ECONOMIC PRODUCTIVITY IN ISRAEL, 1950–1965[1]

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Macroeconomic productivity in Israel is here conceived as comparison of output with factor inputs during given periods, and as creation of sustained capacity out of given resource increments. However, present social accounting practice prevents full implementation of this second approach.

In contrast to nine European countries, only one third of the rapid growth rate of Israel in 1950–1965 is "explained" by the "Residual" because of relatively large infrastructural investments and of growth problems. One of these problems is inflationary pressures which caused productivity increases to restrain the rise of product prices by 30 per cent only below the rise of input prices. The real productivity gain accrued, in Israel and in the U.S.A. (1919–1957), nearly fully to labor because unit returns to capital remained constant whereas those to labor sharply rose.

Some refinements of the statistical models are attempted by incorporating the utilization rates of labor and capital (for industry); and by measuring product from the uses, instead of from the income, side, adding the differences to the capital shares. This makes distributive factor shares nearly constant as postulated by Cobb-Douglas.

In order to get a basis for appraising efficiency in creating long-term capacity, that part of product increments is measured which represents rises of p.c. final domestic uses and changes in the export surplus. This "net margin" formed in Israel one fifth and in the U.S.A. (1889–1913) much less of incremental product. Though in Israel one quarter, and in the U.S.A. over half (in 1919–1953) of the net margin went into sonsumption, large proportions of it presumably actually created human capacity. A comparison of product growth rates with population growth, and of the breakdown of the resulting p.c. product growth rates into full final uses, for Israel and two groups, of developed and less developed countries in the fifties shows, *inter-alia*, that in the L.D.C. only small proportions of their presumable capacity creation was financed by net capital inflows, thus imposing upon them domestic saving rates which presumably are too high to be sustainable.

Productivity is here conceived in two senses. First, it measures how far changes in output are accounted for, besides by changes in input volumes, by the more efficient uses of the inputs. On the macro-economic level, two factor inputs, labor and capital, are the main objects of analysis. The "residual", the quotient, or the difference, between the output and the input volumes, includes—apart from productivity of the factor inputs—the net effects of other influences, such as of the weather upon farm crops, of the political situation upon the tourist trade, and of quality changes in labor and capital not expressed by their volume measures. Therefore, the factor productivity results are to some extent "measures of our ignorance".

[1]This article summarizes the main factual results of a study of the same title. Theoretical and statistical discussions are here restricted to the minimum deemed necessary for proper understanding. Quotations of sources and acknowledgments are nearly entirely omitted. In these respects the reader should consult the study mentioned which will shortly come out in book form.

Unless otherwise indicated, Israel pound (IL) amounts are measured at 1955 prices. Per cent rates of change are geometrical annual averages between the border years indicated.

The Residual, as defined so far, relates only to the period considered but says nothing about developments beyond it. In order to explore such a longer-term aspect of productivity, one should examine, instead of the creation of output per input unit, the creation of productive capacity per unit of real resources—and this is the second meaning of the term productivity. Its measurement meets, however, conceptual and statistical difficulties which at present allow to outline only a line of approach to its implementation. This is so because of the impossibility of separating out of consumption "investment in human resources," on the one hand, and out of tangible investment that part which is not capacity creating in the long run, on the other. Moreover, the very concept of economic capacity relates to a given economic and technological structure of the economy, and has therefore a time dimension which is subject to unforseeable changes.

Total Factor Productivity

Since we are interested mainly in intertemporal changes rather than in comparisons between economies or branches, we measure the Residual by comparing the index of output volume with that of the combined volume of the two factor inputs. Total factor input is composed of the weighted inputs of labor and of capital, the weights being their distributive shares in gross domestic product of the base year, 1955, and the annual changes measured by the volume indexes of employment and of the gross capital stock.

The annual per cent rates of change of the Residual in the total economy and in its main sectors are hereunder summarized.

TABLE 1

Total Factor Productivity, Total Economy and Components, 1950–1965 and Subperiods: Annual Percent Rates of Change

	1950–1965	1953–1965	1950–1955	1955–1960	1960–1965
Total economy	3.4	4.1	4.1	3.2	2.9
adjusted[a]	2.5	3.6	2.8	2.9	1.8
Private nondwelling economy	4.3	5.5	4.6	4.3	3.9
Industry	1.9	4.2	−2.7	3.7	4.9
adjusted[b]	0.9	2.3	−2.0	1.6	3.3
Agriculture	5.4	5.9	3.5	8.6	4.3
Transportation	5.5	6.1	7.2	6.6	2.7

[a]GDPf measured from the uses side, instead of from the income side, and adjusting capital input correspondingly, see below p. 11.

[b]Measuring capital input by 18 industrial branches by using the changes in the power-equipment ratio as indicator of utilization rate of capital stock, see below p. 14f.

The decline of the growth rates in the two aggregates, the total and the private nondwelling economy, over the five-year periods is apparently connected with those of Transportation and of the—private and public—services (not shown), in contrast to the sector industry which shows a steep rise of factor productivity. In 1965–1968 the growth rate of the Residual of the total economy further declined, to 1.4 per cent. The reduction was due to a recession, in 1966 and in the first half of 1967. In 1968 the rate rebounded to 5.7 per cent.

