

# THE SOVIET PATH TO ECONOMIC GROWTH: A COMPARATIVE ANALYSIS

BY STANLEY H. COHN

*State University of New York at Binghamton*

Considerable attention has been devoted in the past to the methodological issues involved in the measurement and explanation of economic growth. Following the method pioneered by Denison and applied by him to the United States and Western Europe, comparative studies have been made of various other countries; that for Japan is of special interest. The present paper extends the analysis to the Soviet Union. In order to preserve comparability, the analysis follows the Denison methodology exactly, and compares the results with those for the United States, Northwest Europe, and Japan.

Past issues of this publication have devoted considerable space to presentation of methodological issues involved in the measurement and explanation of economic growth and of comparative empirical estimates of trends in output, factor inputs, and productivity for the major industrialized economies.<sup>1</sup> The empirical studies have generally followed the methodology pioneered by Denison in his studies of the United States and Western European economies.<sup>2</sup> Of particular interest was the application of Denison's methodology to the Japanese experience.<sup>3</sup> My aim is to complete the comparative empirical analyses for the major developed economies by inclusion of the Soviet experience. Since the most striking features of the Soviet case are found in the particular combinations of factor input and productivity, rather than in the growth rates themselves, the emphasis will be upon the sources of growth.

## METHODOLOGY

In order to facilitate ready comparison with previous estimates for the major market economies, the Denison methodology has been used without significant modification. It is summarized in the following production function:

$$\Delta Y = \alpha \Delta L + \beta \Delta K + \gamma \Delta A + \Delta R, \text{ assuming } \alpha + \beta + \gamma = 1$$

where:

$Y$  = Real national income

$L$  = Labor input, adjusted for quality

$K$  = Capital input

$A$  = Land input

$R$  = Output per unit of input

$\Delta$  = Rate of increase,  $\alpha$ ,  $\beta$ ,  $\gamma$  (= respective shares  $L$ ,  $K$ , and  $A$ ).

<sup>1</sup>See issues of this review on "Factor Input and Productivity Issues" for March and June, 1972.

<sup>2</sup>Edward Denison, *The Sources of Economic Growth in the United States and The Alternatives Before Us*, Committee for Economic Development, 1962. Also his *Why Growth Rates Differ: Postwar Experience in Nine Western Countries*, Brookings Institution, 1967.

<sup>3</sup>Hisao Kanamori, "What Accounts for Japan's High Rate of Growth?," *Review of Income and Wealth*, June 1972.

The shares are measured by their relative income flows in national accounts. The labor share is quality-adjusted for changes in working hours, age and sex composition, and educational attainment. The contribution of the three factor inputs to economic growth is determined by multiplying the factor's relative share of national income by the rate of increase of factor input.<sup>4</sup> The contribution of productivity (unexplained factors) to growth is the residual after subtracting the contributions made by the three explicit factors from the national income growth rate.

There are several shortcomings to Denison's method. Some of the more troublesome are as follows:

1. The relative share of each factor of production indicates the elasticity of output with respect to that factor. Denison has chosen to measure elasticities by income flow shares. While this approach avoids estimation errors from multicollinearity among factors of production arising from the alternative approach of estimation through statistical regression analysis, it depends for its validity upon the key assumption that the return to the factor be equal to its marginal product. It is doubtful if this premise can be fulfilled in the real world.

2. Denison's approach is asymmetrical in allowing for quality improvements in the labor, but not in the capital input. While admittedly a formidable measurement problem, the omission of any qualitative increase in capital stock understates the contribution of that factor and, correspondingly, overstates that of the residual.

3. Since his definition excludes those activities, mainly government services, in which output is generally estimated by input proxies, he also excludes the contributions of factor inputs in these services, such as government capital and the labor services of government employees.

4. Other problems that may be mentioned in passing include the use of standard labor equivalents rather than actual employment for qualitative adjustments, the assumption of Hicks neutral technical change (technical progress does not change relative shares), and the inability of the method to explain, as distinguished from demarcating, input and productivity trends.

