Small -v- Large Firms in Australian Manufacturing

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ABSTRACT. The measurement of the relative efficiency of the sub-groups of large and small enterprises in each Australian manufacturing industry is undertaken in this study using two concepts of efficiency. Technical efficiency is assessed in relation to an estimated frontier production function while economic efficiency is expressed in terms of a sales based price-cost margin — a proxy for profitability. The large enterprises were found, for the most part, to be more technically efficient than the small. In terms of the profitability measure the small firms were just as likely to be the more efficient in any industry. They were generally more dispersed around the mean of both efficiency measures than were the large. The industries in which the large (or small) firms were found to be more technically efficient were not necessarily the industries for which the large (or small) firms were the more profitable. The study highlights the relationships between technical and economic efficiency and emphasises the need for careful definition of the concept "efficiency" when making comparisons of performance among enterprises.

I. The theme

The study has its roots in the seminal paper by Edward Mason (1939). In his paper Mason introduces many of the elements of the industry structure-behavior-performance paradigm which are now found among the central issues of the Economics of Industrial Organization. Of particular interest in the context of this present study is Mason's postulate that "... the size of a firm influences its competitive policies ..." by means of its relative market power; the limitations on its range of available production and marketing strategies; and the factors internal to the firm — such as the relationship between management and shareholders.

This paper examines the proposition that the performance of firms in the same industry is variable and that the efficiency of the firms is not independent of their relative size. To address Mason's proposition directly the questions are asked: Can it be demonstrated that a firm's size within an industry so influences its competitive policies and hence its behaviour such that its efficiency is in some way a function of its size? Can measures be formulated to assess whether small firms are more or less efficient than large firms in Australian manufacturing industries?

II. Introduction

Studies which attempt to assess the relative efficiency of productive units typically encounter serious difficulties in both the definition of concepts and in their measurement. Two broad avenues of approach are identified in the literature:

1. the production function: the performance of small and large firms is assessed in relation to an estimated production function for the industry;
2. profitability: the correlation of firm profits with size.

These approaches form the basis for the empirical work in this study. The ABS Census data (1980/81) for Australian Manufacturing Industries is introduced in order to test hypotheses concerning firm size and efficiency in Australia for that year. Data for additional Census years will be used in further studies to test the invariant nature of the relationships over time. It is hoped that constructive criticisms of the methodology, data sources and the measurement procedures adopted in this study, will lead to an improvement in future studies leading to a better understanding and a more reliable assessment of the relationships being examined.

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To date much of the work done in Australia which relates firm size to performance has been largely descriptive — finding out the facts about small businesses in this country: their sources of finance, their contribution to employment opportunities, their rates of failure, their role in product and process innovation, their position relative to large firms under the taxation regulations, their opportunities for and rates of growth, their profitability and future prospects (John *et al.*, 1976; Williams, 1982; Johns *et al.*, 1989). However, not a great deal has been done in Australia or overseas to develop traditional microeconomic theory and provide more powerful analytical tools to formulate and test hypotheses about the behaviour and performance of small businesses. Nevertheless, it might be said that there is an emerging Small Business Economics and certainly there is a growing Small Business Literature.

III. Definitions employed in this study

a. *The firm*

For much of the theory of competitive pricing and resource allocation the firm has been conceived as a single-minded decision-making unit which is assumed to adjust output and quantities of inputs to relative price changes in order to maximize profits. Williamson (1964), for example, has pointed to the limitations of the traditional concept of the firm. For the purposes of empirical investigation it is necessary to identify the firm in the real world and obtain information about its characteristics and performance. While some studies in the U.S. have relied on data from the *Census of Manufacturers* (U.S. Bureau of the Census), Australian studies have generally taken data from the *Integrated Economic Censuses* published by the Australian Bureau of Statistics (ABS).

In studies which use the country's official published industry census data, both the accuracy of the numbers reported and their reliability as measures of the postulated economic concepts, can be challenged with some justification. Additional problems arise in the Australian case because the most disaggregated industry class microdata which report the variables required for a detailed investigation of this kind, are reported at the enterprise level and then only after they have been aggregated into groups of four. Of course, data for individual establishments would be vastly more instructive, particularly in the assessment of technical efficiency. Because of the regulations requiring the confidentiality of each individual firm's information supplied to the ABS, such data are not available — a prohibition strictly enforced.

