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THE PRODUCTION AND COST STRUCTURE OF ISRAELI INDUSTRY: EVIDENCE FROM INDIVIDUAL FIRM DATA

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ABSTRACT

The main purpose of this paper is to present estimates of production and cost functions obtained from using a time-series, cross-section data set pertaining to Israeli industry. We include a detailed list of heterogeneity controls in the specifications which substantially enhances the explanatory power of the models and contributes to our understanding of the nature of Israeli industry. Econometric problems which arise in attempting to estimate production and cost functions from panel data, such as sample selectivity, serial correlation due to unobserved firm effects, and endogeneity are addressed.

A surprising finding is the relative inefficiency of large firms listed on the stock exchange. Histadrut and public firms appear to be poor performers in a number of dimensions. Large public firms are inefficient and pay excessively high wages. Small (< 300 employees) public firms are not inefficient but pay excessive wages. Large Histadrut firms are inefficient while small Histadrut firms pay excessive wages.

The wage structure in Israeli industry is seen to be systematically related to the heterogeneity controls used in this study. One productivity - related result is that firms experiencing higher than expected productivity also pay higher than expected wages, and about 70% of this productivity "bonus" appears as a wage rate increment.

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1. Introduction

The main purpose of this paper is to present estimates of production and cost functions obtained from using a time-series, cross-section data set pertaining to Israeli industry.

Our primary data set is an expanded version of the data used in Bregman, Fuss and Regev (1991), expanded to include 849 firms over the period 1979 to 1983. These 4,245 observations are available for some 25 variables including constant dollar values of output and inputs (capital, materials and labour), wage rates of labour, and price indexes of output, materials and capital. In addition, firm-specific quality measures of labour, capital and R&D capital services intensity are utilized.[1]

A unique feature of this research is the existence in our data base of a detailed accounting of specific characteristics of individual firms. An individual firm can be characterized by the industry in which it operates; its size; its ownership sector (e.g. the public sector, Kibbutzim, Histadrut etc.)[2]; the area in which it is located (the degree the area being considered is a development area); the age of the firm, and the concentration of the industry in which the firm is classified. This detailed accounting for heterogeneity is shown to significantly improve the explanatory power of the estimated functions. In addition, it is possible to evaluate productivity differences associated with firms of different types.

2. The Israeli Economy During the Period 1979-1983

A short background description of the developments of the Israeli economy in the first years of the eighties is necessary in order to understand the environment in which the industrial firms were producing. The years after the second oil crisis in 1979 were characterized by a rapid acceleration of inflation, by high budget deficits reflecting a high level of military expenditure, and by a consecutive

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[1] See also our above-mentioned article for a comprehensive analysis of these three quality variables.

[2] It should be mentioned that some large, publicly owned military equipment producers are not included in our data due to concerns regarding the statistical reliability of their production and cost accounts.

worsening of the balance of payments. As a result there was a slowdown in the growth rates of productivity and business sector capital intensity. Inconsistent economic policy of violently fluctuating taxes and subsidies prevailed in that period. Short-run changes occurred in product mix, as domestic demand was diverted to military commodities (Bank of Israel Reports, 1980-83).

Table 1 provides a summary of some important indicators of changes in output and inputs in Israeli industry during the period 1979-1983. In 1980 a contracting fiscal policy focused on a wide cut in subsidies and real wages of the public sector. The import surplus shrunk but inflation accelerated. This caused a decline in aggregate demand and industrial production was reduced by some 3 percent (excluding diamonds), together with a similar reduction in the number of employees.

By way of contrast, in 1981 the focus of economic policy shifted to stopping inflation. This year was characterized by considerable increases in the direct subsidies to producers of staples and cuts in taxes. Industrial product increased by 6 percent together with an employment increase of 1 percent.

In 1982 subsidies were reduced again, and following the Lebanon War direct and indirect taxes were raised again. In the beginning of 1983 the emphasis was shifted to the war against inflation; at its end to the improvement of the balance of payments.

As mentioned before, this inconsistent policy worsened the main problems - uncertainty increased and a slowdown in the growth rate of employment and total factor productivity prevailed throughout the period. (See Table 1)

3. The Data Base

The data set used in this research was built in the Israel Central Bureau of Statistics (CBS), mainly on the basis of the current Industrial Surveys for the years 1979 to 1983. Some of the data were computed specifically for the purpose of estimating cost and production functions. It is part of a more comprehensive unique data base designed in the last several years for research on the Israeli industry in the eighties. The data base contains information from other sources as well - R&D surveys, structure of labour force in industry (CBS (1989)) and (mainly) the special survey of fixed capital and investment by vintage for 1982 (CBS (1986)).

For the majority of our results we used a balanced subset of 849 firms out of an approximate 2,000 firms which participated in the 1979 industrial survey, chosen on the grounds of availability of capital stock and investment data from the above-mentioned capital survey.

The firm data include the values of output and material input in current and constant prices[3], the total wage bill, number of employees and hours worked, and capital stock by type of capital (e.g. buildings, equipment and machinery, vehicles). The estimates of price indexes for output and materials were calculated for 100 sub-branches of the industrial sector using various sources of data, some with even a more detailed breakdown. The overall index of output prices for the hundred sub-branches is a weighted average of export prices and the wholesale price index of sales in the domestic market. The weights are the real sales to the different destinations.

The price index of materials is based on information regarding imports and purchases from local production as calculated in the Input-Output Tables. Here the data are classified into 186 sub-branches of commodities and services. The overall index for the materials input price in a branch is a weighted index of import and local production prices, weighted by 1982/83 values from the basic input-output table

[3] The materials data do not include purchased services (e.g. insurance) due to data development difficulties. We hope to rectify this deficiency at a future date.

for this year (CBS (1987)).

Capital service flow is an aggregate of the service flows from structures, machinery and equipment, and vehicles[4]. The price of capital services is computed as the ratio of capital services in current dollars[5] divided by capital services in constant 1979 dollars.

The main characteristics of the firm which serve as heterogeneity controls in the estimation of the cost and production functions are: the size of the firm (grouped according to the number of employee-years in 1979 for the production function and the constant dollar value of the output in 1979 for the cost function); the ownership sector (e.g., public sector, Histadrut); the industry the firm belongs to; the type of area the plant is located in (the extent to which the area is a development area); the age of the firm; the qualities of labour and capital inputs and the intensity of R&D activity. For more detailed information see the List of Variables on page 26 and the data description in our previous paper (Bregman et. al. (1991)).

4. Conceptual Issues

a. Production and Cost Functions

We have specified the production and cost functions in a standard way. For the production function, output is assumed to be a translog function of labour, capital and material inputs. There are three sets of production function estimates, depending on the behavioral assumptions employed. First, the production function is estimated as a single equation. In this case technical efficiency is the only maintained assumption. Second, we have assumed cost- minimizing choice of labour and materials, conditional on

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[4] See Bregman et. al. (1991) for more details.

[5] Current dollar capital service flow is computed using three distinct investment price indexes and depreciation rates for construction, equipment and machinery, and vehicles, and a real rate of interest of 5%. The machinery and equipment price index is a combined index of imported and locally produced equipment.

the amount of capital (short run cost minimization). In this second case another equation is added to the production function, based on the setting of the marginal rate of substitution between labour and materials equal to the ratio of labour and materials prices. Third, we have specified the behaviour of the firm to be long run cost minimization. This results in the addition of a third equation to the system to be estimated. This third equation involves setting the marginal rate of substitution between capital and one of the other factors equal to the relevant ratio of input prices.[6]

In the case of the cost function, we consider two specifications. In the first specification, short run cost minimization, variable cost is a function of the prices of variable factors of production (labour and materials), output, and the quantity of the quasi-fixed factor (capital). Shephard's Lemma is used to add an additional equation to create a two equation system for estimation. In the second specification, we assume long run cost minimization so that total cost is a function of output and factor prices. Shephard's Lemma is used to add two additional equations to the cost function for estimation purposes.

b. **Firm Heterogeneity**

Since we are dealing with a pooled sample of individual firm data, the issue of firm heterogeneity is an important one. In our sample heterogeneity can arise from three main sources.

(1). Firms in different branches of industry can be expected to operate under different technologies which leads to differences in production and cost functions. This will be assumed to be a source of industry-specific heterogeneity, although in practice industries cannot be defined so finely that firm-specific differences in technology within a particular branch are eliminated.

(2). The procedure of deflating current dollar quantities by branch-specific price indices to obtain

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[6] We have not assumed price-taking profit maximizing behaviour as is often the case when a system of production function-based equations is estimated. This assumption would not be appropriate for Israeli industry. We take into account possible departures from non-competitive pricing behaviour in the estimating equations as we have done previously (Bregman et. al. (1991)). See also page 6 below and Appendix A.

constant dollar quantities introduces another source of industry-specific firm heterogeneity. This occurs because the price indices are all equal to unity in the base year (1979), so that the constant 1979 dollar "quantities" we use are the theoretically correct physical quantities confounded with inter-industry base year price variation.

(3). Within any branch, firm-specific heterogeneity will exist due to differences in location, size, age, ownership sector, qualities of capital and labour inputs, etc.

c. Adjusting the Basic Specification for Firm Heterogeneity

Heterogeneity due to differences in technologies has been adjusted for by assuming that the zero and first order coefficients of the production and cost functions differ across the six main branches of industry. Adjustment of the function for heterogeneity introduced by the price deflation process requires specification of the nature of the base year price variation. Following Bregman et al (1991), we assume that base year output price variation is due to industry effects (represented by dummy variables for five of the six main branches) and varying degrees of monopoly power (represented by the domestic firm concentration ratio and the proportion of output that is exported). We assume interindustry variation in base year material prices can be accounted for by the branch dummy variables.

In Appendix A we derive the form of the translog estimating equations consistent with the above assumptions concerning base year price variation. We show that if there are interindustry differences in technologies, we cannot distinguish between the existence or non-existence of base period variation in materials prices, since the two specifications are observationally equivalent.

