

ISRAEL'S ECONOMIC GROWTH: AN INTERNATIONAL COMPARISON¹

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I examine the growth rate of GDP per capita in Israel, and compare it with the growth of many other countries. Although Israel's growth rate was above average, its ranking changes when the comparison is conditioned on the initial level of development, as measured by GDP per capita. This is particularly the case when decade-long averages are used to compare growth rates, because it then transpires that Israel's growth rate was relatively high only in the 1960s. Israel's relative growth rate fell significantly in the 1970s and was extremely disappointing in the 1980s. An examination of the sources of the rise in total factor productivity (TFP) in the 1970s and 1980s shows that slightly more than half the rise in TFP can be attributed to R&D investment and the rest to a rise in the level of education.

Israel's population in 1992 was almost four times as large as in 1953, and by 1953 it had more than doubled since the establishment of the state in 1948.² Whereas the population quadrupled between 1953 and 1992, per capita GDP rose by an annual average of 3.7 percent. This pace was not uniform, however, as Table 1 shows. In the first two decades the annual growth rate was almost 6 percent, and only in the 1990s did the growth rate accelerate appreciably again.

Evidently, the standard of living rose markedly in Israel in that period, despite rapid population growth. Mass immigration imposed significant burdens on the economy, which had to adjust in order to provide the new immigrants with employment and housing. As Yoram Ben-Porath has pointed out, however, the aggregate data show a positive correlation between immigration and growth.³

The structure of Israel's economy has changed unrecognizably since the establishment of the state. In 1953 agriculture accounted for 12 percent of GDP, manufacturing for 21 percent, and services for 25 percent. By the beginning of the 1990s, however, agriculture had dropped to 4.5 percent, manufacturing had risen to 30 percent, and services had risen to approximately 40 percent.⁴ Nevertheless, these changes—however significant—do not accurately represent what happened. In manufacturing, for example, the share of the traditional, labor-intensive industries—such as textiles—plummeted, while that of human-capital-intensive industries—such as electronics, optics, and scientific instruments—rose. The internal changes within manufacturing and the service sector were no less important than the increase in their share of

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¹ Based on a lecture given at a conference of the Israel Economic Association in May 1998.

² I have chosen 1953 as the point of departure for my comparison because it is the first year for which data exists on purchasing power parity adjusted per capita GDP—the index I have used for international comparisons. The data on per capita GDP are taken from the Mark 5.6 database of Summers and Heston, Penn-World Tables.

³ See Ben-Porath (1986).

⁴ In 1997 the share of the services rose to 50 percent, and that of agriculture fell even further, to 2.6 percent.

GDP and the decline in that of agriculture. These trends are reflected in measures of total factor productivity (TFP) growth. Not only did the growth rate of per capita GDP decline over time until the 1990s, but the contribution of TFP to economic growth also fell. The slower pace of TFP growth led the slowing of the growth rate in income per capita in the years after the Yom Kippur War of 1973, which was particularly low in the first half of the 1980s, the period of rapid inflation. Only the Economic Stabilization Program of 1985 restored TFP to its former position as the jewel in the crown of economic growth, and created the infrastructure for renewed growth in the 1990s.⁵

Table 1
Annual Average Growth Rate of Per Capita GDP in Israel, 1953–92

	Growth rate
1953–1969	5.7
1961–1970	5.6
1971–1980	2.8
1981–1990	1.6
1991–1992	2.1

Are these achievements of Israel—by which the standard of living rose fourfold between 1953 and 1992—unique? There is no easy answer to this question, because the period following the Second World War was one of unprecedented progress in the global economy. In this period the economies of many countries flourished, both because of internal efforts—such as high levels of investment in education—and because obstacles to international trade were removed,

a well functioning monetary system was created, and foreign direct investment and technology transfer expanded. These changes led to the expansion of international trade and capital flows, and helped to raise the living standards of many people. The horn of plenty was not universally shared, however, and it did not extend its benefits to all countries, and especially not to countries in Africa.