The ABS sources report some data on business units at each of three levels:

1. the establishment (including associated ancillary units and administrative offices);
2. the enterprise; and
3. the enterprise group.

In this present study, for reasons suggested above, the business of firm is taken to be "The Enterprise" as defined in the explanatory notes of the Australian Integrated Economic Censuses 1977—78 (1980):

> . . . defined broadly as the unit comprising all operations in Australia of a single operating legal entity . . . a sole proprietor, or partnership, or company. . . . Where a number of legal entities operate as a group owned or controlled by a single company, the enterprise is not the group as a whole, but each individual operating legal entity in the group.

b. *The small firm*

Serious investigation of the role and economic importance of small firms in the Australian economy began in the early 1970s. In 1973 the Australian Government released the Report of the Committee on Small Business, the Wiltshire Committee Report (1971), in which a small business is defined to be one in which:

> . . . one or two persons are required to make all the critical management decisions: finance, accounting, personnel, purchasing, processing or servicing, marketing, selling, without the aid of internal specialists and with specific knowledge in only one or two functional areas.

The definition employed by the Committee is rather limited as it places the full weight of identification upon the management characteristics of the firm. In the United States, the United Kingdom and Japan, we observe that governments and researchers have tended to develop definitions which include a wider range of criteria relating to the number fo employees, market share, dominance in the market, gross value of assets, as well as management characteristics.

While it is appropriate for theoretical analyses to employ qualitative definitions for small firms, for legislative and empirical purposes it is often necessary to introduce quantitative or statistical definitions. The Wiltshire Committee (1971) reported, for example, that in their view, manufacturing firms in Austrilia did not satisfy their qualitative criteria unless they employed fewer than 100 persons. This employment size definition has been adopted in this study.

c. *The industry*

The researcher in Australia has little control over the classification of firms to industry groupings but the documentation makes clear the rules and procedures whereby such classifications take place. The system of classification followed for the purposes of this research is the Australian Standard Industrial Classification (ASIC, 1978). The degree of homogeneity of the industrial activities which are classified to each four-digit industry class is always a matter of concern and must be taken into account in evaluating the general conclusions.

In summary then, this study investigates the relative efficiency (a term to be discussed in the following section) of small and large manufacturing enterprises classified to the same ASIC Four-digit class; where a small manufacturing business units are those comprising all the operations in Australia of a single operating legal entity (a sole proprietor, partnership of company) employing fewer than 100 persons.

IV. The elusive concept — efficiency

The concept "efficiency" may be found in a general equilibrium context where it can be used to describe the nature of the allocation of society's scarce resources in satisfying the wants of its members. However, this study is not concerned with a broad, general equilibrium and economy-wide view of efficiency — a much narrower concept is required.

At a microeconomic level the concept "efficiency" may be used in relation to the utilization of resources in the production of an industry's output, or, of more relevance in this study, of an individual firm's output. The standard of efficiency may be a theoretically determined maximum performance; or it may be assessed in relation to the actual performance of the "best" firm in the industry. It is this latter micro-approach which is pursued here.

A major difficulty in this work is the pinning down of the concept "efficiency" and the formulation of operational measures which fit the concept (Dunlop, 1985). During the 1950s and 60s some writers, recognizing the imprecision in the usage of the word in much of the economic literature as well as in common usage, addressed the theoretical issues underlying its definition. The recent work has dealt rather more with the task of specifying and estimating efficiency measures. In this study efficiency is assessed in terms of *technical efficiency* in Section V and in terms of *profitability* in Section VI below.

V. Efficiency in production — technical efficiency

The foundation study by Farrell (1957) in which he outlines his approach to the measurement of productive efficiency has prompted the procedure followed in this part of the study and hence is discussed in some detail below. The purpose of his work was

> ... to provide a satisfactory measure of productive efficiency — one which takes account of all inputs and yet avoids index number problems — and to show that it can be computed in practice. (p. 258)

Farrell commenced by assessing the efficiency of the firm in terms of its

> ... success in producing as large as possible an output from a given set of inputs. (p. 254)

In his simplest model it is assumed that the firms in an industry employ two inputs, say V_1 and V_2, in the production of a single product Q. The quantities of each input required by the ith firm to produce just one unit of output are x_i and y_i where:

$$x_i = v_{1i}/q_i$$

$$y_i = v_{2i}/q_i$$

(lower case represents quantities).

