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Chapter Author: Gregory Grossman

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SOME CURRENT TRENDS IN SOVIET CAPITAL FORMATION

GREGORY GROSSMAN

UNIVERSITY OF CALIFORNIA

1. *Introduction*

THIS CONFERENCE meets thirteen months after the adoption of the *Directives on the Fifth Five-Year Plan* by the Nineteenth Congress of the Communist Party of the Soviet Union, and in the middle of the time span covered by the Plan (1951-1955).[1] Several commentaries on this and attendant documents have already appeared in Western literature.[2] It is indicative of the paucity of our information that we must inquire at the outset whether the plan is still an operational order to those who manage the Soviet economy. The stroke of fate which carried away Stalin's life early in March 1953 has reverberated to upset established balances within the Soviet polity, and to reshape the course of history on both sides of the Iron Curtain. It is inconceivable that this shock could have left the rigid structure of Soviet plans, annual and quinquennial, without need of substantial repair and overhaul.[3] It is therefore safer to view the *Directives* not as a blueprint of the impending development of the Soviet economy through 1955, but as a clue to the Soviet government's estimate, *in mid-1952*, of the possibilities of development in the *then* desired direction. The word "clue" is used advisedly, for the published document is only a brief summary of the Five-Year Plan (FYP). Considering the authorship of the document and the circumstances under which it was issued, we should

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[1] The text of the *Directives* and of the report on it by M. Z. Saburov (the then chairman of the Gosplan) appear in *Pravda*, October 12 and 10, 1952, respectively. English translations in *Current Digest of the Soviet Press*, January 10, 1953, pp. 3-10, and December 6, 1952, pp. 3-8. References to the Fifth Five-Year Plan will be hereafter cited by part and section, thus: *Directives* I, 5.

[2] Among those in English see: "Moscow Has a Plan," *Twentieth Century*, November 1952; *Economic Survey of Europe since the War*, Geneva, United Nations Economic Commission for Europe, 1953, Chap. IV; "The Kremlin's Plan V," *Fortune*, February 1953, pp. 113 ff.; Maurice Dobb, "Rates of Growth under the Five-Year Plans," *Soviet Studies*, April 1953, pp. 364-386; and Peter Wiles, "The Soviet Economy Outpaces Ours," *Foreign Affairs*, July 1953, pp. 566-580.

[3] See the Postscript to this paper.

not assume that it necessarily represents an accurate and faithful summary of the complete Plan.

A third area of doubt is the "realism" of the Plan, or at least of those portions which have been revealed to us. The attainment of the targets for 1955 is predicated on great increases in the productivity of labor and equipment in industry and construction, and of labor and land in agriculture. For instance, labor productivity in industry is to rise by 50 per cent between 1950 and 1955, though this is not inconsistent with the claimed rise of 18 per cent through 1952.[4] While bearing in mind the large program for irrigation and melioration, we may be even more skeptical of the projected increases in the per hectare yields of agricultural crops: about 50 per cent for grains, potatoes, and sunflower seed, and about 25 per cent for cotton, sugar beet, and flax.[5] Since the crop targets are fully dependent on these yields, the opinion that of all portions of the Plan "the agricultural production program is the least likely to materialize" seems reasonable.[6]

With these doubts in mind, I shall discuss the implications of the Plan with respect to capital formation, emphasizing especially the trend toward much greater capital-intensity of investment. Some explanations of this trend will be offered as tentative hypotheses.

2. *Manpower and Investment in the Fifth Five-Year Plan*

One of the most interesting figures in the Fifth FYP is the projected increase of only 15 per cent in the number of workers and employees, or roughly speaking, in the non-agricultural labor force.[7] This amounts to an average annual increase of 2.8 per cent (Table 1). For industry[8] alone, the projected rate of growth in employment is apparently even lower, and can be estimated on the basis of output and productivity targets to be 13 per cent, or 2.5 per cent per year. Contrast the rates of growth of employment in the Fifth FYP with the actual record of the first two Plans taken to-

[4] *Directives*, concluding part, and *Pravda*, January 29, 1952 and January 23, 1953.

[5] See *Economic Survey of Europe since the War*, as cited, Table 19, p. 45, which is based on the *Directives* and other Soviet sources. In the case of grain the yield in 1952 was no higher than in 1950.

[6] "Moscow Has a Plan," as cited, p. 389.

[7] *Directives* IV, 1. The term "workers and employees" in Soviet usage includes a few million employed in agriculture (at state farms and machine tractor stations), but excludes nearly the same number of handicraftsmen; it also presumably excludes forced labor in camps.

[8] For the definition of industry see note a to Table 1.

TABLE 1

Workers and Employees in the U.S.S.R., Selected Years, 1928-1955

YEAR	TOTAL	INDUSTRY[a]	
		Total	*Workers Only*
	Yearly Average (*millions*)		
1928	11.6	3.87[b]	3.36[c]
1932	22.9	8.0[d]	5.76[c]
1937	27.0	10.1[e]	8.05[e]
1940	31.2	10.9[f]	8.38[g]
1941 annual plan	(32.4)[h]	(11.4)[i]	(8.81)[i]
1942 plan	(32.0)[e]	(11.8)[e]	(9.2)[e]
1945	27.3	n.e.	n.e.
1946	31.0	9.9[j]	7.6[j]
1947	32.2	10.7[j]	8.2[j]
1948	34.2	11.8[j]	9.1[j]
1949	36.0	12.6[j]	9.6[j]
1950 plan	(33.5)[k]	(11.9)[j]	(9.1)[j]
1950	38.2	13.8[j]	10.6[j]
1951	39.8	14.7[j]	11.2[j]
1952	40.7	15.1[j]	11.6[j]
1955 plan	(43.9)[l]	(15.6)[j]	(12.0)[j]
	Average Annual Rate of Increase[m] (*per cent*)		
1928-1937 (1st and 2nd FYP's)	9.8	11.2	n.e.
1937-1942 plan (3rd FYP)	3.5	3.2	2.6
1937-1940	5.0[n]	2.6[n]	1.3[n]
1945-1950 (4th FYP)	7.0	n.e.	n.e.
1947-1951	5.4	7.9	
1950-1955 plan (5th FYP)	2.8	2.5	

[a] By Soviet definition includes manufacturing, mining, electric power generation, forestry, and fishing.

[b] *Trud v S.S.S.R.* (*Labor in the U.S.S.R.*), Moscow, Tsentral'noe upravlenie narodnokhoziaistvennogo ucheta (TsUNKhU) Gosplan S.S.S.R. (Central Administration for Economic Accounting, Gosplan, U.S.S.R.), 1936, p. 11. Indicated figure is the sum of figures for large-scale and small-scale industry, forestry, and fishing, and is presumably comparable with data for subsequent years.

[c] Estimated by applying ratio of workers to all personnel in large-scale industry to employment in all industry (*Trud v S.S.S.R.*, as cited, p. 11 and Table 23, p. 93). The 1928 figure includes apprentices; hence rate of growth from 1928 to 1937 not computed.

[d] *Sotsialisticheskoe stroitel'stvo Soiuza S.S.R.* (*Socialist Construction of the U.S.S.R.*), Moscow-Leningrad, 1939, p. 138.

[e] *Tretii piatiletnii plan razvitiia narodnogo khoziaistva Soiuza S.S.R.* (*Third*

(cont. on next page)

TABLE 1 (cont.)

FYP for the Development of the Economy of the U.S.S.R.), Moscow, Gosudarstvennaia planovaia komissiia (State Planning Commission), 1939.

[f] Industry accounted for 35 per cent of all workers and employees in 1940. N. Voznesensky, *Voennaia ekonomika S.S.S.R. v period Otechestvennoi voiny* (*The War Economy of the U.S.S.R. during the Patriotic War*), Moscow, 1948, p. 109.

[g] Computed from employment, output, and productivity data in the 1941 Plan. *Gosudarstvennyi plan razvitiia narodnogo khoziaistva S.S.S.R. na 1941 god* (*State Plan for the Development of the Economy of the U.S.S.R. for 1941*), reprinted by the American Council of Learned Societies, pp. 3, 512, and 513, and adjusted as under note h.

[h] Adjusted by Eason (see the Source) for consistency with published revision of 1940 figure.

[i] *Gosudarstvennyi plan razvitiia narodnogo khoziaistva S.S.S.R. na 1941 god*, as cited, p. 512. Adjusted by the present author as in note h. The figure for "workers only" obtained by applying the same ratio of workers to total personnel in industry as indicated for a somewhat smaller coverage in the Source.

[j] Computed on the basis of scattered statements on changes in industrial output and labor productivity, ultimately linked to the 1940 figure. Productivity changes presumably refer to workers only. Total employment in industry arbitrarily assumed to move proportionately with the number of workers.

[k] *Zakon o piatiletnem plan vosstanovleniia i razvitiia narodnogo khoziaistva S.S.S.R. na 1946-1950 gg.* (*Law on the FYP for the Reconstruction and Development of the Economy of the U.S.S.R. for 1946-1950*), sec. III, 2.

[l] *Directives* IV, 1.

[m] Computed from year preceding inauguration of FYP to last year of Plan.

[n] Not adjusted for intervening changes in territory and length of work-week.

n.e. = no estimate.

Source: Warren W. Eason, "Population and Labor Force," in *Soviet Economic Growth*, Abram Bergson, editor, Row, Peterson, 1953, Table 3.3, p. 110, except as indicated by footnotes. Eason's figures are from official Soviet sources, adjusted to an annual average basis from 1945 on.

gether: 9.8 per cent per year for the whole economy and 11.2 per cent yearly for industry.[9] The Fifth FYP rates are unprecedentedly low except in relation to those of the Third FYP as originally projected and those actually achieved from 1937 to 1940, at least in the case of industry. But this latter comparison must be interpreted with caution because of the specific events which occurred in the 1937-1940 period: the territorial expansion during 1939 and 1940, the rapid conversion to munitions production during those years, and

[9] Were the First FYP taken alone, the rates would have been even higher, but it is combined with the Second FYP because the huge inflow of labor into non-agricultural employment between 1928 and 1932 was not really assimiliated and absorbed until the following quinquennium, while recruitment for non-agricultural employment during the Second FYP was accordingly lower because of this "internal" reserve of manpower. Similiarly, the increase in non-agricultural employment during the Fourth FYP was probably considerably affected in its earlier years by demobilization. Therefore, an alternative calculation covering the later years 1947-1951 is presented in Table 1.

the extension of working hours by some 17 per cent in mid-1940. However, the similarity between the planned growth over 1937-1942 and that over 1950-1955 is of some significance, especially since it extends beyond mere employment data.

The slowness of the increase in non-agricultural employment during the Fifth FYP, relative to past peacetime experience, cannot be explained by a compensating lengthening of the work-week, for no such provision appears in the *Directives*, nor is a lengthening likely, considering that the forty-eight-hour week is still in effect.[10] The question is doubly challenging because the slow rise in non-agricultural employment is to be associated with an unprecedentedly large volume of investment. Evidently, each recruit to employment outside of agriculture will be accompanied by much more new capital than during previous peacetime periods, or even than was planned for the unrealized Third FYP. Unfortunately, although the general picture is fairly clear, it is difficult to give faithful quantitative expression to this phenomenon, not only because of the usual conceptual and theoretical obstacles to the "physical" measurement of investment, but also (and especially) because of the scarcity and unreliability of Soviet data. Hence the cryptic official statements on the volume of investment will have to be supplemented by several indirect real indicators of capital formation.

The Fifth FYP explicitly calls for an increase of 90 per cent in the volume of gross fixed capital investment by the state over the five years, as compared with the preceding quinquennium, and an increase of 110 per cent in agriculture alone.[11] Since it is unlikely that in the Fourth FYP agriculture received more than a fifth of all fixed investment,[12] and an even smaller fraction of fixed investment *by the state*, presumably the increase in fixed investment outside of agriculture for the Fifth FYP period, over the preceding period, has been planned at just under 90 per cent. This seems to check with a scheduled doubling of (gross) investment in industry alone,[13] and with these planned outputs of investment goods in 1955, expressed as ratios of the respective outputs in 1950: cement, 2.2; bricks, 2.3; slate, 2.6; all building materials, "not under" 2.0; output of the machine-building and metal-working industries (proba-

[10] That is, barring the outbreak of war, in which case the Plan as revealed would be scrapped anyway.

[11] *Directives*, concluding part and II, 12.

[12] Cf. Norman M. Kaplan, "Capital Formation and Allocation," in *Soviet Economic Growth*, Abram Bergson, editor, Row, Peterson, 1953, Table 2.7, p. 52.

[13] *Directives* I, 3.

bly including munitions), 2.0; large metal-cutting tools, 2.6; equipment for iron and steel mills, 1.85; and chemical equipment, 3.3. A corollary of these figures is that by 1955 the rate of gross investment (in all forms) out of the gross national product will probably be substantially higher than it was in 1950, when it had already reached, by our very crude estimate, about 25 per cent (factor cost basis, adjusted *à la* Bergson).[14]

At the same time, the *absolute* increase in the number of workers and employees during the Fifth FYP is to be only slightly more than one-half that during the Fourth Plan period, and an even smaller fraction for industry alone.[15] Thus if the investment data are to be taken seriously and the employment targets are not understated, the (gross) "incremental" *capital-intensity* in the non-agricultural sector—defined as the volume of (gross) fixed capital investment divided by the increment in the number of workers and employees—is to be nearly four times as high during the current Plan as in the Fourth FYP period. For industry alone, the incremental capital-intensity seems to increase even more in the present period. It is likely that adjustment to a *net* investment basis, which is not attempted here, would not greatly alter the picture. The relative quality, or relative potential productivity, of an average "unit" of fixed investment in the two quinquennia should of course also be considered. It is not clear to what extent the Soviet index takes account of this element, if at all. The likelihood that an average "unit" of investment increases in its potential productivity over time thanks to the progress of technology in general, and Soviet technology in particular, must be—at least in some part—balanced against the probability of diminishing returns to capital and the depletion of some natural resources.

But comparisons with the Fourth Plan period, so greatly dominated by reconstruction, are perhaps of limited significance for a longer-run view of Soviet capital formation. Consequently, an attempt has been made to construct indicators of the capital-intensity of Soviet investment by selected periods over the whole span of time since the beginning of the Plan Era—that is, for 1928-1955. The calculations and results appear in Table 2. Aggregative ruble figures would have been of very questionable use for this purpose. Un-

[14] Cf. Abram Bergson, *Soviet National Income and Product in 1937*, Columbia University Press, 1953.

[15] Underlying data in Table 1; the exact fraction for industry is not known for lack of an employment estimate for 1945.

fortunately, physical indicators of investment common to all the periods are very scarce. Indeed, the only two series which seem to be more or less usable for the purpose are employed in the table, namely: (1) the consumption of cement during the *whole* period in question, and (2) the absolute *increase* in electric power output (or, alternatively, electric power consumption in industry) between the year preceding the period in question and the terminal year of the period. The rationale of the procedure is that cement consumption is highly correlated with total construction, which in turn is highly correlated with the "physical volume" of investment. (For the Third and Fifth FYP periods estimates of planned cement *output* are substituted for consumption, but the distortion is probably slight.) Furthermore, since the bulk of Soviet power output is consumed by producers, rather than by ultimate consumers, and since at least the share taken by industry is quite stable, the increment in electric power output can be taken as a measure of the increase in power available to the non-agricultural labor force over the period. Analogously, the increase in power consumption by industry is taken as an indicator of the power available to workers employed in industry.