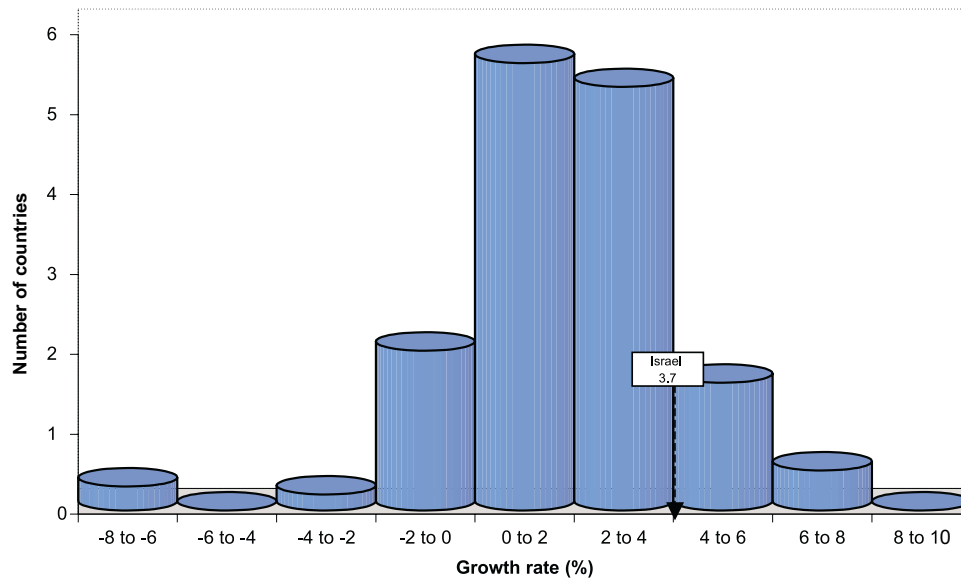
Figure 1 shows the distribution of average per capita GDP growth rates among the 152 countries included in the Summers and Heston database, covering the period from the early 1950s to 1992. In over 20 countries, including Angola, Chad, Haiti, Mali and Somalia, per capita GDP declined. Israel, with a growth rate of 3.7 percent, is not exceptional, even though this is double the total average growth rate of 1.75 percent. Thus, for example, Grenada's annual growth rate was 7.5 percent, while those of Singapore and Hong Kong were about 6.5 percent, and of Japan, Korea, and Taiwan about 6 percent. These are the notable exceptions. However, among the countries whose economic growth was faster than Israel's were also Greece, Malaysia, Malta, Portugal, and Puerto Rico.

Over time some countries moved from the category of poor countries to that of rich ones. Other countries became impoverished and were redefined as underdeveloped. Durlauf and Quah (1998) have shown that over time a distribution with two peaks—the rich countries and the poor countries—has emerged.

In order to place Israel on this spectrum, we can examine the shifts in its relative position over time. Since we do not have data for the beginning of the period for all the 152 countries in the sample, it is possible to rank only the 52 countries for which data are available. Reducing the sample size hurts Israel's ranking on the relative performance scale. Nevertheless, we find

⁵ See Razin and Sadka (1993), who show that there were negative productivity growth rates in the early 1980s. My calculations, based on the data in Table A2 in the appendix, show a similar trend in the development of productivity, but not negative growth rates.

Figure 1
Distribution of All Countries



that, while in 1953 per capita GDP was higher than Israel's in 23 of the 52 countries, in 1992 this number dropped to 19. In other words, over a period of some 40 years, per capita GDP in Israel caught up with and overtook that of four countries on net. In effect, however, it really overtook five countries: Chile, Ireland, Mauritius, Uruguay, and Venezuela. And Israel was overtaken by one country. This period was a difficult one for South America, which partly explains why three of the countries that fell behind came from that region. On the other hand, the one country that had been poorer than Israel in 1953 and became richer than Israel by 1992, is Japan. Not only had Japan's per capita GDP become higher than Israel's in 1992, it was twice as high in that year.