The inputs required by each firm (x_i, y_i) may be represented as points in a two dimensional input/input space — refer Figure 1. In the simplest case, Farrell's efficient isoquant II' is obtained by joining points such that all other points are on or above the joining lines. A firm represented by a point which is above the isoquant, in relation to the origin, is said to be technically inefficient because it is employing more of both inputs than the firm on the isoquant (possibly a hypothetical firm) which employs inputs in the same proportion — that is, the firm represented by the point at the intersection of the ray from the origin with the isoquant. To illustrate, in Figure 1, the input usages per unit of output for five firms comprising an hypothetical industry are represented by:

$\{(x, y) : A(1, 4), B(2, 2), C(5, 1), D(4, 2), E(2, 4)\}$.

By joining points A, B and B, C Farrell's efficient isoquant is obtained. Firms D and E are found to be technically inefficient in the sense he defined. In order to obtain a cardinal measure for technical efficiency, say for firm D, it is necessary to identify the input usages of the hypothetical firm D* on the efficient isoquant. Farrell claimed that his contribution was largely the development of the idea of the technically efficient hypothetical firm on the frontier as the standard and basis for efficiency measurement.

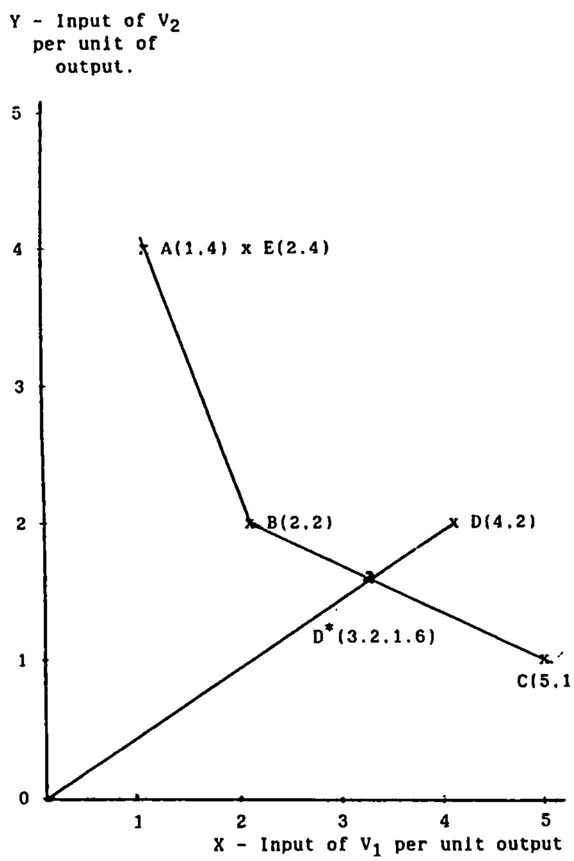

Fig. 1.

The actual measure of technical efficiency (T. E.) is the ratio:

$$\begin{aligned} \text{T.E.} &= \text{OD}^*/\text{OD} \\ &= 0.8. \end{aligned}$$

It is found that D* requires 3.2 units of V_1 and 1.6 units of V_2 to produce one unit of output. The level of usage for each input is 0.8 of the corresponding input usage of the technically inefficient firm D.

Farrell demonstrated that the measure can be generalized to more than two inputs and more than one output. However, the importance of Farrell's work lies in the fact that he pioneered the efficiency frontier approach and also pointed future researchers in the direction of efficiency frontier production function estimation as the path to follow in the analysis of productive efficiency. The efficient frontier technique is applied below in order to assess the relative efficiency of small and large firms in Australian manufacturing industry. The intention is that each firm's performance be assessed in relation to the "best" firms rather than the "average" industry performance.

a. *The model*

The frontier production function adopted in this study is of the constant elasticities, homothetic Cobb-Douglas form. The appropriateness of this constant input elasticities formulation is examined (for industries in which sufficient observations are available) by estimating the parameters of the function for the sub-sets of small and large enterprises and testing for significant differences in the parameter estimates.

