813	85	723,681
1932	87,748	87	967,058
1933	75,154	81	927,028
1934	71,421	76	945,206
1935	67,936	74	919,121
1936	77,200	78	991,600
1937	90,942	80	1,142,700
	(Billions)		(Millions)
1938	84.9	72	1,173.2
1939	93.7	74	1,267.2
1940	98.0	73	1,343.5
1945	65.9	78	843.8
1946	97.9	91	1,078.1
1947	95.7	87	1,094.7
1948	82.5	79	1,049.3
1949	81.3	75	1,080.1
1950	88.0	76	1,163.8
1951	98.5	75	1,315.3
1952	107.4	75	1,440.7
1953	118.3	79	1,504.3
1954	129.1	82	1,573.6
1955	141.4	86	1,641.4
1956	142.4	86	1,658.3
1957	153.4	87	1,754
1958	158.4	86	1,834
1959	164.4	87	1,883
1960	170.8	88	1,950
1961	176.3	90	1,962
1962	189.3	93	2,037
1963	192.0	90	2,139
1964	195.1	87	2,250
1965	201.6	88	2,301
1966	219.4	90	2,450

[a] The 1928–37 data are assembled from Soviet sources in Hunter, *op. cit.*, p. 357. For 1938–40 and 1945–66, TsSU figures from *Transport i sviaz' SSSR* (1967), p. 32, some of which differ slightly from earlier Soviet figures, are transcribed here. The recent figures are from TsSU, *Transport i sviaz' SSSR* (1967), p. 97.

Table D-3. *Soviet Railroad First Main Track, Second Track, and Electrified Line, 1928–66*[a]

(In kilometers)

Year	First Main Track, Annual Average[b]	First Main Track, End of Year[b]	Second Track, End of Year	Electrified Line, End of Year
1928[c]	76,887	76,923	15,609	0
1929	77,010	76,938	16,017	18
1930	77,073	77,861	16,383	52
1931	80,248	80,958	17,481	64
1932	81,564	81,815	18,993	153
1933	82,080	82,614	19,483	350
1934	83,247	83,403	20,907	379
1935	83,818	84,367	22,810	907
1936	84,649	84,931	—	1,352
1937	84,910	84,889	24,500	1,632
1938	84,933	84,977	24,861	1,680
1939	85,695	86,413	—	1,714
1940	96,258	106,102	28,700	1,865
1941	90,000	74,000	—	—
1942	68,900	62,900	14,640	—
1943	72,300	81,646	16,680	—
1944	93,800	106,000	—	—
1945	108,900	112,868	20,800	2,068
1946	113,489	114,110	22,200	2,186
1947	114,456	114,802	—	2,300
1948	115,148	115,493	—	2,500
1949	115,839	116,184	—	2,800
1950	116,530	116,875	26,000	3,042

[a] The annual averages are arithmetic means between successive year-end figures. For 1928–55, see Hunter, *Soviet Transportation Policy*, pp. 365–74, where details of assembly from Soviet sources are discussed. The revised figures in column 2 for 1938–39 are from *Tekhnicheskii spravochnik zheleznodorozhnika* (1958), Vol. 11, p. 424. Revised estimates for 1950 and 1955 in column 3 come from a 7 percent increase of 1955 over 1940 stated in S. K. Danilov (ed.), *Ekonomika transporta* (2d ed.; 1957), p. 117, and a total of 4,700 kilometers double-tracked during the fifth Five Year Plan (*Gudok*, April 25, 1956, p. 3). The revised figures for 1940 and 1945 in column 4 are from TsSU, *Narkhoz '62*, p. 105, and (by subtraction) *Narkhoz '58*, p. 80. The former gives 1955 and 1952 figures; *Narkhoz '64*, p. 109, gives a 1950 figure, and the 1951 and 1953–54 figures then reflect relationships cited in Hunter, *op. cit.*, p. 373.

The 1956–66 data in column 2 are from *Transport i sviaz' SSSR* (1967), p. 95. An estimate for double-tracked line in 1965 comes from V. A. Dmitriev, in *Zheleznodorozhnyi Transport* (hereafter cited as *Zhel. Trans.*), 1965, No. 11, p. 72: "By the end of 1965 over 17,000 kilometers, more than half of all double-track line, will be electrified. Of the single-track line, around 7,000 out of 95,000 kilometers has been electrified." With 3,600 kilometers double-tracked during 1959–65 (*Zhel. Trans.*, 1966, No. 3, p. 69), this yields a 1958 figure; a rise of 686 kilometers in 1959 (*Zhel. Trans.*, 1960, No. 3, p. 36) suggests a 1959 figure.