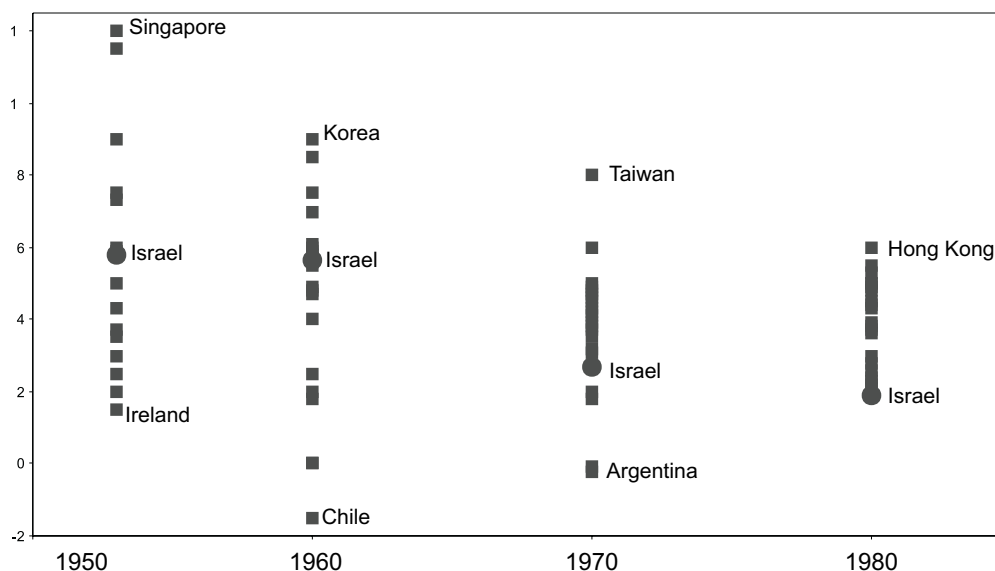
Intercountry differences in the growth rate of per capita GDP can be explained by per capita GDP at the beginning of the period, population growth, capital depreciation, investment, openness to the global economy, the quality of economic policy, human capital, and R&D capital.⁶ Many theoretical studies have clarified the mechanisms whereby these factors affect growth, and many have evaluated the intensity of their impact. A debate regarding the relative importance of each one of these factors exists in the literature, and especially so regarding the factors that explain TFP. Nevertheless, there is wide agreement that the initial conditions are particularly important,⁷ and that the investment rate plays a major role in the evolution of per capita GDP. In addition, there is agreement that the levels of education and R&D investment play important roles in the evolution of TFP.

In order to isolate the effect of the initial conditions—as measured by real GDP per capita—in the international comparison of growth rates, Figure 2 presents the growth rate of groups of

⁶ See Coe and Helpman (1995), and Barro and Sala-i-Martin (1995).

⁷ The higher the initial per capita GDP, the lower the growth rate; see Barro and Sala-i-Martin (1995).

Figure 2
Growth Rates of Countries with Similar Per Capita GDP to Israel



countries, including Israel, at different time periods. The first cluster, which is focused on 1953, contains countries whose per capita GDP is similar to Israel's in 1953. For example, only in 1957 Japan had a per capita GDP similar to Israel's in 1953, and Hong Kong's had become similar only in 1961. Thus, what is common to these countries is that their per capita GDP is like Israel's in 1953, even if theirs was attained in a different year. Each country's growth rate was calculated as an average over seven years, starting with the year in which their per capita GDP was the same as Israel's in 1953. This group consists of Austria, Chile, Greece, Ireland, Portugal, Singapore, Japan, and Hong Kong.

