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The Effects of Capital Subsidization on Israeli Industry

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Abstract

An industrial policy of subsidizing physical capital investment has been utilized in many countries in order to encourage export growth and spread economic development to outlying areas. For Israel, we possess a unique time series-cross section micro data set that details investment and its associated subsidies by vintage at the level of the individual enterprise for 620 firms. These data provide the means by which an empirical analysis of the effects of the policy of subsidizing capital can be undertaken. We estimate that, for the years 1990-94, this policy has resulted in production inefficiencies ranging from 5% for firms that receive the average level of subsidies to 15% for heavily subsidized firms. We also document the fact that much of the subsidization appears not to have been necessary, in the sense that subsidized firms generally have earned higher rates of return on their total physical capital (included that portion which was subsidized) than firms that were not subsidized.

The Effects of Capital Subsidization on Israeli Industry

Introduction

Capital subsidization has been at the center of industrial policy in Israel over the last thirty years. Its declared objectives were to encourage economic growth and employment, as well as to improve the balance of payments and disperse the population throughout the country. Government intervention focused on the Law of Encouragement of Capital Investments (1959; here after "the Law"). This Law was amended periodically[1], but since 1968 it has granted four main types of investment subsidies to "approved enterprises": grants, loans with low rates of interest (often negative real rates), accelerated depreciation, and other tax concessions on income derived from the investment[2].

Similar industrial strategy programs are supported by many countries. Factor subsidies have been used extensively in European countries as important policy instruments, usually in an attempt to reduce regional unemployment differentials (Amstrong & Taylor (1985), Yuill et al (1989), Holden & Swales (1993)). Most developing countries provide fiscal incentives to encourage domestic and foreign investment. These schemes subsidize significantly the use of capital and produce greater capital intensity in manufacturing (Lim (1992)). Moreover, the committee on industrial support policies in the OECD stresses that: "Industrial subsidies often present

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[1] Up to the year 1990 it was changed 39 times, because of problems of implementation or changes in investment needs.

[2] Investments in equipment were entitled to grants of about 35 to 40 percent in Development Zone A, 20 percent in zone B and 0 - 5 % in the central areas. About 40 % of the value of total investments got loans, which were unlinked to inflation until 1981-2. The accelerated depreciation allowance for equipment was twice the rate of the regular one, and that for structures - 4 times. Corporate tax for approved enterprises was 25% instead of the ordinary tax of 45% (foreign investors paid only 10%).

impediments to structural adjustments, distort resource allocation and engender international frictions... Reducing such subsidies is crucial for improving the flexibility of economies and for increasing international trade on a competitive basis" (OECD (1990)).

Canada has had extensive experience with the subsidization of capital investment for the purpose of regional development.[3] The degree of government involvement reached its height in 1982 when the Canadian Government created a new Department of Regional Industrial Expansion (DRIE) with its own cabinet minister; a department whose mandate was to foster increased industrial activity in high unemployment regions. While the level of subsidization has declined in recent years, as late as 1995 one billion Canadian dollars was spent on industrial subsidies by the Canadian federal government (Canadian Tax Foundation (1996)).

The leading principle embodied in the Law in Israel was the favoring of industrial plants located in designated development zones, particularly in Galilee and the Negev, and/or the encouragement of exports. Other general factors taken into consideration in the selection of projects, as declared by the Investment Authority, were the potential for creating employment, for contributing to the development of the area, and for profitability. A rough estimate[4] shows that the average subsidization embodied in grants and loans alone, in the period 1970-1975, was some 20 percent of total investment in industry (including investments that received no subsidies). It reached 31% in 1975-80; and declined again to 15% - 20% in the eighties. One should keep in mind that these averages include many firms with subsidies of more than 50% of their investments; for example - a firm investing in development area A in the second half of

[3] The Atlantic Provinces are Canada's own version of Israel's development area A.
[4] For a detailed explanation, see Bank of Israel Annual Report 1988, pp. 37-43, 156.

the 1970s received an ex-post subsidy of some 60 percent only by grants and loans. In addition, there are other benefits to investing which are not included in the estimates presented here.[5]

The main framework of the system was still functioning in the first half of the nineties, but some alternative routes of subsidization were added: mainly government guaranties for loans and income tax exemption for 10 years. The tax benefits were estimated by the State Revenues department of the Finance Ministry, to approach approximately $300m in 1997. Most investors (three-quarters of them) preferred the grants however. Approved investments entitled to subsidies in the last few years, (since 1990) accounted for some 31% of total industrial investments. The sum of actual grants plus an estimate of the value of the alternative benefits averaged an annual 42% of the value of approved investment in this period.[6] Grants were also the most widely used financial instruments in OECD countries. Many of these countries also used government loans and tax concessions in their regional policies (OECD (1990)).

It has been claimed that capital subsidization, along with high taxes on labor, encouraged capital-intensive industries, decreased capital utilization, caused inefficiency, and distorted the allocation of resources in the economy. Generally speaking, the subsidization system in Israel and elsewhere is full of discriminations: by destination - between production for local markets and exports; by ownership - between local and foreign investors; by industry - manufacturing industry versus services; by area, by type of asset (equipment versus structures), and in practice, also by size.

As we demonstrate below, the Law caused investors to prefer physical capital to

[5] Among the benefits not included are the loan guarantees that were available to firms in the 1990s as an alternative to grants.

[6] The official grant rate in development area A (where 75% of the approved investment was concentrated) was 38%. Accordingly, one firm (Intel) recently received approval for a grant of 600(!) million dollars

labor, and to establish capital-intensive plants in development areas that were profitable to the investor but not necessarily to the economy. Cheap capital, sometimes at a cost of less than half its value, apparently resulted in over-investment, partial utilization of machinery and equipment in industry, and unbalanced growth in the economy.

The development areas did not necessarily benefit over the long term. The high rate of subsidization brought more investments but mainly for short periods. Many of the subsidized plants in these areas closed down a short time after the subsidization period ended (Lavy (1994))[7]. This result suggests that the subsidy scheme is not achieving its declared aims - participation in government subsidy schemes in order to set up new firms in developing towns appears to be associated with shorter life span of firms. Similar developments have also been observed in other countries.

It is difficult to conclude that the Law achieved substantial net development in the southern and northern regions (mainly constituting development area A). Although the estimates show an increase in the rate of employment in these areas up to the beginning of the eighties[8], we cannot tell how much is due to other reasons. (To what extend does the number of employees in the Dead Sea Works, for example, depend on investment subsidization?)

The Law tried to achieve simultaneously two policy objectives that do not necessarily coincide: preventing market failures and promoting specific areas. In addition, the government used a very flexible map and definitions for the development areas, which also changed under political pressure[9]. Although market failures are

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for its intended investment of $1.6 billion, in Kiryat-Gat, in the next several years.

[7] As found in a comprehensive study by D. Schwartz (1990, 1993)

[8] From 21% out of total employees in the business sector in the sixties to 25% in the eighties and 26% in the last years.

[9] For example, a specific project in Haifa was included in development area A for a short while in order to subsidize it.

characteristic of small firms, the government preferred large firms which could deal with the bureaucracy and exert higher pressure on the politicians.