TABLE 2

"EXPLANATION" OF GROWTH BY FACTOR INPUTS AND BY TOTAL FACTOR PRODUCTIVITY (z) IN ISRAEL AND ABROAD

Country	Period	Annual Per Cent Rates of Change of			"Explanation" of (1) by Changes in		
		GDP	Labor input	Capital input	z	Labor Input	Capital Input
		1	2	3	4	5	6
Israel	1950–1965	11.0	5.0	13.1	3.4	3.5	4.1
Western Germany	1950–1959	7.4	1.6	6.0	4.5	1.1	1.8
Italy	1949–1959	5.9	1.1	3.2	4.1	0.8	1.0
Yugoslavia	1949–1959	5.5	1.1	4.9	3.2	0.8	1.5
Netherlands	1949–1959	4.8	1.2	4.8	2.6	0.8	1.4
France	1949– 959	4.5	0.1	3.4	3.4	0.1	1.0
Canada	1949–1959	4.2	2.1	7.1	0.6	1.5	2.1
Norway	1949–1959	3.4	0.3	4.6	1.8	0.2	1.4
Sweden	1949–1959	3.4	0.5	2.0	2.5	0.3	0.6
Belgium	1949–1959	3.0	0.3	2.6	2.0	0.2	0.8
United Kingdom	1949–1959	2.4	0.6	3.1	1.1	0.4	0.9

NOTES: Cols. 1 to 4 are average annual per cent rates of change.

Cols. 5 and 6 are conceptually the rates in cols. 2 and 3 weighted by relative base year factor returns in GDP which happened to be in Israel 0.7 for labor and 0.3 for capital—the same shares as those assumed in our source for the other ten countries. Actually col. 5 and 6 are adjusted to sum up to the difference between col. 1 and col. 4, that is, to the rate of change of factor inputs.

The quantitative relation of the growth rates of output (GDP) to those of the two factor inputs and to the Residual in Israel is compared above to similar computations for ten other countries.

The growth of output in Israel in 1950–1965 is "explained" by approximately one third each by increases in the Residual, in labor input and in capital input,[2] the explanation being based upon the assumption of perfect factor substitutability which obviously is an oversimplification. In nine out of the ten developed countries being compared, the Residual in the fifties explains a much higher share of product growth, about 50 to 75 per cent. Only in Canada is this share lower than in Israel. The difference seems to be due, first, to Israel, as well as Canada, having to devote much larger shares of their output than the more developed countries to infrastructural expenditures which increase output only in the longer run. Second, factor productivity increase is bound up with increase in skill, in the widest sense. That is, there are increases not only of the level of skill of manual workers, but also of entrepreneurial know-how, the level of organization of firms and of government, and the like. The acquisition of such improvements takes time: the human capacity for learning thus puts a ceiling to the growth rate of the Residual, largely independent from the growth of the factors of production. If we therefore regard changes in total factor productivity as more or less independent of changes in factor inputs, Israel's performance

[2]In the period 1953–1968, the growth rates become lower, especially those of labor input. Each of the two factors then "explains" about 30 per cent, and the Residual two fifths of the rate of product.

appears to be rather impressive since it ranks, together with France, third among the eleven countries of Table 2 (see col. 4).

The total factor productivity is not only an expression of the ratios of output and input volumes but also of input prices to output prices. This is so because a change in productivity must express either a change in factor returns in the same direction or an inverse change in output prices. Table 3 shows for the private nondwelling economy as well as for industry and agriculture, in 1950–1965 and subperiods the connection between price development of output (GDPf) and of factor input with the Residual. This approach makes it possible to answer the question how far were changes in total factor productivity used to raise factor unit returns—that is, input prices—and how far to lower output prices.

TABLE 3

AVERAGE ANNUAL RATES OF CHANGE OF FACTOR UNIT RETURNS, OUTPUT PRICES AND THE RESIDUAL: PRIVATE NONDWELLING ECONOMY AND SOME COMPONENTS, 1950–1965 AND SUBPERIODS

Period	Factor input prices	GDPf prices	Residual	Ratio (3) : (1) in %
	1	2	3	4
	PRIVATE NONDWELLING ECONOMY			
1950–1965	15.6	10.9	4.3	28
1950–1955	27.1	21.6	4.6	17
1955–1960	9.3	4.8	4.3	46
1960–1965	11.2	7.1	3.9	35
	INDUSTRY			
1950–1965	13.5	11.4	1.9	14
1950–1955	22.7	26.0	−2.7	—
1955–1960	8.2	4.4	3.7	45
1960–1965	10.1	5.0	4.9	48
	AGRICULTURE			
1950–1965	15.9	9.9	5.4	34
1950–1965	30.0	25.7	3.5	12
1955–1960	9.0	0.4	8.6	96
1960–1965	9.7	5.2	4.3	44

The inflationary development during the greater part of the period 1950–1965 raised the prices of output by about one third less than the wage and profit rates, in the private economy as well as in agriculture, and by one fifth less in industry. In other words, the rise in nominal factor incomes was supported by increased factor productivity only to small extents, the remainder being accounted for by increases of output prices. The notable exception is the sector agriculture in 1955–1960 when the increase in incomes was covered by the Residual nearly in full. But this is presumably due, wholly or largely, to the sharp increase in output and to the relatively low demand elasticity for farm products which prevented output prices from rising with input prices when crops were large.

How much of the productivity gain—defined as the difference between the increase in real gross product and the increase in real factor input—went to labor

and how much to capital? Table 4 answers this question for the private domestic economy of Israel and of the U.S.A.

TABLE 4

FACTOR SHARES IN REAL PRODUCTIVITY GAIN: PRIVATE NONDWELLING ECONOMY OF ISRAEL, 1950–1965 AND SUBPERIODS; PRIVATE DOMESTIC ECONOMY OF U.S.A., 1919–1957 AND SUBPERIODS

	Period	Total Productivity Gain	Per cent Shares of	
			Labor	Capital
Israel (IL m. of 1955)	1950–1965	1,430	93.6	6.4
	1950–1955	196	105.4	−5.4
	1955–1960	426	78.1	21.9
	1960–1965	808	98.9	1.1
U.S.A. ($ m. of 1929)	1919–1957	94,081	99.1	0.9
	1919–1929	13,579	81.2	18.8
	1929–1937	10,520	135.0	−35.0
	1937–1948	32,644	69.0	31.0
	1948–1957	37,338	121.8	−21.8

NOTE: In Israel product and capital returns are gross of depreciation whereas in the United States they are net. Were the latter given gross, too, the per cent shares of capital would become higher and their fluctuations less sharp than they appear in the table.