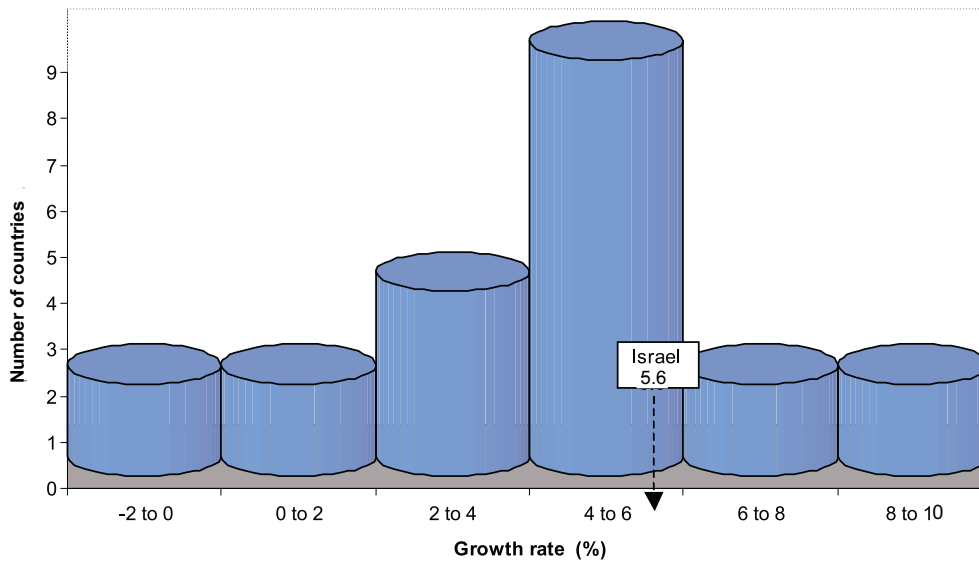
The second cluster, focused around 1960, presents the group of countries whose per capita GDP was similar to Israel's in 1960.⁸ The growth rate in this cluster is for the ten years after this GDP level was attained. The cluster includes some of the countries in the first cluster as well as one new country, South Korea. The same was done for 1970 and 1980. As can be seen from the figure, conditional on the initial conditions Israel has not done exceptionally well, except in the 1960s, and its growth rate was particularly weak in the 1980s in comparison with other countries that had a similar initial level of GDP per capita.

Each of these clusters has a distribution. The outermost countries, those with the highest or lowest growth rates, are reported for each cluster. In the first cluster Singapore is the country with the fastest growth rate and Ireland is the country with the slowest. In the second cluster these countries are Korea and Chile respectively. In the third it is Taiwan and Argentina, and in the fourth it is Hong Kong and Israel. Figure 3 presents the full distribution for the 1960s. The shape of the distributions in the other years is similar.

It is evident from these data that—accounting for the initial conditions—Israel has grown faster than the average, but significantly less so than some of the other economies, whose

⁸ See Table A1 in the appendix for the composition of the clusters in Figure 2.

Figure 3
Countries Similar to Israel in 1960



growth rates were significantly higher. Investment rates explain part of these differences. Even though Israel's investment rate was not lower than those of industrial countries such as the US, the UK, or Sweden, it was far lower than those of Japan and Korea.⁹ These differences partly explain Israel's relative position. Importantly, at times of far-reaching technological change extensive investment in equipment is required in order to incorporate the improvements in technology, even if it is possible to learn about these improvements without additional cost. But even if the extent of investment and the increase in hours worked—due to changes in both the number of persons employed and hours worked per employee—are taken into account, there is still an appreciable gap between the rise in the real gross domestic product of the business-sector and what is explained by capital and labor inputs. This gap is reflected in total factor productivity.

From 1960 to 1991 the real domestic product of the business sector increased by a factor of 6.5; namely, it became 6.5 times higher.¹⁰ In that period, only a factor of 2.7 was contributed by capital accumulation and the increase in hours worked. Hence, TFP contributed a 2.4 times increase.¹¹ It follows that over a period of about thirty years TFP growth was equal in importance to the two traditional factors of production, capital and labor, in raising real GDP.