On the surface it would seem that each of these two indicators contains an upward bias. The great jump in cement consumption in the current quinquennium is undoubtedly connected with the large "cement-intensive" projects of the first half of the 1950's—dams, canals, and probably airfields. In addition, housing and road construction may demand an unusually large amount of cement in the present period. The rate of growth of power output also probably exceeds the rate of growth of physical capital due to the trend toward greater electrification of production in general, and the rapid growth of electricity-using industries (e.g. aluminum). On the other hand, it is likely that, with time, cement tends to be "combined" with more productive equipment, and electric power is used to run more productive machinery (in the sense of more final goods produced by it per kilowatt-hour consumed), so that the upward bias just mentioned may be offset to an unknown degree. Note that while all gross fixed investment is supposed to increase 1.9-fold during the Fifth Plan as compared with the Fourth Plan period, cement consumption (output) is to rise 2.6-fold, and the increment in power output is to rise 1.8-fold.[16]

[16] Lines 1 and 2, columns 3 and 5, of Table 2.

TABLE 2

Indicators of Capital-Intensity of Investment, Selected Years, U.S.S.R., 1928-1955

	1929-1937 (1st and 2nd FYP's) (1)	*1938-1942 (3rd FYP) plan* (2)	*1946-1950 (4th FYP)* (3)	*1948-1951* (4)	*1950-1955 (5th FYP) plan* (5)
1. Cement consumption (or output) (millions of metric tons)	33.65[a]	(40.9)[b]	33.1	38.0	(85.9)[c]
2. Increase in total electric power output (billions of kw-h)	31.4	38.6	40.8	47.1	72.2
3. Increase in electric power consumption by industry (billions of kw-h)	21.7	26.4	n.e.	n.e.	60.0
4. Increase in total number of workers and employees (millions)	15.4	5.01	11.0	6.0	5.7
5. Increase in line 4 corrected for lengthening of work-week in 1940[d] (millions)	15.4	5.01	12.9	7.0	6.7
6. Increase in number of workers and employees in industry[e] (millions)	6.23	1.7	n.e.	4.0	1.8
7. Increase in line 6 corrected as in line 5[d]	6.23	1.7	n.e.	4.7	2.1
8. Cement consumption (output) per added worker or employee, corrected; line 1 ÷ line 5; col. 1 = 100.	100	373	117	249	587
9. Increase in power output per worker or employee, corrected; line 2 ÷ line 5; col. 1 = 100.	100	378	155	330	529
10. Increase in power consumption per worker or employee, corrected, in industry only; line 3 ÷ line 6; col. 1 = 100.	100	445	n.e.	n.e.	821

(cont. on next page)

TABLE 2 (cont.)

[a] Output minus exports.
[b] Output; figures for 1938 through 1941 obtained by straight-line interpolation.
[c] Output; 1953 and 1954 figures obtained by straight-line interpolation.
[d] Employment for years after 1940 multiplied by 1.17.
[e] By definition Soviet industry includes manufacturing, mining, electric power generation, forestry, and fishing.
n.e. = no estimate.
Note: All increases are differences between figures for last year of given period and last year of preceding period.
Source: For cement and power: *Narodnoe khoziaistvo S.S.S.R., Statisticheskii spravochnik* (*The Economy of the U.S.S.R., Statistical Manual*), Moscow, TsUNKhU S.S.S.R., 1932, p. xxxiv; *Sotsialisticheskoe stroitel'stvo S.S.S.R.* (*Socialist Construction of the U.S.S.R.*), Moscow, TsUNKhU S.S.S.R., 1936, pp. 19, 22, and 183; *Tretii piatiletnii plan razvitiia narodnogo khoziaistva Soiuza S.S.R.* (*Third FYP for the Development of the Economy of the U.S.S.R.*), Moscow, Gosudarstvennaia planovaia komissiia (State Planning Commission), 1939, pp. 202 and 205; Demitri B. Shimkin, *Minerals—A Key to Soviet Power*, Harvard University Press, 1953, Tables 95 and 100; *Economic Survey of Europe in 1951*, Geneva, United Nations Economic Commission for Europe, 1952, Table 58; and *Economic Survey of Europe since the War*, Geneva, United Nations Economic Commission for Europe, 1953, Table 17. For power consumption by industry: Table 4. For employment: Table 1.

These series are divided by the *increase* in the total number of workers and employees in the whole economy to obtain indicators of incremental capital-intensity in the non-agricultural sector. However, since the concept of capital-intensity as here used refers in some sense to the combination of the factor "labor" with the factor "capital," a further adjustment is necessary to allow for the lengthening of the work-week by the decree of June 26, 1940. The adjustment factor, applicable only to columns 3 to 5, is 1.17. Other variations in the work-week are disregarded, and it is also assumed that the Third FYP did not contemplate any change in this respect.

The ratios in question are shown in lines 8, 9, and 10 of Table 2. As has been suspected, the figures for the Fourth Plan period turn out to be unrepresentative of the trend and fall much below it, reflecting both the rapid expansion of non-agricultural employment and the setback during the war. But the years 1948-1951 already show a marked turn toward the late prewar situation, as exemplified by the unrealized Third FYP. The upward trend is resumed in the current Plan. Lines 8 and 9 suggest that each *additional* worker or employee is to be accompanied (with adjustment for working hours) during the Fifth FYP period by five to six times as great a volume of investment in fixed capital as was true during the first two Plan periods. Obviously, this is only a very rough and tentative indication

of the rise in the incremental capital-intensity incidental to Soviet economic growth, though the fact of a very marked rise is hardly to be doubted. As may be expected, capital-intensity in industry alone, as suggested by increments in power consumption in industry (line 10), shows an even steeper rise from 1929-1937 to 1950-1955.

3. *Growth of the Capital Stock, 1928-1955*

The effect of a rising incremental capital-intensity in the Soviet economy is, of course, to increase with time the ratio of the *stock* of fixed capital to the amount of labor working with it. Again, satisfactory data are lacking, but some rather indirect evidence of this process may be obtained from the computations presented in Tables 3 and 4, where the consumption of power is used as a rough indi-

TABLE 3

Estimated Supply of Mineral and Hydroelectric Energy, Selected Years, U.S.S.R., 1928-1955
(*per cent; 1928 = 100*)

Year	*Total*	*Per Capita*	*Per Worker or Employee*	*Per Worker or Employee, Adjusted for Lengthening of Work-week*[a]
1928	100	100	100	100
1932	184	n.e.	93	93
1937	352	322	151	151
1940	442	348	164	152
1942 plan	650[b]	n.e.	236[b]	236[b]
1946	407[c]	n.e.	152[c]	n.e.
1950	672	510	204	173
1955 plan	998[b]	700[b]	264[b]	224[b]

[a] 1940 multiplied by .925; 1950 and 1955 multiplied by .85. No adjustment made for 1946, as the statutory work-week was probably significantly exceeded in that year.

[b] Based on planned *output* of energy, rather than on consumption.

[c] Hydroelectric power omitted in both numerator and denominator for lack of data for 1946; indexes probably slightly understated thereby.

n.e. = no estimate.

Source: Appendix Table.

cator of the capital stock on hand. Table 3 shows in index form the total energy available to the Soviet economy from mineral fuels and hydroelectric power in selected years from 1928 through 1955, figures for the latter year being planned targets. The underlying data were obtained chiefly from Shimkin's estimates of mineral consump-

tion, converted to conventional coal units as indicated in my Appendix Table. It must be noted that not all sources of energy are comprised in the index. Fuelwood and horses (as well as other animals) are notable omissions;[17] consequently, the indices in Table 3 exaggerate somewhat the increase in the energy available to the Soviet economy. On the other hand, the omissions may be justified on the ground that our interest in energy is chiefly in its capacity as an indicator of the capital stock assisting the "workers and employees" in production. In this respect the relative importance of fuelwood and animal power is, and has been, probably quite small. Since the personnel of the machine-tractor stations and of the state farms, the "energy-using" parts of agriculture, are subsumed under the category of workers and employees, this category contains virtually all the labor force engaged in lines of activity with a substantial use of power, with the significant exception of the military.

The results of rapid economic development, as well as the setbacks caused by the war, are vividly reflected in the table. By 1950 the index of total energy consumption reached 672 (1928 = 100): and on a per capita basis, 510. However, the intervening influx of labor into "worker and employee" status has been large and the workweek lengthened somewhat, so that the annual amount of energy consumed per worker or employee only doubled, and rose by only 73 per cent on a man-hour basis. Moreover, the levels of energy consumption planned for 1942, whether per capita (insofar as they can be inferred), or per worker or employee, or per man-hour, which were implicit in the Third FYP, were reached in 1950, although total energy consumption was slightly higher. In the case of the supply of energy per man-hour the deficiency is quite large—173 versus 236. Significantly, even by 1955 the supply of energy per man-hour will not yet quite attain the level planned for 1942, if our calculations are without major error.

How faithfully do the data in Table 3 represent the "true" growth of the stock of fixed capital of the Soviet economy? Will the capital stock in 1955 (if the Plan is realized), in some meaningful sense, be in fact ten times as large as in 1928? These questions must be left open. It is curious, though, to note the close agreement between the

[17] In 1937 these two sources accounted for 11.7 and 2.9 per cent, respectively, of total energy production in the Soviet Union. Chauncey D. Harris, "Industrial Resources," in *Soviet Economic Growth*, as cited, Table 5.2, p. 169.

series in column 1 and the data given by Voznesenskii[18]—namely, that the value of fixed capital of the "socialist enterprises" of the U.S.S.R., exclusive of the value of livestock, rose as follows:

Year	*Billions of 1945 Rubles*	*Index Numbers (1928 = 100)*
1928	140	100
1932	285	203
1937	564	403
1940	709	506

For years after 1928, these index numbers are uniformly 10 to 12 per cent above the indexes of total energy supply in Table 3. If Voznesenskii's coverage were extended to include enterprises of all kinds as well as the value of livestock, this gap would probably vanish, and possibly even turn into a difference in the other direction. Unfortunately, his figures are of unknown reliability, and of course do not refer to any year more recent than 1940.

Last, Table 4 presents estimates of electric power consumption per worker in Soviet industry, with a rough correction to a man-hour basis. As may be expected, the series rise much more rapidly than those in Table 3, and, for reasons already intimated, they probably greatly exaggerate the growth of the volume of fixed capital in Soviet industry. For instance, total consumption of electric power in industry rose nineteenfold between 1928 and 1950, though it does not seem plausible that the capital stock of industry increased in a comparable ratio. But whatever the precise magnitudes involved, there is a clear suggestion in Table 4 of a rapid rise in total capital, and capital per worker, in Soviet industry.[19]

4. *Factors behind Capital-Intensity*

The preceding sections have attempted to show that the "incremental" capital-intensity, at least in the non-agricultural sector, is planned to be unprecedentedly high in the current FYP; and that at

[18] N. Voznesensky, *Voennaia ekonomika S.S.S.R. v period otechestvennoi voiny* (*The War Economy of the U.S.S.R. during the Patriotic War*), Moscow, 1948, p. 12.

[19] Contrast the data on electric power use by Soviet industry (Table 4) with the following information on the number of electric motors and their capacity "at work" in Soviet agriculture in 1950: in all agriculture, "over" 75,000 motors, 400,000 kilowatts (*Elektrichestvo*, No. 11, 1952, p. 9); on collective farms, "over" 36,000 motors, 215,000 kilowatts (*ibid.*, No. 10, 1950, p. 8). In that year there were 254,000 collective farms before their amalgamation into 97,000 larger units, and the labor force in *all* agriculture was probably over 40 million.

TABLE 4

Electric Power Consumption per Worker in Soviet Industry, Selected Years, 1928-1955

Year	*Electric Power Consumed by Industry*[a] *(billions of kw-h)* (1)	*Number of Workers in Industry*[a] *(millions)* (2)	*Power per Worker (kw-h)* (1) ÷ (2) (3)	*Power per Worker, Adjusted for Lengthening of Work-week* (4)
1928	3.38	3.36[b]	1,006[b]	1,006[b]
1932	8.88	5.76	1,540	1,540
1937	25.1	8.05	3,120	3,120
1940	33.4	8.38	4,000	3,690
1942 plan	51.5	9.18	5,610	4,770
1950	64.5	10.6	6,080	5,170
1952	83.2	11.6	7,170	6,090
1955 plan	124.6	12.0	10,340	8,790

[a] Industry includes manufacturing, mining, electric power generation, forestry, and fishing.

[b] Number of workers indicated for 1928 includes apprentices; thus power per worker is correspondingly understated for this year by an unknown amount, probably in the order of 10 per cent.

Column

1 For 1928 and 1932, *Sots. stroi.*, 1936, p. 28; for 1937 and 1942, *Tretii piatiletnii plan razvitiia narodnogo khoziaistva Soiuza* S.S.R. (*Third FYP for the Development of the Economy of the U.S.S.R.*), Moscow, Gosudarstvennaia planovaia komissiia (State Planning Commission), 1939, p. 43; for 1940, power consumed by industry assumed to have been the same percentage (69) of total power output as in 1937, and total output (48.3 billion kilowatt-hours) from *Economic Survey of Europe since the War*, Geneva, United Nations, Economic Commission for Europe, 1953, Table 17; for 1950 and 1952, total output from *ibid.*, share consumed by industry taken for both years as five-sevenths, as given in *Elektrichestvo*, No. 10, 1952, p. 93; and for 1955, product of columns 2 and 3.

2 From Table 1.

3 For 1955, consumption in industry per worker is planned to be 1.7 times the 1950 figure, from M. Z. Saburov in *Pravda*, October 12 and 10, 1952, English translations in *Current Digest of the Soviet Press*, January 10, 1953 and December 6, 1952.

4 1940 multiplied by .925; subsequent years multiplied by .85. Note that the increase in power consumption per worker (Column 3) from 1940 to 1955 plan checks very closely with Saburov's assertion of a planned 2.6-fold increase (*loc. cit.*); $4{,}000 \times 2.6 = 10{,}400$.

the end of the period, in 1955, the average Soviet worker (or worker-employee) will presumably have the benefit of a considerably larger amount of productive capital than ever before in Russian experience, as indicated by the projected consumption of electric power in industry and of mineral energy in the whole economy. This development is due not only to the large and rapidly growing volume

of investment, but also (at least in part) to the retardation in the growth of the non-agricultural labor force in general, and of industrial employment in particular. In fact, it is very likely that the whole increase in the category of workers and employees is to be drawn from the natural increase in the population, and that the agricultural population is planned to remain virtually unchanged in number during the quinquennium. If so, this is apparently a new phase in Soviet planning, approximated in the past only by the provisions of the Third FYP.

To facilitate treatment, it may be postulated, probably with little violence to Soviet reality, that the decision on the share of the national product to be allocated to investment over a prospective planning period is most fundamental and has priority over all but a few of the other major planning decisions. It may be further assumed that the posited production targets in the two major sectors, agriculture, and outside of agriculture, can be achieved by a series of alternative combinations of labor and capital. An isoquant may be visualized for each of the two major sectors, with labor and capital along the two coordinates of the plane. The constraints are (1) the total amount of capital for use in both sectors (equal to the stock at the beginning of the period plus additions to it from current investment), and (2) the total labor for distribution between the two sectors. Thus choice of a position on one of the isoquants (say, the combination of capital and labor with which the non-agricultural output target is to be produced) uniquely determines the position on the other isoquant. Moreover, the same decision obviously also determines the capital-intensity, "incremental" and "average," in each sector. This is the highly schematized conceptual framework within which the subsequent discussion will proceed.

Although the distribution of investment and that of labor between the sectors of the economy are in this view mutually determined and of equal significance, the remainder of this article will discuss chiefly the problems of labor transfer within the Soviet economy, since these are probably more complex and more intractable than those of the allocation of investment funds between sectors. In particular, the possible reasons for the retardation in the growth of the non-agricultural labor force will be explored. They will be distinguished according to whether they tend to detain (or even retain) labor in uses other than non-agricultural employment—hereafter referred to as the *detentive* factors—or to deter labor from being advanta-

geously absorbed in non-agricultural employment—hereafter called the *deterrent* factors.