Electrified line data for 1956–57 are from Andrei Ignat'evich Tishchenko, *Elektrifikatsiia zheleznykh dorog SSSR* (1959), p. 19. The 1958, 1960, and 1963 figures are from *Narkhoz '64*, p. 109; 1959 and 1961 are from *Narkhoz '62*, p. 105; and 1962 is from *Narkhoz '63*, p. 95. The rounded 1947–49 data are from TsSU, *Transport i sviaz' SSSR* (1957), p. 28, and the 1964–65 figures are from *ibid.* (1967), p. 47.

[b] First main track is synonymous with total road operated.

[c] For 12 months ending Sept. 30, 1928.

TABLE D-3.—(*Continued*)

Year	First Main Track, Annual Average[b]	First Main Track, End of Year[b]	Second Track, End of Year	Electrified Line, End of Year
1951	117,318	117,761	—	3,445
1952	118,162	118,563	—	3,666
1953	119,253	119,943	—	4,269
1954	120,124	120,304	—	4,869
1955	120,506	120,707	30,700	5,361
1956	120,700	120,700	—	6,380
1957	121,000	121,200	—	7,740
1958	122,000	122,800	31,200	9,489
1959	123,600	124,400	31,900	11,573
1960	125,100	125,800	—	13,814
1961	126,200	126,600	—	15,748
1962	127,200	127,700	—	18,118
1963	128,200	128,600	—	20,389
1964	129,000	129,300	—	22,540
1965	130,050	131,400	34,500	24,902
1966	132,000	132,500	—	—

[b] First main track is synonymous with total road operated.

TABLE D-4. *Active Freight Locomotives, Soviet Railways, by Type, 1950–65*[a]
(In number of locomotives and share of net operating freight metric ton-kilometers)

Year	Steam		Electric		Diesel-Electric	
	Number	Share of Traffic (Percent)	Number	Share of Traffic (Percent)	Number	Share of Traffic (Percent)
1950	10,180	94.6	250	3.2	250	2.2
1951	11,100	93.8	300	3.5	330	2.7
1952	11,860	92.7	390	4.3	370	3.0
1953	12,110	91.8	440	4.7	390	3.5
1954	12,140	90.2	520	5.9	450	3.9
1955	11,390	85.9	610	8.4	510	5.7
1956	11,640	82.9	740	10.2	590	6.9
1957	11,860	79.5	890	12.7	680	8.3
1958	11,290	73.6	1,040	15.1	880	11.3
1959	10,720	66.5	1,250	18.2	1,120	15.3
1960	9,430	56.8	1,480	21.8	1,520	21.4
1961	8,420	48.2	1,730	24.8	1,840	27.0
1962	7,150	38.2	2,080	30.2	2,420	31.6
1963	6,050	29.3	2,460	33.8	2,890	36.9
1964	4,800	21.1	2,730	36.6	3,400	42.3
1965	3,760	15.5	2,960	39.5	3,750	45.0

[a] See Table D-5 for sources.

TABLE D-5. *Number and Performance of Steam, Electric, and Diesel-Electric Locomotives in Freight Service on Soviet Railroads, 1940 and 1950–65*

Year	(1) Net Metric Ton-Kilometers Hauled[a] (Billions)	(2) Average Net Train Weight[b] (Metric tons)	(3) Daily Principal Locomotive-Kilometers[c] (Thousands)	(4) Daily Gross Metric Ton-Kilometers per Locomotive[d] (Thousands)	(5) Average Gross Train Weight[e] (Metric tons)	(6) Daily Principal Locomotive-Kilometers per Locomotive[f]	(7) Number of Active Locomotives[g] (Units)
			STEAM LOCOMOTIVES				
1940	423.3	726	1,597.3	231	1,296	178.0	8,980
1950	579.9	816	1,946.9	274	1,432	191.3	10,180
1951	646.1	839	2,109.6	281	1,478	190.1	11,100
1952	698.2	857	2,252.1	286	1,519	188.3	11,960
1953	743.0	891	2,284.6	297	1,574	188.7	12,110
1954	782.0	930	2,303.7	313	1,649	189.8	12,140
1955	842.1	987	2,337.5	355	1,730	205.2	11,390
1956	906.4	1,029	2,413.3	371	1,789	207.4	11,640
1957	977.6	1,060	2,526.7	402	1,887	213.0	11,860
1958	971.7	1,084	2,455.9	412	1,894	217.5	11,290
1959	965.4	1,107	2,389.3	429	1,924	223.0	10,720

[a] Most Soviet railroad freight performance measures employ a coverage termed "operating" ton-kilometers and derived from train crew trip reports, rather than "tariff" ton-kilometers, derived from the waybills that show the distances for which shippers are charged. The former exceeds the latter, usually by 1.8–2.2 percent, because of circuity and other factors (see Williams, *Freight Transportation in the Soviet Union*, pp. 35–38).