What explains the rise in productivity? The two main candidates are workers' level of education and the creation of knowledge via investment in R&D. My discussion of these factors focuses on 1970–91, the period for which appropriate data are available and in which the real product of the business sector increased by a factor of 2.4 while capital and labor contributed to a 1.6 times increase, causing TFP to contribute a 41 percent rise in real output.

⁹ See Grossman and Helpman (1994).

¹⁰ This discussion is based on data kindly provided by Zvi Hercowitz (see Table A2 in appendix).

¹¹ The calculation of TFP is based on a 68 percent labor share and a 32 percent capital share.

Table 2
Growth Rates of Productivity and R&D Capital Stock, 1971–90

		(percent)
	Productivity	R&D capital stock
US	10	100
Ireland	30	270
Japan	70	320
Israel	41	630
Zaire	–36	
Ghana	–6	
Taiwan	87	
Mauritius	100	
Africa	2	
Asia	31	

SOURCE: Coe, Helpman and Hoffmaister (1997); Coe and Helpman (1995). Productivity in Israel was calculated from the data in the appendix, and differs from the figure in Coe and Helpman (1995), where it is 30 percent.

Table 2 shows the productivity growth rates of several countries in that period. Among the industrial countries, productivity in the US and Ireland grew by less than Israel's, by 10 percent and 30 percent respectively. Productivity in Japan, however, rose by 70 percent, far more than in Israel. Productivity declined in two developing countries, Zaire and Ghana, which suffered from a severe decline in efficiency. Productivity declines were not common to all developing countries, however. In Taiwan and Mauritius, for example, productivity growth outstripped Israel's as well as Japan's. But averages for Africa and Asia are low. In Africa average productivity hardly increased at all.

Part of the rise in TFP in the industrial countries emanates from R&D investment. In order to evaluate the contribution of R&D, we can construct measures of the stocks of knowledge by accumulating the real value of R&D investment. These stocks are known as R&D capital stocks, and their growth rates are given in Table 2. The R&D capital stock doubled in the US, it grew four times larger in Ireland, and by even more than four times in Japan. In Israel this stock grew by a factor of 7.3, a particularly rapid expansion, but the stock was very low at the beginning of the period. For example, whereas in 1990 the R&D capital stock was about 23 percent of GDP in the US, 17 percent in Japan, and 16 percent in France, in Israel it was only about 5.5 percent, following twenty years of rapid growth.¹² In other words, the absolute level of this stock was relatively low in Israel, and while it was not as low as in Australia, Portugal, and Spain, it was lower than that of Austria, Belgium, Switzerland, and Sweden.

Using existing estimates of the elasticity of productivity with respect to the R&D capital stock in small countries (0.078),¹³ we find that R&D contributed 17 percent to the increase in productivity in 1970–91. In this period average years of schooling rose from 8.9 to 11.6.¹⁴ This increase in human capital therefore contributed 12 percent to the rise in productivity, on the assumption that the return to a year of schooling was 10 percent. Estimates of this rate of return range from 7 to 10 percent. Since these estimates are most likely biased downward, I

¹² See Table A7 in Coe and Helpman (1995).

¹³ See Coe and Helpman (1995).

¹⁴ See Table 4 in Harari and Tamari (1993), statistical appendix.⁵

have used the upper limit.¹⁵ In addition, Israel benefited from technological advances made in other countries, and especially in countries with which it engages extensively in foreign trade. Israel's foreign R&D capital stock, calculated as the trade-weighted average of the R&D capital stocks of its principal trading partners, rose by 60 percent in this period. The elasticity of productivity with respect to the foreign R&D capital stock is proportional to the level of openness of the economy, as measured by the share of imports in GDP. Using the Coe and Helpman (1995) estimates, we find that knowledge spillovers contributed 8 percent to GDP growth, i.e., one-fifth of TFP growth in the Israeli economy.

The results are presented in Table 3. GDP rose by 137 percent in 1971–90, TFP contributing three-tenths (41 percent) of this. When the increase in TFP is decomposed into the contribution of education, domestic R&D, and foreign R&D respectively, we find that education contributed 12 percent, domestic R&D 17 percent, and foreign R&D 8 percent, together accounting for the entire increase in TFP.¹⁶

To sum up, Israel's economy grew faster than average, but not exceptionally fast.