5. *Detentive Factors*

The detentive factors are (1) the high goals and composition of the present labor supply in the agricultural sector, (2) the effects of the educational goals, (3) the expected reduction in the proportion of women in the labor force, and (4) the maintenance of the strength of the armed forces.

AGRICULTURE

The ambitious nature of the agricultural part of the Fifth FYP has already been noted. It is apparently planned that the gross output of agriculture will rise by something like 50 per cent over the quinquennium, based on very large expected increases in yields per hectare and per animal, and labor productivity in agriculture is accordingly scheduled to rise by 40 per cent. Although there may be serious doubt whether these goals can be attained and therefore whether the consumption targets of the plan are realistic, the regime's concern over the fulfillment of the latter may have militated against any substantial reduction in the agricultural population over these five years. It must be remembered that, under present circumstances, even a stable agricultural population implies an improvement in the labor supply in this sector. First, at present there is an exceedingly high ratio of women to men in agricultural work and especially among those actually performing field tasks. This is a result of male losses in past wars, military service, transfer to non-agricultural employment, and detention in forced labor camps. While some of these causes will presumably continue to withdraw men from agricultural employment, distortions from other causes, especially war losses, are likely to be gradually rectified with time, thus leading to a slow improvement in the "quality" of agricultural labor. Second, the large age-group born during the second half of the 1930's, between the demographic disasters of collectivization and those of World War II, will be reaching working age in the middle 1950's, thus raising the ratio of workers to dependents. But both of these factors will probably have only a limited effect within the time span of the current Plan, i.e. through 1955.

The extent to which manpower needs in Soviet agriculture at the present time retard the growth of the rest of the economy depends in part on the possibility of replacing labor by capital in this sector. The

very low labor productivity in Soviet collective and state farms, as compared with productivity in American farming, for example, also suggests an extremely low marginal productivity, and therefore ample possibility for such replacement in the *long run.* Thus on examining the ratio of tractors to total *arable* area in the U.S.S.R. and other countries Dobb thinks that "there does not seem to be much sign of an early limit being reached to labor-saving improvement in agriculture" in the former, though he adds that "it is possible, however, that some slackening in the proportional (as distinct from the absolute) growth of the industrial labor-force may have to be allowed for inside the present decade" on this score.[20] He might also have pointed, in this connection, to the remaining vast potential for rural electrification.[21] But other careful students would probably attribute the low productivity largely to the specific organizational forms of Soviet agriculture, which tend to be wasteful of human and material resources and injurious to incentives,[22] and would therefore presumably be skeptical of the possibilities of releasing much agricultural labor through further mechanization.

The whole problem of the transfer of underemployed manpower from agriculture into other sectors of the economy is, of course, not independent of the costs of retraining, moving, and urbanization, as well as the actual opportunities for the substitution of labor for capital in *non*-agricultural employment. This is an extremely complex economic calculation even for a Gosplan; outside observers can do no more than raise questions.

Before leaving the consideration of agriculture as a detentive factor, it should be noted that the regime may have other than strictly economic reasons for not reducing the size of the rural population, such as maintenance of the birth rate, political (and police) control, etc.

EDUCATION

By 1955, enrollment in full-time educational institutions may cut appreciably into the labor force, and may be responsible in considerable measure for the retardation in non-agricultural employment. Most important here is the projected expansion in attendance in the last three grades of secondary education, the so-called grades eight to ten, corresponding roughly to the ages fourteen-fifteen to

[20] *Op. cit.*, p. 372. [21] See footnote 19.

[22] Cf. Naum Jasny, *The Socialized Agriculture of the USSR*, Stanford University Press, 1949, esp. Chaps. XVII and XVIII.

sixteen-seventeen. It is planned to extend education through the tenth grade to all children in the more important cities and towns, and to increase enrollment in the upper grades elsewhere as well. This is to increase total enrollment in the last three grades by 1955 to 4-fold the number in urban centers, and to 4.5-fold in rural areas, as compared with 1950.[23] The absolute numbers involved are not known, but on the basis of prewar school statistics and postwar data on total enrollment the planned *increase* of the number attending the three grades may be about 5 to 7 million.[24] In addition, enrollment in secondary *technical* schools and in institutions of higher learning is apparently scheduled to rise, judging by references to future graduations. Perhaps an increase of several hundred thousand may be anticipated on this account.

However, some of these increases may be at the expense of enrollment in the labor reserve schools for industrial training, and, of course, not all of the pupils and students in question would be in the non-agricultural labor force if not in school. Thus the net impact on employment is likely to be smaller than the above figures suggest, but still probably in the millions. This impact is greatest during the initial years, while the "stock" of pupils and students is being built up. In later years graduations and releases will presumably catch up with admissions, except for the normal growth in the school population, and the retarding effect of this factor will disappear.

HOUSEKEEPING

A very gradual drop in the proportion of women in the non-agricultural labor force may be expected in the foreseeable future. This proportion (related to the total number of workers and employees in the economy) rose during the 1930's to 40 per cent just before the war, then jumped for obvious reasons to 53 per cent in 1942, and fell only to 47 per cent in 1947. Since then there has been a slight reduction to 45.7 per cent for 1950; later postwar data are apparently not available.[25]

The expectation of a further reduction in the proportion of women

[23] *Directives* IV, 5, and Saburov, *op. cit.*, IV.

[24] In 1952 alone, it is claimed, enrollment in grades eight to ten increased by 1 million pupils, as compared with 1951. *Pravda*, January 23, 1953.

[25] All figures are taken from Warren W. Eason, "Population and Labor Force," in *Soviet Economic Growth*, as cited, Table 3.3, p. 110; they were obtained by him from Soviet sources. There may have been a temporary rise in the proportion in 1948, immediately after the currency reform.

in the non-agricultural labor force rests on a priori grounds. The most important of these is the continuous improvement in real wages and consumption standards, which may be expected to reduce the pressure for housewives to seek active employment. A gradual return of the sex ratio among adults to a more normal level is likely to have the same effect, though probably on a smaller scale.

MILITARY SERVICE

An important rival to non-agricultural employment with respect to manpower and the most uncertain and indefinite element from the point of view of an outside analyst is, of course, military service. But two factors point to *at least* a maintenance of the armed forces in a constant ratio to the total population through the current quinquennium. First, the new military classes in the middle 1950's will be larger than at the beginning of that decade, for the reason already mentioned. Second, the Fifth FYP seems to imply an expansion of the military effort[26] and may, therefore, divert at least the same amount of manpower to this use.

6. *Deterrent Factors*

The deterrent factors which tend to keep labor from being advantageously absorbed in non-agricultural employment are (1) the initial cost of transferring workers to urban communities, (2) the goal of maintaining or increasing consumption standards, (3) considerations of military strategy, and (4) the technological bias inherent in Soviet ideology. Working *within* the non-agricultural sector, these factors militate for a lesser use of labor in production, and therefore call for a higher capital-intensity in this sector in order to achieve the desired output. The non-agricultural sector is understood here in a broad sense, including, but not limited to, the urban economy in general. In fact most of the problems discussed under this rubric arise out of the costs and hazards of urbanization, rather than out of the characteristics of the production processes as such.

COST OF URBANIZATION

It seems quite possible that the initial cost of "urbanizing" workers and their families causes Soviet planners to minimize the transfer of manpower from agricultural employment to industrial and other

[26] Consider the increases in the output of aluminum, petroleum products, and other products of military significance. Cf. "The Kremlin's Plan V," as cited.

urban pursuits, and therefore to press for the substitution of capital for labor in the non-agricultural sector.

A major handicap to further industrialization seems to be the severe shortage of urban housing. In the earlier phase of its economic development the Soviet Union had been able to draw on the urban capital (chiefly housing) which it inherited from the past to an extent that was probably not fully appreciated by contemporary observers. Thus, while the urban population increased from 26.3 million at the end of 1926 to 55.9 million at the beginning of 1939, or by 112 per cent, the available urban dwelling space rose only by about 50 per cent. As a result, the urban space per capita fell from 6 square meters to just over 4 square meters, on the average. Some housing slack was acquired with the territorial annexations of 1939-1940, though it was inconveniently localized. Then came the war losses. However, by 1950 not only were these apparently made good (at least in quantity if not in quality) but enough additional space was built to keep pace with the growth of the urban population. Thus approximately the same amount as before the war, 4 square meters per capita, seems to have been available at the beginning of the Fifth FYP.[27] With this figure as an average, the situation must be considerably worse for large parts of the urban population. The regime is, by all indications, seriously concerned with the housing shortage and is making an unusually determined effort to alleviate it. But whether the current Plan in fact provides for a substantial housing improvement is not clear, for the conclusion depends on one's interpretation of the construction provisions of the Plan, and on one's estimate of the growth of the urban population to 1955.[28]

[27] The space estimates are by Timothy Sosnovy, prepared for his forthcoming book, *The Housing Problem in the Soviet Union*, and here used with the author's kind permission. The Soviet concept of dwelling space (*zhilaia ploshchad'*) excludes secondary space such as hallways, kitchens, lavatories, and closets.

[28] The Plan calls for 105 million square meters to be placed in use by the state, and an undetermined, but undoubtedly much smaller, amount by individuals (*Directives* IV, 3). However, there is evidence to the effect that the measure of space was redefined in 1948, resulting in an inflation of new construction figures. (I owe this observation to Carolyn Recht of the Russian Research Center, Harvard University, who is making a careful study of Soviet housing.) The actual increase in urban dwelling space may altogether be under 30 per cent, if the Plan materializes fully. Compare this with the scheduled increase of 15 per cent in the number of workers and employees, with probably an appreciable increase in the number of dependents (students, housewives, etc.) per gainfully employed person, as discussed in the preceding section. Hence the impression that the Plan envisages only a modest improvement in per capita urban housing space at best.

At any rate, it seems quite safe to assume that the regime rules out a further deterioration of the severe housing situation, even if greater overcrowding under peacetime conditions were thinkable. The resource has been depleted. Presumably, new migrants to the cities and towns have to be supplied with at least the existing average housing ration. This space must be newly constructed, with a corresponding claim on the state's investment resources. But capital needs do not stop here. If the already low standards of urban conveniences and necessities are not to be further diluted, additional capital has to be concomitantly invested in such facilities as streets, urban transportation, some public utilities, schools, retail outlets, and so forth. Moreover, the transfer of a given "primary" number of persons to cities or towns requires the transfer of others to service the primary migrants, and still others to service the second group, and so forth in a convergent series. The "secondary" migrants—that is, all those who "follow" the primary—will be engaged in such occupations as retail trade, urban and interurban transportation, municipal services and administration, and education. Finally, if all these people are to be recruited chiefly from among the peasants, a capital outlay by the state is also necessary at the outset to train them in their new functions and to underwrite their low productivity. Very likely also some investment is necessary in agriculture to compensate for the withdrawal of manpower from that sector.

The investment i' by the economy—that is, by the state—occasioned by the movement of an additional person to an urban location can be expressed as follows:

$$i' = [(h + f)(1 + d) + t + a](1 + s)$$

where h = capital cost of housing per person
f = capital cost of other urban facilities per person
d = number of dependents per gainfully employed
t = cost of retraining a migrant, and similar expenses
a = compensating capital investment in agriculture per worker withdrawn
s = number of "secondary" migrants per "primary" migrant.

It must be noted that in the industrialization of typical capitalist countries the capital requirement to the potential employer of raw labor did not, and does not, amount to the full extent designated by i'. True, the private employer may undertake the cost of training or retraining, and not infrequently may find it necessary or expedient

to invest in housing for his personnel, and sometimes even in certain other facilities of an urban character. But he will rarely be concerned with providing the same for the "secondary" labor force, and will never be required to furnish capital to the agricultural sector in order to compensate for his recruitment of manpower. To the planners of the all-embracing Soviet state, all these are, or should be, costs of equal concern; moreover, there is reason to believe that the planners in fact do take such considerations into account.

But there is another quantity of capital, i'', which, if invested in labor-saving equipment in the non-agricultural sector, would completely dispense with the transfer of the worker from the village into the city. In an optimal situation it is the marginal rate of substitution between capital and labor along the isoquants standing for total non-agricultural output. But under actual conditions, and especially with the Soviet distinction between "leading" and other branches of the economy, the value of i'' may be expected to vary widely from one branch to another. If i'' is lower than i' in any particular line of activity, there is patently an economic case for choosing a more labor-saving, i.e. a more capital-intensive, method of producing a given output. Certain preliminary calculations made by Carolyn Recht of the Russian Research Center, Harvard University, point to a strong likelihood that in at least some instances this is the case at the present time in the Soviet economy. Unfortunately, the pertinent quantitative information is scarce, and the whole question is further clouded by uncertainty as to how meaningful Soviet accounting prices are.[29]

Considerations of this sort have apparently figured in the recent thinking of Soviet planners and economists. On the operational side much of the present expansion in the non-agricultural sector, especially in industry, seems to be taking place through the release of manpower from established production units to expanded or newly created ones, thanks to the replacement of labor by capital in the former. Malenkov specifically brought up this point in his report to the Nineteenth Party Congress.[30]

Theoretically, his question was treated in the context of optimum allocation of investment funds by P. Mstislavskii.[31] True, these

[29] Miss Recht's calculations were made for her doctoral dissertation on Soviet housing problems, in progress, and are here mentioned with her kind permission. This whole section owes much to her comments.

[30] *Pravda*, October 6, 1952, and *Current Digest of the Soviet Press*, November 8, 1952, p. 5.

[31] "Nekotorye voprosy effektivnosti kapitalovlozhenii v sovetskom khoziaistve"

sources do not discuss the relative magnitudes of i' and i'', in our symbols, but the preference for the more capital-intensive solution as against a greater influx of manpower from agriculture is perhaps implicit.

In this connection, the efforts of the Soviet Union to mechanize "labor-intensive" processes, and further to automatize production, must be noted. After the initial postwar reconstruction job was largely completed, a vigorous campaign was launched to mechanize the labor-intensive processes in industry, construction, and other branches outside of agriculture. These traditional areas of very low labor productivity in the Soviet economy—e.g. handling of materials, warehousing, inspection, and many construction jobs—are now being mechanized, or in some instances rationalized in other ways, such as through the introduction of statistical quality control.[32]

Automation, a much more ambitious undertaking than the mechanization of labor-intensive processes, is also by all evidence receiving very serious attention. The Soviet interest in automatics and allied problems dates back at least to 1934, when a Committee (later Institute) on Automatics and Remote Control (*Telemekhanika*) was established at the Academy of Sciences. The journal *Avtomatika i Telemekhanika* has appeared since 1936. The Third FYP and the resolutions of the Eighteenth Party Congress (1939) gave political significance to the development of automatics, but apparently very little was done before the war. Since the war the subject has been seriously pursued, and it is very prominent in the *Directives* for the Fifth FYP. Some results have already been accomplished, notably in hydroelectric generation (a minor field for labor-saving) and a few machining operations. But the scope of true automation so far attained is probably small, and the results likely to accrue by 1955 cannot be determined without an intensive examination of the

("Certain Questions of the Effectiveness of Capital Investment in the Soviet Economy"), *Voprosy ekonomiki* (*Problems of Economics*), No. 6, 1949, pp. 96-115; condensed English translation in *Current Digest of the Soviet Press*, March 4, 1950, pp. 12-19. Mstislavskii's contribution pertained to the quarter-century-old, and as yet unresolved, Soviet controversy on the theory and practice of choice of investment variant to achieve a desired fixed output, and the related problem of the place of interest in Soviet economic calculations. See my "Scarce Capital and Soviet Doctrine," *Quarterly Journal of Economics*, August 1953, pp. 311-343, and the bibliographical references therein.