The sharp rise of the capital share in productivity gain in Israel over the first two five-year periods is presumably connected with a downward bias of the estimates of capital returns in the early fifties, caused by the inflationary situation in those years as well as by the lack of experience of the assessors of income tax whose assessments largely served as basis of the estimates of capital returns. This bias decreased with growing normalization towards the mid-fifties. However, the rates of change of the factor shares in 1950–1965 can fairly well be explained by the difference in the development of their prices. The unit price of capital rose at a rate only a shade lower than that of the product price of the private nondwelling economy over 1950–1965—both increased fivefold. In contrast, the unit returns of labor rose more than double product prices. The constancy of capital unit returns relative to product prices by necessity leaves the bulk of productivity gains to labor. This does not mean that capital unit returns were "too low" for encouraging investment—the high rate of increase of the capital stock, by 13 per cent p.a. in 1950–1965, is sufficient proof. This high rate is the result of the encouragement of capital formation in the private economy by the government, by low-interest loans and by other policies, on the one hand, and of not less than three fifths of the capital stock consisting of asset categories rather insensitive to short-run profitability, such as highways, port installations, irrigation facilities, schools, hospitals, and the like.

Similarly, in the United States, practically the whole productivity gain accrued to labor in 1919–1957. During the great depression, 1929–1937, and again in 1948–1957, the capital share even became negative, in the latter period because of the readjustment from the postwar capital shortage which temporarily inflated capital returns.

Efficiency of Resource Uses

We now turn to the problem of longer-term productivity, more precisely to the question how far the uses of resources were conducive to increasing sustained economic growth.

Adapting a model of Kendrick, we deduct from each year's GNP the preceding year's final uses, representing the "maintenance" of the *status quo ante*. The remainder, the "gross margin" is then split up into the "provision" of the increase in population with the preceding year's p.c. portions of consumption and net capital stock, and into the "net margin": the aggregates of the increases in these p.c. portions of the whole population plus the increase in the export surplus.

The final results for Israel and for the United States are summed up in Table 5.

TABLE 5

Breakdown of GNP Aggregates into Maintenance, the Gross Margin, and the Net Margin, in Israel and in the U.S.A.

	Israel				U.S.A.		
	1951–1965	1951–1955	1956–1960	1961–1965	1889–1953	1889–1918	1919–1953
A. Breakdown of GNP Aggregates of each Period (in %)							
Maintenance	70	62	72	72	92	86	93
Gross margin	30	38	28	28	8	14	7
of which provision (for population increase)	12	16	11	11	4	6	4
net margin	18	22	17	17	4	8	3
B. Breakdown of Net Margin (in %)							
Increase in per capita—							
consumption	24	17	21	30	38	19	52
capital stock	81	80	83	82	62	81	48
Export surplus changes	−5	4	−4	−11			

Note: The export surplus is included fully in the U.S.A. gross and net margin whereas in Israel the two margins include only the incremental export surplus.

The gross margin, that is, the aggregate of the incremental GNP, formed much higher shares of the aggregates of GNP in Israel than in the U.S.A., because of the much higher growth rates in Israel. Also the shares of the net margin are higher in Israel because the provision absorbed a smaller share of the gross margin; the latter had higher levels relative to GNP, and the outlays on security in the U.S.A.—included in maintenance—rose sharply and decreased the gross margin nearly by half and the net margin still more. The steep increase of the share of consumption within the net margin in the U.S.A. is connected to growing "investment in human resources," such as education, research, and health control. To regard these outlays as formation of intangible capital might be justified by

the fact that incremental factor productivity rose more than the consumption levels. In Israel, too, the shares of consumption in the net margin rose, and incremental factor productivity rose even more from the first to the second five-year period, but not in 1961–1965. However, the distinction between consumption proper and consumption which conceals "investment in human resources" would need direct criteria not available so far since changes in factor productivity may have been the consequences of economies of scale or other exogenous circumstances.

Changes in the net margin in Israel were associated with opposite changes in the import surplus rather than with changes in the p.c. levels of the domestic final uses. Changes in the import surplus were correlated to changes in both p.c. levels, of consumption and of capital stock, which reveals the dependence on foreign aid. In contrast, in the United States changes in net margin were closely reflected by changes of its capital component whereas the consumption component was nearly unaffected—comparing the two periods 1889–1918 and 1919–1953.

Both the productivity increment and the net margin, can be regarded as criteria of economic performance, the former from the side of product formation, the latter from the side of product use. Productivity is determined by technology and management of production. The use of resources, however, depends upon quite different factors, such as capital import, the distribution of income, and the saving behavior of the population. It is, therefore, not surprising that an economy may rank high in the first respect, and low in the second. In order to illustrate the point, we relate the productivity increments of Israel's economy to its increases in p.c. consumption plus p.c. net capital stock, plus the change in the export surplus, that is, to its net margin. The productivity increment turns out to cover only a fraction of the net margin—obviously because of the high dependence upon foreign resources. To be sure, the ratio nearly doubled from 11 per cent in 1951–1955 to 20 per cent in 1961–1965. In the United States, a similar computation over the periods 1889–1919 and 1919–1953 shows even a steeper rise of the ratio.