The overall effect of this subsidy system on the efficiency and productivity of industrial firms is the ultimate purpose of this study, which is conducted at the establishment level. We try to quantify the effect of capital subsidies on the productive efficiency of firms, utilizing the production function framework. On the one hand, the subsidy reduces the cost of capital, leading to a substitution of capital for labor (allocative inefficency) and perhaps inducing technical inefficiency as well. On the other hand, the subsidy, because it reduces the cost of capital, lowers the cost of production (as long as input substitution occurs). The firm can thus lower its price and expand output and the demand for labor. While the ultimate goal of our study is to try to evaluate the capital subsidy policy by comparing some of the possible benefits of the subsidization system such as output and employment growth with its costs, in this first paper we consider only the efficiency costs.

In the next section we will present a short description of the unique data set that is used for this study. The methodology is described in section 3, followed in section 4 by the empirical results. In the first part of section 4, descriptive statistics that provide evidence concerning the characteristics of firms that receive capital subsidies will be presented. In the second part of section 4 production function estimates of the efficiency effects of subsidies will be provided. Section 5 will conclude the paper with some preliminary policy recommendations and suggestions for further research.

2. The Data

Three main surveys, conducted by the Central Bureau of Statistics, were used to build the cross section - time series panel of firm data used in our study:

(1) The annual Industrial Surveys on incomes, expenditures, exports, labor inputs, investments, and other related data on firms with five or more employees. It should be mentioned that among the characteristics of the firm, the region in which the firm is located is recorded, but unfortunately this is not always the case for individual plants.

The panel covers the 1990-1994 period, and includes approximately 2,000 industrial firms that operated in this period.

(2) A Fixed Capital Stock Survey (as of January 1, 1992)[10] was used to estimate the firm's capital stock by year of investment. A unique feature of this capital stock survey is the fact that the amounts of capital grants are recorded in the same detail as the capital investment. The survey is based on reports submitted to the tax authorities by the firms in order to receive depreciation allowances. It includes detailed data on capital assets by type and year of acquisition.[11] Our data base is a representative unbalanced sub-sample of the above mentioned annual Survey, and includes about 620 firms. Constant dollar capital stock and capital grants at the individual firm level were generated for the period 1990-1994. Estimates for years other than 1992 were obtained by using the Survey data as a benchmark, together with annual investment data, annual grants data, and appropriate price deflators; utilizing the perpetual inventory method of capital stock accumulation.

(3) R&D surveys, conducted by the CBS annually since 1969, which cover expenditures on R&D investment, labor input (by education) and subsidies to R&D. Censuses were conducted in 1979, 1984, and 1990. The R&D capital stock for every firm was estimated from these data, assuming a depreciation rate of 1\7, and using the perpetual inventory procedure used to estimate fixed capital services for the years 1990,91,93,94.

Additional information - on subsidization rates, taxes, and detailed geographic coverage of the development areas - was collected mainly from official publications of

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[10] Only two other Capital Surveys were conducted in Israel, one for 1968 and the other for 1982, because of its complexity and unusual measurement difficulties.

[11] Some firms were excluded from the panel because of statistical problems estimating their capital stock. For the regression analysis we used information on 620 firms, out of the original survey of 727 firms, after elimination of firms with outlying - probably wrong - basic data and firms which did not return the capital stock survey questionaire.

the Investment Authority. See Regev (1993) for a detailed description of the longitudinal panels, part of which we are using in this paper.[12]

The firm data include the values of output and intermediate inputs in current and constant prices. The estimates of the appropriate price indexes were calculated for some 100 sub-branches of the industrial sector using various sources of price data. In some cases there was an even finer detailed breakdown of the price data. The overall index of output prices for every branch is a weighted average of export prices and the wholesale price index for sales in the domestic market. The weights used were the real sales to the different destinations.

The price index of intermediate inputs (materials) is based on information regarding imports and purchases from local production as calculated in the CBS Input-Output Tables. The data are classified here into some 200 sub-branches of commodities and services. The overall materials price index is an average of import and local production prices weighted by 1991 values from the input-output table for that year.

The main characteristics of the firm that serve as heterogeneity controls in the production functions are: the size of the firm (measured by the labor input), a dummy variable for mobility (entry and exit of firms), the qualities of labor and capital inputs (for detailed definitions and explanations of the quality calculations see Regev (1997)), the intensity of R&D activity, the utilization of capital by shift work, the ownership sector (e.g., public sector, Histadrut), the industry the firm belongs to, and the year of activity.

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[12] For additional descriptions of the characteristics of the data base used in this study see our previous publications which utilize these data (Bregman, Fuss and Regev (1991,1995)).

3. The Methodology

The main purpose of this study is to investigate the effect of capital subsidization on the production structure and efficiency in the Israeli manufacturing industries. A firm will invest over time in a number of vintages of capital. The amount of investment in vintage i will depend on the user cost of capital, which in turn will depend on the extent of subsidization current at the time the investment is made. It is these vintage investments and subsidies we observe in our data set. From these data we wish to construct an aggregate capital stock and a measure of the intensity of subsidization embodied in the capital stock in use by a particular firm at a point in time (t).

According to the theory of aggregation (Leontief (1947a,b), Fisher (1965), Hulten (1990)), an aggregate capital stock K_t exists if the relative marginal products of vintages i and k are independent of the inputs outside of the aggregate. In this case the aggregate stock of capital can be calculated as

$$K_t = I_{t,0} + \sum \phi_{t-i} I_{t,i} \tag{1}$$

where

$I_{t,0}$ = new capital investment[13]
$I_{t,i}$ = capital investment of vintage i (in efficiency units) surviving to the beginning of year t
ϕ_{t-i} = marginal product of vintage i capital / marginal product of new capital $= MP_{t,i} / MP_{t,t}$,

and the summation is over all surviving vintages of capital (i>0).

According to the neoclassical model of capital accumulation (Jorgenson (1963), Hall and Jorgenson (1967)), the firm will expect to maximize the present

[13] K_t is defined as the aggregate capital stock at the beginning of period t. Hence $I_{t,0}$ is investment

value of profits from a particular vintage i investment by investing up to the point where the value of the marginal product of capital is equal to the user cost of capital c_i [14],

$$p_i MP_{i,i} = c_i \quad (2)$$

$$MP_{i,i} = c_i / p_i \quad (3)$$

where p_i is the output price at time i.

We now assume that, once an investment has taken place at time i, the marginal product of a unit of capital does not change over time (except due to physical depreciation)[15]. Therefore $MP_{t,i} = MP_{i,i}$. The aggregation weights ϕ_{t-i} can now be expressed as

$$\phi_{t-i} = MP_{i,i} / MP_{t,t} \quad (4)$$

$$= (c_i / p_i) / (c_t / p_t) \quad (5)$$

$$= [(c_i / q_i)(q_i / p_i)] / [(c_t / q_t)(q_t / p_t)] \quad (6)$$

where q_i,q_t are the capital asset prices at time i and t respectively.

