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Reply

Messrs. Campbell, Cohen, and Lewin have very usefully augmented my fragmentary efforts. It is good to have Dr. Lewin's informed judgment concerning the prospects for modest, steady growth in off-farm agricultural output during this period. He has sketched the direct link that Professor Campbell queries between the first plan's targets and the "waste, turbulence, sacrifice, and destruction" that gave rise to a whole new state system. Professor Cohen supplies illuminating detail on the relation of the Stalin-Bukharin struggle to the formulation of the First Five-Year Plan. His suggestion that regional leaders' efforts to get more projects for their regions had the effect of driving up the plan's investment (and therefore output) targets seems especially important. The proposition that Stalin's "socialism in one country," having won out over Trotsky's stress on "permanent revolution" in the outside world, should turn out to embody renewed domestic revolution (or civil war) is a major insight. Professor Campbell's eggs and bacon analogy is likely to become a permanent addition to our pedagogy, especially since this dietary problem still exists in the USSR.

Their gentle criticism also discloses weak points in my argument, so brief efforts at repair are in order. First, the focus of the testing procedure needs clarification. Next, something should be said concerning the location of bottlenecks. Third, the availability of mild alternatives deserves comment. Finally, I note some possibilities for further work to resolve uncertainties.

Output and investment targets in the First Five-Year Plan are given in physical terms, in constant-price ("1926/27 ruble") terms, and often in "reduced-cost" terms. The "reduced-cost" estimates take account of the hoped-for savings in construction costs, and so forth, that optimists foresaw as possible; and the 1933 value amounts are, of course, smaller than those at constant costs, showing less growth over 1928 levels. Since we know that money wages rose, construction periods lengthened, and input-use coefficients deteriorated, there seems little point in testing these dubious, hard-to-interpret estimates. The data tested are those at constant prices, and to this extent are closer to the real world.

The testing procedure focuses on available capital plant and equipment as the dominant factor limiting output expansion. The assumption is that each sector will be able to acquire whatever labor is needed to match its added fixed assets. There may at times be unused capital in a sector if deliveries of intermediate output from other sectors are insufficient, but capital

capacity is the overall constraint on current output, and additions to capital capacity are what place limits on output growth.

The average ratios between available fixed assets and annual gross output that are implicit in tables 3 and 4 of my article are as follows:

	1928	1933
Agriculture	1.11	.90
Industry	.48(.96)	.41(.82)
Transport and communications	5.09	3.69
Construction	.15	.15
Housing	12.83(6.42)	10.10(5.05)
All other sectors	.81	.89

These average capital-output ratios are low by contemporary international standards (except for housing), and they reflect some debatable relationships between current output prices and valuations of the inherited capital stock. The figures in parentheses for industry and housing are my arbitrary adjustments, doubling the industry ratios and halving the housing ratios to make them more realistic. The regime was charging ridiculously low rents, so the value of residential capital obviously requires adjustment; halving puts the ratios in a plausible range. Doubling of the industry ratios puts them, too, at a level more consonant with what one finds in other countries. These opposing adjustments have the net effect of making model solutions somewhat more difficult. They deflect output from household consumption and probably make the tests more realistic.

These initial tests also permit agricultural output to increase steadily and make it available for off-farm use on the terms that prevailed in 1928. In the same vein it is implicitly assumed that an increased share of current incomes will be saved or taxed away so that capital formation is not constrained on the financial side. If the First Five-Year Plan targets were nevertheless unachievable under such generous assumptions, their overambitiousness seems incontestable.