Annual absolute data separating the ton-kilometers carried by each of the three traction types are reported by F. P. Muliukin (Head of the Planning-Economic Administration of the Railroad Ministry) in *Zhel. Trans.*, 1964, No. 5, p. 3, for 1953–63, and in less rounded form for 1955–61 in the same journal, 1961, No. 10, p. 4. For 1940, 1950–52, and 1964–65, a single national total for operating ton-kilometers is available or can be estimated, to which published percentage shares for each traction type can then be applied. The 1940 and 1950–52 totals are taken from Williams, *op. cit.*, p. 171. The 1964 total is from *Zhel. Trans.*, 1965, No. 7, p. 17. The 1965 estimate is extrapolated as 2.0 percent more than reported tariff ton-kilometers, since this is the mean between 1964 and 1963 percent excesses.

The percentage shares of each locomotive type in national operating ton-kilometers (net rather than gross) are reported in *Transport i sviaz' SSSR* (1967), p. 100, for 1940 and 1945–66.

[b] Absolute figures for 1940 and 1950–65 are from TsSU, *Transport i sviaz' SSSR* (1967), p. 114.

[c] Obtained as the ratio of column 1 over column 2, divided by 365 to put it on a daily basis. This simple statistical deduction is justified by the fact that average train weight is calculated in Soviet practice as the ratio of operating ton-kilometers over freight train-kilometers (which is the same as principal locomotive-kilometers). See I. V. Kochetov, *Zheleznodorozhnaia statistika* (1953), p. 126.

[d] Absolute figures for 1940, 1950, and 1955–57 are given in A. P. Mikheev *et al.*, *Effektivnost' elektricheskoi i teplovoznoi tiagi na zhel. trans.* (1960), p. 236. The 1951–52 and 1954 data are from Tishchenko, *Elektrifikatsiia zhel. dorog SSSR*, p. 46. Figures covering 1955–61 are given by F. P. Muliukin in *Zhel. Trans.*, 1961, No. 10, p. 6, and 1962 figures are given by A. I. Tishchenko (Head of the Locomotive Administration of the Railroad Ministry) in *Zhel. Trans.*, 1963, No. 6, p. 11. Figures for 1953 and 1963 appear in *Zhel. Trans.*, 1964, No. 5, p. 6. The 1964 and 1965 figures are from annual reports in *Zhel. Trans.*, 1965, No. 3, p. 11, and 1966, No. 3, p. 71.

[e] Same as for column 2.

[f] Obtained as the ratio of column 4 over column 5. This procedure is predicated on the assumption that only principal locomotive-kilometers are in the numerator, with all active freight locomotives in the denominator. It produces a series for average daily kilometers per locomotive that runs about 25 percent below the series that is regularly published in Soviet railroad reports. This excess is consistent with the relation between principal locomotive-kilometers (called "locomotive-kilometers at the head of trains" in Russian) and the additional locomotive-kilometers accounted for by double-heading, light mileage, pusher service, switching, and other conventional work. For details, see IU. A. Komarnitskii *et al.*, *Rezervy rosta proizveditel'nosti truda na zhel. dorogakh* (1963), pp. 85–86, and A. I. Smetanin in *Zhel. Trans.*, 1964, No. 4, p. 11.

[g] Obtained as the ratio of column 3 over column 6. It should be noted that inactive freight locomotives and locomotives in passenger service are not covered in this calculation. The total number of locomotives in the Soviet railroad stock is thus perhaps twice as large as the portion enumerated here. Nevertheless, this computation brings out clearly the shift from steam to electric and diesel-electric traction, and most likely comes close to a correct indication of the numbers of active locomotives involved.