We now make the simplifying assumption that the asset price - output price ratio has remained approximately constant over vintages. In that case, the aggregation weights are determined by the equation

$$\phi_{t-i} = (c_i / q_i) / (c_t / q_t) \quad (7)$$

For asset type j, the weights can be written as

$$\phi_{t-i,j} = (c_{ij} / q_{ij}) / (c_{tj} / q_{tj}) \quad (8)$$

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during the previous period.

[14] In the present value calculation, it is assumed that the firm expects all input and output prices to inflate at a rate θ, so that for any price expected at time s (expectations formed at time i), $p_{s,i} = p_i e^{\theta(s-i)}$. In that case the correct first order condition for maximization is equation (2), where the rate of return embedded in c_i is the real rate of return.

[15] This assumption is known as the “putty-clay” assumption.

To compute the weights $\phi_{t-i,j}$ we must calculate the user cost ratios c_{ij} /q_{ij}. We begin by defining the subsidy ratio (hereafter denoted by h_{ij}) as the subsidy per unit of investment in asset vintage i, type j. The grants portion of this subsidy is denoted by g_{ij} and the loans portion by l_{ij}. The user cost c_{ij} is determined by the equilibrium condition that the portion of the asset price paid by the firm is equal to the (after tax) present value to the firm of the benefits obtained from a unit of investment. This condition results in the equation:

$$q_{ij} [1 - h_{ij} - u_i(1-g_{ij}) Z_{ij}] = (1-u_i) \int \exp\{-(r_i+\delta_j)\} c_{sj} ds \qquad (9)$$

where the integration is from s=i to ∞ , and

i = investment vintage; j = 1,2,3 = structures, equipment, vehicles
q_{ij} = the asset price for a capital good of vintage i, type j
r_i = the real rate of interest associated with vintage i
d_j = the depreciation rate for the jth type of asset
u_i = the tax rate on profits associated with vintage i
g_{ij} = the grant ratio of investment
Z_{ij} = the present value of depreciation expense allowances
T_{ij} = the life expectancy of the assets for tax purposes

$$Zij = \frac{1}{r_i T_{ij}} \left(1 - e^{-r_i T_{ij}}\right) \qquad (10)$$

In equation (9), the actual price paid by the firm is the asset price reduced by the amount of the grant (per unit of investment), and further reduced by the per unit present value of the income tax savings due to accelerated depreciation on that portion of the investment which is eligible for depreciation expenses.

We solve (9) for the user cost of capital to obtain

$$c_{ij} = q_{ij}\left(r_i + d_j\right)\left[\left(1\text{-}u_i Z_{ij}\,(1-g_{ij}) - h_{ij}\right)/\left(1-u_i\right)\right] \tag{11}$$

From equation (11) it is clear that as the subsidy ratio h_{ij} increases, the user cost of capital declines. This will induce a cost-minimizing firm to substitute capital for labor and thus become more capital intensive. While the direction of this effect is clear from economic theory, the empirical magnitude is unknown without the kind of empirical analysis undertaken in this paper. The effect is likely to be both statistically and economically significant, since in the peak period of subsidization the user cost of capital for a firm that received no subsidies was nearly four times larger than the cost for a firm in Zone A that received the maximum benefits[16].

The utilization of equation (11) as the formula for the user cost of capital implies that the weights used to aggregate the various vintages and types of capital explicitly incorporates the effects of the subsidies. This definition of capital should be superior to a definition of capital that ignores the existence of subsidies. We will explore this issue in the empirical section of the paper.

The final step in the construction of the capital input variable is to aggregate the three types of capital. As in our previous papers (Bregman, Fuss and Regev (1991, 1995)), the capital service flow was estimated as the aggregate of the service flows from structures, equipment and vehicles; where the service flow from each type of asset is depreciation plus opportunity cost (evaluated at a 5% real rate of interest).

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[16] This calculation is based on applying equation (11) to our subsidies data.

4. Empirical Results

a. Descriptive Statistics

Tables 1 to 3 present some characteristics of the firms, sorted by the incidence of capital subsidies. The data pertain to the years 1990-94. The descriptive statistics are based on the full sample of 727 firms, where imputations were used to construct any missing data. The data for these 727 firms were then expanded to the total population of industrial firms in the Israeli economy using Central Bureau of Statistics expansion factors (based on employment), in order to represent more accurately the whole of Israeli industry. All data with the exception of the first row of Table 1 are after expansion. By way of contrast, the regressions that follow (Tables 4 and 5) do not employ this weighting procedure and include only the sample of 620 firms for which missing data imputations were not necessary.

From Table 1 it can be seen that 293 of the 727 firms (40%) received grants for capital in use as of the date of the observation. After expanding this sample of 727 firms, we obtain the result that over the 1990-94 period, 39% of the labor force in Israeli industry worked for firms that utilized capital partially financed by grants. These employment shares vary from a low of 22% in Printing and Paper to a high of 60% in Chemicals and Plastic. As the size of firm increases, the share increases. As expected, the highest percent of employment in firms with grants (70%) is in development area A, with the next highest being development area B (52%). Perhaps surprising is the sizeable percentage of firms in development area A without grants (30%), and the percentage of firms in development area C with grants (27 %).

Table 2 provides a number of relevant economic indicators by size and incidence of grants. The results in this table show that while there is some variation by size group, on average, those firms who received grants had higher labor productivity, were more capital intensive (higher capital/labor ratio) and had higher rates of return on capital. The fact that firms with grants had higher labor productivity and were more capital intensive suggests these firms were substituting cheaper capital for labor. **The higher labor productivity is not an indicator of greater efficiency**, since a number of characteristics (including capital intensity) varied systematically between firms with and without grants. We will take this variation into account in our regression analysis (Table 4), where we demonstrate that firms with grants were actually **less** efficient.

The fact that firms with grants had, on average, higher rates of return on capital stock is surprising. It is particularly surprising since the calculation does not take into account the leverage enjoyed by firms with grants who finance only a portion of their capital stock. We will return to this issue below.

Table 3 highlights the differences in economic indicators among development areas. Firms with grants have higher labor productivity and are more capital intensive than firms without grants, regardless of area. With the exception of the anomalous result in development area A[17], firms with grants had higher rates of return than firms without grants. Once again, the effective differences are understated since the leverage effects on rates of return are ignored.

The comparative rates of return suggest that some segments of the subsidization policy have been unnecessary, or at least too generous. In particular, consider development area C. In this area, the issue of locating plants in underdeveloped regions to stimulate employment is not at issue. The higher rates of return earned by firms that

[17] The sample in this cell is small (42 firms), and the result is influenced by several firms with very high calculated rates of return (over 1000%!) However when we remove the most unusual rates of

received grants than those that did not is indicative of the possibility of unnecessary subsidization.

b. Construction of Alternative Subsidy Variables

As noted in the data section of this paper, the grants portion of the subsidy (g_{ij}) for every firm is recorded in the Capital Stock Survey. The loans portion (l_{ij}) was estimated by matching the individual observations with the terms of the loans specified in the Law. The terms depend on the time and location of the investment, and whether the firm qualifies as an exporter. This information is available from the data on firm investments and characteristics. The actual subsidy embodied in the loan depends on the nominal rate of interest charged, the nominal rate of interest prevailing in the market, expected inflation during the payback period of the loan, and on the length of this loan period. Our general approach to using this information to calculate the loan subsidy is similar to that used in Litvin and Meridor (1983), Bregman (1985), and Bar-Nathan (1989).