Professor Campbell is properly curious about the locus of bottlenecks. Though six-sector tests are crude, the many variations examined to date uniformly indicate a very tight situation at the beginning of the plan period. Shadow prices in the first year are extremely high. The fixed-capital projects that were under way when the First Five-Year Plan began were evidently quite inadequate. In this sense the gestation-period problem was certainly the major one. On the other hand, it seems to me that Campbell underestimates the degree of structural change called for by the plan. Both in the columns of final demand and in the rows of gross output, marked differences in growth rates were intended. Sharp structural change is likely to give rise to idle

capital in some sectors in some years, and idle capital crops up in many of the variations tested to date. He is correct, of course, in noting that if the 1933 targets for household consumption are reduced, less growth is required for output and capacity in the agricultural and housing sectors. With even sharper structural change of this kind, expansion quickly becomes easy. It is as if pigs thrive on a bacon-and-eggs diet. Diversion of eggs from the chicken sector to the hog sector (shades of *Animal Farm*!) was called for by the First Five-Year Plan targets and in actual practice went proportionately even further.

The apparent contradictions in my discussion of alternative expansion paths relate partly to the difficulties of getting past the tight constraints of the first plan year and partly to the looseness of a six-sector model. The CTAR(6), CTAR(7), CTAR(8), and 91 percent KTAR(8) trajectories shown on chart 3 illustrate ways of getting through the bottlenecks at the beginning of the plan period and producing either a lot of capital or a lot of household consumption by 1933. Incidentally, an optimal solution to the basic (*otpravnoi*) variant of the official targets might look something like CTAR(6). This lower set of targets would still have required a substantial temporary fall in living standards. Disaggregation of the model to twelve or eighteen or twenty-four sectors would lower these consumption paths by introducing tighter constraints, but one cannot be sure in advance how badly consumption would be harmed. Perhaps my early results seriously overstate the ease of finding milder growth paths. Nevertheless there is every reason to anticipate that alternative paths with plausible parameters can improve on the actual record.

The potential for Soviet output expansion lay in input growth: in expanding the nonagricultural labor force, creating new capital capacity, and building into this new human and material capital the modern technology that had already been developed elsewhere. The strains that had developed in the economy by 1929 gave clear evidence that reorganization to take advantage of this potential would not be easy. There was, however, nothing in the situation that called for a downturn in the economy. Even the impending collapse of overage industrial equipment that worried some officials proved a mirage. The drastic fall in living standards during the First Five-Year Plan period went far beyond what was "necessary" to provide resources for capital formation. As David Granick has shown in his book *Soviet Metal-Fabricating and Economic Development* (Madison, 1967), disruptive organizational changes in machine building and metal working, the heart of the modern sector, outweighed the benefits of new technology to such an extent that there was on balance negative technological progress during the 1928–37 period. The agricultural sector did not even regain its 1928 level until the end of the 1930s.

The transport crisis of 1931–34 hamstrung the economy for four years. The construction sector immobilized huge amounts of plant and equipment in unfinished projects. By comparison with this record, it does not seem unlikely that a network of viable, empirically verifiable relationships can be hypothetically assembled, the results of which will be to produce 1933 or 1937 outputs with less clumsiness and sacrifice.

Additional difficult research is clearly needed. Subdivision of these six large sectors into smaller ones will uncover more structural bottlenecks, realistically demonstrating the difficulties of rapid expansion. Collectivization of agriculture can be studied as a policy variable, following Professor Campbell's suggestion, through controlled variation in appropriate parameters. Similar controlled variation in export and import parameters can test the hypothetical impact of world depression on Soviet growth. Painstaking reconstruction of annual developments would make available column vectors of household consumption, new fixed capital, and sectoral gross outputs; these could then be compared with computed linear programing optimal allocations to see where resources may have been squandered.

The whole testing process should be extended to the Second Five-Year Plan period as well, though a new price structure will have to be dealt with, and the second plan is considerably less detailed than the first. Analysis of the nine-year period, 1929 through 1937, will permit adequate recognition of the impressive results that flowered during the Second Five-Year Plan period after having been launched during the first plan period. Examination of the first plan period by itself truncates the record unfairly, because economic growth processes take a good deal of time. The proper question is how gradual alternatives for the 1929–37 period would compare with the actual performance of Stalin's economy. Readers of this exchange are encouraged to join the search for answers.