#### COMPARATIVE GROWTH TRENDS AND SOURCES<sup>5</sup>

As noted earlier, the distinctive feature of Soviet growth performance has not been its growth rate, but the means by which it has been achieved. The Soviet growth rate has not been notably higher than that for Northwest Europe and barely half that of Japan since 1962 (Table 1). What is noteworthy are the rapid rates of increase in all three factor inputs, considerably higher than those for Northwest Europe and the United States, but somewhat below those for Japan (Table 2). Perhaps even more distinctive by contrast is the comparatively low

<sup>4</sup>If we assume neutral technological progress and perfect competition with returns to factors equal to their marginal products, then the relative share of national income accruing to each factor of production equals the percentage increase in real output when the input of that factor is increased by  $x$  percent (= elasticity of production with respect to that factor input).

<sup>5</sup>Detailed derivation of the growth sources for Soviet national income may be found in an appendix "Sources of Estimates." Copies of this appendix may be obtained upon written request to the author.

TABLE 1  
COMPARATIVE NATIONAL INCOME GROWTH RATES

	Period	Annual Growth Rate
		%
U.S.S.R.	1950-62	6.1
U.S.S.R.	1962-70	5.4
Japan	1955-68	10.1
Northwest Europe	1950-62	4.8
United States	1950-62	3.3

*Sources:* U.S.S.R.: See appendix note on derivation of Soviet national income growth trends. Japan: Kanamori, *op. cit.*, p. 156. Northwest Europe and United States: Denison [7], p. 17.

Soviet rate of advance in output per unit of input, i.e., in joint factor productivity. The periods of comparison are not similar since the Soviet estimates span the entire period from 1950-70, while the Northwest European and United States estimates of Denison cover only the earlier portion of this period, 1950-62, and the Japanese estimates of Kanamori the years 1955-68. However, from the Soviet standpoint there would be little difference in the results if the Soviet data were limited to the initial 12 years, as will be demonstrated in a later section of this essay.

Table 3 compares the Soviet Union with the other major economies in terms of each factor's contribution to economic growth. In this context "factor's contribution" is defined as developed by Denison—the product obtained by multiplying the rate of increase of factor input by the elasticity of output with respect to that factor, i.e., by the factor's share in national income. The table indicates that the U.S.S.R. showed the highest contribution of labor input to growth and a capital contribution only slightly below that of Japan and much above that of the other major market economies. It was unique in having a positive contribution of land. By contrast the contribution of output per unit was below that of Japan and the average for Northwest Europe and not much above that of the United States.

Table 4 offers a capsule contrast of the growth formulas of the Soviet Union and Japan, the two late comers among the major industrial powers. While in the Soviet case the growth contributions of factor inputs, especially those of capital, were considerably higher than those of Northwestern Europe and the United States, their effects were seriously offset by inferior productivity performance. On the other hand, Japan managed to enjoy the best of all possible worlds with significantly higher growth contributions for both factor inputs and output per unit of input. The Soviet-Japanese direct comparison shows that superior productivity accomplishment furnishes the full explanation of Japan's higher growth rate.

If the growth contributions in Table 4 are recast in terms of each factor's proportionate contribution to growth (Table 5) the unique Soviet developmental formula becomes apparent. Its unusually heavy reliance on factor inputs, as distinguished from their more productive utilization, has already been stressed.

TABLE 2  
COMPARATIVE RATES OF INCREASE IN FACTOR INPUTS<sup>a</sup> (ANNUAL AVERAGES)

	U.S.S.R.	Japan	Northwest Europe	U.S.A.	France	Germany	Italy	United Kingdom
Total Factor Input	3.99	4.2	1.67	1.71	1.20	2.71	1.65	1.16
Labor	2.13	1.9	1.08	1.42	0.58	1.84	1.32	0.77
Employment	1.80	1.5	0.93	1.14	0.11	2.00	0.56	0.65
Hours of work	-0.68	-0.1	-0.18	-0.21	-0.03	-0.36	0.07	-0.19
Age-sex composition	0.06	0.3	0.04	-0.13	0.13	0.05	0.13	-0.05
Education	0.99	0.2	0.30	0.62	0.37	0.15	0.55	0.37
Capital <sup>b</sup>	8.90	10.5	4.53	3.58	4.17	6.37	3.50	3.35
Non-residential fixed	9.57	9.6	4.55	3.74	3.99	6.17	3.78	3.58
Inventories	7.06	12.4	4.47	3.00	4.77	7.05	2.66	2.56
Land	1.74	0.0	0.00	0.00	0.00	0.00	0.00	0.00
Output per Unit of Input	1.70	5.5	3.04	1.36	3.65	4.43	4.25	1.18

<sup>a</sup>Years of coverage: U.S.S.R.: 1950-70. Japan: 1955-68. United States and Northwest Europe: 1950-62.