TABLE D-5.—(*Continued*)

Year	(1) Net Metric Ton-Kilometers Hauled[a] (Billions)	(2) Average Net Train Weight[b] (Metric tons)	(3) Daily Principal Locomotive-Kilometers[c] (Thousands)	(4) Daily Gross Metric Ton-Kilometers per Locomotive[d] (Thousands)	(5) Average Gross Train Weight[e] (Metric tons)	(6) Daily Principal Locomotive-Kilometers per Locomotive[f]	(7) Number of Active Locomotives[g] (Units)
1960	872.6	1,103	2,167.5	442	1,923	229.9	9,430
1961	733.0	1,094	1,960.9	446	1,914	233.0	8,420
1962	640.6	1,077	1,829.6	433	1,901	227.8	7,150
1963	582.0	1,053	1,358.2	422	1,880	224.5	6,050
1964	499.0	1,001	1,094.8	414	1,814	222.2	4,800
1965	396.0	999	870.8	409	1,767	231.5	3,760
			ELECTRIC LOCOMOTIVES				
1940	3.6	800	29.4	425	1,367	310.9	95
1950	19.7	872	61.8	378	1,481	251.9	250
1951	24.1	931	71.0	381	1,588	239.9	300
1952	32.4	971	91.4	389	1,668	233.2	390
1953	38.0	998	104.3	409	1,732	236.1	440
1954	51.0	1,090	128.2	464	1,809	244.3	520
1955	82.3	1,193	189.2	641	2,070	300.7	610
1956	112.0	1,242	247.1	715	2,152	332.3	740
1957	149.8	1,264	324.7	799	2,192	364.5	890
1958	199.0	1,300	419.4	919	2,284	402.4	1,040
1959	265.2	1,322	549.6	1,020	2,320	439.7	1,250
1960	335.3	1,361	675.0	1,087	2,383	456.2	1,480
1961	407.0	1,385	805.1	1,125	2,422	464.5	1,730
1962	506.5	1,406	987.0	1,169	2,468	473.7	2,080
1963	602.0	1,425	1,157.4	1,182	2,517	469.6	2,460
1964	694.0	1,431	1,328.7	1,232	2,532	486.6	2,730
1965	786.0	1,455	1,480.0	1,284	2,568	500.0	[illegible]
			DIESEL-ELECTRIC LOCOMOTIVES				
1940	.75	655	3.16	393	1,343	292.6	11
1950	13.8	699	53.9	276	1,311	210.5	250
1951	18.6	745	68.5	286	1,379	207.4	330
1952	22.6	772	80.2	308	1,422	219.6	370
1953	28.0	845	90.8	355	1,530	232.0	390
1954	34.0	881	105.7	377	1,609	234.3	450
1955	55.5	1,000	158.1	531	1,795	295.8	510
1956	75.4	1,094	188.8	620	1,939	319.8	590
1957	102.7	1,158	243.0	723	2,024	357.2	680
1958	148.7	1,214	335.6	863	2,154	382.1	870
1959	221.8	1,292	470.3	955	2,281	413.7	1,120
1960	323.5	1,359	662.3	1,042	2,335	436.9	1,520
1961	410.0	1,360	826.0	1,074	2,391	449.2	1,840
1962	529.9	1,367	1,062.0	1,056	2,406	438.9	2,420
1963	657.0	1,387	1,297.0	1,099	2,449	448.8	2,890
1964	801.0	1,396	1,572.0	1,146	2,478	462.5	3,400
1965	895.0	1,406	1,741.5	1,160	2,497	464.6	3,750

Notes appear on p. 185.