Perhaps nore significant than the ratio of the productivity increment to the net margin as a whole is relating the former to the aggregate increase in p.c. consumption; this ratio shows how far the increase in output per unit of factor inputs was not matched by raising p.c. capital stocks and net foreign assets. In Israel, the ratio was about 0.7 in 1951–1965 whereas in the United States it somewhat exceeded unity over the two periods mentioned. The difference between the two countries stems from a lower growth of the productivity increment in Israel, as well as from the fact that, in contrast to the United States, its net domestic saving was negative because capital formation and some part of apparent consumption was financed by foreign resources.[3]

So far we confined our analysis to data for Israel and the United States. In order to broaden the statistical basis of comparison, and in particular to include also underdeveloped countries, we also use a less sophisticated approach. We ask in regard to two groups, of 25 developed and 18 less developed countries—apart from Israel—how much of the rates of increase of GDPm in 1950–1960 is

[3]"Apparent consumption"—because it contains investment in human resources which is at present unidentifiable.

TABLE 6

ANNUAL PER CENT RATES OF CHANGE IN REAL GDPm, IN PER CAPITA RATES OF GDPm, AND OF REAL FINAL USES, 1950–60, IN ISRAEL AND ABROAD

Line	Israel			18 Less developed Countries			25 developed Countries		
		%	%		%	%		%	%
1 GDPm	11.1	*100*		5.3	*100*		4.0	*100*	
2 Population	5.3	49		2.3	43		1.5	38	
3 Per capita GDPm	5.5	51	*100*	3.0	57	*100*	2.5	62	*100*
Of line (3) accounted for by per capita changes in—									
4 private consumption	3.0	28	55	2.0	38	67	1.3	32	52
5 public consumption	0.5	5	9	0.7	13	23	0.6	15	24
6 gross domestic capital formation	−0.3	−3	−5	0.7	13	23	0.6	15	24
7 export surplus	2.3	21	41	−0.4	−7	−13	0.0	0	0

accounted for by the rate of increase of population, and changes in the p.c. levels of the four final uses.

Though in Israel the growth rate of p.c. GDP is more than double that of 25 developed countries, and nearly double that of 18 backward countries, the share of private consumption in that rate differs much less among the three groups; it absorbs in Israel and in the developed countries half, and in the backward countries two thirds of the growth rate of p.c. product. Public consumption took less than one tenth of that rate in Israel, against nearly a quarter in the 43 other countries. These also devoted the same proportion of p.c. product growth to domestic investment. This was supported by net capital import in the underdeveloped countries. The developed countries, however, do not show a net change in their foreign balance. (The domestic and net foreign investment data for Israel are affected by the high levels of the beginning of the fifties; their comparison with those of the other countries has, therefore, little meaning.)[4]

An interesting feature of the table is the fact that the net capital inflow—represented by the negative export surplus—in the less developed countries falls short of gross investment—not to speak of the human capacity creation included in public and in private consumption. The very high implicit domestic saving rate shows in a nutshell one of the basic problems of underdevelopment.

Summing up our exploration of the efficiency of resource uses, we saw that in Israel as well as in the U.S.A. the increase in p.c. consumption absorbed rising shares of GNP so that the shares of domestic and foreign capital formation

[4]As a byproduct of our analysis, we obtain the ratios of p.c. GDP and p.c. private consumption in the countries in Table 6. The trend line of the 18 less developed countries turns out to have an angle of about 45 degrees whereas that of the other group, and Israel among them, is lower. This means that in the less developed countries private consumption levels go up in proportion to product levels whereas in Israel and in the developed countries p.c. consumption increases less than p.c. product. This seems to prove—it might be expected also without statistical evidence—that countries behave like individuals: the richer they get the higher a share of additional income is saved.

decreased over time. We also saw that the productivity increment in Israel covered less than three quarters but in the U.S.A. the whole of the increases in p.c. consumption. A comparison of Israel with 18 less and 25 more developed countries for the fifties showed that in Israel about half of GNP increase was needed to supply the increases in population with the same p.c. product as the old population, whereas in the two groups of other countries the share was lower. Of the remaining p.c. product two thirds were used for consumption in Israel, but 80–90 per cent in the other countries, the remainders being used for domestic and foreign capital formation.

These findings should be regarded as only the first, though basic, step towards the goal of appraising resource uses. What still needs to be done is to separate out of consumption, private and public, and of domestic capital formation the creation of sustained economic capacity. This task encounters formidable difficulties—on statistical and to an even greater extent, on conceptual levels.

We now turn to the development of the ingredients of macro-economic productivity, that is of output, the factor inputs, and their interconnections.

Output

Israel's economy has a record of high growth during the period 1950–1965. Growth measured over gross domestic product at factor cost (GDPf) amounted to annual rates of $10\frac{1}{2}$ to 11 per cent p.a.—more than in any other country for which records for recent years are available. To be sure, no other country in modern history had such high capital inflows which made investment independent of domestic saving, nor a similar rate of increase of population and of manpower which provide both the markets and the human resources for expansion. But even on a per capita basis Israel ranks among the fast growing countries, though at some distance behind Japan.

The pace of growth was higher in 1950–1955, $12\frac{1}{2}$ to 13 per cent, than in 1955–1965, $9\frac{1}{2}$ to 10 per cent; but in the industrial sector (including mining) it accelerated over the three five-year periods, and in agriculture it rose over the first decade and then dropped.

Labor

The development of labor input, that is employment, is shown below in comparison to that of population and of the labor force.

TABLE 7

Population, Labor Force and Employment: Annual Per Cent Rates of Change, 1950–65 and Subperiods, for Population also 1948–65

	Population	Labor Force	Employment
1948–1965	6.7	—	—
1950–1965	4.8	4.5	5.0
1953–1965	3.7	3.6	4.3
1950–1955	6.7	5.6	6.5
1955–1960	3.9	3.5	4.0
1960–1965	3.9	4.4	4.7

The highest growth rates within total employment are recorded for industry, and during the first years after independence for the public sector. Agriculture shows the lowest rates after 1950–1955, and in 1960–1965 even an absolute decline.