The firm-specific heterogeneity control variables were described in the data section. One of these variables, size, deserves further elaboration at this point. We have assumed in specifying the basic translog production and cost functions that production is subject to constant returns to scale (CRS). This implies that our dependent variables output and cost can be transformed into output per unit labour

(labour productivity) and cost per unit of output (unit cost). We relax the CRS assumption by including size dummy variables in the list of heterogeneity controls. Relative to the more usual way of specifying non-constant returns to scale in translog functions, our specification has the following properties. First, since the dummy variables are introduced linearly and only into the production and cost functions (i.e., not into the other equations in the systems of equations) production is assumed to be homothetic. Second, the scale (cost) elasticity, which is usually specified to be a continuous function of the size variable is here specified to be a step function.

5. Estimation Methods

There are three sources of econometric problems in our data and specifications. First, the use of a balanced panel for most of our analysis raises the possibility of selectivity bias since new firms (those that opened during the period 1979-1983) and unsuccessful firms (those that closed during 1979-1983) are systematically excluded from this panel. As emphasized by Olley and Pakes (1991), this exclusion may bias the estimates of the production and cost function parameters. Second, simultaneity in the choice of inputs and outputs may lead to biased and inconsistent production function estimates when OLS is used. Simultaneity between unit variable cost and the quasi-fixed factor (capital per unit output) may cause similar problems in cost function estimation. Third, our adjustment of the specifications for heterogeneity cannot be expected to control for all firm heterogeneity. Unobserved firm heterogeneity which persists over time may introduce serial correlation and, while OLS parameter estimates remain consistent in this case, they are inefficient and the estimated standard errors may induce a false sense of statistical significance.

Our basic set of production function results stems from applying OLS to a balanced panel of 849 firms over a five year period (4245 observations). For the cost function, the iterative Zellner seemingly unrelated regression procedure (IZ) was applied to the same sample to generate the basic cost function results.

Sample selection bias was investigated by estimating the production function for an unbalanced panel which included a number of firms that closed during the sample period, and a number that opened. As discussed below, the results suggest that selectivity may not be an important issue in our sample.

Instrumental variables (IV) estimation procedures were used to try to account for simultaneity. We utilized relative factor prices as instruments in the production function estimation. In the estimation of the cost function, the price of capital services relative to the prices of labour and materials were used as instruments for the capital input. We do not believe that the available sets of instruments are entirely satisfactory for the purpose of exploring simultaneity issues in the various specifications. With the exception of the price of labour, there is minimal cross-sectional variation in the factor prices[7], and it is the cross-sectional dimension of our sample which is dominant. The unsatisfactory nature of some of our instrumental variables results is illustrated by the estimate of the input-output elasticities for formulation (5) in table 2.

We have utilized two panel data estimation procedures and an averaging procedure to investigate the effects of unobserved firm heterogeneity. Our first method is to apply the model due to Chamberlain (1982, 1984), which produces efficient estimates without imposing any structure on the variance-covariance matrix. When estimating the production function parameters we treat each year as a separate equation in an IZ (or iterative 3SLS) estimation. For the cost function estimation, each equation-year combination results in a separate equation, so there are 15 equations in the model.[8]

Chamberlain's method is difficult to apply to unbalanced panels. Hence when dealing with the data

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[7] In the case of the materials price, there are 186 distinct prices in each of the years 1980-1983. Hence there are 745 distinct materials prices for 4245 observations. The variation of capital service prices across firms is due only to the existence of different mixes of capital components.

[8] There are 3 equations (the cost function and 2 share equations) and 5 years, so that 5x3=15 equations need to be estimated simultaneously.

set containing openings and closings we apply the random effects error components model.[9]

Finally, as a third method of controlling for unobserved firm heterogeneity, we have averaged the temporal observations and applied our estimation procedures (OLS, IZ, IV) to the 1979-83 average observations per firm.

In summary, we have estimated the production function parameters: (1) using OLS (ignoring simultaneity and unobserved heterogeneity); (2) using IV procedures (ignoring unobserved heterogeneity); (3) using panel data procedures (ignoring simultaneity); and (4) combining IV with panel data procedures. A similar strategy was employed for cost function estimation, with the exception that the cost function was always estimated as part of a system of equations which included the relevant cost-minimizing input demand function specification. In general the results of interest did not differ appreciably from the basic OLS and IZ results when the more complicated procedures were employed.

[9] Concise descriptions of these two approaches to efficient estimation with panel data are contained in Hsiao (1989, pp. 32-63).

6. The Empirical Results

Tables 2 - 7 in the text and tables B.1 - B.3 of Appendix B contain various aspects of our empirical results. There are three categories of empirical findings. First, the nature of the basic production technology for Israeli industry is described in terms of estimates of sample average input-output elasticities, input cost shares, and partial elasticities of substitution (tables 2 - 4). Second, the estimated effects of heterogeneity controls on productivity and cost are explored (tables 5 - 6 and B.1 - B.2). Finally, as described below, we have estimated several wage equations to investigate the behaviour of wage rates over our sample. Those results appear in table 7.

We now turn to a discussion of the production and cost function results. The majority of the parameters in the estimated production and cost functions are significant at conventional levels, and have the expected signs. If a heterogeneity control has a positive impact on output per unit of labour (labour productivity) in the production function, we would expect it to have a negative impact on cost per unit of output in the cost function.[10] So, for example, the fact that a firm has a higher quality of capital (e.g. a higher ratio of new machinery and equipment) is reflected in higher labour productivity in the production function estimates and in lower costs per unit of output in the cost function estimates.

Because the results corresponding to all specifications are too voluminous to discuss in detail, in what follows we restrict much of our detailed discussion to two specifications: the OLS production function results and the long run cost function IZ results.[11] Parameter estimates and associated standard errors for these two specifications are contained in tables 5 and 6. We chose these specifications for

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[10] The exceptions are the base period price variation effects CONC and EX, which were included in the models in such a way that their associated parameters should be of the same signs in both the production function and cost function results (positive for CONC and negative for EX). For more details see Appendix A.

[11] All specifications reported, including the two to be discussed in detail contain the full set of "observed" heterogeneity effects (e.g., zero and first order technology differences) since all attempts to simplify the specifications were rejected by the data.

several reasons. First, in general the results of interest are relatively insensitive to the estimation method, although of course some specific examples of differences can be found. In particular, the panel data estimation procedures do not appear to indicate that the statistical significances of the OLS and IZ results are overstated. Second, the more complicated specifications do not improve the percentage of observations satisfying the regularity conditions to any appreciable extent, and in one case (long-run cost function estimation) there is a substantial deterioration from the use of the panel data estimation procedure.[12] Third, in choosing between the long run and short run cost function specifications, considerable weight was given to the fact that the long run cost function satisfied the regularity conditions at all observations, whereas the short run cost function satisfied the regularity conditions at a maximum of 64% of the observations. A subset of parameter estimates (primarily associated with the heterogeneity controls) for selected other specifications can be found in tables B.1 and B.2.

7. General Characteristics of the Production Technology

a. Input-Output Elasticities and Cost Shares

Table 2 presents estimated mean input-output elasticities for a number of production function specifications, including the specification (formulation (1)) that we will be discussing in detail. An implication of cost-minimizing behaviour is that the ratio of two input-output elasticities should equal the ratio of the corresponding cost shares. This will be a maintained hypothesis with respect to the three factors of production for the case of long run cost minimization, and with respect to materials and labour for short run cost-minimization. Since specifications (1)-(3) impose no cost-minimizing conditions, it is of interest to compare the relevant estimated ratios from these specifications with the ratios from (8). Comparing the ratio of elasticities from (1) with the ratio of cost shares, it can be seen that the

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[12] This result may not be surprising since this specification contains 120 variance-covariance parameters to be estimated, in contrast to the 6 parameters of the IZ procedure.

materials/capital ratio satisfies the cost minimizing conditions, whereas the materials/labour and capital/labour ratios suggest that too much labour relative to materials or capital is being employed. Formulation (2) also suggests that too much labour is utilized, but in addition implies too much materials relative to capital is used.[13]

b. **Elasticities of Substitution**

In table 4 we present Allen and Morishima partial elasticities of substitution derived from the OLS production function estimates and the IZ long run cost function estimates. The difference between these two elasticity definitions can best be understood in the context of cost minimizing behaviour. The Allen elasticity E_{ij} is the cross-price elasticity of demand for factor i with respect to the price of factor j, divided by the jth cost share. It measures the responsiveness of factor i to changes in the price of factor j (in terms of logarithmic derivatives) and is symmetric ($E_{ij} = E_{ji}$). The Morishima elasticity M_{ij} measures the responsiveness of the *ratio* of the demands for factors i and j to a change in the price of the jth factor. Since M_{ji} measures the responsiveness of the ratio of demands to changes in the jth price, the Morishima elasticity is not symmetric.[14]

The Allen elasticities are the most commonly presented elasticities, but are not very useful for estimating isoquant curvature in the case of more than two inputs. In this circumstance the Morishima definition is preferred (Blackorby and Russell (1989)). The Allen elasticities are useful for exploring the extent to which the estimated functions satisfy the regularity conditions for well-behaved production and cost functions, since these conditions can be expressed as relatively simple functions of Allen elasticities.

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[13] If EM/EL > SM/SL, this implies $F_M/F_L > P_M/P_L$, where F_M, F_L are marginal products and P_M, P_L are input prices. Under these conditions we say that too much labour relative to materials is being employed for production to be cost-minimizing. We did not attempt to consider whether the estimated departures from cost-minimizing behaviour were statistically significant.

[14] For a more detailed discussion of partial elasticities of substitution and the differences between the Allen and Morishima definitions, see Chambers (1988, pp. 27-36 and 93-100).

The regularity conditions are satisfied at all data points for the cost function and at 64% of the observations for the production function.[15]

The results presented in table 4 suggest that capital, labour and materials in Israeli industry are substitutes for one another.[16] Because of the relative magnitudes of the pairwise substitution elasticities, the production function results imply that substitution possibilities are dominated by the substitution of materials for capital and labour, i.e., factor substitution is to a considerable extent a choice of the degree of vertical integration. This pattern is not so apparent from the cost function results.