The gross output (GO) is the dependent variable in the model and is expressed as a function of the inputs of Labour (L), Capital (K) and Materials (M).

In natural logarithms of the observations over N enterprises, the model is specified as:

$$\ln \mathrm{GO} = (a_0 - m) + a_1 \ln \mathrm{L} + a_2 \ln \mathrm{K} + a_3 \ln \mathrm{M} - (e - m),$$

where e is a composed error term (being the sum of the one-sided positive disturbances and normally distributed disturbances) and m is the mean of the distribution of e. This approach ensures a zero-mean but not a normally distributed residual, and Corrected Ordinary Least Squares procedures have been shown to provide unbiased and consistent estimates of the parameters of the frontier function (Greene, 1980). All observations are included in the frontier estimation and extreme values are accepted as highly efficient or inefficient enterprises as the case may be (Forsund *et al.*, 1980). Some studies have excluded the top x percent of observations on the assumption that they may be outliers. In the absence of any theoretical justification for selecting a particular value for x this procedure has not been adopted in this study.

b. *The data base (1980—81)*

The data base for this study has been supplied on magnetic tape by the Australian Bureau of Statistics (ABS). As noted in Section III above, the ABS initially ranked the enterprises by turnover and then aggregated them into groups of at least four. The "enterprise" in this study is then a four-enterprise-group (FEG) and the data items are averages of the figures reported by the firms within the group. Clearly, this procedure obscures important information about individual firms, reduces the variability in the data and the number of degrees of freedom available for econometric investigations. However, there is no superior format in which the data is available and one objective of this present study is to examine the reasonableness of the results obtained by the procedures followed using the available data, in the light of what is known about small and large firm relationships from other sources.

c. *The variables*

Gross Output (GO). The gross output is derived from the ABS data by adjusting the turnover for the year to account for the changes in stocks held.

Labour (L). The data source provides the total employment figure for each FEG as an unweighted aggregate of the number of male and female employees. In order for employment to be a satisfactory measure of the labour input, it is required that each employee represent a homogeneous unit of labour — at least in terms of hours worked. It is unlikely that this condition would be satisfied and it is assumed in this study that wages and salaries paid provide a more satisfactory measure of the labour input. The system of wage awards in Australia gives some reason to believe that wages paid will reflect more closely the labour input, particularly across the enterprises in any one industry and at one point in time.

Capital (K). The procedure adopted in this study is to estimate the capital input (K) as the weighted sum (weights being w_i) of the figure reported for depreciation, DL (Land) and DP (Plant and Machinery) and the payments for renting and leasing, RL:

$$\mathrm{K} = w_1 \cdot \mathrm{DL} + w_2 \cdot \mathrm{DP} + w_3 \cdot \mathrm{RL}.$$

The weights $w_1 = 50$, $w_2 = 5$ and $w_3 = 4.2$ have been estimated for the purposes of this study following the investigation of the company reports (1980—81) of a random sample of 30 enterprises. It is clear that the fixed weights can be only crude estimates, but it is desirable that some attempt be made to apply appropriate weightings in the aggregation process to avoid, as far as possible, a bias in the capital variable.

Test variable for weighting of RL (T). Aggregation bias may present more of a problem if small firms engage relatively more in renting and leasing of equipment than the larger firms. To deal with this problem a Griliches and Ringstad type test variable was introduced and the weighting of RL was adjusted as required (Griliches and Ringstad, 1971).

The construction of a credible capital stock measure from the census data is a formidable task. The perpetual inventory method often employed in deriving the capital stock series for manufacturing industries cannot be applied in these circumstances. The time series constructed from appropriately depreciated historical data on the additions and replacements to capital stocks of the four enterprise groups would be meaningless because it is almost certain that following the ranking procedure, the firms comprising each group would differ in each census period.