[32] This is not the place to appraise the success of the campaign up to now. Undoubtedly, some advance has been registered in the last five or six years. What I should like to stress is the direction and earnestness of the planners' thinking.

available literature, which is not attempted here. It is quite likely that the successes to date have been chiefly of an experimental and pilot nature, so far of little impact on labor requirements. Nevertheless, the direction of thought and the intensity of interest must be noted. With time, this field may affect considerably the character of Soviet industrialization and may conceivably upset the still rather close relationship between industrialization and urbanization.[33]

A corollary of the emphasis on capital-intensive (i.e. labor-saving) modes of production, to which the cost of urbanization under present Soviet conditions may be contributing, is a more rapid rise in the productivity of labor, especially in industry. This is not to say that rising labor productivity is not a target per se, independent of the pressure of urbanization costs, but it must also be seen in the broader context of the allocation of the economy's investment resources between "overhead" and "production" capital. For this reason, as well as for many others, some of the recent appraisals of the prospects of labor productivity in the Soviet Union may turn out to be unduly negative.[34]

SUPPLY OF CONSUMERS' GOODS

The burden of maintaining desired consumption standards, or desired rates in their improvement, may also cause Soviet planners to hold down the transfer of agricultural manpower to non-agricultural, especially urban, employment. The consumption levels of the non-agricultural population (excluding, of course, inmates of concentration camps) are probably at this point (1953) appreciably higher than those of the peasants. This is probably particularly true of the per capita purchases of manufactured consumers' goods. What is more, the gap between the two has been, by all indications, steadily widening over the last few years, and will probably continue to widen, considering the doubt as to the attainability of the agricultural goals of the Fifth FYP. Given the gap, the smaller the move-

[33] In this connection, I found stimulating an unpublished paper by Richard L. Meier of the University of Chicago, entitled "Automatism in the Early Stages of Economic Development" (February 1953). Meier sees the advent of automation in industry as ushering in new opportunities for industrialization in hitherto backward areas with a minimum of social dislocation and with large savings in investment in social overhead capital. Much of his thinking is relevant to the Soviet situation. Cf. John T. Diebold, *Automation*, Van Nostrand, 1952, *passim*.

[34] E.g. Irving H. Siegel, "Labor Productivity in the Soviet Union," *Journal of the American Statistical Association*, March 1953, pp. 74 ff.

ment out of agriculture into other employment, the more consumption standards can be raised in *each* sector, other things being equal. This may correspond to the political aims of the regime, and thus may argue against a rapid increase in the category of workers and employees.

CONSIDERATIONS OF MILITARY STRATEGY

The hazard of aerial bombing in the event of war reinforces the other considerations against rapid urban agglomeration, and perhaps lends an aspect of imperativeness to them. But if industrialization goals are not to be sacrificed while the size of the urban population is held down, additional capital equipment, often expensive and complex, must replace labor. This makes the physical plant a more rewarding target to the attacker, and renders repair more difficult and more protracted in case of damage. It is hard to say where the balance is struck in the minds of Soviet planners.

However, labor-saving variants of production processes, and especially automatic processes, also have the advantage that they are less likely to be disrupted by a withdrawal of manpower during a mobilization. This holds especially true, of course, for industries of strategic importance, the "leading" branches of the economy and of industry in Soviet parlance. The preference enjoyed by these industries in the U.S.S.R. in terms of allocation of capital, modern equipment, skilled labor, etc., is perhaps understandable for this reason. Although in general the economic effect would be greatest if capital were so allocated as to equalize its marginal productivity of the factor in all uses, in the "leading" as well as in the other branches, actual Soviet practice becomes more rational than may seem the case at first glance if a correction factor, representing the probability of the particular enterprise not being operated at all in the event of war, is introduced into the calculation. Whether Soviet planners reason in these terms or not, their practice seems to produce such an effect.

TECHNOLOGICAL BIAS

The several deterrent factors discussed above militate against the transfer of manpower from agriculture into industrial and urban employment, with the implication that the productivity of labor in industry and other branches (except agriculture) must be raised by means of a greater capital-intensity of production to the levels required to achieve the desired outputs. But high labor productivity

and its concomitant, advanced technical design, may be desirable in themselves or as manifestations of the technological and political achievements of the regime. Technological supremacy and high labor productivity have been an integral part of the ideology of Soviet communism since Lenin's day and have been continuously regarded as prime political goals. Moreover, individual achievements in the technical field, or even mere intentions of achievement, have been adroitly used for whipping up enthusiasm at home and earning good will abroad. Despite the condemnation of "gigantomania" in the late 1930's, there has constantly been a preference for the grandiose project and for the most advanced technical design, sometimes at excessive economic cost. Even on more modest levels economic calculation often yields to technological criteria, at least in the "leading" branches and "leading" enterprises (which are fortunate enough to be allotted the necessary means).[35] Is it not possible, therefore, that the combination of a low rate of absorption of labor into non-agricultural employment, and especially into industry, with the large volume of investment in this sector is viewed with favor because it harmonizes with the technological bias of the Soviet regime, quite apart from strictly economic calculations?

7. *Concluding Remarks*

I shall not try to divine the relative importance of the several factors, detentive and deterrent, enumerated in the last two sections. The list is undoubtedly incomplete anyway. But there is no doubt that one of the outstanding features of the Fifth FYP is a significant retardation in the rate of growth of non-agricultural employment. In this respect it is reminiscent of the Third FYP (see Table 1), which, of course, was never fully realized. There are other interesting similarities between the two Plans: in projected rates of growth of the output of all industry and of many individual commodities, in the relationship between the planned increases in the output of producers' goods and of consumers' goods, in the growth of agricultural output and of railroad traffic, and in rates of increase in labor productivity.[36]

Good reasons can be found for these similarities. In the fall of 1952 as well as in the spring of 1939—the times of adoption of the Plans—the U.S.S.R. found itself in an uneasy peace. Military needs

[35] Cf. "Scarce Capital and Soviet Doctrine," as cited.

[36] The two Plans are conveniently compared in *Economic Survey of Europe since the War*, as cited, pp. 39 and 41.

claimed much of the national product at both times (although the size and character of the military establishment were considerably different in 1952 from what they were in 1939). Each Plan was adopted six to seven years after the passing of a major disaster and after a feverish period of construction or reconstruction, marked by an unforeseeably large expansion of the non-agricultural labor force. The task of assimilating and absorbing this labor faced each of the two Plans (though the Second FYP had already done some of this for the Third). Urban consumption levels were, I believe, approximately the same in 1952 and in 1939; so was urban housing space—about 4 square meters per person. But the peasants were probably worse off in the later period. Finally, the rates of investment out of the national product were about the same at the start of each Plan; whatever advantage now accrues to the Soviet economy from a larger total product is largely offset by the heavier military burden and by the larger number of mouths to feed. But the similarity should not be pressed too far, for the absolute goals of the Fifth Plan are much larger than those of the Third FYP, the volume of investment much greater, the industrial base much broader, and the levels of technological skill higher. The figures in Tables 2 through 4 reflect some of these differences.

At the present time there is not only unprecedentedly high average capital-intensity (for the U.S.S.R.), but also extreme unevenness in technological advance and in labor productivity. Within certain limited areas of the "leading" branches of the Soviet economy, labor productivity is probably quite comparable with, and sometimes possibly even exceeds, the accepted levels in the United States, thanks to modern equipment, mass production, incentive pay, sufficient training, and pressure from all the agencies of the state. Moreover, in these limited areas Soviet technologists and scientists are undoubtedly pushing against the frontiers of knowledge, with the aid of Western achievements, largely available to them, and of their own not inconsiderable talents. It would be wrong in my estimation, however, to view these areas as typical of the Soviet economy, however much Soviet propaganda would so desire. Walter Galenson's computations of productivity relative to American levels show a wide difference between individual industries, with machine-building and iron-and-steel industries yielding the highest, and consumers' goods industries the lowest, ratios.[37] These computations pertain to

[37] "Industrial Labor Productivity," in *Soviet Economic Growth*, as cited, pp. 202 ff., esp. Table 6.8.

the late 1930's. If an analogous investigation were possible for the present, Soviet industries would probably show a similarly wide range of labor productivities relative to the American.[38] Moreover, smaller organizational units—individual shops or operations—would exhibit an even greater variation in the relative levels of labor productivity. Greater contrasts than those within Soviet industry can hardly be found, and, for that matter, the same is true for contrasts between industry and agriculture in the U.S.S.R.

The regime is well aware of this general picture,[39] and, like any inefficiency, low labor productivity presents a challenge and a potential for improvement—the inefficient group "hiding" a "reserve" in Soviet parlance. Moreover, this reserve has a considerable advantage over a pool of underemployed manpower in agriculture inasmuch as it is already within the urban environment, is presumably provided with housing and other facilities at the existing norms, and has been exposed to techniques. It is made up mainly of workers who are now being supplied with additional capital equipment and are gradually being reshuffled over the non-agricultural sector.

However, the consequences of a high planned incremental capital-intensity are not limited to a beneficial effect on labor productivity. Other problems arise simultaneously, such as the creation of a spectrum of skills required by the higher level of mechanization, and an appropriate replacement policy for equipment. To date, the prevalent attitude of Soviet writers (though less of engineers than of economists) has been to deny the existence of an obsolescence problem in the Soviet economy. The position has been dogmatic, but perhaps not without some merit under conditions of extreme shortage of equipment in relation to the demands of the Plans. However, if the stress is now about to shift to modernization, in order to permit the release of labor with low productivity to man the new production lines, a more flexible attitude on replacement will undoubtedly be required. It will be interesting to watch the Soviet response and, especially, its theoretical underpinnings.

The discussion so far has assumed that both the volume of investment and the desired bill of goods for the prospective period are given, and has revolved essentially around the question of the optimum capital-intensity (ratio of capital to labor) in each sector,

[38] *Ibid.*, pp. 207-210.

[39] Cf. Malenkov's complaint of the low productivity in certain areas of industry at the Nineteenth Party Congress. *Pravda*, October 6, 1952, and *Current Digest of the Soviet Press*, November 8, 1952.

i.e. of the best allocation and distribution of the available investment resources and labor over the economy. It has been suggested that problems of labor transfer are more difficult and complex than those of the distribution of investment funds, and the possible reasons behind the provisions of the Fifth FYP has been therefore treated primarily from the side of labor allocation. However, the available volume of investment resources and the production targets are of course not independent postulates for planning, but are mutually defined in their broader outlines. Thus it is quite possible that the retardation in the expansion of non-agricultural employment, and the rising capital needs required to assist the transfer of manpower and to replace labor, might explain the small but perceptible retardation in the rate of growth of industrial output indicated by the Fifth Five-Year Plan. The average yearly rate for *all* industry called for by the Plan is 12 per cent. The rates already realized within this period are, by Soviet claim:

Period	*Per Cent Increase*
1950-1951	16
1951-1952	11
1952-1953 (first halves)	10

Compare these rates with past rates as recomputed by Hodgman:[40]

Period	*Per Cent Increase per Year*
1927/1928-1932	14.5
1932-1937	16.6
1927/1928-1937	15.7
1946-1950	20.5

(The rate of growth during 1946-1950 was, of course, favorably affected by the reconstruction character of most of the period.) Other reasons for the slowing down of industrial expansion can be adduced, and Dobb in his analysis of this question does not assign causal significance to the small increase in non-agricultural employment.[41]

Furthermore, the element of rationality in Soviet economic development should not be overstressed. Not all the major decisions are

[40] D. R. Hodgman, "Industrial Production," in *Soviet Economic Growth*, as cited, p. 242. Hodgman's index is essentially one of *large-scale industry*; extension to *all* industry would somewhat lower his figures. The official claims of industrial growth have of course been very much higher and are generally considered by American students to be inflated. However, the new Soviet index, in effect apparently since 1950, may contain little upward bias, if any (cf. Alexander Gerschenkron, "Reliability of Soviet Industrial and National Income Statistics," *The American Statistician*, April-May 1953, p. 19).

[41] *Op. cit.*, pp. 376 ff.

the result of "scientific social engineering"; ideological constraints and technological biases play their part. To put it another way, not everything is calculated with paper and pencil in hand. To a large extent the Fifth Five-Year Plan is probably a resultant of numerous autonomous forces, a compromise between several political factions and scores of bureaucratic leviathans within the body of the regime. These forces have a dynamic of their own, and a full understanding of the Plan requires the knowledge of this dynamic, which is unfortunately denied the outside observer.

Postscript

The preceding lines were written in July 1953. It is known now (March 1955) that productivity in industry and construction has not advanced at the pace foreseen in the Fifth FYP, though claims are made that industrial production targets have been met on the whole. Accordingly, the number of workers and employees by the end of 1954 already exceeded the goal for the end of 1955, and the urban population is probably growing more rapidly than anticipated. These developments must be seen in the context of the far-reaching measures, especially with regard to agriculture, that have been introduced since Stalin's death.

As a result of these changes, the Fifth FYP—in the sense of a definite and detailed document—may be pronounced dead, though its demise has not been officially subscribed. The new measures are too far-reaching not to affect significantly every major part of the Plan for the remainder of its life span. However, it would be easy to overrate the deflection in the economic course which has taken place since March 1953. There is no evidence that the larger trends have already suffered significant reversal or change. The Soviet Union is apparently continuing to invest at a very high rate in relation to its product and in very large absolute volume, to raise rapidly the amount of capital supplied to each industrial worker, to press for large technological gains, and to push up labor productivity with all the means at its command. In these respects, as in most others, the same range of means is employed as heretofore, and the institutional structure has hardly been affected. More fundamentally, the potentials for development and the limitational factors inherent in the Soviet economy must have outlived Stalin, and are now guiding the thought and shaping the actions of his successors. Hence, although this paper may now pertain to a historical rather than a living and operational document, its relevance to an analysis

APPENDIX TABLE

Supply of Mineral and Hydroelectric Energy, U.S.S.R., Selected Years, 1928-1955
(*millions of metric tons, except as indicated*)

	1928 (1)	*1932* (2)	*1937* (3)	*1940* (4)	*1942 Plan* (5)	*1946* (6)	*1950* (7)	*1955 Plan* (8)	*Factor to Convert into 1 Million Tons of Conventional Coal* (9)
					In Natural Units				
1. Coal, bituminous and anthracite	31.9	55.7	108.3	142.5	230.0	124.0	215.0	372	.907
2. Lignite	3.05	6.91	17.6	23.5		48.0	62.7		.486
3. Peat	5.32	14.79	23.8	32.1	49.0	28	42.4	53.8	.41
4. Petroleum	8.60	15.24	26.57	28.50	49.5	23.7	35.0	69.9	1.4
5. Natural gas (billions of cubit meters)	.27	.905	1.98	2.0	5.5	1.7	2.6	4.7	1.3
6. Hydroelectric power (billions of kw-h)	.36[a]	.70[a]	4.0	5.1	9.2	n.e.	12.7	35.0	.6
					In Conventional Coal Units of 7,000 Calories per Kilogram				
7. Coal	28.9	50.5	98.2	129.2	191	112.5	195.0	303	
8. Lignite	1.5	3.4	8.5	11.4		23.3	30.5		
9. Peat	2.2	6.1	9.8	13.2	20.1	11.5	17.4	22.1	
10. Petroleum	12.0	21.3	37.2	39.9	69.3	33.2	49.0	97.9	
11. Natural gas	.3	1.2	2.6	2.6	7.2	2.2	3.4	6.1	
12. Hydroelectric power	.2[a]	.4[a]	2.4	3.1	5.5	n.e.	7.6	21.0	
13. Total, lines 7-12	45.1	82.9	158.7	199.4	293.1	182.7[b]	302.9	450.1	
14. Population, approximate annual average (millions)[c]	152	n.e.	166	193	n.e.	n.e.	200	217	
15. Workers and employees (annual average, millions)[d]	11.6	22.9	27.0	31.2	32.0	31.0	38.2	43.9	
16. Supply of mineral and hydroelectric energy (kg. of conventional coal per capita)[e]	297	n.e.	955	1,030	n.e.	n.e.	1,510	2,070	
17. Supply of mineral and hydroelectric energy (kg. of conventional coal per worker or employee)[e]	3,890	3,620	5,880	6,390	9,160	5,890[b]	7,930	10,250	

(cont. on next page)

APPENDIX TABLE (cont.)