There are two ways in which the subsidy data was used. Section 3 of this paper presents a theoretical model of the impact of subsidies based on an explicit application of the neoclassical investment literature. This model was applied to the data. However, before applying that model we first investigated a more ad hoc formulation. For each firm at each point of time, each surviving investment was multiplied by the subsidy ratio[18] and aggregated to provide data on the proportion of the capital stock which is subsidized. This calculation was performed for both the grants data (which is actual

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return observations, the high average rate of return of about 20% for these firms remains.

[18] At this stage of the research we calculated the subsidy ratio for every firm from data on total investments for every period of time (vintage), by using weighted averages of the different ratios of the three types of capital available to us (structures, equipment and vehicles). We will perform the

data) and the grants + loans data (a mixture of actual and estimated data). These variables were used as characteristics of the firm to be included in an augmented production function estimation similar to the heterogeneity controls approach of Bregman, Fuss and Regev (1995) and Griliches and Regev (1995). In this case, the capital input is constructed as if subsidies were not present[19].

c. The Regression Results

Table 4 contains OLS estimates of the parameters of the augmented Cobb-Douglas production function.[20,21] The more flexible translog function was also estimated, but since the results were similar to the simpler Cobb-Douglas specification, the translog results are relegated to an appendix (Appendix 2). The four columns of results in Table 4 differ because of different versions of the subsidy variable and different ways of measuring the capital input variable.[22]

In columns I and III, the capital input (LHON) is measured as the service flow from the gross capital stock when the user cost of capital used to construct the aggregate

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disaggregated calculations in later work. We do not expect the revised calculations to have a significant influence on the results.

[19] To construct this variable, the aggregation theory outlined in section 3 was utilized, but the implications of subsidies for the user cost of capital was ignored.

[20] Definitions of the neumonics representing the right hand side variables is contained in Appendix 1.

[21] In previous work with this data set we have also attempted to provide instrumental variable estimates to account for the possible endogeneity of the input variables. The various results have never been sensitive to this change in estimation method, so we did not pursue this alternative in the current paper.

[22] A general issue with respect to all four columns is how to treat rental expenditures. The Israeli data set has separate observations on the current dollar rental expenditures, unlike the U.S. manufacturing survey data that include rents in the intermediate inputs expenditure data. There are three possibilities: (1) ignore the data, (2) include it in materials (for comparability with U.S. results), (3) include it in capital. In previous work we ignored the information. Here we include it in capital by assuming an annual return of 12.5% on rented capital (rented capital=8*real rents). This inclusion characterizes both the regression results to follow and the previous descriptive statistics. A problem with the inclusion of rents in capital is that we have no data on grants associated with rented capital. We have investigated all three possible treatments of rent and the regression results are not sensitive to the choice.

capital is calculated ignoring the existence of investment subsidies.[23] In columns II and IV, the capital service flow variable (LPCT) is calculated by applying the user cost of capital variable that includes the subsidy adjustment (equation (11)) to estimate the capital service flow. By construction, since subsidies lower the cost of capital, they also lower the estimated service flow from a given stock of capital. The interpretation is that firms with access to subsidized (hence less expensive) capital will extend their purchases of capital to capital with a lower marginal product and therefore the service flow from a given capital stock will be reduced.

In columns I and II the subsidies variable is represented by the proportion of (constant dollar) grants actually received as a proportion of the (constant dollar) capital stock (GNT)[24]. An increase in this variable implies a greater degree of capital subsidization. In columns III and IV the subsidies variable CSB is calculated by adding to the numerator of GNT the calculated non-grant subsidies (loans, tax concessions) described above. This variable (CSB) represents our estimate of the total subsidy to capital as a proportion of capital[25]. It is a mixture of actual grants observed and our calculation of the additional subsidies the firms were entitled to receive as a result of having qualified for the subsidy program in one of the various categories. An increase in CSB implies a greater degree of subsidization.

Before we proceed to discuss the subsidy results, we first discuss the other results of interest in Table 4. Since these other results are not very sensitive to the

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[23] The gross definition of capital was used because the grants were calculated on a gross basis. When the production function was estimated without including the subsidy variables, the estimated structure was invariant to whether the gross or net definitions of capital were used.

[24] The variable used in the regression is LGNT = log (1+GNT). The empirical results suggested that this logarithmic transformation was the preferred way to deal with the fact that the majority of firms (60%) did not receive grants. For such firms GNT=0.

[25] Once again, the variable actually used in the regression is the logarithmic transformation LCSB = log (1+CSB).

different versions of subsidy and capital input variables used, we will use the results in column I as representative.

First, constant returns to scale appears to be a reasonable description of the technology (the scale elasticity is 1.01[26]). Increases in the quality of capital and the quality of labor result in increases in labor productivity (or equivalently, increases in output or efficiency of production). A unique variable that we have available is the extent of shift work. This variable is a direct measure of capital utilization. Not surprisingly, increases in the number of work-shifts within a twenty-four hour period has a statistically significant positive impact on output through the more intensive utilization of the capital stock.[27]

Investment in R&D capital has a significant impact on labor productivity.[28,29] Firms that opened or closed during the period of our data sample had lower productivity than continuing, established firms. During those years in our sample when these firms operated, new firms were 4.7% [30] less productive, whereas firms that closed were 12.5% less productive[31]. Several branches of industry had lower output per unit labor than the

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[26] Since all non-labor input variables and output are deflated by labor, 1+ the coefficient on the labor input (LL) measures returns to scale (excluding the impact of R&D).

[27] The estimated coefficient implies that a firm that moved from one shift to two shifts and doubled its use of labor and materials inputs would double output. Hence the utilization of capital would double.

[28] In our formulation R&D capital plays a role in the production process analogous to structures and equipment capital. The variable used in the regression is LKRD = log (1+KRD) since KRD =0 for many firms. Due to this formulation, the estimate .13 is not the estimate of the R&D elasticity. The elasticity estimate is .13*[KRD/(1+KRD)], which is equal to 0.07 at the mean value of KRD for those observations where KRD >0. By comparison, the elasticity for physical capital is 0.06.

[29] We also estimated the model with a "no R&D" dummy variable included. As was the case for Griliches and Regev (1995), we obtained a statistically significant positive coefficient, which is counterintuitive. However, the change in specification had no impact on the coefficients associated with the subsidy variables.

[30] Calculated as (exp(-.048) -1)*100.

[31] Whether firms close is not independent of their productivity, so there is a potential simultaneity bias associated with the variable CLS. However, deleting CLS and OPN from the regressions in Table 4 did not change the other coefficients. The fact that closed firms are less productive than other firms suggests a possible selectivity bias in our sample which should be kept in mind. Firms that closed prior to 1990 are not observed in our sample. Much of the subsidization activity took place prior to 1990. If a disproportionate number of low productivity firms that failed after a short existence and hence closed

reference branch (electronics). These branches were food, textiles, printing & paper, and wood & minerals. Of considerable interest is the fact that the Histadrut and Public sectors, during the 1990-94 period, had higher productivity than the Private (reference) sector. This is a reversal of the results for the 1979-83 period reported in Bregman, Fuss and Regev (1995), and suggests that firms in these sectors have made important relative improvements in productive efficiency in recent years[32].