The most striking feature of table 4 is the fact that the production function estimates suggest considerably greater degree of substitutability among inputs than do the cost function estimates. This is true for both the Allen and Morishima estimates, and remains true when the observations which fail to satisfy the regularity conditions in the case of the production function are eliminated from the averaging process. A similar phenomenon was found by Denny and Fuss (1977) for U.S. Manufacturing, based on aggregate data. The obvious question is: which is the preferred set of elasticity estimates?

On balance we prefer the cost function estimates. As noted previously, the OLS production function parameter estimates satisfied the regularity conditions for a smaller percentage of observations than was the case with the IZ long run cost function estimates. In addition, the variability of the firm-specific

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[15] For the various specifications of the production function the percentage of observations which satisfied the regularity conditions ranged from 42% to 74%. For the cost function the analogous range was 45%-100%.

[16] The results presented in table 4 are averages over the entire sample, which for the production function include estimates where the regularity conditions are violated. The average results are fairly robust to the exclusion from the averaging process of observations where regularity is violated or the results appear unreasonable. This is especially true for the Morishima elasticities. The one important elasticity result which is sensitive is that capital and labour become Allen complements in the restricted sample, although they remain Morishima substitutes. The restriction of the sample (from 4,245 observations to 2,459 observations) tends to eliminate small firms with low capital and labour output elasticities. The restricted sample has an average EK=.089 and EL=.329 compared with EK=.067 and EL=.250 for the complete sample (see table 2).

elasticity estimates is much higher for the production function specification than for the long run cost function specification, and many production function estimates for observations which satisfied the regularity conditions were of unreasonable magnitudes. Our results provide an interesting illustration of a phenomenon which has been noted previously in the production function empirical literature - the difficulty of estimating substitution elasticities from direct specification of a quadratic approximating production function. This is the case because the estimates depend primarily on second order parameters. Even adding the cost minimization assumption does not help matters much since, while the substitution parameters appear as first order parameters in the marginal rates of substitution equations, these equations are highly non-linear in parameters. By way of contrast, the substitution parameters appear linearly in the cost share equations of a cost function specification.

It cannot be denied that the characterization of input substitutability depends on whether the production function or cost function is chosen as the approximating function. Fortunately, the remainder of the results of this paper (the heterogeneity effects) are robust to the choice of the approximating function.[17]

c. **Estimates of the Heterogeneity Effects**

Tables 5 and 6 contain the parameter estimates for the two specifications we are discussing in detail.[18] Initial regression results made it clear to us that the heterogeneity controls would not adequately explain the data without size - sector interaction effects. We have included these effects by distinguishing between large and small firms in each sector, where for this purpose large firms are defined

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[17] Not only are estimates of the heterogeneity effects robust to the question of whether the cost or production function is the better approximating function, they remain essentially unchanged even when the production function is restricted to be Cobb-Douglas in order to ensure that the regularity curvature conditions are satisfied at all observations.

[18] Results for additional specifications can be found in tables B.1-B.2 of Appendix B.

as those firms with 300 or more employees. Hence, for example, the variable HIL in tables 5 and 6 is a dummy variable which takes on the value 1 if the firm is in the Histadrut sector and employs more than 300 workers, and 0 otherwise. The variable HIS takes on the value 1 if the firm is in the Histadrut sector and employs 300 or fewer employees.

We now turn to the main results concerning the heterogeneity effects. A list of the heterogeneity control variables categorized by type can be found on pages 26-27 of the paper.

Returns to scale (or, "is Small nice" in Israeli industry)

Scale was measured by dummy variables defined over four size groups: the smallest (S1) has up to 50 employees, the largest (S4) - more than 300 - with the smallest firms comprising the reference group. The size variables for the cost function were measured by parallel groupings with output being the size variable. We obtained qualitatively somewhat similar answers to the scale-size question from the cost and the production function regressions. The estimates imply that firms in size groups larger than the "small group" (S1) have higher labour productivity and lower unit cost than the smallest firms. From the production function estimates we obtain the result that the second group (up to 100 employees) is the most efficient (compared to the first)[19]. The cost function estimates imply that cost per unit output is minimized in the second and third size groups rather than just in the second size group.[20]

As noted above, the highest labour productivity is found in the small - medium group (S2),

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[19] This is true despite the fact that the coefficient for S4 (.047) is greater than the coefficient for S2 (.037). The variable S4 represents the size effect for large private firms, rather than large firms in general, because of the way the size-sector interaction effects are specified. The size effect for large firms on average can be obtained by combining the size and sectoral effects. Since large firms in sectors other than the private sector are estimated to be less efficient than large private firms (see the sectoral results), the average effect of the largest size group on labour productivity is less than .047.

[20] The argument of footnote 16 applies to the cost function estimates as well. Large non-private firms have higher unit costs than large private firms and as a consequence, on average, large firms have higher unit costs than firms in group 2 or group 3.

employing between 50 to 100 workers. From an international perspective, this size of firm is generally considered to be a "small firm." Even the other size group estimated to have comparable cost efficiency characteristics (S3: 100 to 300 employees), does not contain especially large firms by international standards. One of the interesting results of this research is the apparent efficiency advantages of medium size firms.

Another interesting finding is the relatively low labour productivity and cost efficiency displayed by the very small firms (S1: 5 to 50 employees). Some of the possible reasons for this disadvantage of the smallest size group are noted in Yinon et. al. (1990). The smallest firms appear to be more vulnerable to market failures than others. Problems such as access to information services, the ability to hire highly skilled workers, the ability to penetrate foreign markets, and the ability to get the needed financial services and/or credit are just some of the problems that must be overcome. Finally, small firms are not given all available government aid due to lack of connections or knowledge of the possibilities. (For additional details see also Brodet, Justman, and Teubal (1990)).

The technological indicators

There is no doubt that technological change in general and specifically the increase in human capital are the main factors leading to high rates of growth of productivity in Israel, as in many other countries in the modern world. (See, for example, Berman and Halprin (1990))

The technology variables (QL, QK and R&D) were treated thoroughly in our previous study (Bregman, Fuss and Regev (1991)). In general, the results here, based on a much larger data set, agree with the conclusions offered in that paper. Most coefficients show the expected positive effects of these technology indicators (qualities of labour and of capital, and R&D capital services) on production and the negative impact on costs. A variable, NORD, introduced in this study, did not appear in our previous paper. This variable takes on the value unity if the firm does not engage in R&D activity and zero otherwise. Its coefficient is expected to be negative in the production function results and positive for the cost function. Generally, the expected sign is obtained, but statistical significance occurs only for the OLS production function case. Another surprising result is the lack of significance of the R&D variable.[21]

The sector effects

One of the unique features of this study is our ability to investigate sectoral differences in labour productivity and unit cost. We do this by specifying a set of control variables by sector, distinguishing between large and small firms.

The reference group for this set of dummy variables is the group of privately-owned small firms - partnerships and private corporations.[22] Combined with the large private firms (S4), and the (private) firms which belong to the Israeli stock exchange (STL,STS)[23], they constitute about 52 percent of total industrial gross product in 1982. The Histadrut (HIL,HIS) and Kibbutzim (KIL,KIS) produced an additional 22 percent of the product and the publicly-owned firms (PUL,PUS) produced the remaining 25 percent. A firm is defined in this study as a public enterprise if at least 50% of the control is directly or indirectly in the hands of the government, the municipal authorities, or the national agencies. It is defined as a Histadrut firm if control belongs to the Havrat Hovedim or cooperatives of the Histadrut.

The unique Israeli feature with respect to industry organization is the large share of activity

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[21] This variable is an estimate of the stock of R&D expenditures and is less inclusive than the R&D indicator variable used in Bregman et al (1991). Data necessary to construct this indicator variable were not available for the current sample. In addition, the coefficient of correlation between QL and RD is relatively high for this sample (.42) (see Table B.3) which suggests the possibility of multicollinearity problems. Finally, only about 300 firms out of our sample of 849 firms were engaged in R&D activity. This fact may also explain some of the instability and sensitivity of the results.

[22] Recall that the size variable S4 represents the large private firms (see footnote 16).

[23] Strictly speaking, the stock exchange firms in our sample include not only those that are active on the stock exchange but also any firm which has legal "public" status, enabling it to sell stocks and bonds to the public. An important distinguishing feature of such firms is the requirement of public financial disclosure.

controlled by union-owned Histadrut and Kibbutzim firms. The primary goals of investors and entrepreneurs in the Histadrut are probably in-between those of the private and public sectors - in terms of profit seeking and risk-taking (Bank of Israel (1988)). Kibbutzim firms, especially the smaller firms, may also differ in their goals from other firms.

In Israel, the public sector is highly export-intensive, and includes firms like the Dead Sea Works, the Negev Phosphates, and the Military Industry (Kondor (1990)).

The private sector is relatively the least capital intensive (capital stock per worker). Approximately 66 percent of the industrial workers belong to this sector. This sector also contains the majority of the smaller (<50 employees) firms. The larger firms are concentrated in the public and Histadrut sectors. These firms are characterized by high capital intensity. The average wage per employee in public sector industrial firms is double or more the wage in private sector firms. Wages are influenced by the higher capital per worker, the higher level of human capital, and depend on the branch to which the firm belongs. For example, wages are highest in the major branch Electronics and Transportation Equipment. (see also table 7 and Bank of Israel (1988)).

Tables 5 (column 1) and 6 and B.1-B.2 of Appendix B contain our results concerning sectoral differences in production and cost efficiency using the balanced panel of 849 firms and 4,245 observations. For example, the parameter value -.140 for STL in table 5 implies that large stock firms had 13%[24] lower production efficiency than large private firms. The parameter value .128 for STL in table 6 implies that large stock firms had 14% higher unit cost (i.e. lower cost efficiency), ceteris paribus, than private large firms.