Compared with countries at a similar level of development, Israel is by no means a shining example. Seven-tenths of the rise in its GDP is explained by an increase in hours worked and investment in machinery, structures, and equipment, so that most of its growth was through 'sweat and tears.' Nonetheless, this investment was made possible, to a large extent, by the increase in productivity, which in turn was fed by improved levels of schooling, investment in R&D, and knowledge spillovers from other countries. R&D investment has the highest rate of return. In the US, for example, it was estimated that this high rate of return justifies the doubling of R&D investment, even though the US R&D capital stock is far higher than Israel's. Similar estimates do not exist for Israel, however. Nevertheless, based on the level of schooling and the stock of R&D, it is reasonable to presume that there exists in Israel considerable growth potential that has not been tapped into so far.

Table 3
Contribution of Productivity to Growth, and its Components; Israel, 1971–90

	(percent)
Business-sector product	137
Total factor productivity	41
Contribution of	
Education	12
Domestic R&D	17
Foreign R&D	8

¹⁵ Using a return of 8 percent reduces human capital's contribution to productivity by 1 percent only.

¹⁶ 1.12 multiplied by 1.17 and 1.08 is roughly 1.41.

REFERENCES

- Barro, Robert and Xavier Sala-i-Martin (1995). *Economic Growth*, New York, McGraw-Hill.
- Ben-Porath, Yoram (1986). "The Entwined Growth of Population and Product, 1922–1982," in Y. Ben-Porath (ed.), *The Israeli Economy: Maturing through Crises* (Cambridge, MA; Harvard University Press).
- Coe, David T. and Elhanan Helpman (1995). "International R&D Spillovers," *European Economic Review* 3, 9 859–887.
- Coe, David T., Elhanan Helpman and Alexander Hoffmaister (1997). "North–South R&D Spillovers," *Economic Journal* 107, 134–149.
- Durlauf, Steven N. and Danny T. Quah (1998). "The New Empirics of Economic Growth," NBER Working Paper No. 6422, forthcoming in *Handbook of Macroeconomics*.
- Grossman, Gene M. and Elhanan Helpman (1994). "Endogenous Innovation in the Theory of Growth," *Journal of Economic Perspectives*, 823–44.
- Harari, Batya and Efraim Tamari (1993). *Israel's Labor Market* (Israel Ministry of Economics and Planning, National and Economic Planning Authority) (Hebrew).
- Razin, Assaf and Efraim Sadka (1993). *The Economy of Modern Israel: Malaise and Promise* (Chicago, Chicago University Press).