Though the changes in the volume of employment are the appropriate measure for actual labor input, for certain purposes another measure is relevant, namely, if one is interested in the question what could the economy have produced had it used its human factor to a fuller extent. A quantitative notion of this factor results from a comparison of actual employment with the labor force. This ratio rose from 0.89 per cent in 1950 and 1953 to 0.96 in 1965, that is by nearly one tenth. Assuming the ratio employment to labor force of 1965 also for 1950, and the actual labor productivity also for the additional employment, the product foregone by underemployment results at one tenth of actual product in 1950 and gradually diminishes in the subsequent years.

The degree of utilization of the human factor in economic production can be measured, not only by asking what share of the labor force was actually employed, but also by dividing up the changes of output into that part which is due to the increase of the volume of employment, and that part due to increased product-per-man, thus conceiving the rise in labor productivity as more intensive use of employed manpower. We assume that the labor productivity in the first year of each of the three five-year periods would apply to the incremental employment volume; this yields for each subperiod a hypothetical product increment due to the rise in employment only. The ratio of this hypothetical amount to the actual incremental product measures the contribution of employment. Algebraically this is just the ratio of the growth rate of employment (L) divided by the growth rate of product(y).[5] The corresponding contribution of labor productivity is then the complement of the contribution of incremental employment. For the total economy the increase in employment contributed around two fifths to the incremental product in each subperiod, somewhat more in 1950–1955 and 1960–1965, and somewhat less in 1955–1960. The contribution of labor productivity thus was around 60 per cent. In the private nondwelling economy the share of incremental employment is around one third, so that labor productivity contributes two thirds of incremental product.

The rise in labor productivity is, of course, closely connected with the volume of capital per worker. In the total economy labor productivity rises less than the capital–labor ratio. The same holds for the private nondwelling economy for 1950–1955; from then on the two magnitudes rise approximately at the same rates. The lag of labor productivity behind the capital–labor ratio is just an expression of the fact that the capital stock has higher growth rates than output, the main exception being agriculture. For the economy as a whole this may be an indication of the accumulation of reserve capacity of capital which will yield fruit in the future.

Capital

The capital stock is measured in two ways: first, "gross," that is comprising the aggregate of the real gross investment in fixed reproducible assets during the

[5] $\frac{(y_0/L_0)(L_t - L_0)}{y_t - y_0} = \frac{(y_0/L_0)\,dL_t}{dy_t} = \frac{dL_t/L_0}{dy_t/y_0}$

economic lifespan of each asset group. The gross stock changes over time are believed to represent current services of capital in Israel better than our second measure of capital stock which deducts straight-line depreciation from each annuity of gross investment in accordance to its age.

The growth rates of the two capital stock concepts are below compared.

TABLE 8

GROSS (S) AND NET (N) CAPITAL STOCK, TOTAL AND BY MAJOR COMPONENTS, ANNUAL PER CENT RATES OF CHANGE, 1950–1965 AND SUBPERIODS

	1950–1965		1950–1955		1955–1960		1960–1965	
	S	N	S	N	S	N	S	N
Total economy	13.1	13.5	17.4	19.5	11.2	10.9	10.8	10.4
Private nondwelling economy	12.5	12.5	16.1	17.6	11.0	10.3	10.6	9.9
Industry	14.4	15.5	19.7	26.0	12.0	9.3	11.7	11.9
Agriculture, irrigation	9.9	9.5	13.1	13.6	9.5	9.2	7.1	5.9
Transportation	15.1	14.4	19.3	17.6	11.0	11.2	15.2	14.4

The growth rates of N exceed those of S in those periods in which either the average age of the stock decreases because the growth rate of investment rises; or because the weight of asset groups with shorter lifespans rises relative to those with longer lifespans, or because of both. In fact, in the total economy the changes in the weights of the various asset groups with different lifespans affected the N/S ratios much less than the changes in the pace of investment which shows up in the decrease of the average age of the gross stock, from 7 years in 1950 to $5\frac{1}{2}$–6 years in 1955–1965.

Data for the industry sector suggest to use electricity per equipment unit as a rough indication of the utilization rate of capital stock (see below p. 14f).

For the economy as a whole, another adjustment attempts to improve the basic series of output and capital input, namely, the addition of "errors and omissions" to GDPf and to the distributive share of capital. This adjustment is based upon two assumptions: that measurement of gross product from the uses side is statistically better than from the income side, and that the discrepancies, called in the national accounts "errors and omissions," are due entirely to deficiencies of the estimates of capital returns. The adjustment of capital input and of GDPf results in significantly lower rates of increase of the Residual. Since "errors and omissions" cannot be broken down by sectors, the adjustment is applicable to the economy as a whole only and not to its components.

Of the characteristics of the capital stock, two seem to be of analytical interest, namely, the ratio of the net stock (N) to the gross stock (S) in different years which shows what per cent share of the gross stock is still economically "alive"—under the lifespan assumption for each asset group; and, second, capital–output ratios.

We show the N/S ratio in Table 9 for various aggregates, in Israel and for comparison in the United States and in West Germany.

TABLE 9

NET-GROSS RATIO OF CAPITAL STOCK IN ISRAEL, UNITED STATES, AND WEST GERMANY, IN SELECTED YEARS, in PER CENT

Country	Total Economy		Private Non-Dwelling Economy		Agriculture		Industry	
Israel	1955	1965	1955	1965	1955	1965	1955	1965
N/S ratio	80.2	77.4	79.2	74.4	82.0	76.3	74.7	66.8
United States	—	—	1945	1961	1945	1961	1945	1961
N/S ratio			48.6	54.0	51.0	48.9	51.5	54.2
West Germany	1950	1960	—	—	1950	1960	1950	1960
N/S ratio	59	67			57	60	60	69

Israel has the highest ratios because its capital stock is much younger than the stock of the two older economies, only $5\frac{1}{2}$ and 6 years respectively in the overall average of the two years of comparison, as against 18.5 and 13.6 years in the U.S.A., and 23 and 16 years in West Germany. However, whereas in Israel the N/S ratio declines and the average age of the capital stock rises, the opposite trends prevail in the other two countries over the periods considered. Of particular interest is the sharp rise of the N/S ratio in Germany's industry; its ratio in 1960 even exceeds the level in Israel for 1965.