There is general agreement between the production and cost function results, with the exception of the results pertaining to Kibbutzim firms. We will discuss the Kibbutzim firms below. The most striking

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[24] Computed as [exp(-.140)-1]*100% =-13%. All other percentage differences stated in the text are obtained in the same way from the relevant regression coefficient.

result pertains to the inefficiencies estimated for large (>300 employees) firms outside the private sector (as we have defined it). While it is probably not surprising to find that large Histadrut, Kibbutzim and public firms were inefficient, what is surprising is the low productive efficiency and high unit cost for the large stock market firm. Our results imply that, at least during the period 1979-1983, Israeli firms who could obtain access to financial resources from the public were inefficient, or that many inefficient firms may have entered the stock exchange in Israel in order to solve their financial problems.

During the period studied, the large Histadrut firms were also relatively inefficient - with estimated production and cost efficiency 10% below that of large private firms. This result is not surprising, given the crisis of "Koor" enterprises (the main Histadrut conglomerate) towards the end of the eighties; a blow from which they have still not recovered.[25]

The large Kibbutzim firms are estimated to be 13% less efficient than the large private firms. As noted above, the cost function results are not in agreement, suggesting no significant differences in cost efficiency. The same discrepancy occurs with respect to small Kibbutzim firms. From the OLS results we estimate no production efficiency differences between small Kibbutzim firms and small private firms, but a significant 8% cost efficiency advantage for the Kibbutzim firms. The serial correlation corrected results are somewhat different, but the direction and magnitude of the discrepancy remain. The answer probably resides in the fact that the wage rates for Kibbutzim firms are largely imputed wages based on the average consumption expenditure of a Kibbutz member, rather than a market-determined wage. To analyze the effect of this imputation we estimated a wage equation from our data set (see section 9). Small Kibbutzim firms appear to have imputed wages which are 23% below market (opportunity cost) wages.

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[25] This result is however in sharp contrast to that obtained by Ben-Ner and Estrin (1988) using aggregate 2 digit branch data for 14 branches over the period 1969-1981. They obtained the result that union-owned (Histadrut) firms were 43% more efficient than other firms in Israeli industry. A somewhat similar result was also obtained by Kondor (1991), who claimed that Histadrut and public firms were more efficient than private firms. His conclusions were based on average data of 13 branches for one year -1982. His regressions utilize a maximum of 35 observations.

If these firms behave as if they paid market wages rather than imputed wages in determining industry employment, this would explain the production-cost discrepancy. However, the discrepancy with respect to large Kibbutzim firms cannot be rationalized in this manner, since our wage equation shows no significant difference between imputed and opportunity cost wages for this group of firms.

With respect to the public sector enterprises, large public firms are estimated to be 10% less efficient in production than large private firms, and 6% less cost efficient.

The sector efficiency results demonstrate the reason for separating large and small firms in the specification of heterogeneity effects. From table 5 it can be seen that there are no significant production efficiency differences among small firms classified by sector. The cost function results (table 6) do suggest some cost inefficiencies in the small stock and Histadrut sectors. However, the main sectoral differences in production and cost efficiencies reside in the large firms.

Development areas

We estimate that production and cost inefficiency (approximately 3%) are phenomena characterizing Development Area B, as compared to the central areas. Low productivity and high costs could be expected in firms that received extensive capital subsidies in the 1970s and as a result may have had over-investment and under-utilization of capital. The counter-intuitive results concerning Development Area A are puzzling. Even wages are not significantly lower in that region (table 7). The results may be related to the specific geographic location of some successful natural resource developers, e.g., the Dead Sea Works in the Negev, etc. The issue of the effect of development subsidies on production and cost efficiency requires more detailed research, which we hope to pursue in the near future.

Other heterogeneity effects

In Appendix A we developed a rationale for the inclusion of the 1979 concentration ratio of the sub-branch in which the firm is located (CONC), and the firm's 1979 export ratio (EX). We also noted that the sign of the parameter associated with CONC should be positive and that associated with EX should be negative. The cost function results are consistent with this analysis. However, for the production function, the estimates of both parameters are insignificantly different from zero, although the one associated with EX is consistently negative as expected.

The variable EY represents the year of establishment of the firm and hence is a measure of the age of the firm. The signs of the associated parameters in the production function and cost function equations imply that younger firms have lower productivity and higher unit costs. A crucial part of the ceteris paribus assumption is the conditioning on equal qualities of capital, since a young firm would generally have a higher quality of capital which would raise its relative productivity. The higher productivity of older firms may stem from workers' on the job training or other time-related expertise which is not measured in our QL variable. The process of "learning by doing" may reduce costs and raise productivity.

Among our heterogeneity controls are year-specific dummy variables. The high, accelerating inflation rate and the rapid changes in government policies, particularly towards taxes and subsidies (see section 1), are no doubt reflected in the output and input variables concerning production and cost. By adding specific dummy variables for the different years we are trying to control for the real influences of these developments on production and cost which are not otherwise accounted for by our other right-hand side variables. The coefficients on these dummy variables will be a compounding of these year effects and shifts of the functions caused by disembodied technical change. As can be seen from the parameters, the sharp policy measures of 1980 had a negative impact on labour productivity and unit cost. The net impact of the following two years (1981 and 1982) was positive in both the production and cost function results. The results for 1983 seem somewhat at odds with what we would have expected, since they suggest a decline in production and cost efficiency. However variation in the year dummy variable parameters may also result from statistical measurement errors stemming from the deflation of basic nominal data during periods of high inflation, a problem which was becoming acute in the last year of our sample.

8. The Issue of Sample Selection

As noted earlier, the use of a balanced panel raises the issue of sample selection bias, which could occur if the excluded firms differed systematically in their productivity and cost characteristics from the included firms. To investigate that possibility we added to the sample a number of firms which either opened or closed during 1979 or 1982. The augmented sample consisted of 935 firms and 4,361 observations. The second column of table 5 contains the results of applying OLS to the production function[26]. We added to the specification two new dummy variables, CL and OP. The variable CL takes the value 1 if the firm closed during 1979 or 1982 and 0 otherwise. The variable OP is analogously defined to distinguish firms which opened during 1979 or 1982.

A comparison of the results in the two columns of table 5 indicate that the sample selection process which created a balanced panel has not substantially affected the main results of this paper. This statement should be tempered by the realization that a relatively small proportion of the excluded firms could be added due to data limitations. On the other hand, the firms selected against clearly had lower production efficiency than those in the balanced panel. Firms which closed were estimated to be 18% less efficient than survivor firms, and new firms were estimated to be 27% less efficient than these continuing firms. (For a detailed analysis of firm entry and exit in Israeli industry see Griliches and Regev (1991)).

9. Wages and the Characteristics of Israeli Industry

The wage rate is a central variable in the estimation of the cost function. It is measured separately

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[26] The cost function could not be estimated due to the lack of availability of cost data for the additional firms.

for every firm on a yearly basis so it is the main contributor to variation in relative prices in the cost function. Because of its importance it seems worthwhile to investigate to some extent the features of Israeli industry that influence the wage rate of the firm. We do not pretend to have done an in-depth analysis of wage determination, a topic that deserves a separate study.

Table 7 contains OLS regressions of the logarithm of the wage rate (annual wages per full-time equivalent employee) on the heterogeneity controls used in the production and cost functions estimation, both for the balanced and unbalanced samples[27]. One new control variable, FEM, has been added to the wage equation. FEM measures the percentage of employees that are female. We do not observe this variable for each firm, but use instead the average percentage for the three digit industry which contains the firm (firms are allocated to one of 100 three digit industries). In addition, log K, $(\log K)^2$), and interactions between log K and the branch dummy variables are included among the right-hand side variables. Finally, a variable QRESID has been included among the regressors. QRESID is the logarithm of actual output divided by predicted output, where predicted output is calculated from the corresponding OLS production function estimated structure. QRESID then is a measure of the extent to which production efficiency exceeds its expected level, conditional on the observed characteristics of the firm (this excess in some cases will of course be negative).

As seen from table 7, it is clear that the main economic characteristics of Israeli industry have significant impacts on a firm's wage rate. Higher quality of labour, quality of capital and capital intensity are associated with higher wages in a firm. Firms which do not engage in R&D activity pay lower wages. For firms that do engage in R&D activity, the more intensive this activity (R&D stock per worker) the higher the wage. The wage rate is an increasing function of the size of the firm. For example, private

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[27] The variable EX had to be eliminated from the unbalanced panel regression due to lack of data. We did not explore the panel data estimation techniques used in the production and cost function estimations, with the exception of the use of average data. The average data regressions were essentially similar to the individual observations regressions, and given the lack of sensitivity of the main results in the earlier production and cost function regressions, we decided not to pursue the matter further.

firms with more than 300 employees pay 21% higher wages (balanced panel results)[28] than firms with between 5 and 50 employees. It is interesting to note that from the production function results we estimate that average labour productivity is only 5% higher for such firms. This discrepancy may be due to the relative strengths of unions operating among small and large firms.

The sectoral effects are as expected. As noted previously, imputed wages for the small Kibbutzim firms are 23% below the expected wages of firms with the same characteristics in other sectors. High wage rates appear in the Histadrut and public sectors, with the effect being most striking in the public sector, with an excess wage rate of 23-29%. The large public firms appear particularly problematic. These firms are characterized by an excess wage rate of 29% and a labour productivity deficiency of 10%, compared to large private firms.

Wage rates are lower in development areas, although the effect is small with respect to Area A. As expected, firms in more concentrated industries pay higher wage rates. A surprise is the negative relationship between the export rate and the wage rate. A possible rationale is that relatively low wages (conditional on the quality of labour) is a condition necessary to compete in the international market. This is consistent with the finding that Israel has a comparative advantage internationally in the export of goods intensive in high quality labour (see Bregman et al (1991)). The coefficient on EY demonstrates that younger firms pay lower wages, ceteris paribus.