We now turn to an analysis of the subsidy results. We consider first the results in column I, where subsidies are measured in terms of actual grants and the capital input is not adjusted for the presence of subsidies. The coefficient on LGNT is significantly negative, implying that subsidized firms produce less output per unit labor, ceteris paribus. For subsidized firms, the mean of LGNT is 0.104 and the maximum value is .597. Hence at the mean value, subsidized firms are 3.0%[33] less productive than unsubsidized firms. For heavily subsidized firms, the productivity shortfall ranges up to 15.8%[34]. The same calculations can be performed for the broader subsidy variable LCSB. For subsidized firms, this variable has a mean of 0.184 and a maximum value of 0.620. From column III of Table 1 it can be seen that the corresponding productivity shortfalls are 4.8% and 15.2% respectively. The productivity differential estimate is somewhat higher for the average subsidized firm when a broader range of subsidies is taken into account. For heavily subsidized firms, grants dominate the subsidy-ratio calculation, so that the two ways of calculating the subsidy ratio produce more similar results.

The calculations above do not distinguish between productivity effects due to the

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prior to 1990 were subsidized firms, then we will underestimate the effect of subsidization on productivity.

[32] The apparent efficiency advantage of the Kibbutz firms may be an artifact of the likely underreporting of the amount of labor used in production.

incentives created by the subsidy system and productivity shortfalls that are due to technical inefficiency. Because subsidized capital is cheaper capital, subsidized firms have a rational incentive to purchase additional lower productivity capital, so that for such firms the flow of services from any observed capital stock should be lower. As noted earlier, we have taken this incentive into account by constructing a capital input variable (PCT) for which the capital service prices used as weights explicitly incorporate the subsidy effects. The impact of this weighting procedure is to create a capital input variable that is systematically lower for subsidized firms than the previous variable HON. It is also equal to HON for firms that did not receive subsidies. We would expect that the lower output observed for subsidized firms would at least in part be accounted for by this revised capital input variable. If this variable is correctly specified, and the only output-lowering effect of subsidization is the rational purchase of additional lower productivity capital by subsidized firms, the use of LPCT[35] in place of LHON should wipe out the impact of the subsidy variable (LGNT or LCSB). Inspection of columns II and IV demonstrates that this is not the case[36].

The coefficients of LGNT and LCSB are substantially reduced (from -.289 to -.175 and -.265 to -.123 respectively). Approximately 50-60% of the productivity shortfall observed which is associated with capital subsidization is estimated to be attributable to technical inefficiency, while the remainder is caused by the rational choice

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[33] Calculated as (exp(-.289*.104)-1)*100.
[34] Calculated as (exp(-.289*.597)-1)*100.
[35] LPCT is the logarithm of PCT. LHON is the logarithm of HON.
[36] It has been suggested to us that the apparently lower output may be due to the fact that a single industry-specific output price is used to deflate the revenues of both subsidized and unsubsidized firms. If firms with lower cost capital passed on the lower costs in the form of lower prices, such a result could be the case. However, this would only occur if a pattern of market power existed such that unsubsidized firms did not have to lower their prices under competitive pressure from subsidized firms, and there is no reason to believe this pattern exists.

of firms, faced with relatively inexpensive capital, to overcapitalize.[37]

We now focus more closely on the question of overcapitalization. We do so by estimating a capital intensity equation, where the dependent variable is the capital stock per unit of labor and the subsidy variable used is the grants ratio[38]. Table 5 contains the results of this estimation. We include relative input price and output variables, as well as an extensive number of heterogeneity controls. While we are particularly interested in the impact of subsidization on the capital intensity (capital stock per unit of labor), we begin by considering the results pertaining to the other variables in the equation. The capital- labor ratio is an increasing function of output, suggesting that the production process is not homothetic.[39] Capital and labor are estimated to be substitutes, whereas capital and materials are estimated to be complements.

Firms that export a greater proportion of their output are more capital-intensive. There is a tradeoff between quantity and quality of capital in satisfying production needs (note the negative sign on the quality of capital). While capital intensity is estimated to be an increasing function of the quality of labor (suggesting skilled labor-capital complementarity), the effect is not statistically significant[40]. An interesting finding is that capital-intensive production processes are associated with a lower proportion of women in the workforce. Capital-intensive production processes are also associated

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[37] Although we utilize a time series – cross section data set, the above results of the effects of subsidies are primarily determined by the cross section component of the data. We estimated both within (fixed effects) and between versions of the model. For the within version, the subsidy effects were insignificant. The between version produced results similar to those reported in the paper. That the fixed effects version did not yield significant results is not surprising, since for any individual firm there would not be much variation in the proportion of subsidized capital over the five year period of our time series component.

[38] An equation containing the subsidy ratio is not estimated since, due to its construction, this variable is endogenous with respect to the price of capital services, a variable which appears as a right-hand side variable.

[39] While this result contradicts the use of the Cobb-Douglas production function above, recall that we also estimated a translog function (which can be non-homothetic) with similar results regarding the productivity effects of subsidies.

[40] Capital includes structures, equipment and vehicles. If the capital stock in this equation were

with more shift work - suggesting a not surprising desire to utilize capital more intensely when it represents a larger proportion of production costs. R&D capital and physical capital may be substitutes in production, but the effect is not statistically significant (see the previous footnote for a possible rationale for lack of statistical significance).

Firms that closed sometime during 1990-94 are significantly more capital intensive than continuing firms. We may be observing a period of low utilization of capital just prior to closure. New firms are less capital intensive than continuing firms, but not significantly so. There are significant differences in capital intensity among branches, with electronics being the least capital intensive and chemicals & plastics being the most capital-intensive. The Kibbutz sector appears to be a relatively capital-intensive sector. This counterintuitive result is probably due to a systematic under-reporting of the labor input, where labor hours supplied by Kibbutz members are not always recorded. The individual year dummy variables demonstrate the phenomenon of an increase over time in the capital intensity of production, ceteris paribus. This result is consistent with labor-saving technical change. However, since an inter-temporal increase in capital intensity is a basic feature of the data, the dummy variable coefficients probably also reflect in part the impact of left-out variables and measurement errors.

We now come to the effects of grants on the capital intensity of production. It is clear from the very significant positive coefficient of LGNT that subsidized firms are more capital-intensive firms, even after accounting for the reduction in the capital service price associated with subsidization. There are two possible explanations for this result. First, we may have uncovered evidence of private allocative inefficiency on the part of subsidized firms, although it should be noted that the capital used to construct the intensity variable is the stock, not the service flow. Alternatively, the significant

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restricted to equipment, a statistically significant effect would probably be found.

coefficients of the subsidy variables may be acting as controls for the mis-measurement of the subsidy-adjusted capital service price. Since we cannot account for all the subsidies obtained by subsidized firms, our estimate of the subsidized price may be too high and therefore may not fully represent the rational incentive to use a more capital intensive production process.