In order to compare both the capital–output ratios, as well as the absolute levels of p.c. capital stock and p.c. product in Israel with those in thirteen other countries in various years between 1950 and 1956 we transform the relevant capital stock and net product data from amounts in domestic currencies into U.S.A. dollars, over purchasing power parities or some substitute thereof, and convert the results to 1955 Dollar values over the implicit price index of the GNP of the United States.

A scatter diagram of the results shows some correlation between p.c. product and p.c. capital stock if two very capital-intensive countries, Norway and Luxembourg, are omitted. The p.c. net stock in the United States in 1956 is four times, and in nine other developed countries between 1.7 (West Germany in 1956) and 4.9 (Luxembourg in 1951) times as large as in Israel in 1955.

The spread between Israel's p.c. net product in 1955 and that of the other developed countries is smaller, the ratios being 3.55 for U.S.A., in 1956 and between 1.4 (Netherlands) in 1953 and 2.8 (Canada) in 1956.

Whereas in Israel the marginal gross capital-gross product ratio (ICOR) equals in 1953–1965 the average ratio, about 2.8, in seven other countries for which records in the fifties are available, ICOR seems to exceed the average ratio, in part considerably. These results can be correctly interpreted only by taking account of the inter-country structural differences. In part, the excess of ICOR over the average ratios abroad may well reflect the growing capital intensity of

TABLE 10

PER CAPITA NET CAPITAL STOCK AND NET PRODUCT, THE RESULTING CAPITAL–OUTPUT RATIOS AND THEIR RANKING IN ISRAEL AND THIRTEEN OTHER COUNTRIES, CIRCA 1955, IN 1955 U.S. DOLLARS

Country	Year	Per Capita			Capital-output Ratio	
		Net Product 1955$	Net Capital Stock 1955 $	Rank of (3)	Ratio	Rank of (5)
	1	2	3	4	5	6
U.S.A.	1956	2,234	5,010	2	2.24	8
Canada	1956	1,759	3,269	4	1.86	12
Luxembourg	1951	1,262	6,128	1	4.86	1
U.K.	1954	1,183	2,261	9	1.91	10
Belgium	1951	1,133	2,818	7	2.49	7
West Germany	1956	1,104	2,110	10	1.91	10
Norway	1954	1,097	4,522	3	4.12	3
Australia	1956–1957	1,075	3,114	5	2.90	5
France	1955	1,064	2,896	6	2.72	6
Netherlands	1953	874	2,682	8	3.07	4
Israel	1955	631	1,256	11	1.99	9
Japan	1956	248	404	13	1.63	13
Yugoslavia	1954	121[a]	528	12	4.36	2
India	1951	53	79	14	1.49	14

[a]Net *material* product.

modern industry. Some negative correlation of the growth rates of GDP in Israel and in 12 other countries in the fifties with ICOR is ascertainable, if two countries with very high ICOR are excluded (see Table 11).

The necessity of such an inverse correlation has recently been proven and verified by empirical studies. The theoretical argument is that the lower the growth rate of gross product, the larger becomes the share of gross investment needed for replacement relative to product, so that ICOR (since it is generally measured over accumulated gross investment) rises.

Product growth is, of course, only in part explained by the growth of the labor force; the ranking of the growth rates of GDP is by and large matched by the ranking of the increase in labor productivity which, in turn, approximately fits the ranking of the capital formation proportion.

The capital employment ratio in the total economy and in industry of Israel rose about three times in 1950–1965—more in the public sector and in transportation, and less in agriculture (including irrigation). How far are the overall changes in this ratio connected with changes in the sector composition of the economy? It seems that these structural changes were more or less offsetting. If we apply the 1955 ratio of capital per labor unit to the actual employment volumes of each sector in 1950, 1960 and 1965, we receive for the economy as a whole a nearly constant ratio in all these years; and, *vice versa*, the employment–capital ratios of each sector in 1955 applied to their capital stock in the other years yield a more or less constant overall ratio, too.

TABLE 11

OUTPUT CHANGES, CAPITAL FORMATION PROPORTIONS (KfP), INCREMENTAL CAPITAL–OUTPUT RATIOS (ICOR), LABOR FORCE (LF) AND LABOR PRODUCTIVITY CHANGES IN ISRAEL AND IN TWELVE OTHER COUNTRIES IN THE FIFTIES (AT CONSTANT PRICES)

Country	GDP % Rate of Change p.a. 1949–1959	KfP 1949–1958 %	ICOR (2)/(1)	LF % Rate of Change p.a.	Labor Productivity % Rate of Change p.a. $\frac{(1)+100}{(4)+100} - 100$
	1	2	3	4	5
Israel (1953–1965)	10.8	30.6	2.9	4.3	6.2
West Germany	7.4	24.2	3.3	1.6	5.7
Austria	6.0	23.3	3.9	1.1	4.8
Greece	5.9	17.8	3.0	1.5	4.3
Italy	5.9	21.9	3.7	1.1	4.7
Netherlands	4.8	25.0	5.2	1.2	3.6
France	4.5	20.6	4.6	0.1	4.4
Canada	4.2	25.5	6.0	2.1	2.1
Finland	4.2	30.0	7.2	0.7	3.5
Norway	3.4	32.6	9.5	0.3	3.1
Sweden	3.4	21.4	6.3	0.5	2.9
U.S.A.	3.3	18.1	5.5	1.2	2.1
U.K.	2.4	16.1	6.7	0.6	1.8

INPUT OF ELECTRIC POWER

The comparison of the use of electricity—practically the sole energy source in Israel—with output, capital stock, and consumption seems to be a source of some additional insight into the working of the economy. Table 12 shows some relevant data.