[a] Regional hydraulic stations only, but exclusion of other hydraulic stations not significant for these years.

[b] Exclusive of hydroelectric power.

[c] Population figures are approximate estimates by the author.

[d] Number of workers and employees as in Table 1.

[e] Rounded.

n.e. = no estimate.

Source: All fuel and power data in natural units are estimates of *consumption*, except the following, which are output data: all figures for peat and hydroelectric power and all figures for 1942 (plan) and 1955 (plan). All consumption estimates are from Demitri B. Shimkin, *Minerals —A Key to Soviet Power*, Harvard University Press, 1953, Table 100, p. 391. Output targets for 1942 are from *Tretii piatiletnii plan razvitiia narodnogo khoziaistva Soiuza S.S.R.* (*Third FYP for the Development of the Economy of the U.S.S.R.*), Moscow, Gosudarstvennaia planovaia komissiia (State Planning Commission), 1939, pp. 44 and 202. Conversion of natural gas into cubic meters is from Shimkin, *op. cit.*, p. 198. Output targets for 1955 are from *Economic Survey of Europe since the War*, Geneva, United Nations Economic Commission for Europe, 1953, Table 17, pp. 42-43, except that the 1955 target for natural gas was obtained by applying ratio of increase in the *Directives*, i.e. 1.8, to Shimkin's estimate. Peat output: for 1928 and 1932 from *Sots. stroi.*, 1936, p. 130; for 1937, 1940, 1946, 1950, and 1955 (plan) from *Economic Survey of Europe since the War*, as cited, Table 17, pp. 42-43; and for 1942 (plan) from *Tretii piatiletnii plan . . .*, as cited, pp. 44 and 202. Hydroelectric power output: for 1928 and 1932 from *Sots. stroi.*, 1936, p. 90 (refers to regional stations only); for 1937 from Chauncey D. Harris, "Industrial Resources," in *Soviet Economic Growth*, Abram Bergson, editor, Row, Peterson, 1953, p. 169; for 1940, 1950, and 1955 (plan) from *Economic Survey of Europe since the War*, as cited, Table 18, p. 44; and for 1942 (plan) from *Tretii piatiletnii plan . . .*, as cited, pp. 44 and 202.

Conversion to conventional coal units: For coal and lignite through 1940 at 6,350 and 3,400 calories per kilogram, respectively, which are the approximate rates implicit in Shimkin, *op. cit.*, Tables 49 and 50, pp. 176-177; for 1942 (plan) at 5,800 calories per kilogram for coal and lignite together (cf. *ibid.*); and for 1950 and 1955 (plan) at 5,700 calories per kilogram for coal and lignite together (cf. *ibid.*). For other sources of energy, rates as given by Harris, *op. cit.*, Table 5.2, note j, p. 169, based chiefly on Soviet sources.

and evaluation of current problems of Soviet economic development has not seriously suffered from the recent turn of events.

COMMENT

NORMAN M. KAPLAN, Rand Corporation[1]

Grossman has presented an able, thoughtful, and very interesting analysis of the growth of the Soviet labor force. Observing an un-

[1] I am indebted to my colleague Gershon Cooper for helpful discussions during the preparation of these comments.

precedentedly low rate of increase in the non-agricultural labor force planned for 1951-1955, he states and explores a number of hypotheses as possible explanations. Though this discussion is inconclusive, though the hypotheses are neither accepted nor rejected, the paper brings forcibly to our attention possible perspectives in Soviet economic development. Indeed, one of these—an unprecedented emphasis on the growth of agriculture—has had rather dramatic verification in recent months.

The intent of the paper, however, is more ambitious than the achievements just described. The analysis of changes in the non-agricultural labor force is part of a larger argument which, to put it baldly, goes as follows: The basic empirical observation is that in the non-agricultural sector of the economy "incremental capital-intensity," defined as the ratio of investment to the absolute increase in the labor force, is planned to be unprecedentedly high in 1951-1955. This increase in incremental capital-intensity is due to an increase in investment and a decrease in the increment to the non-agricultural labor force. If investment and labor increments are regarded as substitutes in the process of economic growth, the decrease in the increment to the non-agricultural labor force is itself an explanation of the increase in non-agricultural investment and incremental capital-intensity. Furthermore, when the retardation in the growth of the non-agricultural labor force is analyzed, the labor-saving explanation for the increase in incremental capital-intensity is reinforced by the discovery of factors which suggest a desire or a necessity to substitute capital for labor in the non-agricultural sector of the economy. Thus the conclusion seems to be that non-agricultural incremental capital-intensity is unprecedentedly high because capital is being substituted for labor.

Because I have reservations about the relevance of the argument to trends or policy in capital formation and because these reservations do not depreciate the analysis of labor force changes, I wish to discuss separately and in turn: (1) the trends in capital-intensity, (2) the meaning of capital-intensity, and (3) the demand for, and supply of, non-agricultural labor.

1. *Trends in Capital-Intensity.* The basic quantity which Grossman seeks to measure is the incremental capital-intensity, i.e. the ratio of investment to the increment in the labor force, in the non-agricultural sector of the economy. In the absence of investment data at constant prices for the entire period of interest, two series are used as indicators of investment: cement output (where possible,

less exports) and the absolute *increase* in electric power output. The results of the calculation show a very large increase in the incremental capital-intensity of the non-agricultural sector, especially for the Fifth FYP (1951-1955). Depending upon which of the two series is used as the investment indicator (see Grossman, Table 2), the incremental intensities turn out to be as follows (1929-1937 = 100):

1938-1942 plan	373-378
1946-1950	117-155
1948-1951	249-330
1951-1955	529-587

The rationale for the indicator series is that: (1) cement consumption and new construction are correlated; (2) the absolute increase in electric power output and that in producers' durables are correlated; and (3) new construction and investment are correlated, as are producers' durables and investment.[2] Except for a comparison of the increase in investment, cement output, and the increment in electric power output between 1946-1950 and plan 1951-1955, the hypothesized relationships among the series are not tested. I have attempted to show the comparison, with the limited data available, in Table 1. Since the use which Grossman makes of the indicator series requires not only that investment be correlated with cement output or the increment in electric power output but that the *percentage changes* in the series be *equal*, Table 1 compares for various time periods the percentage changes in investment with the percentage changes in cement output and the increment in electric power output.[3]

The results provide small comfort.[4] *Within* each of the time seg-

[2] I have improvised somewhat on Grossman's statement of the rationale: see Grossman, pages 176, 177 above.

[3] There are a number of ambiguities in the postwar data which I have not taken the space to discuss.

[4] I have also looked into the relationships between cement output and new construction and between the increment in electric power consumption and producers' durables in the United States, with the following data and results emerging:

a. For new construction I used the sum of private and public construction in 1945-1949 prices (*Construction and Building Materials, Statistical Supplement*, Dept. of Commerce, May 1953, pp. 40 and 42). For cement output I used the Federal Reserve Board index of cement production. I compared the two series for 1920 to 1929, 1935 to 1950, and 1946 to 1952 separately. For each of the periods as a whole the percentage increase in cement output was appreciably *less* than the percentage increase in new construction. Within each of the periods cement output became a substantially better indicator of new construction whenever the ratio of public to private investment increased substantially.

b. The comparison between incremental electric power consumption and

TABLE 1

Investment, Cement Output, and the Increment in Electric Power Output, U.S.S.R., Selected Time Periods from 1933 to 1955
(in percentages with the first year of each time period equal to 100)

Time Period	*Investment*	*Cement Output*	*Increment in Electric Power Output*
1933 plan	100[a]	100[a]	100[a]
1934 plan	140[a]	158[a]	128[a]
1935 plan	156[a]	182[a]	203[a]
1936 plan	168[a]	218[a]	243[a]
1937 plan	178[a]	273[a]	325[a]
1937	100[b]	100[b]	100[c]
1942 plan	166[b]	178[b]	226[c]
1946	100[d]	100[e]	100[e]
1947	110[d]	139[e]	161[e]
1948	135[d]	194[e]	198[e]
1949	162[d]	245[e]	261[e]
1949	100[d]	100[e]	100[e]
1950	123[d]	127[e]	103[e]
1951	138[d]	152[e]	106[e]
1952	153[d]	174[e]	112[e]
1946-1950	100[f]	100[f]	100[f]
1951-1955 plan	190[f]	263[f]	177[f]
1950	100[g]	100[h]	100[h]
1955 plan	160-180[g]	220[h]	117[h]

[a] Calculated from data in State Planning Commission of the U.S.S.R., *The Second Five Year Plan for the Development of the National Economy of the USSR (1933-1937)*, London, Lawrence, pp. 560-561, 577, and 581. The investment data are in 1933 plan prices.

[b] Calculated from data in *Tretii piatiletnii plan razvitiia narodnogo khoziaistva Soiuza S.S.R. (1938-1942 gg.)*, Moscow, Gosudarstvennaia planovaia komissiia, 1939, p. 26. The 1937 investment figure is in 1937 prices, and the 1942 plan figure in December 1936 prices; consequently, the percentage change in investment is somewhat understated.

[c] The figures for 1937 and 1942 plan electric power output are from *Tretii piatiletnii plan . . .* , as cited, p. 213. The 1936 figure is from *Narodnokhoziaistvennyi plan Soiuza S.S.R. na 1937 god*, Moscow, Gosudarstvennaia planovaia komisssiia, 1937, pp. 64-65. The 1941 plan figure is obtained by linear interpolation between the 1937 and 1942 plan figures. The percentages are then calculated from the increments in electric power output.

[d] Annual investment for 1947 through 1950 is obtained from I. Kuz'minov, "Nepreryvnyi pod'em narodnogo khoziaistva S.S.S.R.—zakon sotsializma," *Voprosy ekonomiki*, 1951, No. 6, p. 33. The 1951 and 1952 figures are from *Pravda*, January 29, 1952, p. 2 and January 23, 1953, p. 2, respectively. Each of these figures is stated as a percentage of the figure for the preceding year and is in comparable prices. I have chained the percentages.

[e] Calculated from data in *Economic Survey of Europe in 1951*, Geneva, United Nations Economic Commission for Europe, 1952, pp. 127 and 128;

(cont. on next page)

TABLE 1 (cont.)

Economic Survey of Europe since the War, Geneva, United Nations Economic Commission for Europe, 1953, pp. 42 and 43; and Kuz'minov, *op. cit.*, p. 30.

[f] Grossman, pp. 178-180 above.

[g] If 1951-1955 plan investment is 190 per cent of 1946-1950 investment, 1955 plan investment is less than 190 per cent of 1950 investment because of the very rapid increase in investment from the low of 1945 to 1950. On the basis of 1951 and 1952 investment figures I would judge that 1955 plan investment is to be about 160 per cent of 1950 investment. To take account of possible underfulfillment of the 1951 and 1952 investment figures, I have set a range with an upper limit of 180 per cent for the ratio between 1955 plan investment and 1950 investment.

[h] Calculated from data in *Economic Survey of Europe in 1951*, as cited, p. 127, and *Economic Survey of Europe since the War*, as cited, pp. 42 and 43. Electric power output for 1954 plan was obtained by linear interpolation between the 1950 and 1955 plan figures.

ments examined, except for the most recent years, both cement output and incremental electric power output increase by larger percentages than investment; in the years since 1949, cement output leads, but incremental electric power output lags behind, investment in percentage increases. There may very well be relationships over time between investment, on the one hand, and cement or incremental electric power output, on the other, but the data seem to deny equality in percentage increase over time. The hypothesized relationships may be adequate to yield what Grossman requires—namely, an indication of *increasing* incremental capital-intensity—but as indicators in a more accurate sense they seem to fail.

Although incremental capital-intensity in conceived as a measure of the additional capital available per additional worker, it is defined in terms of *gross* investment and the difference between net and

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producers' durables was made separately for two periods, 1923 to 1929 and 1947 to 1951. For the 1923-to-1929 period, I used Shaw's series on total producers' durables in 1913 prices (William H. Shaw, *Value of Commodity Output since 1869*, National Bureau of Economic Research, 1947, p. 77). For the same period I used alternatively two electric power series: electric energy used in manufacturing and extracting, and sales of power in kilowatt-hours by electric utilities to non-residential consumers (*Historical Statistics of the United States, 1789-1945*, Bureau of the Census, 1949, pp. 157 and 159). For the period from 1947 to 1951, only the second electric power series was available to me (in the *Statistical Abstract of the United States*, Bureau of the Census, for the relevant years). For the 1947-to-1951 period, I used producers' durables in 1929 dollars from the GNP accounts. In both the 1923-to-1929 and 1947-to-1951 periods the percentage changes in incremental electric power output behaved in an extremely erratic fashion vis-à-vis the percentage changes in producers' durables: for some years the percentage change in electric power output was far below, and for other years far above, the percentage change in producers' durables.

gross investment in the numerator is ignored.[5] In the Fifth FYP as against prewar periods, I suspect the difference is appreciable. For example, capital repairs as a percentage of total investment (inclusive of capital repairs) were 18 per cent in 1951 plan as against 13 per cent in the Plan for 1938-1942, 11 per cent in 1937, and less than 10 per cent in 1933-1937.[6] After twenty years of economic growth and five years of war (1928-1953) the arithmetic aspects of the matter suggest a ratio of capital consumption to gross investment which is appreciably greater at the end of the period than in the early years of the period.[7] Accordingly, if the incremental capital-intensity series are accurate as defined, I would suspect an overstatement of the trend in additional capital per additional worker due to time changes in the ratio of capital consumption to gross investment.

In addition to incremental capital-intensity, Grossman seeks to measure trends in average non-agricultural capital-intensity, i.e. the ratio of capital to labor in the non-agricultural sector of the economy. In this calculation the total supply of mineral and hydroelectric energy (in conventional coal units) is used as the indicator of capital. The results of the calculation show a large increase in average capital-intensity between 1928 and 1955 plan, interrupted en route by declines between 1928 and 1932 and between 1940 and 1946; in 1955 plan, average capital-intensity, however, is to be less than that foreseen for 1942 by the Third FYP (Grossman, Table 3). For the prewar years the percentage increases in energy supply and the percentage increases in capital at constant prices correspond very closely; for the postwar years no capital series is available for comparison.[8]

[5] A statement that adjustment to *net* investment "would not greatly alter the picture" apparently refers to the comparison between 1951-1955 plan and 1946-1950 capital-intensities only.

[6] For the underlying data see A. Zverev, "Biudzhet mirnogo khoziaistvennogo i kultur'nogo stroitel'stva," *Planovoe khoziaistovo*, 1952, No. 1, pp. 29 and 30; *Tretii piatiletnii plan razvitiia narodnogo khoziaistva Soiuza S.S.R. (1938-1942 gg.)*, Moscow, Gosudarstvennaia planovaia komissiia, 1939, pp. 26, 115, 116, and 225; *Sotsialisticheskoe stroitel'stvo Soiuza S.S.R. (1933-1938 gg.)*, Moscow-Leningrad, Tsentral'noe upravlenie narodnokhoziaistvennogo ucheta, 1939, pp. 113 and 115; and E. Granovskii and B. Markus, *Ekonomika sotsialisticheskoe promyshlennosti*, Moscow, 1940, p. 533.