To this point we have concentrated primarily on documenting the productive inefficiency associated with subsidized firms. But subsidizing firms is part of the Israeli government's policy of encouraging regional development of industry. It may be that the only way to obtain regional development is to subsidize inefficient firms, who, as part of the agreement will locate plants in development areas A and B as the pro quid pro for obtaining the subsidies they need to compete. Hence we cannot, at least at this stage of the research, determine whether firms are inefficient because they are subsidized, or are subsidized because they are inefficient.[41]

One way to begin looking at this "chicken and egg" question is to compare the profitability of subsidized firms with the profitability of unsubsidized firms. We saw from Tables 2 and 3 that, on average, subsidized firms have higher rates of return than unsubsidized firms. In fact, from Table 3 we can see that the rate of return for subsidized firms in development area A exceeds that of unsubsidized firms in other areas of Israel[42]. It does not appear that these firms have needed the subsidies to survive, assuming the 1990-94 data is representative. That such firms appear to be both less

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[41] It has been suggested that an alternative explanation for the apparent inefficiency observed in subsidized firms is the fact that olim (new immigrants), who are probably less productive in their early years in Israel, are concentrated in development areas and hence concentrated among the employees of subsidized firms. To explore this issue we estimated a specification that included a variable that measured the proportion of the labor force that was made up of the new immigrants. While this variable had the expected significant negative coefficient, the coefficients of the subsidy variables were unaffected.

[42] Once again the peculiar result for unsubsidized firms in development area A clouds the issue and will need to be understood.

efficient and more profitable remains a mystery as of this writing. The mystery only deepens when one considers that the gap in rates of return will widen if only non-subsidized capital were used in the denominator of the rate of return calculation.

5. Conclusions and Suggestions for Further Research

Perhaps for the first time, we have provided empirical evidence on the impact that a program of subsidizing capital investment has on the nature of industrial production. We have estimated, for the case of Israeli industry, the empirical realization of the incentive to over-invest in subsidized (cheaper) capital. We have also found that subsidized firms are likely to be technically inefficient - an effect which is separate from the privately rational incentive to over-investment.

To this point we have only considered one side of the subsidy program - its costs. In the next stage of the research we need to consider the possible benefits to the economy of a program of subsidizing capital accumulation.

Because the subsidy ratio reduces the user cost of capital it lowers the cost of production (as long as some degree of input substitution occurs). The firm can thus lower price and expand sales, which is a growth-inducing effect that also increases the demand for labor. This effect of subsidies on output-supply and labor-demand relationships represents a potential benefit of subsidization that we need to try to estimate. Whether the growth-inducing effect is greater than the adverse substitution effect will help determine the net effect on the demand for labor (employment) which results from the capital subsidy policy. Since the ultimate goal of government-supplied capital subsidies is to provide additional employment at reasonable cost, calculation of the net effect will be of most use to policy makers.

In principal, the calculation of the net benefit should also consider the opportunity cost of the subsidies - the alternative public resource investments that could have been undertaken using the same budget. The Law encouraged investments in physical capital, while the rate of return for the economy may have been much higher in investments in infrastructure and in R&D (a reasonable assumption according to results of recent studies (Bregman & Marom (1998), Griliches & Regev (1995))). Devoting more resources to these alternative investments might have resulted in higher growth rates and additional employment in the development areas. To the extent that greater growth would have occurred, the use of public resources to fund physical capital accumulation represents an additional degree of allocative inefficiency which should not be ignored by policy makers when evaluating the subsidy system.

References

Bar-Nathan, M. (1989), “Encouragement of capital incentives Law in Israel - Its Development and Results”, Bank of Israel, Research Department, mimeograph (Hebrew).

Bregman, A. (1985), “The Slowdown of Industrial Productivity - Causes Explanations, and Surprises”, Bank of Israel, **Economic Review**, No. 56.

Bregman, A., M. Fuss, and H. Regev (1991), “High-Tech and Productivity: Evidence from Israeli Industrial firms, **European Economic Review** 35, pp. 1191-1221.

Bregman, A., M. Fuss, and H. Regev (1995), “The Production and Cost Structure of Israeli Industry: Evidence from Individual Firm Data”, **Journal of Econometrics**, Vol. 65, No. 1, pp. 45 - 81.

Bregman, A. and A. Marom (1998), “Factors of Productivity in the Israeli Industry, 1960 - 1996”, Bank of Israel Research Department, Discussion Paper Series 98.03, (Hebrew).

Canadian Tax Foundation (1996), **The Finances of the Nation**, Toronro, Canada

Fisher, F. (1965), “Embodied Technical Change and the Existence of an Aggregate Capital Stock”, **Review of Economic Studies**, pp. 263-288.

Griliches, Z. and H. Regev (1995), “ Firm Productivity in Israeli Industry, 1979-1988”, **Journal of Econometrics**, Vol. 65, No. 1, pp. 175 - 203.

Hall, R.E. and D.W. Jorgenson (1967), “Tax Policy and Investment Behavior”, **American Economic Review**, June, pp. 391-414.

Holden, D. and J. K. Swales (1993), “Factor Subsidies, Employment Generation, and Cost per Job: A Partial Equilibrium Approach”, **Environment and Planning**, 25(3), March, pp. 317-338.

Hulten, C. (1990), “The Measurement of Capital”, in E. Berndt and J. Triplett (eds.), **Fifty Years of Economic Measurement**, NBER Studies in Income and Wealth, Volume 54, University of Chicago Press, Chicago, Illinois, pp.119-152.

Lavy, V. (1994), “The Effect of Investment Subsidies on the Survival of Firms in Israel”, The Maurice Falk Institute for Economic Research in Israel, Discussion Paper No. 94.04, August.

Lim, D. (1992), “Capturing the Effects of Capital Subsidies”, **The Journal of Development Studies** Vol. 28 No. 4, July, pp. 705-716.

Leontief, W. (1947a), “A Note on the Interrelation of Subsets of Independent

Variables of a Continuous Function with Continuous First Derivatives", **Bulletin of the American Mathematical Society**, pp. 343-50.

Leontief, W. (1947b), "Introduction to a Theory of the Internal Structure of Functional Relationships", **Econometrica**, April, pp. 361-73.

Litvin, U. and L. Meridor (1983), "The Grant Equivalent of Subsidized Investment in Israel", Bank of Israel, **Economic Review**, No. 54.

Mohr, M.F. (1986), "The Theory and Measurement of the Rental Price of Capital in Industry- Specific Production Analysis: A Vintage Rental Price of Capital Model", in A. Dogramaci, ed. **Measurement Issues and Behavior of Productivity Variables**, pp. 99-159.

Razin, E. and D. Schwartz (1992), " Evaluation of Israel's Industrial Dispersal Policy in the Context of Changing Realities", **The Economic Quarterly** 153, December, pp. 236-276.

Regev, H. (1993), "Industrial Enterprises Longitudinal Panels in Israel: Construction, Definitions and Use in Research", Proceedings of the International Conference on Establishment Surveys, American Statistical Association, Virginia.