<sup>b</sup>Housing stock excluded.

Sources: U.S.S.R.: See appendix note, and appendix "Sources of Estimates." Japan: Kanamori [10], p. 158. United States and Northwest Europe: Denison [7], p. 190.

TABLE 3  
COMPARATIVE CONTRIBUTIONS OF FACTOR INPUTS AND PRODUCTIVITY TO ECONOMIC GROWTH (PERCENTAGE POINTS)

	U.S.S.R.	Japan	Northwest Europe	U.S.A.	France	Germany	Italy	United Kingdom
National Income	5.76	10.1	4.76	3.32	4.92	7.26	5.96	2.29
Total Factor Input	4.03	4.03	1.69	1.95	1.24	2.78	1.66	1.11
Labor	1.45	1.31	0.83	1.12	0.45	1.37	0.96	0.60
Employment	1.20	1.03	0.71	0.90	0.08	1.49	0.42	0.50
Hours of work	-0.45	-0.07	-0.14	-0.17	-0.02	-0.27	0.05	-0.15
Age-sex composition	0.04	0.21	0.03	-0.10	0.10	0.04	0.09	-0.04
Education	0.66	0.14	0.23	0.49	0.29	0.11	0.40	0.29
Capital	2.57	2.72	0.86	0.83	0.79	1.41	0.70	0.51
Non-residential fixed	1.66	1.62	0.64	0.45	0.56	1.02	0.54	0.43
Housing	0.31	0.14	0.07	0.25	0.02	0.14	0.07	0.04
Inventories	0.60	0.96	0.18	0.10	0.19	0.33	0.12	0.09
Land	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Output per Unit of Input	1.73	6.1	3.07	1.37	3.68	4.48	4.30	1.18

Coverage: Same as Table 2.

Sources: U.S.S.R.: Same as Table 2. Japan: Kanamori [10], p. 159. Northwest Europe and United States: Denison [7], p. 192.

TABLE 4  
FACTORS ACCOUNTING FOR DIFFERENTIALS IN SOURCES AND RATES OF GROWTH  
(ANNUAL AVERAGE RATES)

	U.S.S.R. Northwest Europe	U.S.S.R. United States	U.S.S.R. Japan	Japan Northwest Europe	Japan United States
Total Factor Input	2.34	2.08	0.00	2.34	2.08
Labor	0.62	0.33	0.14	0.48	0.19
Employment	0.49	0.30	0.17	0.32	0.13
Hours of work	-0.31	-0.28	-0.38	0.07	0.10
Age-sex composition	0.01	0.06	-0.17	0.18	0.31
Education	0.43	0.17	0.52	-0.09	-0.35
Capital	1.71	1.74	-0.15	1.86	1.89
Non-residential fixed	1.02	1.23	0.04	0.98	1.19
Housing	0.24	0.06	0.17	0.07	-0.11
Inventories	0.42	0.50	-0.36	0.78	0.86
Land	0.01	0.01	0.01	0.00	0.00
Output per Unit of Input	-1.34	0.36	-4.37	3.03	4.73
National Income	1.00	2.44	-4.34	5.34	6.78

*Coverage:* Same as in Tables 1 and 2.

*Sources:* Derived from Table 2.

Of particular prominence has been the role of capital, at least double the proportion for any of the other major economies. In this respect Soviet development has followed Marxist precepts in their most literal sense. This generalization would apply across the spectrum of capital inputs, but is most apparent for investment of direct productive significance—non-residential equipment and construction outlays. The wisdom of this unusual reliance upon capital will be appraised in a subsequent section on productivity. This rapid rate of accretion of capital stock results from a high investment to GNP ratio, around 30 percent in 1970.<sup>6</sup> Only Japan among the countries in the comparison exceeds the Soviet investment ratio in 1970 with reflection in that country's equally rapid rate of increase in capital stock.