[7] See Evsey Domar, "Depreciation, Replacement and Growth," *Economic Journal*, March 1953, pp. 1 ff., for an analysis of the relationships between capital consumption and gross investment and for illustrative calculations (p. 3) of the ratio of depreciation to gross investment as a function of time, the rate of increase of gross investment, and the average life span of capital.

[8] See Grossman, pages 180-182, where the correspondence between percentage increases in total capital and in energy supply is noted. A similar cor-

Thus the trends noted are (1) an unprecedentedly high incremental capital-intensity projected by the Fifth FYP in comparison with earlier periods and (2) increasing average capital-intensity over time. In one sense there is nothing inherently surprising, i.e. demanding explanation, about such trends. Similar trends have occurred elsewhere in growing economies. In the United States, for example, average capital-intensity in the non-agricultural sector of the economy was, with 1880 = 100, 130 in 1890, 143 in 1900, and 166 in 1912.[9] In manufacturing, incremental capital-intensity was, with 1899-1904 = 100, 105 in 1904-1909, 115 in 1909-1913, and 186 in 1913-1920.[10]

2. *The Meaning of Capital-Intensity.* Why measure capital-intensity, incremental or average? What do such measures signify?

Average capital-intensity, as a measure of the stock of capital available per worker, is certainly relevant to problems of economic growth. If by economic growth we mean an increase in aggregate and per capita output, probably the two most important determinants of growth are technological advance and increased average capital-intensity. Emphasis on average capital-intensity is further warranted by the absence of aggregate measures of technological advance, and by the reflection in increased average capital-intensity of significant aspects of technological advance, i.e. the industrialization of productive processes.

From the relevance of average capital-intensity, however, that of incremental capital-intensity does not follow. Incremental and average capital-intensities are not so related that inferences about one can be drawn from observations of the other. Increasing incre-

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respondence can be obtained for percentage increases in non-agricultural capital or in non-agricultural productive capital and percentage increases in energy supply. For the capital series see Norman M. Kaplan, "Capital Formation and Allocation," in *Soviet Economic Growth*, Abram Bergson, editor, Row, Peterson, 1953, Appendix Table v (Appendix distributed separately).

[9] For non-agricultural capital in 1929 prices see Simon Kuznets, *National Product since 1869*, National Bureau of Economic Research, 1946, pp. 218 and 219. For the non-agricultural labor force see *Historical Statistics of the United States, 1789-1945*, as cited, pp. 63 and 65. The increase in average capital-intensity is understated by being unadjusted for the decrease in hours worked per week (*ibid.*, pp. 66-67).

The same data indicate the following changes in incremental capital-intensity, with 1880-1890 = 100: 94 in 1890-1900, 111 in 1900-1912.

[10] See Paul H. Douglas, *The Theory of Wages*, Macmillan, 1934, Tables 6, 8, and 9, pp. 121, 125, and 126. The same data indicate the following changes in average capital-intensity, with 1899 = 100: 119 in 1904, 143 in 1909, 154 in 1913, and 213 in 1920 (*ibid.*, Table 12, p. 129).

mental capital-intensity does not imply increasing average capital-intensity; increasing average capital-intensity does not imply increasing incremental capital-intensity.[11] Therefore, inferences about

[11] Let K = capital; L = labor; t = time; $\dot{K}$ and $\ddot{K}$ = the first and second derivatives, respectively, of capital with respect to time; and $\dot{L}$ and $\ddot{L}$ = the first and second derivatives, respectively, of labor with respect to time. For the present purposes K and L are each regarded as functions of time alone. By definition, average capital-intensity is K/L and incremental capital-intensity is $\dot{K}/\dot{L}$. What does increasing average capital-intensity imply? If

$$\frac{d\left(\frac{K}{L}\right)}{dt} > 0$$

then

$$\frac{L\dot{K} - K\dot{L}}{L^2} > 0 \text{ or } \frac{\dot{K}}{\dot{L}} > \frac{K}{L}$$

What does increasing incremental capital-intensity imply? If

$$\frac{d\left(\frac{\dot{K}}{\dot{L}}\right)}{dt} > 0$$

then

$$\frac{\dot{L}\ddot{K} - \dot{K}\ddot{L}}{\dot{L}^2} > 0 \text{ or } \frac{\ddot{K}}{\dot{L}} > \frac{K}{L}$$

Since

$$\frac{\dot{K}}{\dot{L}} > \frac{K}{L}$$

does not imply

$$\frac{\ddot{K}}{\dot{L}} > \frac{\dot{K}}{\dot{L}}$$

and

$$\frac{\ddot{K}}{\dot{L}} > \frac{\dot{K}}{\dot{L}}$$

does not imply

$$\frac{\dot{K}}{\dot{L}} > \frac{K}{L}$$

average capital-intensity may be increasing with either increasing or decreasing incremental capital-intensity, and incremental capital-intensity may be increasing with either increasing or decreasing average capital-intensity.

There is, however, one set of circumstances in which an observation of increasing incremental capital-intensity adds information about the change in average capital-intensity. Suppose that for $t = t_0$,

$$\frac{\dot{K}}{\dot{L}} > \frac{K}{L}$$

changes in the stock of capital per worker cannot be drawn from observations of incremental capital-intensity. The justification for measuring incremental capital-intensity must lie elsewhere.

Grossman relates increasing incremental and average capital-intensity to the substitution of capital for labor in investment alternatives. His problem is, Why are the non-agricultural capital-intensities (incremental and average) provided for by the Fifth FYP (1951-1955) so unprecedentedly high? The problem is approached as an allocation problem, i.e. What determines the distribution of capital and labor between the agricultural and non-agricultural sectors, given the total output of each sector and the total capital and labor force for the economy?[12] Moreover, the only problem explicitly discussed is, Why is the rate of growth of the non-agricultural labor force foreseen by the Fifth FYP so unprecedentedly low?

To pursue the conceptual framework employed by Grossman, suppose we postulate a production function for the non-agricultural sector of the economy in which output X is a function of labor L and capital K, a function which is different for different points in time. Suppose, further, we date the variables by using the subscripts 0, 1, and 2 to represent the values of the variables at the successive points in time 0, 1, and 2, respectively. Thus we have observable values of output, labor, and capital for each of three points in time. In addition, for each of the three outputs we have, at least conceptually, an isoquant which represents alternative combinations of capital and labor yielding the given output. Chart 1 presents (1) the isoquants for $X = X_0$, $X = X_1$, and $X = X_2$; (2) three points A, B, and C, the coordinates of which represent observed capital and labor for $X = X_0$, $X = X_1$, and $X = X_2$; and (3) for expository purposes, point D, an alternative (and unobserved) combination of labor and capital on the isoquant for $X = X_2$. If we connect the points A, B, and C by straight lines, the slopes of the lines represent observed incremental capital-intensities, e.g.

$$\frac{K_1 - K_0}{L_1 - L_0}$$

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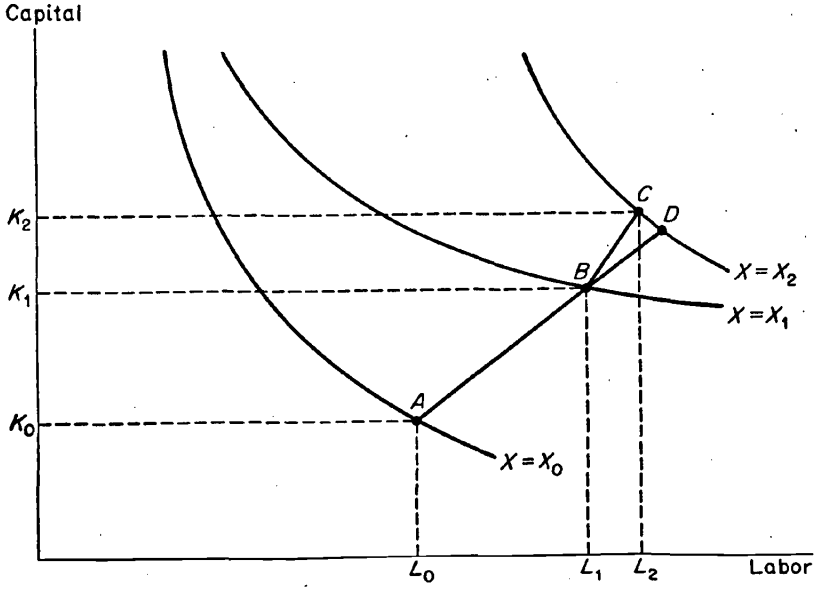
and that for $t \geqq t_0$, $\dot{K}$ and $\dot{L}$ are positive. Then if $\dot{K}/\dot{L}$ is a monotonically increasing function of time for $t \geqq t_0$, K/L is also a monotonically increasing function of time for $t \geqq t_0$.

[12] For a closer examination of Grossman's conceptual framework see my footnote 15.

CHART 1



The ratios of each pair of coordinates of points *A*, *B*, and *C* represent observed average capital-intensities, e.g. K_0/L_0. I have selected the points so that incremental and average capital-intensities increase with time.[13]

In a static sense the alternative implied by capital-labor substitution is a movement along an isoquant, e.g. a movement from point *C* to point *D*. In a dynamic sense the alternative implied by capital-labor substitution is a movement from one to another time path of investment and additions to the labor force by which a later (and higher) output is achieved, e.g. a movement from *BC* to *BD*. Is there in either sense a relationship between capital-intensities, as time series, and substitution between capital and labor?

In the static sense the marginal rate of substitution between capital and labor is the slope of the isoquant (and is negative). Thus conceptually associated with points *A*, *B*, and *C* are three such marginal rates of substitution—the tangents to each of the isoquants at points *A*, *B*, and *C*. What Grossman has measured, however, are the (positive) slopes of *AB* and *BC* and the ratios of each pair of

[13] I.e. the slope of *BC* exceeds the slope of *AB*, point *C* is above the straight line drawn through *B* from the origin, and point *B* is above the straight line drawn through *A* from the origin.

coordinates for points *A*, *B*, and *C*. It is clear that neither the marginal rate of substitution nor changes therein are measured by incremental or average capital-intensities. Moreover, without permissive information about the production functions, one cannot infer from increasing average capital-intensity that the marginal rate of substitution is numerically larger at point *C* that at point *B*; nor can one make the converse inference.[14] Finally, it is clear from Chart 1 that incremental capital-intensity per se is irrelevant to this class of inferences.

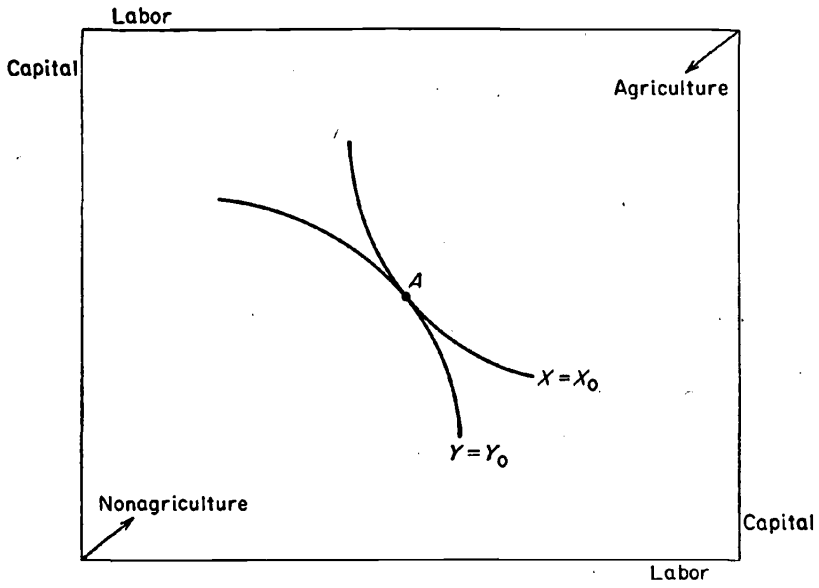
In a dynamic sense the substitution of capital for labor can be interpreted to mean that in the movement from one isoquant to a later (and higher) one a time path is followed which has a larger ratio of investment to the increment in the labor force than an alternative time path, e.g. in Chart 1 that the slope of *BC* is greater than that of *BD*. Within Grossman's conceptual framework, however, there is in one sense no alternative time path. If total output in each of the agricultural and non-agricultural sectors of the economy is given, if total capital and labor for the economy are given, and if the allocation of resources is (or is planned to be) efficient in the sense that no reallocation of resources can increase one of the outputs without decreasing the other, the distribution of capital and labor between sectors is uniquely determined by the given outputs and the given capital and labor totals.[15] To avoid this,

[14] There is a special case in which increasing average capital-intensity implies increasing marginal rates of substitution at the observed points, and conversely—namely, a production function which is invariant with time and homogeneous of degree 1. This case, however, is certainly not applicable to Soviet economic development.

[15] Grossman's conceptual framework for the analysis of capital-intensity in the Fifth FYP, adopted to "facilitate treatment," is as follows (pp. 182-185): In each of the agricultural and non-agricultural sectors of the economy, output is given by the plan and there is an isoquant which states the alternative (minimum) combinations of capital and labor by which the given output can be produced. Given also are total capital (the sum of beginning capital and net investment during the plan) and total labor. The problem is, What determines the unknowns, the distribution of capital and labor between the sectors? The system is stated to have the property that choice of a point on one isoquant "uniquely determines" the point on the other and also determines average and incremental capital-intensity in each sector.

It seems to me that these simplifying assumptions have all but simplified the problem out of existence. If the isoquants in each of the sectors have the usual properties of negative slope and convexity to the origin, i.e. if the marginal rate of substitution of capital for labor increases as the quantity of capital increases relative to that of labor, there is no factor distribution problem within the framework stated except in the special sense of a choice between two inefficient allocations. Suppose we draw the usual Edgeworth diagram in

which the two sectors of the economy are related through their common use of capital and labor, from given totals, to produce agricultural output Y and non-agricultural output X. Of the infinite number of isoquants in each sector



associated with the infinite number of outputs in each, only the pair for the given outputs ($Y = Y_0$ and $X = X_0$) is presented. If the two isoquants touch (but do not intersect) as in the diagram at point A, there is only *one* distribution of capital and labor consistent with the given outputs and the given total capital and labor. That is to say, the distribution of capital and labor between sectors is uniquely determined by the given outputs and the given total capital and labor. If the isoquants intersect, there are *two* distributions of capital and labor between the sectors which will produce *exactly* the outputs given with full employment of total capital and labor. Both points of intersection, however, represent inefficient allocations of resources in the sense that reallocations of capital and labor between the sectors can increase one of the outputs without decreasing the other. There are an infinite number of such possible reallocations, represented by all points in the area bounded by the intersecting isoquants. For any pair of given outputs in this area, however, there is only *one* distribution of capital and labor consistent with the given total capital and labor. Thus either (1) the problem is a choice between two, and only two, inefficient allocations in the face of unambiguously preferable allocations; or (2) the assumption of given outputs must be relaxed and the problem cannot be conceived as a choice among points on a given isoquant; or (3) the assumption of full employment of total capital and labor must be relaxed, in which case choice of a point on one isoquant does *not* determine the point on the other.

If *within* either the non-agricultural sectors or the agricultural sectors the ratio of the marginal physical productivities of capital and labor is not uniform in all uses, the entire conceptual apparatus collapses because the allocation of resources cannot be described as a point on an isoquant.

let us treat the output of the agricultural sector as a residual and consider the non-agricultural sector of the economy alone.