Female employees are paid lower wages than males. According to our results, the average female wage rate is 23% below the male wage rate, conditional on the other control variables in the

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[28] The percentage difference in wages attributed to the sectoral effect is calculated as [exp(.189)-1]*100% = 21%. In the following discussion we will use the results from the balanced panel regression except when discussing the characteristics of firms that closed and opened during the period under consideration.

regression.[29,30]

Particularly interesting is the strong effect of QRESID. Firms characterized by higher efficiency levels clearly pay higher wages. According to our regression results, approximately 70% of the excess average labour productivity is reflected in higher wage rates.[31]

The year effects are consistent with the changes in real wages described in section 2. Real wages in our sample declined by 5% in 1980, increased by 8% in 1981, by 1% in 1982, and declined by 3% in 1983. These changes can be compared with the changes in average labour productivity evident from table 5. The directions of change are the same, but there appears to be a large one-time increase in real wages in 1981 not mirrored by productivity improvement.

Wage rates appear to be higher in the Electronics industry than in the other five main branches defined in this study. The differential appears particularly large for the food and tobacco and textile

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[29] The gender effect is one of the few effects which is sensitive to whether the sample chosen is the balanced or unbalanced panel. For the unbalanced panel, we estimate that the female wage rate is 28% below the male wage rate, rather than the 23% for the balanced panel.

[30] We included FEM as a control variable in the OLS production function estimation, and it proved to be completely insignificant. For example, for the balanced panel the coefficient on FEM was -0.01 with a t-statistic of -0.3. The remainder of the results were virtually identical to those reported in table 5. The fact that firms with higher percentages of female workers paid lower wages without suffering productivity penalties suggests the possibility of gender-based labour market discrimination. We are reluctant to offer that conclusion without further study. The lower wages paid to female workers may be due to the fact that wage rates tend to depend on seniority and continuity in the work force, and we have no control variables for these effects. In addition females may be concentrated in highly competitive low wage industries, the effect of which is probably not captured adequately by our six branch dummies. Finally, if the proportion of females in industry is highly correlated with the proportion of employees from the West Bank and Gaza, and employees from the territories are willing to supply labour at low wage rates (relative to non- territories employee rates), this effect will be attributed to the gender variable in our results. Nevertheless, the finding of a large discrepancy between wage rates and productivity with respect to gender opens up an intriguing avenue for further research which we hope to pursue in a future paper.

[31] It is possible that at least a portion of this effect is due to unmeasured aspects of labour quality as conventionally defined. In this case, the phenomenon, while still representing a return to more efficient production, should be partially incorporated into the QL effect.

industries.[32]

Finally, we move to the unbalanced sample to consider the wage rate differences between firms which existed throughout the five years of the sample and those that either opened or closed during those years. The coefficients on the variables CL and OP indicate very substantial differences. Ceteris paribus, firms that closed (opened) during the sample period paid 32% (40%) lower wages than firms in existence throughout the sample period. This exceeds the average labour productivity difference of 18% (27%).

10. Summary and Conclusions

In this paper we have used a unique individual firm data set to estimate the production and cost characteristics of Israeli industry. We have seen that our ability to include a detailed list of heterogeneity controls in the specifications substantially enhanced the explanatory power of the models and contributed to our understanding of the nature of Israeli industry. We have tried to examine carefully the econometric problems which arise in attempting to estimate production and cost functions from panel data. Questions of sample selectivity, serial correlation due to unobserved firm effects, and endogeneity were addressed. For *this* particular data set the estimates did not appear to be particularly sensitive to alternative estimation procedures, so that the OLS results for the production function and IZ results for the cost function provided adequate representations.

Among the large number of empirical results, several stand out. Production and cost inefficiencies seem to be concentrated among large (>300 employees) firms in sectors other than the private sector (private firms not listed on the stock exchange). Because of this result, although large private firms are efficient relative to smaller private firms, large firms on average are not, so that efficient production on

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[32] This effect cannot be determined by just looking at the coefficients on the branch dummy variables because the interaction effects with capital per worker need to be taken into account. Once this is done the apparent large discrepancy with respect to chemicals disappears.

average is concentrated among medium sized firms.

A surprising finding is the relative inefficiency of large firms listed on the stock exchange (Stock firms). We have suggested several explanations for this finding but clearly we do not have the complete answer. Histadrut and public firms appear to be poor performers in a number of dimensions. Large public firms are inefficient and pay excessively high wages. Small (<300 employees) public firms are not estimated to be inefficient but pay excessive wages. Large Histadrut firms are inefficient while small Histadrut firms pay excessive wages.

Finally, the wage structure in Israeli industry is seen to be systematically related to the heterogeneity controls used in this study, in ways which are generally as expected. There are three particularly intriguing results which merit further investigation. First, small Kibbutzim firms impute wages which fall far short (23%) of market (opportunity cost) wages, but this is not true of large Kibbutzim firms. Second, female wage rates are 23-28% below male wage rates without corresponding productivity differences[33] Third, there is a very statistically significant and economically important impact of higher than expected labour productivity on wages, where firms experiencing higher than expected productivity also pay higher than expected wages, and about 70% of this productivity "bonus" appears as a wage rate increment.

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[33] For a sample of firms for the year 1988 drawn from the Central Bureau of Statistics individual firm data base, Berman (1991) , using a related but different set of control variables, estimated that the imputed wage rate of Kibbutzim firms was on average 23% below the market wage rate. He did not distinguish between large and small Kibbutzim firms. He also estimated that female wage rates were 27% below male wage rates.

List of Variables for the Cost and Production Functions

Dummy Variables

Industry:

D1	Food and Tobacco
D2	Light industries
D3	Chemicals, Minerals
D4	Metal, Machinery
D5	Textile, Clothing Leather
D6	Electronics, Transportation Equipment, Other (reference group)

Size: (In the cost function we use equivalent output groups)

S1	=	less than 50 employees (reference group)
S2	=	from 50-100 employees
S3	=	from 100-300 employees
S4	=	300+ employees

Ownership sector: (the suffix L is added if the firm is large (>300 employees) and S is added if the firm is small (300 or less employees)

PRV	=	Private owners, partnerships, private corporations (reference group)
ST	=	Stock Exchange members
HI	=	Histadrut firms
KI	=	Kibbutz firms
PU	=	Public sector

Development Area:

DA	=	Development A
DB	=	Development B + Jerusalem
DC	=	Development C - all others (reference group)

Years:

YR79	=	1979 (reference year)
YR80-83		1980, 1981, 1982, 1983

Other Variables

CONC	=	three firm concentration ratio at the three digit industry level, including competitive imports and excluding exports (Index, 1979)
FEM	=	percentage of employees that are female, calculated at the three digit industry level
EY	=	establishment years (Index from 1922 to 1979)
EX	=	export ratio (percentage, 1979)
QL	=	quality of labour - proportion of engineers and technicians (Index, average 1979 and 1983)
RD	=	R&D capital services (Index, average 1979-83)
QK	=	Ratio of new capital (investment in last 6 years, 1982)
Q	=	output per labour unit, constant prices
M	=	materials per labour unit, constant prices
K	=	capital services per labour unit, constant prices
P	=	price index of output (implied price index)
W	=	wages (cost of labour including benefits) per worker (relative to P)
PML	=	materials price index (relative to P) divided by W
PKL	=	capital services price index (relative to P) divided by W
TC	=	total costs, per unit of output (current prices)
VC	=	variable costs, per unit of output (current prices)

Table 1
Indicators of Industrial Growth, 1979-1983
(Annual average real change, percent)

	1979-1983	1980	1981	1982	1983
Industrial production[1]	1.8	-3.0	6.3	0.9	3.5
Labour input	1.1	-3.3	1.4	1.5	1.5
Capital stock	5.2	6.0	4.4	4.0	4.9
Total factor productivity	0.0	-3.4	3.7	-1.6	0.6
Industrial exports[1]	7.3	15.3	11.9	0.3	-0.7
Wages per unit of output	4.3	3.7	5.1	3.3	4.7
Inflation Rate	139	133	101	131	191

[1] Excluding diamonds.

Source: Bank of Israel Annual Reports.

Table 2

Estimated Output Elasticities of Materials, Labour, Capital Services for Various Production Functions[1]

	EM	EL	EK	SM	SL	SK
Production Function Specifications (Balanced Panel)						
(1) OLS	.683	.250	.067			
(2) IZ (Chamberlain procedure)	.662	.264	.074			
(3) OLS (average data)	.689	.247	.064			
(4) Short run cost minimization	.634	.298	.068			
(5) Short run cost min (Chamberlain procedure, IV)	.757	.075	.168			
(6) Long run cost minimization	.655	.266	.078			
(7) Long run cost minimization (Chamberlain procedure)	.650	.306	.044			
(8) Actual cost data				.619	.320	.061

[1] Parameter estimates are contained in table 5 and table B.1.

Table 3

Estimated Cost Shares of Materials, Labour, Capital Services for Various Cost Functions[1]

	SM	SL	SK
Cost Function Specifications (Balanced Panel)			
(1) Long run cost minimization	.634	.305	.061
(2) Long run cost minimization (Chamberlain procedure)	.702	.250	.048
(3) Long run cost minimization (average data)	.633	.306	.061
(4) Actual total cost data	.619	.320	.061
(5) Short run cost minimization[2]	.670	.330	....
(6) Short run cost min (Chamberlain procedure)[2]	.658	.342	....
(7) Short run cost minimization (average data)[2]	.671	.329	....
(8) Actual materials and labour cost data[2]	.658	.342	....

1. Parameter estimates are contained in table 6 and tables B.2.
2. Cost shares are cost of materials or labour divided by the cost of materials plus labour.