The Soviet Union also relied heavily on labor inputs. Its rate of growth of employment (Table 2) was the fastest, except for Germany which benefited from a large influx of able-bodied refugees from the east before the construction of the Berlin Wall. Since the U.S.S.R. was not favored with a superior demographic growth advantage, it managed to attain a rapid rate of growth of employment through the strenuous measure of a steady increase in the labor participation ratio.<sup>7</sup> By 1970, the Soviet ratio was 81.7, compared with 71.2 for Japan, 64.6 for the United States and France, 69.3 for Germany, 52.9 for Italy, and 70.1 for the

<sup>6</sup>Estimates based upon basic study underlying estimates of Central Intelligence Agency, *Research Aid—The Soviet Economy in 1973: Performance, Plans, and Implications*, July 1974, p. 21.

<sup>7</sup>Defined as employment ÷ population of working age, i.e., 15–64 years.

TABLE 5  
PROPORTIONATE CONTRIBUTIONS OF FACTOR INPUTS AND PRODUCTIVITY TO ECONOMIC GROWTH (PERCENTAGES OF TOTAL)

	U.S.S.R.	Japan	Northwest Europe	United States	France	Germany	Italy	United Kingdom
Total Factor Input	70.0	39.9	35.5	58.7	25.2	38.3	27.8	48.5
Labor	25.2	13.0	17.4	33.7	9.1	18.9	16.1	26.2
Employment	20.8	10.2	14.9	27.1	1.6	20.5	7.0	21.8
Hours of work	-7.8	-0.7	-2.9	-5.1	-0.4	-3.7	0.8	-6.5
Age-sex composition	0.7	2.1	0.6	-3.0	2.0	0.6	1.5	-1.7
Education	11.5	1.4	4.8	14.8	5.9	1.5	6.7	12.7
Capital	44.6	26.9	18.1	25.0	16.1	19.4	11.7	22.3
Non-residential fixed	28.8	16.0	13.5	13.6	11.4	14.0	9.1	18.8
Housing	5.4	1.4	1.5	7.5	0.4	1.9	1.2	1.7
Inventories	10.4	9.5	3.8	3.0	3.9	4.5	2.0	3.9
Land	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Output per Unit of Input	30.2	60.1	64.5	41.3	74.8	61.7	72.1	51.5
National Income	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Derived from Table 3.

United Kingdom.<sup>8</sup> Such a high and rising participation ratio could only be achieved by a high ratio of female employment.

The Soviet economy has also been outstanding in its educational effort. Its educational contribution to growth ranks among the highest (Table 5) and its rate of growth for this aspect of labor quality was superior to that of any other major economy (Table 2). By 1969, its university enrolment ratio per 1000 population was second only to that of the United States.<sup>9</sup> According to UNESCO estimates the ratios were as follows: United States—39, U.S.S.R.—19, Japan—16, France—12, United Kingdom and Germany—8, and Italy—3. Furthermore, the increase in its enrolment ratio since 1958 was the highest of any of the seven countries.<sup>10</sup>

#### PRODUCTIVITY COMPARISONS

The other striking feature of Table 5 is the unusually small proportion of growth attributed to productivity in the Soviet case. At first approximation this phenomenon appears to be a disquieting aspect of a system which has otherwise managed to introduce both human and physical inputs into the productive process at rapid rates. Might there be some interrelation between inferior productivity performance and (Table 2) the rate and structure of input infusion?

TABLE 6  
RATES OF INCREASE IN PRODUCTIVITY OF CAPITAL AND LABOR AND THE  
CAPITAL-LABOR RATIO (ANNUAL AVERAGE RATES)

	Labor Productivity <sup>a</sup>	Capital Productivity <sup>b</sup>	Total Productivity <sup>c</sup>	Capital- Labor Ratio <sup>d</sup>
U.S.S.R.	3.5	-2.6	1.6	6.4
Japan	8.0	-2.4	5.5	8.4
Northwest Europe	3.7	0.3	3.0	3.4
United States	1.9	-0.3	1.4	2.1

<sup>a</sup>Rate of increase in national income ÷ rate of increase in labor input.