In the economy as a whole the "power intensity"—kwh per IL of real GDPf—rose in 1950–1965 1.6 times, in agriculture 1.5 times, and in industry 1.9 times. Household and public power use per unit of consumption rose by half, but per capita of population three times. The sales of electricity rose 17 per cent more than the gross capital stock in the total economy and by 14 per cent more in industry—which, by the way, seems to be quite a good check of the respective gross capital stock estimates since they were made independently. It may well be that the relatively low increase of the power intensity of agriculture is going to change when the north–south water carrier is in full operation.

For the sector industry, a breakdown of power use by 18 branches was possible for the years 1958 and 1965. From the disaggregation of output, power use, and equipment by 18 branches, it emerges that the ratio of equipment to output is not explained by the changes of the industrial branch composition. However if we assume for each branch of industry that the intake of power per unit of output and of equipment in 1958 was applicable to the actual power use in 1965, the resulting overall output–power and equipment–power ratios become larger than they were in reality. This is due to a relatively small extent to power intensive branches growing faster than others. The main reason seems to be the growth in the utilization rate of equipment. To be sure, the volume measure of equipment may not, or not fully, account for improvements in its

TABLE 12

SECTOR SHARES IN REAL GDPf AND IN ELECTRICITY SALES, AND POWER USE PER IL OF GDPf, OF CONSUMPTION, AND PER CAPITA OF POPULATION, IN SELECTED YEARS

	Per Cent Shares in—		Kilowatt Hours		
	GDPf of Total Economy	Electricity use of Total Economy	Per IL of GDPf	Per IL of Consumption	Per Capita
	1	2	3	4	5
Total economy					
1950	100	100	0.455		
1955	100	100	0.556		
1960	100	100	0.633		
1965	100	100	0.729		
Agriculture and irrigation[a]					
1950	12.5	18.3	0.666		
1955	12.2	24.2	1.102		
1960	15.7	23.2	0.932		
1965	14.0	19.4	1.006		
Industry					
1950	29.9	30.3	0.461		
1955	22.5	28.8	0.713		
1960	25.0	36.0	0.913		
1965	29.6	35.1	0.864		
Private and public households					
1950		51.4		0.197	188
1955		47.0		0.245	281
1960		40.8		0.255	358
1965		42.3		0.301	569

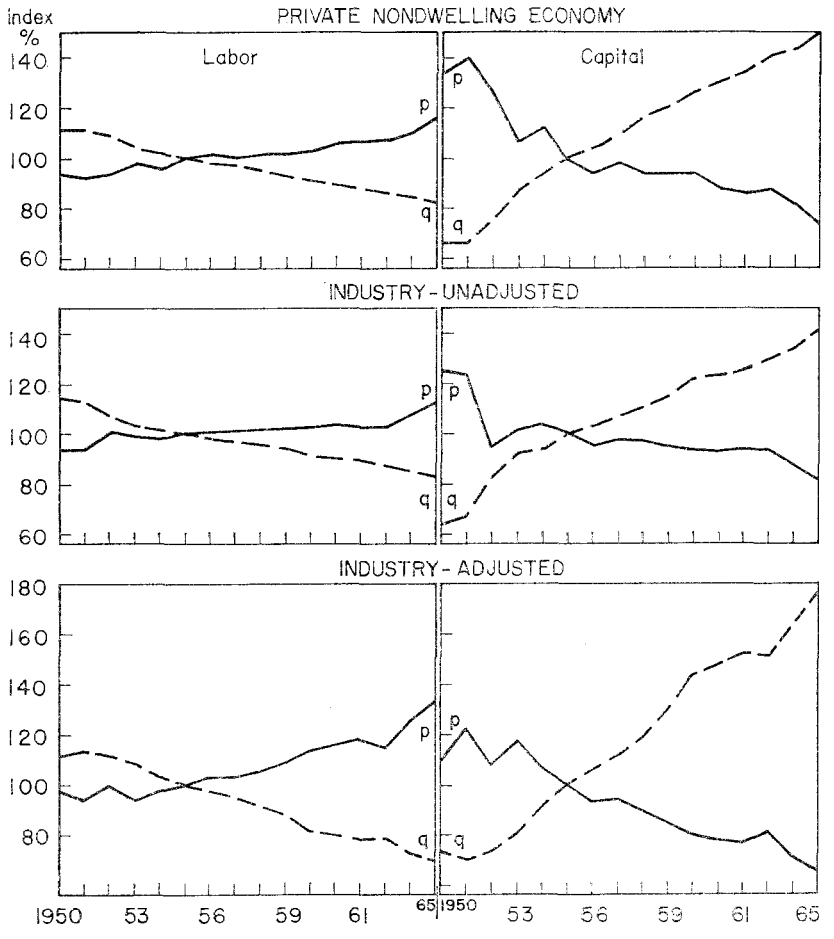
[a]The electricity input in Agriculture is that for irrigation only. Other electricity uses by farm settlements which are available separately for 1961–1965 only are omitted also for 1965 in col. 2.

quality, in particular higher kilowatt capacity. Disregarding this statistical shortcoming, we tentatively use the index of the power-equipment ratio as representing the utilization rate of fixed capital, and superimpose it upon the capital input of the sector Industry in the whole period 1950–1965. This raises the rate of growth of capital input and, therefore, its weight and the weight of total factor input within GDPf so that the rates of growth of total factor productivity become much smaller than in the unadjusted model (see Table 1).