Table 4

Measures of Input Substitution

Inputs	Production Function Estimates[1]	Cost Function Estimates[2]
Allen Elasticities of Substitution		
Capital-Labour	0.7	0.9
Labour-Materials	4.0	0.9
Materials-Capital	4.2	2.0
Morishima Elasticities of Substitution		
Labour-Capital	0.7	0.9
Capital-Labour	0.9	1.6
Labour-Materials	3.4	0.9
Materials-Labour	3.9	1.0
Capital-Materials	1.4	1.7
Materials-Capital	4.1	1.7

1. Obtained from the OLS production function estimates.

2. Obtained from the IZ long-run cost function estimates.

Table 5
Production Function Regression Results - OLS Estimation

Variable	Balanced Panel Par.	Balanced Panel T	Unbalanced Panel Par.	Unbalanced Panel T
C	2.365	33.8	2.390	34.8
QL	.208	2.6	.185	2.4
RD	-.001	-0.2	-.000	-0.1
NORD	-.038	-2.2	-.037	-2.2
QK	.031	5.8	.031	5.7
S2	.037	3.7	.034	3.3
S3	.016	1.5	.013	1.3
S4(prv)	.047	2.7	.037	2.2
STL	-.140	-5.4	-.130	-5.0
STS	-.023	-1.1	-.018	-0.9
HIL	-.096	-4.0	-.088	-3.7
HIS	-.025	-1.7	-.023	-1.6
KIL	-.136	-2.9	-.134	-2.8
KIS	.005	0.3	.005	0.3
PUL	-.108	-3.0	-.103	-2.9
PUS	.020	0.5	.002	0.0
DA	.004	0.3	.004	0.3
DB	-.029	-2.6	-.030	-2.7
CONC	.003	0.5	.005	0.7
EY	-.015	-1.6	-.019	-2.1
EX	-.019	-1.2	..	..
CL			-.201	-7.9
OP			-.320	-5.6
YR80	-.029	-2.5	-.033	-2.8
YR81	.018	1.5	.013	1.2
YR82	.008	0.7	-.001	-0.1
YR83	-.018	-1.5	-.021	-1.8
D1	.051	0.9	.028	0.5
D2	-.028	-0.5	-.058	-1.1
D3	.579	8.1	.517	7.4
D4	.267	5.1	.249	4.8
D5	-.428	-7.1	-.462	-7.8

Table 5 (continued)

Variable	Balanced Panel Par.	Balanced Panel T	Unbalanced Panel Par.	Unbalanced Panel T
K	.143	7.8	.138	7.6
M	.148	5.7	.147	5.8
KK	.003	0.5	.000	0.0
MM	.188	25.5	.185	26.0
KM	-.033	-6.1	-.030	-5.7
KD1	.028	1.8	.023	1.5
KD2	.023	1.5	.017	1.1
KD3	.128	7.1	.121	6.9
KD4	.033	2.2	.025	1.7
KD5	-.031	-2.0	-.036	-2.4
MD1	-.057	-3.0	-.048	-2.6
MD2	-.014	-0.7	-.002	-0.1
MD3	-.189	-8.3	-.169	-7.5
MD4	-.091	-5.1	-.082	-4.7
MD5	.117	5.7	.129	6.4
R^2	.892		.892	
MSE	.238		.240	
N	4,245		4,361	

Table 6

Long Run Cost Function Estimation Results - IZ Estimation (Balanced Panel)

Variable	Par.	T
C	-.939	-22.9
QL	-.157	-2.2
RD	-.001	-0.4
NORD	.002	0.2
QK	-.023	-4.9
S2	-.143	-15.2
S3	-.146	-15.0
S4(prv)	-.223	-14.4
STL	.128	5.3
STS	.061	3.4
HIL	.101	4.8
HIS	.040	3.2
KIL	.013	0.3
KIS	-.083	-5.7
PUL	.057	1.8
PUS	-.015	-0.5
DA	-.040	-3.0
DB	.027	2.7
CONC	.024	4.1
EY	.048	5.9
EX	-.103	-7.0
A80	.024	2.4
A81	-.060	-5.8
A82	-.059	-5.7
A83	-.030	-2.9
D1	.513	21.4
D2	.132	5.8
D3	.188	6.9
D4	.063	2.9
D5	.286	12.2

Table 6 (continued)

Variable	Par.	T
PK	.063	12.4
PM	.610	45.8
PKK	-.038	-3.6
PMM	-.024	-2.0
PKM	.039	3.7
PKD1	-.012	-3.7
PKD2	-.001	-0.5
PKD3	.028	7.7
PKD4	.004	1.3
PKD5	.000	0.1
PMD1	.188	22.7
PMD2	.048	6.1
PMD3	.079	8.6
PMD4	.018	2.4
PMD5	.052	6.3
R^2	.821	
MSE	.221	
N	4,245	

Table 7

Estimation of the Influence of Industry and Firm Characteristics on the Wage Rate in Israeli Industry

	Balanced Panel		Unbalanced Panel	
Variable	Par.	T	Par.	T
C	2.437	37.1	2.425	37.1
QL	.816	7.1	.753	6.6
RD	.035	5.2	.031	4.6
NORD	-.131	-5.1	-.103	-4.0
QK	.049	6.3	.048	6.2
S2	.127	8.5	.119	7.9
S3	.156	9.8	.128	8.2
S4(prv)	.189	7.3	.140	5.6
STL	-.050	-1.3	-.022	-0.6
STS	-.026	-0.8	-.040	-1.3
HIL	.032	0.9	.052	1.4
HIS	.070	3.3	.081	3.9
KIL	-.035	-0.5	-.060	-0.9
KIS	-.259	-10.7	-.263	-10.8
PUL	.257	4.9	.241	4.6
PUS	.211	3.7	.218	3.8
DA	-.035	-1.6	-.043	-2.0
DB	-.089	-5.4	-.098	-5.9
CONC	.059	5.9	.072	7.3
EY	-.040	-3.0	-.055	-4.1
EX	-.207	-8.2	..	..
FEM	-.258	-4.9	-.330	-6.5
K	.137	8.3	.133	8.0
KK	-.016	-2.3	-.014	-2.0
QRESID[1]	.684	30.0	.687	30.3
YR80	-.052	-3.1	-.057	-3.3
YR81	.131	7.7	.127	7.4
YR82	.141	8.3	.132	7.8
YR83	.114	6.6	.110	6.4
D1	-.229	-9.6	-.222	-9.3
D2	-.065	-3.1	-.057	-2.7
D3	-.180	-5.9	-.178	-5.8
D4	-.002	-0.1	.004	0.2
D5	-.234	-9.9	-.248	-10.5
CLOSE	..	..	-.388	-9.3
OPEN	..	..	-.515	-4.5

[1] QRESID is the logarithm of actual output divided by predicted output (see text, page 23).

Table 7 (continued)

Variable	Balanced Panel Par.	Balanced Panel T	Unbalanced Panel Par.	Unbalanced Panel T
KD1	.050	2.3	.044	2.0
KD2	.003	0.2	.005	0.3
KD3	.073	2.9	.067	2.7
KD4	.010	0.5	.008	0.4
KD5	-.003	-0.2	-.008	-0.4
R^2	.488		.493	
MSE	.351		.354	
N	4,245		4,332	

APPENDIX A

Heterogeneity Effects Induced by Base Year Price Variation

As noted in the text, the procedure of deflating current dollar quantities of output and materials by branch-specific price indexes to obtain constant dollar quantities introduces a source of industry-specific firm heterogeneity. This occurs because the industry price indices are all equal to unity in the base year (1979), so that the constant 1979 dollar "quantities" we use are the theoretically correct physical quantities confounded with inter-industry base year price variation. In this appendix we develop the method used to adjust the model to account for this source of heterogeneity.

We begin with a discussion of the materials data. The current value of the materials input is $P_{Mit} \cdot M_{it}$, where P_{Mit} is the materials price for the ith firm at time t, and M_{it} is the quantity of materials employed by the ith firm at time t. This current value can be decomposed as follows:

$$P_{Mit} \cdot M_{it} = \left(\frac{P_{Mit}}{P_{MBt}}\right) \cdot \left(\frac{P_{MBt}}{P_{MB,79}}\right) \cdot \left(\frac{P_{MB,79}}{\bar{P}_{M,79}}\right) \cdot \left[\bar{P}_{M,79} \cdot M_{it}\right] \tag{A1}$$

where
P_{MBt} = the materials price index at time t for the branch which contains the ith firm
$P_{MB,79}$ = the materials price index in 1979 for the branch which contains the ith firm
$\bar{P}_{M,79}$ = a reference price index for 1979, assumed equal to a constant.

The first ratio in (A.1) is assumed equal to unity for each of 186 branches of industry. The second ratio is the branch price index (for each of 186 branches) used to deflate current dollars materials to obtain constant dollar materials. It is also the "price of materials" used in cost function estimation. The third ratio represents the variability of branch material price indexes in the base year (1979). This variability is not observable since all branch materials price indices are normalized to unity in the base year. We assume this variability can be modelled by the equation

$$\log P_{MB,79} = \log \bar{P}_{M,79} + \sum_{B=6} \theta_B \cdot D_B \tag{A.2}$$

where D_B is a dummy variable corresponding to one of the six major branches of industry.

Since $\bar{P}_{M,79}$ is a constant, $\bar{P}_{M,79} \cdot M_{it}$ is a constant 1979 dollar representation of the physical materials input.

We now proceed to consider the output data. The current value of output is $P_{Qit} \cdot Q_{it}$, where P_{Qit} is the output price for the ith firm at time t, and Q_{it} is the quantity of output of the ith firm at time t. Analogously to the case of materials, the current value of output can be decomposed as follows:

$$P_{Qit} \cdot Q_{it} = \left(\frac{P_{Qit}}{P_{QBt}}\right) \cdot \left(\frac{P_{QBt}}{P_{QB,79}}\right) \cdot \left(\frac{P_{QB,79}}{\bar{P}_{Q,79}}\right) \cdot \left[\bar{P}_{Q,79} \cdot Q_{it}\right] \tag{A.3}$$

Analogous to the case of materials, the term in the first set of brackets is assumed equal to unity for each of the 100 branches of industry for which an output price index is calculated. The second ratio is the output price index used to deflate current value of output. The third ratio represents the variability of branch output price indices in the base year 1979. Once again, this variability is not observable because all branch output price indices are normalized to unity in 1979.