Regev, H. (1997), "Innovation, Skilled Laabor, Technology and Performance in Israeli Industrial Firms: 1982 - 1993", The Maurice Falk Institute for Economic Research in Israel, Discussion Paper No. 97.06, May.

Schwartz, D. (1993), "The Implications of the Law for the Encourage of Capital Investment on Investment in Industry in Developing Areas", Settlement Study Center, Rechovot (Hebrew).

OECD (1990), **Subsidies and Structural Adjustment, Industrial Support Policies in OECD Countries, 1982-1986.** OECD, Paris, May.

Table 1*: Distribution of Firms by Incidence of Grants

(percentage)

FIRMS:	TOTAL	WITHOUT GRANTS	WITH GRANTS
Total Observations	727	434	293
Branch - all	**100**	**61**	**39**
Food	100	61	39
Textiles	100	64	36
Printing, Paper	100	78	22
Wood, Minerals	100	73	27
Chemicals, Plastic	100	40	60
Metals, Machinery	100	66	34
Electronics	100	53	47
Size Group - all			
Up to 20 employees	100	92	8
21-50 employees	100	80	20
51-100 employees	100	58	42
101-300 employees	100	46	54
300 + employees	100	37	63
Development Area - all			
A.	100	30	70
B.	100	48	52
C.	100	73	27

* The figures are weighted and include imputations for missing data in the full sample.

Table 2*: Productivity, Capital Intensity, Grant Ratio and Rate of Return, by size and Grants Availability

(thousands $, 1990 prices)

FIRMS:	WITH GRANTS	WITHOUT GRANTS	TOTAL
SIZE GROUPS:			
UP TO 20 employees			
1. Labor productivity	72	54	55
2. Capital intensity	115	31	37
3. Grant ratio (%)	37.6	0	7.4
4. Rate of return (%)	3.5	0.7	1.3
21- 50 employees			
1. Labor productivity	77	67	69
2. Capital intensity	98	33	43
3. Grant ratio (%)	23.4	0	7.6
4. Rate of return (%)	8.5	4.6	6.0
51-100 employees			
1. Labor productivity	92	72	79
2. Capital intensity	102	40	62
3. Grant ratio (%)	17.5	0	11.6
4. Rate of return (%)	11.8	14.4	12.8
101- 300 employees			
1. Labor productivity	99	99	99
2. Capital intensity	111	56	85
3. Grant ratio (%)	16.1	0	11.6
4. Rate of return (%)	12.2	16.6	13.5
300 + employees			
1. Labor productivity	119	87	103
2. Capital intensity	111	60	86
3. Grant ratio (%)	14.8	0	10.2
4. Rate of return (%)	15.0	7.0	12.2
All employees			
1. Labor productivity	105	75	86
2. Capital intensity	109	44	68
3. Grant ratio (%)	16.3	0	10.3
4. Rate of return (%)	13.0	8.3	11.0

* The figures are weighted and include imputations for missing data in the full sample.

Table 3*: Productivity, Capital Intensity, Grant Ratio and Rate of Return, by Area and Grants Acquisition

(thousands $, 1990 prices)

FIRMS:	WITHOUT GRANTS	WITH GRANTS	TOTAL
AREAS:			
DEVELOPMENT AREA A:			
1. Labor productivity	75	90	85
2. Capital intensity	41	133	104
3. Grant ratio (%)	0	23.0	20.2
4. Rate of return (%)	24.0	11.2	12.8
DEVELOPMENT AREA B:			
1. Labor productivity	68	108	88
2. Capital intensity	47	125	86
3. Grant ratio (%)	0	19.3	14.9
4. Rate of return (%)	7.8	11.2	10.3
DEVELOPMENT AREA C:			
1. Labor productivity	76	115	86
2. Capital intensity	44	89	56
3. Grant ratio (%)	0	8.1	3.7
4. Rate of return (%)	6.8	15.3	10.4
TOTAL			
1. Labor productivity	75	105	86
2. Capital intensity	44	109	68
3. Grant ratio (%)	0	16.3	10.3
4. Rate of return (%)	8.3	13.0	11.0

* The figures are weighted and include imputations for missing data in the full sample.

Table 4: Production Functions, 1990-1994 (Cobb-Douglas)
Dependent Variable: Labor Productivity – LP (Production per Person-Year)

		I		II		III		IV	
		Coef.	*T.*	*Coef.*	*T.*	*Coef.*	*T.*	*Coef.*	*T.*
Intermediate inputs (per p.y.)	LM	.758	142.5	.759	142.1	.757	141.6	.759	142.0
Capital services (per p.y.)	LPCT			.055	13.4			.055	13.3
Capital intensity	LHON	.059	14.1			.060	14.3		
Returns to Scale	LL	.007	1.8	.009	2.5	.008	2.3	.010	2.7
Capital Subsidy	LCSB					-.265	-6.1	-.123	-2.9
Grants	LGNT	-.289	-5.6	-.175	-3.5				
Quality of capital	LQK	.031	4.3	.028	3.8	.027	3.8	.025	3.5
Quality of labor	LQL	.097	1.7	.112	2.0	.099	1.8	.114	2.0
Capital Utilization	SHFT	.127	4.2	.137	4.6	.129	4.3	.138	4.6
R&D capital services	LKRD	.128	10.4	.127	10.3	.126	10.3	.125	10.2
Mobility (ref.= stayers)									
Closed 1991 - 1994	CLS	-.133	-4.4	-.133	-4.4	-.132	-4.4	-.133	-4.4
Opened 1990 - 1994	OPN	-.048	-3.2	-.047	-3.2	-.047	-3.2	-.047	-3.1
Branch (ref. = electronics)									
Food	FD	-.114	-6.9	-.115	-7.0	-.115	-7.0	-.115	-7.0
Textiles	TX	-.062	-3.8	-.064	-3.9	-.064	-3.9	-.065	-4.0
Printing, paper	PA	-.039	-2.3	-.041	-2.4	-.040	-2.3	-.041	-2.3
Wood, minerals	LH	-.031	-1.9	-.035	-2.1	-.034	-2.1	-.036	-2.1
Chemicals, plastic	HM	.004	.2	.006	.4	.004	.2	.006	.4
Metals, machinery	MA	.040	2.6	.039	2.6	.038	2.6	.039	2.6
Sector (ref. = private)									
Reg. stock market	STCK	.009	.7	.012	.9	.014	1.1	.015	1.1
Histadrut	HIST	.068	4.5	.072	4.8	.072	4.8	.073	4.8
Kibbutz	KIBZ	.121	8.7	.129	9.3	.128	9.1	.131	9.2
Public sector	PUBL	.092	3.5	.085	3.2	.090	3.5	.084	3.2
Year dummies (ref.= 1990)									
Year 1991		.019	1.5	.019	1.5	.019	1.5	.019	1.5
Year 1992		.004	.3	.004	.3	.004	.3	.004	.4
Year 1993		-.016	-1.3	-.016	-1.3	-.016	-1.3	-.016	-1.3
Year 1994		-.017	-1.4	-.017	-1.3	-.018	-1.4	-.016	-1.3
Intercept		1.272	44.2	1.268	43.9	1.274	44.3	1.265	43.8
Observations		2907		2907		2907		2907	
R2		.925		.924		.925		.924	
Root MSE		.208		.208		.208		.209	