In Chart 1, then, there are an infinite number of alternative paths from, say, X_1 to X_2 : some will have slopes greater than the slope of *BC* and others like *BD* will have slopes less than *BC*. All, moreover, are in the nature of the case unobserved. If it is held that, in the dynamic sense, *BC* substitutes capital for labor, the alternative and unobserved time path (say, *BD*) with which *BC* is compared must somehow be specified. Two possible specifications come to mind from Grossman's paper: an optimal time path with a slope less than that of the observed path,[16] and an extrapolation of previous trends. It is possible that *BC* substitutes capital for labor is an uneconomic way, i.e. that there is an alternative path, *BD*, which in some sense is optimal. But the optimal time path, however defined, is not relevant to *observed trends* in capital-intensities because the implication of an optimal, less capital-intensive time path is only that incremental and average capital-intensities, whether increasing or decreasing, are larger than they *should* be.

To infer from increasing incremental capital-intensity that capital is being substituted for labor might also mean that, apart from the choice among investment alternatives which yield identical outputs, incremental capital-intensity is (or should be) invariant with time. That is to say, *BC* is held to substitute capital for labor because its slope is greater than that of *BD*, derived from a continuation of *AB*. I see no reason, and Grossman advances none, to expect a continuation of past trends. The variables omitted are the increment in output[17] and technological change: the ratio of investment to the increment in the labor force depends not only on capital-labor substitutions but also on the increment of output, in kind and quantity, and on the range of technologically possible

[16] As a possible explanatory factor in the retardation of the rate of growth of non-agricultural labor, Grossman mentions a technological bias on the part of Soviet planners in favor of "the grandiose project and . . . the most advanced technical design" in non-agricultural production, a bias which originates in ideological affection for high labor productivity and uneconomic criteria for investment choice (page 195).

It should also be noted that Grossman regards his discussion as one of "optimum capital-intensity" (page 197).

[17] In a concluding paragraph Grossman relaxes his assumption of given output but only to point out the possibility "that the retardation in the expansion of non-agricultural employment, and the rising capital needs required to assist the transfer of manpower and to replace labor, might explain the small but perceptible retardation in the rate of growth of industrial output indicated by the Fifth Five-Year Plan" (page 198).

capital and labor coefficients associated with the increment of output and feasible capital-labor substitutions. I see no reason to believe that the influence of output increments and technological change is (or should be) neutral with respect to capital-labor ratios, incremental or average. Accordingly, I see no reason to infer from increasing incremental capital-intensity, from the fact that the slope of *BC* exceeds the slope of *AB* (or *BD*), that capital is being substituted for labor.

Where does all this lead? My original question was, Why measure incremental or average capital-intensity? By way of summary, I am led to the following conclusions: (1) Though the stock of capital available per worker is a relevant quantity from the viewpoint of economic growth, no justification for the measurement of incremental capital-intensity can be derived thereby. Incremental and average capital-intensities, as defined, are not so related that an increase in one implies an increase in the other. (2) In the structure of Grossman's argument, increasing incremental and average capital-intensities are related to the substitution of capital for labor in investment alternatives. No connection between the quantities measured and the concept suggested is successfully established in the paper, nor am I able to establish one. If a connection cannot be established, Grossman's analysis of the retardation in the rate of growth of the non-agricultural labor force—interesting enough in itself—bears no systematic relationship to the observed trends in capital formation. In my opinion his conceptual framework fails to unify the empirical observations of increasing capital-intensities and the explanatory analysis which follows.

3. *The Non-agricultural Labor Force, Demand and Supply.* Apart from its implications with respect to Soviet capital formation, Grossman's analysis of recent trends in the non-agricultural labor force commands attention on its own merits. The basic observation is that, as foreseen in the Fifth FYP, the 1951-1955 percentage increase in the non-agricultural labor force is to be unprecedentedly low.[18] The problem is to explain the retardation in the rate of growth.

[18] It should be noted that this retardation is especially striking in comparison with previously realized increases (Grossman, Table 1). Both the Third and the Fourth FYP (1938-1942 and 1946-1950) provided for rates of growth which were not substantially larger than that in the Fifth FYP and for absolute increases which were about the same as that in the Fifth FYP. Thus the average annual rate of growth of the non-agricultural labor force was 3.5 per cent from 1937 to 1942 plan, 3.8 per cent from 1945 to 1950 plan, and 2.8 per cent from 1950 to 1955 plan; the absolute increments were about 5.0 million "workers and employees" from 1937 to 1942 plan, about 6.3 million from 1945 to 1950

Grossman states and explores a number of hypotheses as possible explanations. They are classified into *detentive* factors, i.e. those which tend to detain labor in uses other than non-agricultural employment, and *deterrent* factors, i.e. those which tend to deter labor from use in non-agricultural employment. More conventionally, the classification separates the factors which influence the supply of non-agricultural labor from the factors which influence the demand for it. It would be difficult to think of hypotheses which are important possibilities and which are excluded from consideration. It is impossible to disqualify any considered.

Among the most interesting of the possible explanatory factors is the cost of urbanization. The hypothesis is that the capital cost of urbanization is sufficiently high to deter the transfer of labor from agriculture and to promote the substitution of capital for labor in non-agricultural sectors (Grossman, pages 188-193). The calculus suggested is as follows: Given outputs in the agricultural and non-agricultural sectors, there is a capital cost to the economy (i') involved in the transfer of an additional worker from agriculture to another sector. In somewhat simplified form,

$$i' = h(1 + d) + t + a$$

where h = the capital cost of housing and other urban facilities per person
d = the number of dependents per wage earner
t = the cost of training an agricultural worker in non-agricultural work
a = the investment in agriculture necessary to replace the transferred worker and maintain output.

Under the same assumptions there is an alternative capital cost to the economy (i'') which is the equipment expenditure in non-agricultural sectors necessary to maintain output in lieu of the use of

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plan, and about 5.7 million from 1950 to 1955 plan. The Third FYP was, of course, interrupted by the war: the average annual rate of growth from 1937 to 1940 was 5.0 per cent, though this partly reflects the territorial additions in 1939-1940. The increases foreseen by the Fourth FYP were vastly overfulfilled. Thus the query arises, Will the Fifth FYP increases in the non-agricultural labor force be significantly overfulfilled? The data available in November 1953, when this comment was written, suggested a negative answer (see *Pravda*, January 29, 1952 and January 23, 1953, and *Vestnik statistiki*, 1953, No. 4, p. 8). However, as Grossman's postscript indicates, recent data reveal that in 1954 the number of "workers and employees" was already in excess of that originally planned for 1955 (see *Pravda*, January 21, 1955).

an additional worker. If $i' < i''$, the worker will be transferred; if $i' > i''$, the worker will be retained in agriculture. Grossman mentions some preliminary calculations which suggest that for some branches of the non-agricultural economy, $i' > i''$. Needless to say, when these calculations appear they will be received with great interest.

A few comments, however, are in order here.

1. Population growth in the U.S.S.R. implies expenditures on housing, consumer facilities, and training whether or not there is a transfer of labor from agriculture to the non-agricultural economy. In the decision to transfer or not to transfer labor, only the difference in such expenditure is relevant. Thus if i' and i'' are calculated literally as defined, i' will be overstated in relation to i'' because the capital cost of rural housing and other rural facilities has been ignored in h and the cost of training agricultural labor has been ignored in t.

2. If there is surplus labor in agriculture, as Grossman elsewhere suggests (page 186), this may imply zero or negative marginal productivity in agriculture and, therefore, a zero value for a.

3. The need to compensate agriculture with capital for its loss of labor derives from the assumption that (planned) outputs in agriculture and the non-agricultural sectors are given. Under less restrictive assumptions, whether agriculture should be so compensated depends upon the marginal productivities of capital in agriculture and other sectors, made commensurate by the planners' preference function. Though there is certainly an allocation problem posed by possible capital-labor substitutions, it would be irrational for Gosplan to think in terms of the calculus suggested, *given* the output of both sectors. There is also a marginal rate of substitution between agricultural output and non-agricultural output which cannot be ignored.

4. It seems to me that Grossman overstates the failure of a market economy, in comparison with an all-embracing planned economy, to take into account the social costs of urbanization. There may be many such social costs which do not enter the private cost function of the entrepreneur. However, the costs of housing and urban facilities would seem to enter the cost functions via the wages found necessary to attract labor.

5. In connection with the data on capital-intensity, it should be noted that a larger increase in the non-agricultural labor force might increase observed incremental capital-intensity via the impact on

observed investment of increased expenditures on housing and other urban facilities. Unless the numerator of incremental capital-intensity is restricted to certain kinds of investment, it is not clear to me that a decrease in the incremental labor force means an increase in investment, even abstracting from the considerations previously mentioned.

With respect to the other hypotheses listed by Grossman I have only a few scattered comments:

1. Grossman's remarks on the Soviet bias in favor of advanced technology (pages 194-195) and on the Soviet interest in mechanization and automation (pages 192-193) whet my appetite for more. I would like to know how advanced Soviet technology is, how uneven their advances are, what opportunities exist for further technological imitation of advanced economies, what modifications they have made in borrowed processes and products, what capital-labor substitutions they make in detail, which inputs they economize relative to United States practices, etc. It seems to me that a comparative study, combining engineering and economic talents, of U.S.-U.S.S.R. technology, manufacturing processes, and product design is long overdue.

2. Grossman expects a reduction in the proportion of females in the non-agricultural labor force largely on the grounds of the continuous improvement in real wages and consumption standards (page 187). An increase in real wages, however, has both an income effect and a substitution effect on the choice between housekeeping (leisure?) and gainful employment.[19] It is not clear, therefore, whether an increase in real wages deters or encourages participation of females in gainful employment.

3. Grossman notes a planned increase, from 1950 to 1955, of 5 to 7 million students in the last three grades of secondary school and of possibly several hundred thousand in secondary *technical* schools and in institutions of higher learning. Of course, not all these students would be in the *non-agricultural* labor force were they not in school, but many would be and those that would have been in the agricultural labor force might have permitted additional transfers of labor from agriculture to other sectors. If, in the absence of the increased educational program, the planned 1955 non-agricultural labor force would have been 4 million more than presently planned for 1955, the absolute increase in the non-agricultural labor force

[19] See Gershon Cooper, "Taxation and Incentive in Mobilization," *Quarterly Journal of Economics*, February 1952, pp. 43 ff.

would have been almost 10 million from 1950 to 1955 plan as against 11 million between 1945 and 1950 and the average annual rate of increase would have been 4.7 per cent as against 5.4 per cent between 1947 and 1951, 5.0 per cent between 1937 and 1940, and 3.5 per cent between 1937 and 1942 plan (Grossman, page 193). Thus the increased educational program might well be the entire explanation for the *unprecedented* lowness of the Fifth FYP rate of increase. In any case, the increased educational program certainly represents, in a real and important sense, a substitution of capital for labor via investment-in-self.

4. Among the factors mentioned as possible explanations for the retardation in the rate of growth of the non-agricultural labor force is the ambitious nature of the Fifth FYP agricultural output goals. The suggestion of an increased concern on the part of Soviet authorities for future agricultural development is of particular interest because of its rather dramatic verification in recent events.[20]

Achievements recorded by the end of 1952 must have made it clear to Soviet authorities that, without extraordinary measures, the announced goals for 1955 plan agriculture and consumers' goods were unattainable. In an August 1953 speech Malenkov sounded a new note of urgent concern for the Soviet consumer. The newness of the note consisted in: (1) repetition of a two- to three-year time horizon within which a sharp rise in consumers' goods output is to be effected, (2) admission that the current level of consumers' goods output is unsatisfactory and the diagnosis that this is due to past emphasis on heavy industry and transport in capital formation, and (3) admission that agricultural output has lagged seriously and that it is necessary "first of all" to develop agriculture if consumption increases are to be attained. Though various measures were more or less vaguely described, even less than usual was to be learned about resource allocation from the 1953 Soviet budget, presented in August 1953, because of unusually large unexplained residuals on both the revenue and expenditure sides. Consequently, in the absence of further revelations of intentions, reservations about possible shifts in the pattern of Soviet economic development seemed prudent.

The new note continued in the Soviet press during August and

[20] These remarks were written in November 1953 and are based on *Pravda* issues from August through October. The decrees referred to on agriculture, retail trade, and consumers' goods are in *Pravda*, September 26, September 29, October 1, October 23, October 28, and October 30, 1953.

September 1953. Finally, there appeared a series of speeches, reports, and *decrees* which add up to quite impressive *plans* for large and short-run consumption increases and agricultural improvements. There is not space to discuss these developments in detail. Suffice it to note here that: (1) despite failures in 1951 and 1952, many of the ambitious goals set by the Fifth FYP for 1955 plan agriculture and consumption are now to be achieved in 1954; (2) investment in agriculture, trade, and consumers' goods industries is to be increased markedly: (3) little is now being said about the "Great Stalin construction projects" and nothing about the most ambitious of them (e.g. the Turkmenian project); (4) there is little indication of a problem with respect to the agricultural labor force except in the case of specialists, of whom 100,000 are to be sent to machine and tractor stations from ministries and local authorities in 1954 plan; (5) there are suggestions of the use of international trade to provide consumers' goods imports in exchange for producers' goods exports.

So far, of course, these are just plans. But if fulfilled, the plans will mean rapid increases in living standards. If not fulfilled by significant margins, I feel from the way in which the changes have been stated that serious internal problems may ensue. Future developments in these sectors must be watched with care.

ALEXANDER ERLICH, Russian Research Center, Harvard University; and National Bureau of Economic Research

Grossman has marshaled impressive evidence in support of his thesis. The increase in capital-labor ratios in Soviet industry as shown by his figures is striking indeed; and while I have no quarrel with his interpretation of this trend, I would like to contribute a very tentative additional suggestion. It seems not unreasonable to surmise that the Soviet economy may now be experiencing a delayed "replacement echo" of the great investment boom which began in the late 1920's and continued unabatedly until the German invasion of 1941. There can be no doubt that a good deal of equipment built in the period of the First and Second FYP's is now ready for retirement. True, in earlier years the presence of large blocks of worn-out and antiquated equipment would by no means have justified the conclusion that this equipment would actually be scrapped: the Soviet writings of the 1930's and 1940's bear eloquent testimony to the fact that the Soviet economic administration consistently

adhered to the policy of working the old equipment to death. In view of the very substantial expansion of the Soviet capital-making capacity in the postwar period, however, a guess could be ventured that the Soviet economy could now afford to retire the still serviceable old plant and replace it with the new, rather than to let the latter come, as it were, on the top of the first.

Should such a change in policy have actually taken place (and this is for the time being, to repeat, merely a not implausible hypothesis), the increase in the *net* investment per industrial worker would be, in all probability, considerably smaller than Grossman's figures would indicate. It should be noted, however, that his two indicators of the capital-labor ratio would not be affected by this to the same degree. Since the cement series reflects the behavior of *total* constructional activity over time, the increase of the share of replacement in the gross investment should correspondingly reduce the net portion of this series for the relevant years. The situation is different with regard to the power consumption series, which measures *increments* and not totals: the figures it contains should be taken to represent net magnitudes even under assumption of a change in replacement policy, since the part of the newly installed plant which represents the replacement of the retired units would now be consuming the power supply set free after the scrapping of the old plant. The figures in the relevant part of line 10 in Grossman's Table 2 would still tend to overstate the incremental capital ÷ labor ratio to the extent to which the increased power consumption per worker would be paralleled by a less-than-proportional increase (or by an actual decline) in the use of non-electrical energy per worker. But this qualification raises no new points because the possibility of such upward bias was explicitly recognized by Grossman.