<sup>b</sup>Rate of increase in national income ÷ rate of increase in capital input.

<sup>c</sup>Rate of increase in national income ÷ rate of increase in combined inputs.

<sup>d</sup>Rate of increase in capital input ÷ rate of increase in labor input.

Source: Table 2.

If Soviet productivity trends are compared with those of the other major economies, the apparent feature is the sharply declining marginal returns to capital inputs. While the Japanese capital-labor ratio was higher than that of the Soviet Union, the benefit to labor productivity was over twice as great and the

<sup>8</sup>Joint Economic Committee, U.S. Congress, *Soviet Economic Prospects for the Seventies*, 1973, pp. 474-476, 521-522. OECD, *Labour Force Statistics, 1950-1970*, 1972.

<sup>9</sup>See my basic estimate in Morris Bornstein and Daniel Fusfeld, *The Soviet Economy: A Book of Readings* (4th edition), Irwin, 1974, p. 263.

<sup>10</sup>*Ibid.* [2].

declining marginal productivity of capital much less. The economies of North-western Europe sustained a higher labor productivity growth and a favorable one for capital with a marginal capital-labor ratio barely half as high as that of the U.S.S.R. It would appear that the Soviet economy was over-investing, i.e., experiencing rapidly diminishing returns to capital investment. If the 20-year period of measurement is divided at 1962, the productivity challenge becomes clearer.

TABLE 7  
U.S.S.R.: PERIOD GROWTH SOURCES AND CONTRIBUTIONS

Sources	Growth Rates		Growth Contributions	
	1950-62	1962-70	1950-62	1962-70
National Income	6.03	5.37	N.A.	N.A.
Total Factor Inputs	4.35	3.69	4.25	3.70
Labor	2.43	1.80	1.63	1.20
Employment	1.63	2.06	1.09	1.38
Education	1.19	0.71	0.80	0.47
Hours of work	-0.55	-0.87	-0.37	-0.58
Age-sex composition	0.16	-0.10	0.11	0.07
Capital	8.78	8.40	2.61	2.50
Output per Unit of Input	1.73	1.67	1.78	1.67

Source: See Table 2.

#### EVOLVING TRENDS AND PROSPECTS

As the estimates in Table 7 indicate, the decline in Soviet growth rates in the later period can be explained almost wholly in terms of declining increases in human inputs. In the middle and late sixties there has been a marked slowdown in the growth of educational attainments. Such a trend is to be expected as future possibilities of continued rapid growth are being exhausted with the approach of universal secondary education and a relatively high university level enrolment ratio. At the same time there has been a deterioration in the age-sex composition of the employed labor force as participation rates have reached saturation levels. Finally, the period also experienced a sharp decline in the length of the work week. The accelerated rate of growth of employment could not offset these other factors and was achieved at the expense of a qualitative decline in employment.

Maintenance of capital investment growth rates at previously high levels in the face of reduced quantitative and qualitative labor input infusions undoubtedly contributed to the relatively high falling marginal return to capital investment. In the face of these adverse trends for factor inputs, there has been no offset, but rather a small decline, in productivity growth trends.

Continuation of these trends against the background of resource availabilities does not bode well for the future. The Ninth Five-Year Plan, which guides Soviet economic development from 1971 through 1975, envisaged a GNP

growth rate of approximately 5.8 percent.<sup>11</sup> The prospective employment growth rate is set at a reduced 1.0 percent and that of capital stock at 7.1 percent.<sup>12</sup> If it is assumed that the growth rate for educational attainment would be offset by trends in age-sex composition and hours of work, the growth rate for combined factor inputs would be only 2.8 percent, representing a sharp reduction from previous trends. If the GNP growth target is to be sustained, combined productivity would have to increase by 2.9 percent per year compared with only 1.7 percent for the previous 20 years. Therefore, in order to sustain future growth at rates comparable to the past, the Soviet Union must adopt the growth pattern followed by the principal market economies. Whether the system is as capable of eliciting favorable productivity responses as it has been of maintaining high rates of increases in employment and capital investment will be its ultimate test.