Table 5: “Demand” for Capital, 1990-1994

Dependent Variable: Capital Intensity LGK (Capital per Person-Year

		Coef.	*T.*
Output	LPTO	.108	8.6
Price Capital/labor	LPKL	-.573	-13.0
Price Capital/Inputs	LPKM	.448	6.7
Export ratio	EXP	.003	4.5
Grants	LGNT	2.370	11.3
Quality of capital	LQK	-.322	-12.6
Quality of labor	LQL	.162	0.8
Women ratio	WMN	-.012	-13.0
Capital Utilization	SHFT	.005	4.1
R&D capital services	LKRD	-.020	-0.4
Mobility (ref.= stayers)			
Closed 1991 - 1994			
Opened 1990 - 1994	CLS	.335	3.0
	OPN	-.016	-1.1
Branch (ref. = electronics)			
Food			
Textiles	FD	.457	7.3
Printing, paper	TX	.591	8.9
Wood, minerals	PA	.330	5.0
Chemicals, plastic	LH	.287	4.6
Metals, machinery	HM	.666	11.8
	MA	.116	2.1
Sector (ref. = private)			
Reg. stock market			
Histadrut	STCK	.104	2.2
Kibbutz	HIST	.202	3.6
Public sector	KIBZ	.177	3.4
	PUBL	.002	0.0
Year dummies (ref.= 1990)			
Year 1991		.069	1.5
Year 1992		.117	2.6
Year 1993		.167	3.6
Year 1994		.213	4.5
Intercept		.200	1.1
Observations		2906	
R2		.509	
Root MSE		.765	

Appendix 1

List of variables for the production and factor demand functions

P = Output per labor unit (person-year), constant prices

PTO = Total output, constant prices

M = Intermediate inputs (materials and purchased services) per labor unit, constant prices

PCT = Capital services adjusted for subsidies

HON = Capital services unadjusted for subsidies

GNT = Rate of real capital grants to gross capital. [LGNT=log(1+GNT)]

CSB = Rate of total calculated and real subsidy (including GNT) to gross capital.

LCSB = log [1+(PSB-CGNT+GNT)], when: PSB =calculated total subsidies,

CGNT = calculated grant

QK = Quality of capital - Ratio of new capital (investment in last five years) to total capital

QL = Quality of labor - proportion of engineers and technicians to total employment (index, average 1990-1994)

SHFT= Indicator of capital utilization - index of shift work

KRD = R&D capital services, [LKRD = log (1+KRD)]

EXP = Export ratio (of sales, percentage, 1990-1994)

WMN = Percentage of employees that are female

PL = Cost of labor (wages including benefits) per hour

PM = Intermediate inputs price index

PK = User cost of capital (relative to gross capital price index)

Dummy variables:

Mobility - CLS = Firms that closed between 1991 and 1994

OPN = New firms that opened in 1990 - 1994

Industry - FD = Food

Ownership Sector - STCK.......

Year - 1991.....1994

Appendix 2: Production Functions, 1990-1994 (Translog)
Dependent Variable: Production – LP

		I		II		III		IV	
		Coef.	*T.*	*Coef.*	*T.*	*Coef.*	*T.*	*Coef.*	*T.*
Intermediate inputs	LM	.197	6.1	.181	5.6	.215	6.8	.180	5.6
Labor	LL	.628	21.1	.621	21.3	.612	21.2	.625	21.4
Capital services	LPCT			.182	9.7			.181	9.7
Capital input	LHON	.138	7.5			.157	8.7		
	(LL)2	.131	10.9	.132	11.6	.134	11.6	.132	11.6
	(LM)2	.140	18.5	.150	19.5	.141	18.8	.150	19.5
(LHON)2 /	(LPCT)2	.005	1.6	.016	4.2	.016	4.4	.016	4.2
	LL*LM	-.117	-16.5	-.118	-16.8	-.117	-16.6	-.119	-16.9
LL*LHON /	LL*LPCT	-.000	-.1	.002	.4	-.001	-.3	.002	.4
LM*LHON /	LM*LPCT	-.015	-3.6	-.028	-6.3	-.023	-5.2	-.028	-6.2
Capital Subsidy	LCSB					-.257	-6.4	-.115	-3.1
Grants	LGNT	-.191	-4.2	-.139	-3.1				
Quality of capital	LQK	.019	2.9	.025	3.8	.024	3.7	.022	3.4
Quality of labor	LQL	.158	3.0	.132	2.6	.118	2.4	.134	2.7
Women ratio	WMN	-.001	-2.8	-.001	-2.6	-.001	-2.5	-.001	-2.6
Capital Utilization	SHFT	.002	6.4	.002	5.8	.002	5.5	.002	5.8
R&D capital services	LKRD	.082	5.7	.113	10.1	.112	10.1	.112	10.1
Mobility (ref.= stayers)									
Closed 1991 - 1994	CLS	-.088	-3.1	-.111	-4.1	-.113	-4.2	-.111	-4.1
Opened 1990 - 1994	OPN	-.052	-3.8	-.049	-3.6	-.051	-3.8	-.048	-3.6
Branch (ref. =electr.)									
Food	FD	-.121	-7.7	-.118	-7.9	-.118	-7.9	-.119	-7.9
Textiles	TX	-.117	-7.0	-.114	-7.0	-.117	-7.9	-.115	-7.1
Printing, paper	PA	-.028	-1.7	-.021	-1.3	-.020	-7.9	-.021	-1.3
Wood, minerals	LH	-.054	-3.4	-.053	-3.5	-.054	-7.9	-.054	-3.6
Chemicals, plastic	HM	-.002	-.1	.006	.4	.002	-7.9	.006	.5
Metals, machinery	MA	-.010	-.7	.003	.2	.003	-7.9	.003	.2
Sector (ref. = private)									
Reg. stock market	STCK	.036	3.0	.030	2.5	.032	2.6	.032	2.7
Histadrut	HIST	.047	3.6	.052	3.8	.050	3.7	.053	3.9
Kibbutz	KIBZ	.152	11.1	.139	11.2	.138	10.9	.142	11.2
Public sector	PUBL	.060	2.1	.034	1.3	.031	1.3	.033	1.3
Year dummies (ref.= 1990)									
Year 1991		.012	1.1	.012	1.1	.012	1.1	.012	1.1
Year 1992		.012	1.1	.011	1.0	.011	1.0	.011	1.0
Year 1993		-.005	-.5	-.005	-.4	-.006	-.5	-.005	-.4
Year 1994		-.023	-2.0	-.025	-2.2	-.026	-2.3	-.024	-2.2
Intercept		2.357	29.2	2.338	29.4	2.273	28.7	2.335	29.3
R2		.987		.988		.988		.988	
Root MSE		.185		.186		.186		.186	
Mean Elastisities	EL	0.23		0.23		0.23		0.23	
	EK	0.06		0.06		0.06		0.06	
	EM	0.75		0.75		0.74		0.75	