ABRAM BERGSON, Columbia University

In his illuminating essay Grossman describes and explains recent trends in the allocation of labor and capital between the agricultural and non-agricultural sectors of the Soviet economy. This is a topic that might be examined from more than one standpoint, but interest here revolves chiefly around the recurring problem of the efficiency of resource allocation. In the present context what is in question particularly is the extent to which the Russians tend to realize their "production possibilities" in the allocation of labor and capital be-

tween the agricultural and non-agricultural sectors. In studying the trends in this allocation, one is interested in variations in this tendency over time. The realization of production possibilities, it will be recalled, is a desideratum that is entirely independent of the Soviet authorities' preferences regarding the bill of goods. If production possibilities are not attained, a suitable reallocation affords an opportunity to increase the output of either agricultural or non-agricultural goods, or, if it is so desired, both of these products.

While it has seemed desirable to state this problem somewhat more explicitly than Grossman does, I must leave to the reader a review, in the light of my remarks, of the interesting facts and arguments he sets forth. I will comment here on only one or two aspects of the problem.

Grossman cites a number of factors which may tend to limit Soviet transfers of labor from agriculture to industry. One is the "technological bias" of the Soviet planners which leads them to seek continually to raise the productivity of labor in industry. A review of Soviet writings would undoubtedly yield a good deal of support for the view that such a bias actually operates in the U.S.S.R. Moreover, it is a familiar notion that in a country such as Russia, where a vast population has been and still is engaged in agriculture, the bias might lead to economic waste. The precise sense in which a waste results, however, is not always made clear, so it may deserve underlining that the diseconomy takes the form of a failure to realize the theoretic desideratum, the community's production possibilities. Thus if the Russians are to achieve this goal, sizable transfers of labor from agriculture to industry may have to be carried out year after year. These transfers would proceed simultaneously with an allocation of investments which would both assure the release of workers from agriculture and equip them for work in industry.

Insofar as a country attains its production possibilities, the total output of both industrial and agricultural products is greater than it would be otherwise. But with the indicated allocation of labor and capital the productivity of labor in industry may nevertheless rise only slowly. If an allocation in accord with production possibilities were instituted in circumstances where previously it had not been realized, it might even lead to a drop in labor productivity. This is to say that with a bias in favor of labor productivity such as that in the U.S.S.R., an efficient allocation might never be realized at all. Moreover, the barrier to its full-scale introduction

would grow ever greater, the higher the level of industrial productivity actually attained.

While Russia has a vast agricultural population, the question involved here is the extent to which it is economically surplus, in the sense that labor may be released from the agricultural sector at the price of relatively limited investments or loss in output. Grossman comments only briefly on this question. For reasons which I have set forth elsewhere,[1] my own inclination is to think of larger possibilities of further labor economies than he does.

Grossman points out that the transfer of labor from agriculture to industry may be limited also by superior urban living standards. Given this superiority, the transfers are costly in terms of consumers' goods. I have no question to raise on this score, but account should be taken also of the further problem of transferring food from the country to the city. The transfer of workers does not lead automatically to a release of the agricultural produce needed to support the migrants; somehow the government must extract the produce from the peasantry. This problem of the "marketed share" of agricultural produce has long been central in the government's relations with agriculture. While the government's control of agriculture through the collective farm system has enabled it to raise the marketed share far above the low levels attained under peasant agriculture in the late 1920's, the government must hesitate to increase still further such exactions. This would be an additional factor tending to limit transfers of labor. Moreover, as will readily be seen, this would also tend to cause further deviations from production possibilities.

In his discussion of recent trends in the allocation of labor and capital, Grossman focuses attention especially on the low rate of growth (2.8 per cent per year) projected for the non-agricultural labor force under the Fifth FYP (1951-1955). He views this as marking a new phase in Soviet planning. On the face of it this development also emphasizes the question of the degree to which Soviet resource allocation realizes production possibilities. But I do not wish to pursue this aspect further here. Rather, my concern is a limited factual one. In my opinion Grossman is undoubtedly right in thinking that the low rate of growth projected in the current plan sets a precedent, but in appraising its extent I would like to emphasize a few matters which he may not have stressed sufficiently.

[1] See my discussion in *Soviet Economic Growth*, Abram Bergson, editor, Row, Peterson, 1953, pp. 308-310.

While I agree with Grossman in assuming that the Fifth FYP still warrants careful study despite the important economic events since Stalin's death, a question is in order concerning the "realism" of the Plan at the time of its promulgation. One inevitably wonders in particular how seriously to take the feature which occupies a central place in the discussion: the rate of growth projected for the non-agricultural labor force. Some interest may attach, then, to the following tabulation of the Russians' record of fulfillment of the labor force goals of their Five-Year Plans to date:[2]

	Workers and Employees[a] (*millions*)
Actual, 1927/1928	11.3
1st FYP goal, 1932/1933	
Minimal variant	14.8
Optimal variant	15.8
Actual, 1932	22.9
2nd FYP goal, 1937	28.9
Actual, 1937	27.0
3rd FYP goal, 1942	32.0
Actual, 1940	31.2
Actual, 1945	27.3
4th FYP goal, 1950	33.5
Actual, 1950	38.2
5th FYP goal, 1955	43.9
Actual, 1951	39.8
Actual, 1952	40.7

[a] Strictly speaking, these Soviet official data refer to all hired labor, including not only non-agricultural but also several million agricultural wage earners.

Evidently, the four previous Plans were unevenly fulfilled. Since the First and Fourth Plans were greatly overfulfilled, one is impelled to question the "realism" of the goal of the current Plan. However, it will be noted too that during the first two years of the present Plan, 1951-1952, the Russians managed to keep more or less within the framework of their current long-term goal; very possibly the present plan will turn out to be operational after all.

[2] On the scope of the figures see Grossman's essay, notes to Table 1. The figures on actual employment are from *Trud v S.S.S.R.*, Moscow, TsUNKhU, 1936, pp. 10 ff.; Warren W. Eason, "Population and Labor Force," in *Soviet Economic Growth*, as cited, p. 110; and Grossman's essay, Table 1. The Plan goals are from Grossman's essay; *Piatiletnii plan narodno-khoziaistvennogo stroitel'stva* S.S.S.R., Tom I, Moscow, Gosplan S.S.S.R., 1929, p. 127; and State Planning Commission of the U.S.S.R., *The Second Five Year Plan for the Development of the National Economy of the USSR (1933-1937)*, London, Lawrence, p. 545.

In considering to what extent the present Plan represents a break with past experience, two other matters must be examined. First, as Grossman explains, the rate of growth projected under the Fifth FYP (2.8 per cent per year) is actually only a little lower than the one that was projected under the Third (3.5 per cent per year). The rate actually realized under the latter Plan prior to the German attack, i.e. in the period 1937-1940, was 5.0 per cent, but the 1940 employment figure on which this growth rate is based reflects the expansion in Soviet territory during 1939-1940. However, it does not take into account an increase in working hours from an average of about forty-one to forty-eight per calendar week in June 1940.

Second, the actual rate of growth under the Second FYP was but 3.3 per cent. Grossman apparently feels that for his purposes the Second FYP ought to be lumped with the First. This is on the plausible ground that many of the workers recruited under the First FYP were not really assimilated until the following quinquennium. It should be observed, however, that the current Plan may in some measure be similiarly related to its predecessor, which witnessed a major expansion in the labor force not only during but after demobilization.

Reply by the Author

My appreciation to the three commentators for lighting their lamps in the dark alley into which I have lured them! I find myself in sympathy with all of Bergson's and Erlich's remarks, and so, after a nod in their direction, I turn to Kaplan's comments. Kaplan has paid me the high compliment of studying my paper carefully, and preparing a most patient and valuable critique of it. I am in accord with him on some of his points; with regard to some others our differences are slight. My rejoinder is therefore addressed only to the major issues between us.

Do my indicators—cement consumption and the increment in electric power output—indicate anything? Kaplan has constructed his Table 1 to show the relationship between annual movements in investment (at stable prices) and in these two series[1] during selected periods in Soviet experience. The investment series are from Soviet sources and their exact derivation is not always clear, but they may be provisionally accepted in the absence of more reliable data. The

[1] The fact that he uses cement *output* while I refer to cement consumption where possible should not make much difference.

three series show far from identical annual changes, the correspondence between investment and increment in power being poorer than that between investment and cement output. Better correspondence would probably be found if blocks of years (as in my Table 2) rather than individual years were the basis of comparison; but the nature of the data prevents this.

Kaplan is probably right that "as indicators in a more accurate sense" my two series "seem to fail." But I was not so hopeful as to demand this of them. My purpose has not been to draw exact inferences with regard to the relative volume of investment during the various periods, but rather to sketch the major outline of the rise in incremental capital-intensity in the non-agricultural sector of the Soviet economy. I regarded the two series as a "very rough and tentative indication," and Kaplan's Table 1 seems to support me in this view, for it does show that on the whole the order of magnitude of the volume of investment is preserved in one or both of the other series. In Kaplan's own words (italics his), "The hypothesized relationships may be adequate to yield what Grossman requires—namely, an indication of *increasing* incremental capital-intensity. . . ."

Kaplan's section on "The Meaning of Capital-Intensity" is most stimulating. He is quite right, of course, about the mathematics. Increasing incremental capital-intensity does not imply increasing average capital-intensity. If in the paper I appear to assume so, it is only because the suggested magnitudes are such that the incremental capital-intensity in the U.S.S.R. during the Fifth FYP must almost certainly have exceeded the average capital-intensity, and therefore the latter must have been rising as well. The contrary possibility is hardly worth attention in this instance. Further, he is correct in that the marginal rate of substitution between capital and labor is not measured by the incremental or average capital-intensities. (Nor have I tried to use them in this way.) Now he asks: (1) Since the stock of capital per worker, i.e. the average ratio, is the relevant quantity from the viewpoint of economic growth, why introduce the incremental concept? and (2) What is the relation between a rising incremental capital-intensity and a notion of substitution of capital for labor (which can be read into my approach)?

1. I would answer that the incremental ratio is relevant to the *process* of economic growth, and hence to planning for it, quite apart from its impact on the average. The characteristic features of an economy derive not only from the capital-labor ratio at some

point in time, but also from the slope of the path traversed to get there, i.e. from the incremental ratio. This indeed is implicit in much of the contemporary discussion of the "advantages" of economic backwardness. Average capital-intensity is an inadequate tool for a dynamic analysis of the process of growth, in part because of such well-known phenomena as the limited economic mobility of capital after it has been embodied in capital goods and the poor reversibility of certain socio-economic processes such as urbanization.

Perhaps an appeal to extreme cases will help to emphasize my point. Surely the process of growth is different if capital is the only factor whose supply increases significantly while the supply of other factors remains constant (incremental capital-intensity equals infinity), or if it is labor which alone increases (incremental capital-intensity equals zero). Numerous important variables are affected thereby, such as the technology of new investment projects, extent of obsolescence and replacement of existing capital equipment, transfer of labor within the economy to achieve its better combination with capital, urbanization, and so forth. (Given the target isoquant, the marginal rate of substitution is affected thereby, though we cannot a priori tell more than the direction of the difference.) This range of problems overlaps those discussed in my paper in connection with labor allocation, thus showing the presence, if not of a "systematic relationship" between the two parts of my paper (which Kaplan fails to find), at least of a logical nexus between them.

It has been pointed out[2] with good reason that by comparison with average capital-intensity, incremental capital-intensity will fluctuate violently and so give an exaggerated picture of policy changes. This difficulty can be avoided in part by comparing groups of years instead of individual years, as is done in the paper. But in this instance we may be particularly fortunate in that erratic fluctuations in the incremental ratio are presumably kept down, thanks to full employment of labor and capacity in the non-agricultural sector in all periods, consistently high rates of investment out of national product, and constant pressure to expand output.

2. Inquiring into the existence of a logical connection between incremental capital-intensity and the notion of substitution of capital for labor, Kaplan fails to find it established in my paper, nor can he establish one for a dynamic context. His critique is illuminating, but his search is unnecessary. Insofar as a notion of substitution underlies

[2] E.g. by Moses Abramovitz in a private communication to the author.

my discussion, it is substitution *along* the target isoquant, i.e. in a static and not in a dynamic sense. (Substitution of capital for labor does have an unambiguous meaning in the former sense, as Kaplan agrees.) Incremental capital-intensities enter only as alternative paths traversed to reach the target isoquant. The substitution in question is therefore not a dynamic concept, but a description of the difference between points on the same isoquant.

Perhaps if the phrase is to have a useful connotation in a dynamic picture at all, it should be defined operationally: we can call it a significant replacement of labor by capital in *existing* enterprises so as to release all or part of the manpower required to operate the newly created production facilities. The reshuffle of labor would presumably be based on efficiency considerations, i.e. on a comparison of the marginal rates of substitution between capital and labor in the old and in the projected production facilities. It is clear that incremental capital-intensity would have to be above a certain value in order for this, and not the reverse, movement of labor to take place; and the higher the incremental ratio, the more labor has to be so transferred (given the target isoquant of the sector within which the reshuffling takes place). A large reshuffle of this sort is an important aspect of the economy's growth process—hence perhaps a justification of the use of the incremental concept. As mentioned in the paper, the Soviet economy seems now to be experiencing such labor transfer within the non-agricultural sector.

Kaplan correctly points out[8] that under my "simplifying assumption" of the whole economy's being represented by two isoquants, and fixed supplies of two factors, the choice of a position on one of them does not uniquely determine the position on the other, as I stated, except at the optimum for the whole system.

The last section of Kaplan's comments deals with numerous points in relation to my detentive and deterrent factors. I reply selectively.

I omitted the cost of training agricultural labor and of providing rural housing from the definition of i' because these, under Soviet conditions, are typically not costs to the state, and it is the state's computations that we are trying to reconstruct. I would not expect Soviet planners to be especially concerned with them in choosing between investment alternatives.

Kaplan's case "that a larger increase in the non-agricultural labor force might increase observed incremental capital-intensity via the

[8] His footnote 15.

impact on observed investment of increased expenditures on housing and other urban facilities," assuming (I take it) an invariant non-agricultural output, is not a possibility that would be knowingly and rationally chosen by the planners. It requires more of *each* factor of production to achieve the same output. It is, of course, just with reference to Soviet attempts to get away from this inefficiency that I try to explain the small planned increase in non-agricultural employment during the Fifth FYP.

I expect a reduction in the proportion of women in the non-agricultural labor force as a result of a future rise in real wages. Kaplan points out, correctly, that "An increase in real wages . . . has both an income effect and a substitution effect on the choice between housekeeping (leisure?) and gainful employment." He concludes, "It is not clear, therefore, whether an increase in real wages deters or encourages participation of females in gainful employment." Prediction in this case is no less hazardous than in so many others, but perhaps past experience tips the scales in favor of the attitude taken in my paper. I refer to the increase in the proportion of women in the non-agricultural labor force coincident with the decline in real wages after 1928, and the small reduction in this proportion since 1947.[4] True, the proportion continued to rise even in the late 1930's, i.e. after real wages had substantially recovered from their lows in the first half of the decade. But it must be remembered that these years also witnessed a sharply accelerated withdrawal of males from the non-agricultural labor force into military service and forced labor camps.

I should like to conclude by reiterating Kaplan's plea for a thorough and competent study of the various facets of Soviet technology. The results should be most relevant to an understanding of past Soviet development, the potential for growth in the near future which the economy contains, and the dynamics of the growth process itself.

[4] Cf. Warren W. Eason, "Population and Labor Force," in *Soviet Economic Growth*, Abram Bergson, editor, Row, Peterson, 1953.