FACTOR INPUTS AND FACTOR PRICES

The comparison of labor and capital real inputs, on the one hand, and of their respective returns (or prices), on the other, is presented in Chart 1 for the private nondwelling economy and for industry as indexes, computed relative to the factor input totals. The declining trends of the labor input curve and the steep rise of the curve of capital input express the fact that over 1950–1965 labor input rose at much lower rates than capital input (see Table 2, first line). If one of the assumptions of the Cobb-Douglas production function were fulfilled in

Israel, a given per cent rise in the real input of one factor should be accompanied by the same per cent decrease of its unit returns. In fact, the downward trend of the labor input curve and the upward trend of the capital input curves are not mirrored by the trends of the unit return curve, p: the latter are less steep than the former. The exception is the total economy adjusted by the addition of "errors and omissions" which smoothes the ratio of distributive factor shares to near constancy—1.05 in 1950–1965—which means that the index of the volume ratio capital–employment nearly parallels the index of the price ratio labor to capital unit returns, thus making the model nearly consistent with Cobb-Douglas.



p factor unit returns (prices)
q factor volumes

The behavior of the two factor inputs can be considered as a process of substitution of labor by capital.

TABLE 13

AVERAGE ANNUAL PER CENT RATE OF SUBSTITUTION OF LABOR BY CAPITAL, TOTAL ECONOMY AND COMPONENTS, 1950–1965 AND SUBPERIODS

	1950–1965	1953–1965	1950–1955	1955–1960	1960–1965
Total economy, unadjusted	2.3	2.1	2.3	2.1	2.2
Total economy, adjusted	2.7	2.4	2.7	2.4	2.5
Private nondwelling economy	2.2	2.1	2.3	1.9	2.1
Industry, unadjusted	2.4	1.8	2.9	2.0	1.8
Industry, adjusted	3.2	3.9	2.1	4.1	3.4

NOTE: Explanations of adjustments—see above pp. ii and p. 14f.

As the rates of substitution are measured as the "changes of the index of capital per unit of labor input weighted by the relative shares of capital" in GDPf (Kendrick), they are explained by the rates of change of gross capital stock (Table 8) relative to those of employment (Table 7), as well as by the capital and labor input curves (q) in Chart 1. The decline of the growth rates from 1950–1955 to 1955–1965 in all series except the adjusted industry data reflects the steep rise of the capital input curves, that is, the very heavy capital formation of those early years.

The counterpart of the rates of factor substitution are the changes in the ratio to capital prices. That wages react more sharply upon the general rise of prices than profits, is due, not only to their linkage through the cost-of-living agreements, but also to profits being residual incomes in non-monopoly situations

TABLE 14

ANNUAL PER CENT RATES OF CHANGE OF THE RATIO OF LABOR TO CAPITAL UNIT RETURNS, TOTAL ECONOMY AND COMPONENTS, 1950–1965 AND SUBPERIODS

	1950–1965	1953–1965	1950–1955	1955–1960	1960–1965
Total economy, unadjusted	5.2	3.5	8.2	2.5	4.9
Total economy, adjusted	7.3	4.4	11.4	3.2	7.4
Private nondwelling economy	5.5	4.5	7.3	1.9	7.4
Industry, unadjusted	4.1	3.0	5.8	1.8	4.7
Industry, adjusted	5.7	8.0	2.6	7.3	7.3

NOTE: See note to Table 13.

which presumably prevail in Israel's product markets. In addition, the much steeper increase of real capital input than of employment (see Chart 1), must restrain the rise of capital unit returns. If we compare the development of labor unit returns with the implicit price index of equipment (as component of annual gross capital formation), their ratio, the relative price of labor, sharply declines from 1951 to 1954, because of the steep increase of equipment prices relative to

wages in consequence of the devaluation in 1952–1954, and then nearly doubles from 1954 to 1965—a development obviously conducive to substitution of labor by capital.

The comparison of the development of factor unit returns with output per factor unit shows that competitive equilibrium in the two factor markets did not prevail: wage rates were higher than marginal product per labor unit, though the distortion abated over time. Nor was the main Cobb-Douglas assumption fulfilled, namely constant factor elasticity, which shows up as the decrease of the distributive share of labor in nominal product.[5] The correct procedure would be to compute the factor weights by formulating a complete regression model of the kind Michael Bruno has used. However, our attempts at multiple regression analysis did not lead to satisfactory results, either because of the relative shortness of the period surveyed, or because of statistical weaknesses.

The interconnections between factor inputs and factor prices implicit in the models used, can serve under certain simplifying assumptions, to explore *ex ante* consequences of adjustments of labor unit returns (or wage rates). Two abstract models are constructed, both based on *ceteris paribus* conditions. The first model assumes the adjustment of wage rates by changes in total factor productivity; the second by changes in labor productivity.

The adjustment of wage rates by total factor productivity affects the unit returns of capital in the same proportion. The changes of the two nominal distributive shares depend upon any change in the capital–labor input ratio; if capital input rises faster than labor input—which is the rule—the distributive share of capital will rise relative to that of labor. The adjustment of wage rates by labor productivity leaves the ratio between the nominal distributive shares unchanged. Capital unit returns will decline relative to wage rates, if capital volume rises faster than employment. The change of the profit rate depends therefore upon the behavior of capital productivity. The adjustment of wage rates by some index of product prices turns out to have the same effects as the adjustment by labor productivity: it leaves the distributive shares ratio constant and reduces the unit returns of that factor which is growing faster or declining at a slower rate than the other factor.

The choice between the two kinds of wage adjustment discussed above depends upon that of the targets of general economic policy: if, for example, the target is sustained increase in capital formation the adjustment of wage rates by total factor productivity would be preferable because profit rates would not be discriminated against in relation to wage rates. If, however, for non-economic reasons the share of labor in product is to be kept stable, the adjustment of wage rates by labor productivity is indicated.

[5]With the exception of the total economy model adjusted by "errors and omissions," see above p. 16.