#### APPENDIX: NOTE ON DERIVATION OF SOVIET NATIONAL INCOME ESTIMATES

In any comparative context most researchers have been obliged to either adjust official Soviet national income magnitudes so that they conform to methodology used by most market economy statistical agencies or construct their own current accounts and growth indexes according to conventional methodologies from raw data provided by official Soviet sources. The differences in method and empirical results obtained by using Soviet estimates and those of U.S. or Western European specialists have been adequately explained elsewhere and will not be repeated in this note, other than to comment that official Soviet estimates show higher growth rates.<sup>13</sup> Presumably if official estimates were used in a comparison of growth trends, growth estimates for market economies would have to be adjusted upward by applying the Soviet methodology.

The national income growth estimates used in this study are taken from a preliminary study of the Office of Economic Research of the Central Intelligence Agency.<sup>14</sup> They follow the same methodology which has been described in an earlier publication of the author.<sup>15</sup> In this instance basic gross national product accounts have been constructed for 1970. The base year estimates are then moved by weighted originating sector output indexes, constructed in the manner described in this reference [4]. The GNP indexes are recalculated as national income indexes in the manner described in the appendix "Sources of Estimates" to this study.

<sup>11</sup>If the official goals for industrial and agricultural production and for transportation, construction, trade, and the principal services are weighted by respective value-added by sector in 1970 (see CIA, *op. cit.*) the GNP growth rate of 5.8 percent is obtained. For official targets see Joint Publications Research Service, *State Five-Year Plan for the Development of the U.S.S.R. National Economy for the Period 1971-1975*.

<sup>12</sup>*Ibid.* [9].

<sup>13</sup>See Abraham Becker, "National Income Accounting in the U.S.S.R.," and Stanley Cohn, "National Income Growth Statistics," in Vladimir Treml and John Hardt (eds.), *Soviet Economic Statistics*, Duke University Press, 1972.

<sup>14</sup>A comprehensive preliminary set of national accounts which underlie estimates found in CIA, *op. cit.* [3].

<sup>15</sup>Stanley Cohn, "General Growth Performance of the Soviet Economy," in Joint Economic Committee, U.S. Congress, *Economic Performance and the Military Burden in the Soviet Union*, 1970, pp. 15-16.

## REFERENCES

- [1] Becker, Abraham, "National Income Accounting in the U.S.S.R.," in Vladimir Treml and John Hardt (eds.), *Soviet Economic Statistics*, Duke University Press, 1972.
- [2] Bornstein, Morris and Fusfeld, Daniel, *The Soviet Economy: A Book of Readings* (4th edition), Irwin, 1974.
- [3] Central Intelligence Agency, *Research Aid—The Soviet Economy in 1973: Performance, Plans, and Implications*, July 1974.
- [4] Cohn, Stanley, "General Growth Performance of the Soviet Economy," in Joint Economic Committee, U.S. Congress, *Economic Performance and the Military Burden in the Soviet Union*, 1970.
- [5] ———, "National Income Growth Statistics," in Vladimir Treml and John Hardt (eds.), *Soviet Economic Statistics*, Duke University Press, 1972.
- [6] Denison, Edward, *The Sources of Economic Growth in the United States and the Alternatives Before Us*, Committee for Economic Development, 1972.
- [7] ———, *Why Growth Rates Differ: Postwar Experience in Nine Western Countries*, Brookings Institution, 1967.
- [8] Joint Economic Committee, U.S. Congress, *Soviet Economic Prospects for the Seventies*, 1973.
- [9] Joint Publications Research Service, *State Five-Year Plan for the Development of the U.S.S.R. National Economy for the Period 1971–1975*.
- [10] Kanamori, Hisao, "What Accounts for Japan's High Rate of Growth?," *Review of Income and Wealth*, June 1972.
- [11] Organization for Economic Cooperation and Development, *Labour Force Statistics, 1950–1970*, 1972.