APPENDIX

Figure A1
Productivity Growth Rate

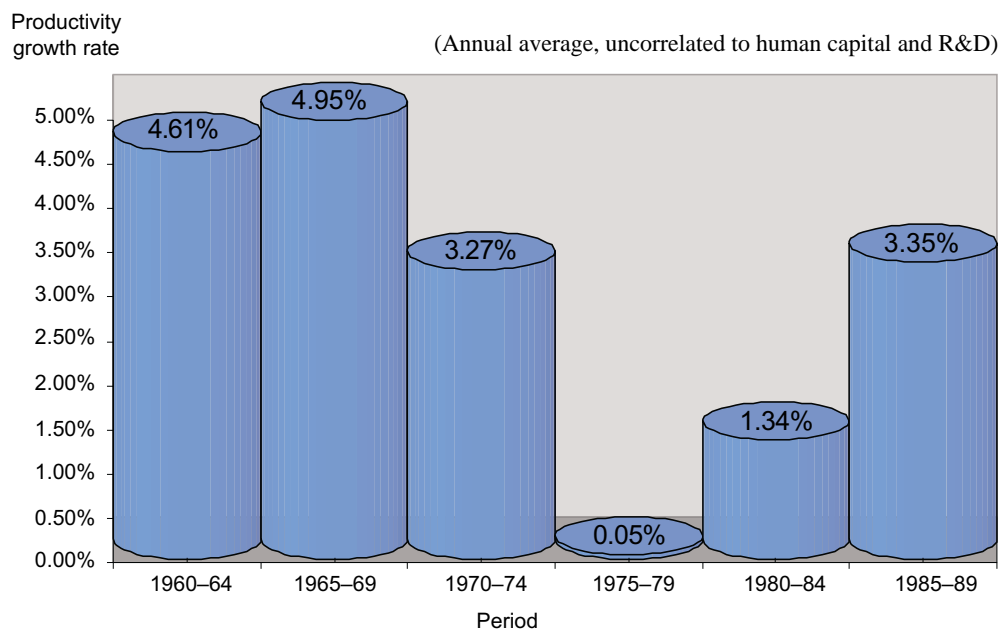


Table A1
Countries which Reached Israel's GDP Level in Cluster Year

	Israel 1953	Israel 1960	Israel 1970	Israel 1980
Argentina		1950	1973	
Australia				1962
Austria	1950	1954	1964	1971
Belgium			1962	1969
Canada				1963
Chile	1950	1966		
Denmark			1958	1964
Finland		1950	1964	1970
France			1961	1967
Germany		1950	1959	1965
Greece		1962	1967	1984
Hong Kong	1961	1965	1976	1979
Iceland			1964	1972
Ireland	1950	1961	1976	1988
Italy	1950	1954	1966	1972
Japan	1957	1961	1968	1972
S. Korea	1975	1982	1989	
Luxembourg				1960
Malaysia	1972	1979		
Mexico	1951	1966	1980	
Netherlands			1960	1967
New Zealand				1960
Norway			1962	1969
Portugal	1967	1970	1988	
Singapore	1968	1971	1977	1982
S. Africa	1963	1973		
Spain	1952	1961	1971	1986
Sweden			1952	1961
Switzerland				1955
Taiwan	1971	1976	1986	1990
Thailand	1983	1990		
Turkey	1971	1987		
UK			1954	1967
Uruguay		1950		

Table A2
Israel, 1960–92

	Labor	Capital	Business-sector real domestic product
1960	22.57	27,078.5	20,068
1961	23.69	29,604.1	22,486
1962	25.29	33,053.3	24,981
1963	26.10	36,178.1	27,790
1964	27.66	39,293.3	30,781
1965	27.97	43,691.3	33,649
1966	27.48	47,453.3	33,461
1967	24.76	49,480.6	33,557
1968	28.65	50,369.7	39,865
1969	30.09	53,879.9	45,740
1970	30.80	58,597.8	49,141
1971	32.23	63,477.6	55,493
1972	35.09	71,176.1	63,311
1973	34.25	77,166.0	64,319
1974	34.68	84,413.2	67,856
1975	34.93	90,054.5	70,043
1976	35.01	94,460.5	70,046
1977	35.30	97,355.5	70,875
1978	36.52	99,305.5	73,634
1979	38.23	102,128.0	77,289
1980	37.55	106,565.0	80,593
1981	38.54	107,827.0	85,468
1982	38.55	109,647.0	85,969
1983	39.88	112,557.0	88,566
1984	40.96	118,051.0	90,710
1985	40.78	120,404.0	96,289
1986	41.72	121,711.0	101,347
1987	43.24	122,998.0	109,795
1988	43.33	126,313.0	113,740
1989	43.96	128,795.0	115,117
1990	44.98	129,625.0	123,765
1991	46.95	134,125.0	131,568
1992	51.02	142,762.0	142,570

Labor: Total hours worked in business sector (millions of hours per week).

Capital: Net business-sector capital (beginning of year) at 1995 prices, comprising machinery, structures, roads, and transport equipment.

Business-sector real domestic product: In NIS million, at 1995 prices.

SOURCE: Zvi Hercowitz.