Materials (M). The value of the materials used in the manufacturing process are not reported separately but are in a composite variable which includes also certain expenses incurred. The purchases comprise the intermediate goods, materials used as inputs, containers and packaging required and finished goods purchased for resale. The major selected expense items are: energy and water charges (electricity, fuels, gas); transport expenses (carriage of goods outwards, motor vehicle expenses); maintenance and repairs expenditures; commissions paid; payments for subcontracted work.

d. *The technical efficiency index*

The parameters of the frontier production function, a_i, were estimated by the Corrected Ordinary Least Squares procedures (Forsund *et al.*, 1980). Once the frontier function has been estimated, it follows that:

$$\begin{aligned} -e &= \ln \mathrm{GO} - (a_0 + a_1 \ln \mathrm{L} + a_2 \ln \mathrm{K} + a_3 \ln \mathrm{M}) \\ &= \ln (\text{actual GO}) - \ln (\text{estimated frontier GO}) \\ &= \ln (\text{actual GO / estimated frontier GO}). \end{aligned}$$

By taking antilogarithms, the ratio of the actual gross output and the estimated possible output if the enterprise was operating at the technical efficiency frontier, can be calculated for each enterprise in the industry. The Farrell-type index is constructed such that the index value for enterprises on the frontier is 1.0000. The mean and standard deviation of the index for the size groups within each industry can then be calculated and the Pearsonian correlation of the index with employment size can be computed. The industries have been classified according to the magnitude of d, where d equals the Mean Technical Efficiency of the Large Firms, minus the Mean Technical Efficiency of the Small Firms.

e. *Summary of results*

The ABS data base for 1980/81 provides information for 156 four-digit manufacturing industries; commencing ASIC 2115 through to ASIC 3487. It has not been possible to compute the technical efficiency index for 66 (42 percent) of these industries because, either they comprised too few firms to allow the estimation of the industry frontier production function, or there were no large firms in the industry. In some industries there were sufficient observations for the analysis of the industry as a whole but not sufficient for the complete analysis of the sub-sets of small and large enterprises taken separately. In these, the majority of cases, it has been possible to estimate the industry frontier production function, calculate the efficiency index in relation to this frontier and obtain the means and standard deviations of the indices for the sub-groups of small and large enterprises. The results for the meat industry (ASIC 2115) are shown in detail in Table I.

This Table presents the estimated parameters of the production functions for the industry and the sub-groups of small and large enterprises. Also included are the means and variances of the technical efficiency measures. In addition, the sales based cost-price margin calculations, which are considered in Section VI, are shown in this Table.

Of the 90 industries which could be analysed by this procedure there were 52 industries (58 percent) for which the mean technical efficiency of the large enterprises exceeded that of the small by one percentage point or more. Of these, there were 34 industries (38 percent) for which the difference was 3 percentage points or more (see Table II). The eleven industries which showed a significant positive correlation between efficiency and size were found, with the one exception, within these industries.

There were 29 industries (32 percent) for which there was little evidence of superior performance by either sub-group since the difference in mean technical efficiency was no more than plus or minus one percentage point. For the remaining nine industries (10 percent) the mean efficiency of the small enterprises exceeded that of the large by more than one percentage point. The correlations

TABLE I
ASIC 2115: Meat (except smallgoods or poultry)

Production functions	All enterprises ($N = 79$)	Small enterprises ($N = 60$)	Large enterprises ($N = 19$)
Intercept a_0	1.1097	1.2497	1.0630
	(13.80)	(8.87)	(3.87)
Labour a_1	0.2432	0.2229	0.2669
	(11.15)	(7.83)	(5.97)
Capital a_2	−0.0022	0.0016	−0.0211
	(−0.15)	(0.09)	(−0.74)
Materials a_3	0.7311	0.7351	0.7303
	(49.76)	(40.35)	(30.58)
Adj. R^2	0.998	0.995	0.996
F-test for H_0: a_i(small) = a_i(large): V NE $F = 1.1987$; Accept H_0			
Index of efficiency (relative to the industry frontier)			
Mean	0.7819	0.7789	0.7914
St. Dev.	0.0655	0.0697	0.0504
Correlation with empl. size	0.045	0.099	−0.026
	(0.40)	(0.76)	(−0.11)
Sales based price-cost margin			
Mean	0.0876	0.0964	0.0598
St. Dev.	0.0783	0.0817	0.0601
Correlation with eff. index	0.710	0.742	0.610
	(8.86)	(8.43)	(3.17)
Correlation with empl. size	−0.224	−0.161	−0.353
	(−2.01)	(−1.24)	(−1.56)

Note: t-ratios shown in parentheses.

between technical efficiency and size were small and negative but not significantly different from zero. (See Table III.)