Following Bregman et al (1991), we assume that the base year output price index variability is partially due to the existence of variations in market power, which we represent by the 1979 four firm concentration ratio (CONC). This measure of market power is only relevant for sales into the domestic Israeli market. We also include as an explanatory variable the 1979 ratio of exports to sales (EX), since the output price index is a weighted average of export and domestic price indices. Adding fixed effects corresponding to the six main branches of industry, we obtain the base period output price index variability equation

$$\log P_{QB,79} = \log \bar{P}_{Q,79} + \sum_{B=6} \gamma_B D_B + \alpha_c \cdot CONC + \alpha_x \cdot EX \qquad \text{(A.4)}$$

We would expect that $\alpha_c > 0$ and $\alpha_x < 0$ (since Israeli firms with domestic market power would be unlikely to also possess market power in export markets).

Now consider the translog production function with output Q_{it} and inputs labour (L_{it}), capital (K_{it}), and materials (M_{it}). We also assume technological heterogeneity by permitting zero and first order fixed effects with respect to the six main branches. The production function takes the form:

$$\begin{aligned}
\log (\bar{P}_{QB,79} \cdot Q_{it}) &= \alpha_o + \underline{\alpha}_z \cdot z \\
&+ \sum_B \alpha_B D_B + (\alpha_L + \sum_B \alpha_{LB} D_B) \cdot \log L_{it} + (\alpha_K + \sum_B \alpha_{KB} D_B) \cdot \log K_{it} \\
&+ (\alpha_M + \sum_B \alpha_{MB} D_B) \cdot \log(\bar{P}_{MB,79} \cdot M_{it}) \\
&+ \tfrac{1}{2}[\alpha_{LL} \cdot (\log L_{it})^2 + \alpha_{KK} (\log K_{it})^2 + \alpha_{MM} \cdot \log(\bar{P}_{M,79} \cdot M_{it})^2] \\
&+ \alpha_{LK} \log L_{it} \cdot \log K_{it} + \alpha_{LM} \cdot \log L_{it} \cdot \log(\bar{P}_{M,79} \cdot M_{it}) \\
&+ \alpha_{KM} \log K_{it} \cdot \log(\bar{P}_{M,79} \cdot M_{it})
\end{aligned} \qquad \text{(A.5)}$$

where the constants $\bar{P}_{QB,79}$ and $\bar{P}_{MB,79}$. have been included without loss of generality. The vector $\underline{z}$ represents all the non-price induced firm-specific heterogeneity effects (size, location, etc.), and $\underline{\alpha}_z$ is the corresponding vector of parameters.

But $\bar{P}_{QB,79} \cdot Q_{it}$ and $\bar{P}_{MB,79} \cdot M_{it}$ are not observable. Equation (A.5) can be put in terms of observable data by substituting from equations (A.2) and (A.4) and rearranging:

$$
\begin{aligned}
&\log(P_{QB,79} \cdot Q_{it}) = \\
&\alpha_o + \underline{\alpha} \cdot \underline{z} + \alpha_c \cdot CONC + \alpha_x \cdot EX \\
&+ \sum_B (\alpha_B + \gamma_B - \alpha_M \cdot \theta_B + \tfrac{1}{2}\alpha_{MM} \cdot \theta_B^2) \cdot D_B \\
&+ [\alpha_L + \sum_B (\alpha_{LB} - \alpha_{LM} \cdot \theta_B) \cdot D_B] \cdot \log L_{it} \\
&+ [\alpha_K + \sum_B (\alpha_{KB} - \alpha_{KM} \cdot \theta_B) \cdot D_B] \cdot \log K_{it} \qquad \text{(A.6)} \\
&+ [\alpha_M + \sum_B (\alpha_{MB} - \alpha_{MM} \cdot \theta_B) \cdot D_B] \cdot \log(P_{MB,79} \cdot M_{it}) \\
&+ \tfrac{1}{2}[\alpha_{LL}(\log L_{it})^2 + \alpha_{KK}(\log K_{it})^2 + \alpha_{MM}(\log(P_{MB,79} \cdot M_{it}))^2 \\
&+ \alpha_{LK}\log L_{it} \cdot \log K_{it} + \alpha_{LM}\log L_{it} \cdot \log(P_{MB,79} \cdot M_{it}) \\
&+ \alpha_{KM}\log K_{it} \cdot \log(P_{MB,79} \cdot M_{it})
\end{aligned}
$$

The variables $P_{QB,79} \cdot Q_{it}$ and $P_{MB,79} \cdot M_{it}$ are the data calculated as "constant dollar" output and materials input and hence are observable. Equation (A.6) is observationally equivalent to a production function with zero and first order technological heterogeneity effects and no materials price heterogeneity effects (i.e. $\theta_B = 0$), as was noted in the text.

A similar procedure can be adopted for the long run cost function. The constant returns to scale cost function takes the form

$$\log(C_{it}/(\bar{P}_{Q,79} \cdot Q_{it})) = \beta_o + \beta_z \cdot z$$
$$+\sum_B \beta_B D_B + (\beta_L + \sum_B \beta_{LB} D_B) \cdot \log P_{Lit}$$
$$+(\beta k + \sum_B \beta_{KB} D_B) \cdot \log P_{Kit}$$
$$+(\beta M + \sum_B \beta_{MB} D_B) \cdot \log(P_{Mit}/\bar{P}_{M,79}) \tag{A.7}$$
$$+\tfrac{1}{2}[\beta_{LL}(\log P_{Lit})^2 + \beta_{KK}(\log P_{Kit})^2$$
$$+\beta_{MM}(\log(P_{Mit}/\bar{P}_{M,79}))^2]$$
$$+\beta_{LK} \log P_{Lit} \log P_{Kit} + \beta_{LM} \log P_{Lit} \cdot \log(P_{Mit}/\bar{P}_{M,79})$$
$$+ \alpha_{KM} \log P_{kit} \cdot \log(P_{Mit}/\bar{P}_{M,79})$$

where C_{it} is the total cost of production for firm i at time t.

Substituting (A.2) and (A.4) into (A.7) and rearranging, we obtain

$$\log(C_{it}/(P_{QB,79} \cdot Q_{it})) = \beta_o + \beta_z \cdot z - \alpha_c \cdot CONC - \alpha_x \cdot EX$$
$$+\sum_B (\beta_B - \gamma_B + \beta_M\theta_B + \tfrac{1}{2}\beta_{mm}\theta_B^2) \cdot D_B$$
$$+ \left[\beta_L + \sum_B (\beta_{LB} + \beta_{LM} \cdot \theta_B) \cdot D_B \right] \cdot \log P_{Lit}$$
$$+ \left[\beta_k + \sum_B (\beta_{KB} + \beta_{KM} \cdot \theta_B) \cdot D_B \right] \cdot \log P_{kit} \tag{A.8}$$
$$+ \left[\beta_M + \sum_B (\beta_{MB} + \beta_{MM} \cdot \theta_B) \cdot D_B \right] \cdot \log (P_{Mit}/P_{MB,79})$$
$$+ \tfrac{1}{2} \left[\beta_{LL} \cdot (\log P_{Lit})^2 + \beta_{KK} \cdot (\log P_{Kit})^2 + \beta_{MM} \cdot (\log (P_{Mit}/P_{MB,79}))^2 \right]$$
$$+ \beta_{LK} \log P_{Lit} \cdot \log P_{kit} + \beta_{LM} \log P_{Lit} \cdot \log (P_{Mit}/P_{MB,79})$$
$$+ \beta_{km} \log P_{Kit} \log (P_{Mit}/P_{MB,79})$$

We now present the specification of the short run variable cost function. The constant returns to scale translog variable cost function can be written in the form

$$\log (VC_{it}/\bar{P}_{Q,79} \cdot Q_{it}) = \delta_o + \delta_z \cdot z$$
$$+ \sum_B \delta_B D_B + (\delta_L + \sum_B \delta_{LB} D_B) \cdot \log P_{Lit}$$
$$+ (\delta_M + \sum_B \delta_{MB} D_B) \cdot \log (P_{Mit}/\bar{P}_{M,79})$$
$$+ (\delta_K + \sum_B \delta_{KB}) \cdot \log (K_{it}/\bar{P}_{Q,79} \cdot Q_{it}) \tag{A.9}$$
$$+ \tfrac{1}{2} \left[\delta_{LL}(\log P_{Lit})^2 + \delta_{MM} (\log (P_{Mit}/\bar{P}_{M,79}))^2 + \delta_{KK}(\log (K_{it}/\bar{P}_{Q,79} \cdot Q_{it}))^2 \right]$$
$$\delta_{LM} \log P_{Lit} \cdot \log(P_{Mit}/\bar{P}_{M,79})$$
$$+ \delta_{LK} \log P_{Lit} \cdot \log (K_{it}/\bar{P}_{Q,79} \cdot Q_{it})$$
$$+\delta_{KM} \log(P_{Mit}/\bar{P}_{M,79}) \cdot \log (K_{it}/\bar{P}_{Q,79} \cdot Q_{it})$$

Equation (A.9) can be reformulated in terms of observable data, as was done with the other specifications, by substituting from (A.2) and (A.4), the expressions

$$\log \bar{P}_{M,79} = \log P_{MB,79} - \sum_{B \neq 6} \theta_B D_B \tag{A.10}$$

$$\log \bar{P}_{Q,79} = \log P_{QB,79} - \sum_{B \neq 6} \gamma_B D_B - \alpha_c \cdot CONC - \alpha_x \cdot EX \tag{A.11}$$

APPENDIX B

Selected Alternative Specifications of Production and Cost Functions

Table B.1
Production Function Estimation* (1979-1983)

Chamberlain Procedure:

Variable	PFS-IZ Par.	PFS-IZ T	PFS-3SLS Par.	PFS-3SLS T	PFS-C.M. Par.	PFS-C.M. T	PFL-C.M. Par.	PFL-C.M. T
QL	.288	2.3	.206	1.1	.108	0.9	.048	0.4
RD	-.006	-0.8	-.009	-0.8	-.012	-1.8	-.008	-1.2
NORD	-.009	-0.3	.018	0.4	.008	0.3	-.003	-0.1
QK	.030	3.5	.036	2.5	.031	4.0	.024	3.1
S2	.034	2.1	.044	1.7	.001	0.0	.008	0.6
S3	.010	0.6	.007	0.3	.002	0.1	.002	0.1
S4(Pr.)	.051	1.8	.023	0.5	.029	1.1	.031	1.2
STL	-.137	-3.3	-.204	-3.2	-.080	-2.1	-.097	-2.6
STS	-.012	-0.4	-.072	-1.4	.007	0.2	.009	0.3
HIL	-.104	-2.7	-.129	-2.3	-.104	-3.0	-.087	-2.5
HIS	-.011	-0.5	-.074	-2.0	-.029	-1.4	-.010	-0.5
KIL	-.135	-1.8	-.124	-1.1	-.109	-1.5	-.098	-1.4
KIS	.056	2.1	-.037	-0.9	.098	4.0	.100	4.2
PUL	-.133	-2.3	-.182	-2.1	-.167	-3.2	-.071	-1.4
PUS	.071	1.1	.005	0.1	.018	0.3	.047	0.9
DA	.001	0.0	-.029	-0.8	.025	1.1	.030	1.4
DB	-.027	-1.5	-.022	-0.8	-.009	-0.5	-.000	-0.0
CONC	-.008	-0.7	-.031	-1.8	-.004	-0.5	-.014	-1.5
EY	-.014	-1.0	-.016	-0.7	-.009	-0.7	-.014	-1.1
EX	-.048	-1.8	-.073	-1.8	-.012	-0.5	-.007	-0.3
YR79	2.643	(29.2)	2.208	(7.8)	2.656	(41.3)	2.727	(43.4)
YR80	2.613	(28.8)	2.185	(7.8)	2.622	(40.7)	2.700	(42.9)
YR81	2.661	(29.3)	2.221	(7.8)	2.649	(41.2)	2.728	(43.4)
YR82	2.649	(29.2)	2.212	(7.8)	2.629	(40.8)	2.714	(43.0)
YR83	2.621	(28.9)	2.174	(7.7)	2.614	(40.3)	2.707	(42.8)

Di
K,M,KK,MM,KM,Kdi,Mdi

* PFS = Short-run production function; PFL = Long-run production function. For other explanations, see text, p. 7-9.

Table B.1
Production Function Estimation (continued)

	Cobb-Douglas		Deviations from the Mean:*				Average Data:			
	Unbalanced		PFS-Balanced		PFS-Unbalanced		PFS-Balanced		PFS-Unbalanced	
Variable	Par.	T	Par.	T	Par.	T	Par.	T	Par.	T
C	1.505	22.9					2.218	16.3	2.291	17.4
QL	.193	2.3	.246	1.8	.218	1.6	.174	1.3	.107	0.8
RD	.000	0.0	-.002	-0.3	-.001	-0.2	-.001	-0.1	.002	0.3
NORD	-.028	-1.5	-.032	-1.0	-.031	-1.0	-.038	-1.2	-.041	-1.3
QK	.014	2.4	.035	3.7	.034	3.6	.029	3.1	.029	3.0
S2	.011	1.0	.042	2.4	.039	2.2	.032	1.8	.024	1.3
S3	-.005	-0.4	.022	1.1	.019	1.0	.010	0.5	.008	0.5
S4(Pr.)	.002	0.1	.053	1.7	.043	1.4	.041	1.3	.020	0.7
STL	-.138	-4.9	-.143	-3.1	-.131	-2.9	-.144	-3.1	-.113	-2.4
STS	-.060	-2.6	-.026	-0.7	-.020	-0.5	-.028	-0.7	-.006	-0.2
HIL	-.104	-4.1	-.099	-2.4	-.089	-2.1	-.098	-2.4	-.081	-1.9
HIS	-.034	-2.2	-.028	-1.1	-.023	-0.9	-.023	-0.9	-.021	-0.8
KIL	-.147	-2.8	-.129	-1.6	-.123	-1.5	-.146	-1.7	-.128	-1.5
KIS	.019	1.1	.002	0.1	.003	0.1	.010	0.4	.010	0.3
PUL	-.103	-2.6	-.123	-2.0	-.111	-1.8	-.106	-1.7	-.086	-1.3
PUS	.003	0.1	.038	0.5	.022	0.3	.001	0.0	-.082	-1.2
DA	.001	0.1	-.003	-0.1	.001	-0.0	.008	0.3	.003	0.1
DB	-.033	-2.7	-.032	-1.6	-.032	-1.7	-.026	-1.3	-.033	-1.7
CONC	.029	4.0	-.004	-0.3	-.002	-0.2	.008	0.7	.008	0.7
EY	-.013	-1.4	-.014	-0.9	-.020	-1.3	-.017	-1.0	-.027	-1.7
EX			-.024	-0.8			-.017	-0.6		
YR79			2.590		2.624					
YR80	-.034	-2.7	2.561		2.593					
YR81	.010	0.8	2.608		2.640					
YR82	-.001	-0.1	2.597		2.626					
YR83	-.018	-1.4	2.570		2.602					
CL	-.167	-6.0			-.203	-4.6			-.192	-7.3
OP	-.334	-5.4			-.330	-3.3			-.316	-6.3
Di										
K,M,KK,MM,KM,Kdi,Mdi										
R^2	.873		.988		.988		.926		.925	
MSE	.2600		.1678		.1682		.1875		.1958	
N	4,361		4,245		4,361		849		935	

* The random effects error components model applied to the balanced and unbalanced panels (see text, p. 9).

Table B.2
Cost Function Estimates* (1979-1983)

	CFL-GSL		CFL-DEV		CFS-GSL		CFL-AV**		CFS-AV**	
Variable	Par.	T	Par.	T	Par.	T	Par.	T	Par.	T
C							-1.018	-13.4	-1.312	-11.0
QL	-.207	-1.9	-.077	-0.7	-.143	-1.1	-.150	-1.2	-.159	-1.3
RD	.004	0.7	.005	0.8	.001	0.1	-.002	-0.3	-.002	-0.3
NORD	-.005	-0.4	-.002	-0.2	.031	2.0	.007	0.5	.014	1.0
QK	-.018	2.5	-.022	-2.9	.005	0.6	-.023	-2.7	-.023	-2.7
S2	-.111	-7.5	-.113	-7.3	-.086	-4.8	-.138	-8.3	-.140	-8.1
S3	-.102	6.6	-.108	-6.7	-.043	-2.3	-.136	-7.9	-.141	-7.9
S4(Pr.)	-.157	-6.5	-.158	-6.2	-.084	-2.8	-.218	-7.8	-.213	-7.6
STL	.124	3.3	.123	3.1	.069	1.5	.121	2.8	.122	2.8
STS	.065	2.4	.066	2.3	-.021	-0.6	.056	1.8	.058	1.7
HIL	.104	3.1	.104	3.0	.037	0.9	.095	2.6	.090	2.3
HIS	.028	1.4	.056	2.7	-.033	-1.4	.038	1.7	.034	1.5
KIL	.028	0.4	.030	0.4	.044	0.6	.009	0.1	.015	0.2
KIS	-.112	-4.9	-.091	-3.8	-.137	-5.0	-.084	-3.3	-.085	-3.2
PUL	.080	1.6	.103	2.0	-.018	-0.3	.058	1.1	.075	1.3
PUS	-.022	-0.4	.006	0.1	-.005	-0.1	-.024	-0.4	.009	0.2
DA	-.029	-1.4	-.032	-1.5	-.065	-2.6	-.038	-1.7	-.038	-1.6
DB	.018	1.1	.017	1.1	.003	0.2	.029	1.7	.030	1.7
CONC	.005	0.6	.020	2.1	.019	1.5	.022	2.2	.029	2.7
EY	.034	2.7	.038	2.9	.042	2.7	.046	3.2	.045	3.0
EX	-.096	-4.2	-.081	-3.4	-.079	-2.6	-.099	-3.9	-.110	-4.2
D1	.326	7.8	.382	8.6	-.004	-0.1	.513	10.8	.443	4.6
D2	.042	1.1	.081	1.9	-.198	-3.0	.133	2.9	.061	0.7
D3	.108	2.2	.111	2.2	-.370	-4.6	.188	3.4	-.225	-2.0
D4	.030	0.8	.038	0.9	-.049	-0.8	.060	1.4	-.070	-0.8
D5	.098	2.4	.148	3.4	-.046	-0.7	.305	6.5	.318	3.3
YR79	-.576	-9.3	-.695	-10.5	-.523	-5.8				
YR80	-.567	-9.1	-.668	-10.1	-.526	-5.9				
YR81	-.646	-10.4	-.739	-11.1	-.604	-6.7				
YR82	-.632	-10.1	-.729	-10.0	-.611	-6.8				
YR83	-.621	-9.9	-.695	-10.5	-.597	-6.6				
Kdi, Mdi										
R^2				.789				.855		.856
MSE				.1425				.1769		.1759
N	4,245		4,245		4,245		849		849	

* CFL = Long-run cost function; CFS = Short-run cost function. GSL = Chamberlain procedure, see text, p. 7-9.

** Average Data of 849 firms.

Table B.3

<u>Pearson Correlation Coefficients</u>
(N = 4,250)

	QL	RD	QK	CONC	EY	EX	Q
RD	.42						
QK	.08	.11					
CONC	.15	.07	-.01				
EY	.10	.05	.10	-.11			
EX	.17	.25	.11	-.11	.14		
Q	.13	.15	.15	.19	-.09	.04	
K	.15	.19	.05	.17	-.16	.11	.48
M	.10	.12	.15	.17	-.07	.04	.92
P	-.00	-.05	.03	.20	-.08	-.22	-.08
W	.22	.18	.10	.23	-.11	-.05	.56
PM	-.08	-.07	.03	.15	-.13	-.10	.10
PK	-.00	-.01	.01	-.01	-.00	-.01	-.07

	K	M	P	W	PM
M	.42				
P	.08	?			
W	.40	.42	.11		
PM	.16	.07	.37	.10	
PK	.05	-.06	-.04	-.04	-.03

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