Table D-6. *Soviet Railroad Output and Input Measures, 1928–40 and 1950–63*

Year	Operating Metric Ton-Kilometers[a] (Billions)	Capital Stock[b] (Billions of 1933 rubles)	Operating Labor Force[c] (Thousands)	Freight Car Capacity[d] (Thousands of metric tons)	Annual Freight Car-Kilometers[e] (Billions)	Freight Car-Kilometers per Active Car-Day[f]
1928	97.1	11.53	863.0	6,002	10.54	84.6
1929	118.6	11.92	868.0	7,028	12.53	87.3
1930	142.6	12.55	951.0	7,364	14.12	89.5
1931	164.0	13.28	1,064.0	8,737	15.69	90.9
1932	177.1	14.23	1,105.0	9,032	17.07	97.3
1933	176.7	15.56	1,022.0	9,533	17.46	97.6
1934	217.4	16.65	1,143.0	9,623	20.91	117.5
1935	268.8	17.37	1,249.0	10,930	24.54	128.4
1936	333.0	18.80	1,216.0	11,232	29.96	140.3
1937	367.8	20.43	1,250.0	12,270	32.00	139.8
1938	384.4	21.28	1,309.0	13,600	33.45	138.4
1939	407.6	22.06	1,315.0	14,149	35.88	145.2
1940	432.5	26.85	1,394.0	15,383	36.83	139.9
1950	613.7	31.48	1,712.4	20,292	47.35	146.4
1951	689.5	33.84	1,764.6	21,140	52.88	159.0
1952	753.9	36.58	1,866.5	22,344	57.33	165.2
1953	810.8	39.02	1,900.7	23,357	61.54	171.8
1954	867.9	41.91	1,968.3	25,180	66.09	173.3
1955	960.0	45.14	1,980.0	25,643	72.50	188.2
1956	1,095.8	48.30	1,980.4	28,174	79.98	191.2
1957	1,250.1	51.83	1,995.4	29,796	89.08	206.4
1958	1,319.4	56.10	1,997.5	30,626	94.90	216.5
1959	1,452.4	61.42	1,993.7	32,919	104.43	222.5
1960	1,536.4	65.92	2,011.1	34,484	110.74	227.0
1961	1,597.0	68.49	1,986.7	36,683	115.97	225.2
1962	1,677.0	71.58	1,972.5	38,315	121.70	228.0
1963	1,781.0	74.69	1,973.1	40,215	129.99	233.8

[a] See the notes to Table D-5, column 1, for the 1950–63 figures. The 1928–40 figures are assembled from Soviet sources as explained in Hunter, *Soviet Transportation Policy*, pp. 362–63.

[b] These estimates for railroad fixed assets are assembled from a variety of Soviet sources. Periodic revaluations of existing assets, together with undisclosed details in recording annual changes, create a substantial margin of uncertainty around the resulting compiled series. The sources for the 1928–40 figures are set forth in Hunter, *op. cit.*, pp. 396–98, and for a 1951–65 series in U.S. Congress, Joint Economic Committee, *New Directions in the Soviet Economy* (Government Printing Office, 1966), p. 577. The prewar data are supposed to be at 1933 prices, and the 1951–65 series (which is supposed to be at 1961 prices) was converted to an equivalent series in 1933 prices—after shifting it to an average annual basis—by the application of a conversion factor of 2.64. The factor is one which moves the 1951–65 data up on a semilogarithmic graph so that a trend line through them passes through the 1940 figure. For this purpose the years 1941–47 were excluded, that is, 1950 was placed in the position of 1943. An annual average for 1950 was chained in to the 1951–65 figures using an index presented by A. V. Isosimov in his *Osnovnye sredstva zhel. dorog SSSR* (1956), p. 32, and its previous edition (1952), pp. 22–23.

[c] The 1928–40 labor force figures are from Hunter, *op. cit.*, p. 383, and the 1950–63 figures are from Vasilii Nikolaevich Shvetsov, *Statistika truda zhel. transporta* (1965), p. 44.

[d] The aggregate tons of carrying capacity in the active Soviet freight car fleet has to be estimated as the product of five other series, assembled or estimated on the basis of scattered Soviet data. Average daily tons originated divided by the average static load per two-axle car yields average daily carloadings. Average daily carloadings (in two-axle units) times average turnaround time gives the average daily cars in use, and this series times the average capacity per two-axle car gives the total carrying capacity of the fleet in each year.

[e] Total annual freight car-kilometers run is estimated as the product of average daily cars in use times average car-kilometers per active car-day times 365.

[f] The reported data for average car-kilometers per active car-day are assembled from Hunter, *op. cit.*, p. 406, for 1928–40, and from TsSU, *Transport i sviaz' SSSR* (1967), p. 110, for 1950–63.

TABLE D-7. *Soviet Railroad Freight Revenue, Cost, and Net Income, 1928–58*[a]

Year	Kopeks per Metric Ton-Kilometer			Net Income as a Percentage of Revenue
	Revenue	Cost	Net Income	
1928	1.50	1.27	.23	15.4
1929	1.53	1.21	.32	20.9
1930	1.54	1.12	.42	27.3
1931	1.80	1.24	.56	31.1
1932	1.80	1.36	.44	24.4
1933	1.65	1.51	.14	8.5
1934	1.51	1.66	− .15	− 9.9
1935	1.50	1.78	− .28	−18.7
1936	1.91	1.91	.00	0.0
1937	2.00	2.17	− .17	− 8.5
1938	2.09	2.24	− .15	− 7.2
1939	3.01	2.41	.60	19.9
1940	3.16	2.57	.59	18.7
1941	3.27	2.68	.59	18.0
1942	3.36	3.67	− .31	− 9.2
1943	4.20	4.29	− .09	− 2.1
1944	4.14	4.71	− .57	−13.8
1945	3.85	4.36	− .51	−13.2
1946	3.36	4.87	−1.51	−44.9
1947	3.42	5.18	−1.76	−51.5
1948	3.38	4.50	−1.12	−33.1
1949	6.01	5.05	.96	16.0
1950	5.29	4.86	.53	9.8
1951	5.29	4.50	.79	14.9
1952	4.83	4.30	.53	11.0
1953	4.80	4.06	.74	15.4
1954	4.95	3.93	1.02	20.6
1955	4.63	3.54	1.09	23.5
1956	4.30	3.32	.98	22.8
1957	4.24	3.16	1.08	25.5
1958	4.04	3.02	1.02	25.2

[a] I. V. Ivliev (ed.), *Transportnye Tarify* (1960), p. 49. The 1928 cost estimate is from Narodnyi Komissariat Putei Sooboshcheniia, *Materialy*, Vypusk 96, p. 12.

Table D-8. ***Route Length, Freight Traffic, and Freight Train Movement on Indian Broad-Gauge Railways, 1950–65, and Three United States Railways, 1954–63***[a]

Year[b]	Indian Broad-Gauge Railways			Three United States Railways		
	Route Length[c] (Kilometers)	Freight Traffic[d] (Millions of metric ton-kilometers)	Train Movement[e] (Millions of kilometers)	Route Length[c] (Kilometers)	Freight Traffic[d] (Millions of metric ton-kilometers)	Train Movement[e] (Millions of kilometers)
1950	25,255	37,946	77.2	—	—	—
1951	25,265	40,832	81.9	—	—	—
1952	25,313	40,065	83.4	—	—	—
1953	25,417	40,833	82.6	—	—	—
1954	25,661	44,701	87.2	27,452	125,430	85.2
1955	25,911	50,463	93.3	27,433	157,459	99.6
1956	26,000	55,597	98.2	27,437	170,828	104.1
1957	26,064	62,532	102.0	27,500	168,877	99.0
1958	26,263	64,568	103.3	27,470	133,498	81.3
1959	26,427	69,187	109.3	27,504	134,444	81.4
1960	26,575	73,724	112.1	25,320	138,681	82.0
1961	26,873	76,023	115.3	28,315	134,746	77.5
1962	27,215	84,328	120.3	28,255	144,821	81.8
1963	27,409	89,130	126.6	28,159	153,637	82.7
1964	27,790	88,569	126.1	—	—	—
1965	28,346	97,251	—	—	—	—

[a] The Indian data come from three annual publications of the Ministry of Railways: *Report by the Railway Board on Indian Railways* (cited hereafter as *Report*), *A Review of the Performance of the Indian Government Railways* (cited hereafter as *Review*), and *Indian Railways* (cited hereafter as *IR*). Year-end route length figures for 1950 through 1960 are from *IR 1960–61*, p. XXXVI; for 1961 from *Report . . . for 1961–62*, p. 72; for 1962 and 1963 from *IR 1963–64*, p. 51; for 1964 from *IR 1964–65*, p. 60; and for 1965 from *IR 1965–66*, p. 57. Successive year-end figures are averaged here. The freight traffic figures for 1950 through 1960 are from *IR 1960–61*, p. XLV, and for 1961 through 1963 from *Review* (May 1967), p. 19. The freight train movement figures for 1950 through 1960 are from *IR 1960–61*, p. XLVI; for 1961 and 1962 from *Report . . . for 1962–63*, p. 17; for 1963 from *Report . . . for 1963–64*, p. 19; and for 1964 from *Report . . . for 1964–65*, p. 18.

The United States data for the Pennsylvania, the Chesapeake and Ohio, and the Norfolk and Western railroads are from U.S. Interstate Commerce Commission, *Transport Statistics in the United States*, annual volumes, Part I. Route length is figured as 1.609344 times Item 530, "Average mileage of road operated in freight service." Freight traffic is figured as 1.45998 times Item 609, "Net ton-miles of revenue and non-revenue freight." Train movement is figured as 1.609344 times Item 532, "Total freight train-miles."

[b] The Indian data cover a fiscal year ending March 31 of the following calendar year.

[c] Average annual kilometers of first main track operated in freight service.

[d] Total annual metric ton-kilometers of revenue and nonrevenue freight carried.

[e] Total annual train-kilometers run in freight service.

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