The evidence suggests that the large enterprises (employing 100 or more persons) tend on average to be more technically efficient, as defined in this study, than are their small counterparts in the majority of industries. It was also observed that the small firms tended to be more dispersed around a lower mean technical efficiency performance. The evidence also indicated that there was no clear difference in the performance of the small and large firms in about one-third of the industries.

Meeusen and van den Broeck (1977) previously examined the relationship between technical efficiency and firm size in the 1962 French Manufacturing industry census data. They concluded that their results "seem to indicate that the larger firms are technically more efficient, i.e., are relatively closer to their production frontier, than the smaller ones", a result consistent with the findings of this present study.

f. *Comment*

There is a danger in assuming that the enterprise operating below the frontier is necessarily suboptimal or inferior in some sense. The optimal

TABLE II
Industries for which $d > = +3$ percentage points

ASIC No.	Industry title (abbrev.)	Mean technical efficiency			Corre. with emp. size
		Large %	Small %	Difference(d) %	
2123	Cheese	94.54	91.36	+3.18	+0.175 (0.40)
2161	Bread	77.04	68.68	+8.36	+0.171 (2.27)*
2162	Cakes and	91.49	88.04	+3.45	+0.150 (1.10)
2173	Confection	98.28	92.00	+6.28	+0.261 (0.97)
2185	Soft drinks	87.76	84.35	+3.41	+0.170 (0.98)
2349	Textile fin.	96.47	89.57	+6.90	+0.251 (0.90)
2441	Hosiery	95.31	91.08	+4.23	−0.068 (0.18)
2453	Womens outer	64.18	59.90	+4.28	+0.058 (0.76)
2456	Headwear and	94.24	85.44	+8.80	+0.132 (0.98)
2531	Log sawmill	74.46	63.12	+11.34	+0.169 (1.97)*
2535	Wooden struct.	74.33	64.01	+10.32	+0.179 (2.86)*
2542	Mattresses	96.55	88.81	+7.74	+0.093 (0.30)
2644	Printing and	78.26	73.47	+4.79	+0.103 (1.91)*
2645	Printing trade	86.43	81.42	+5.01	+0.166 (1.25)
2752	Industrial gas	94.88	86.82	+8.06	+0.078 (0.22)
2864	Ceramic goods	89.30	82.62	+6.68	+0.035 (0.13)
2872	Ready mix con.	84.99	81.72	+3.27	+0.037 (0.19)
2873	Concrete pipe	85.96	79.43	+6.35	+0.210 (1.74)*
2884	Non-metalic	91.34	88.13	+3.21	+0.146 (0.47)
3142	Arch. metal	90.11	85.60	+4.51	+0.181 (1.56) ≠
3153	Sheet metal	83.10	79.01	+4.09	+0.144 (1.99)*
3161	Cutlery and	83.71	75.33	+8.37	+0.361 (1.10)
3162	Springs and	92.54	86.82	+5.72	+0.134 (0.87)
3164	Metal coat	81.57	76.39	+5.18	+0.131 (1.23)
3166	Boiler and	96.73	91.72	+5.01	+0.239 (1.13)
3167	Metal blinds	93.27	89.46	+3.81	+0.186 (0.66)
3168	Fabr. metal	83.63	75.11	+8.52	+0.106 (1.28) ≠
3232	Motor vehicle	85.28	81.95	+3.33	+0.154 (1.34) ≠
3342	Photo. film	95.89	92.36	+3.53	+0.141 (0.70)
3361	Agri. mach.	89.53	85.24	+4.29	+0.149 (1.03)
3363	Mat. mandling	85.73	81.97	+3.76	+0.158 (0.96)
3365	Pumps and com.	93.15	88.31	+4.84	+0.327 (1.32) ≠
3369	Ind. machine	77.19	72.87	+4.32	+0.137 (2.13)*
3484	Signs and adv.	85.90	78.78	+7.12	+0.137 (1.10)

* Significant at 5% and ≠ significant at 10% on a one-tail t-test (t-values in parentheses).

capital replacement strategy for a particular firm may be to delay the adoption of more advanced technology. Such a firm may appear less technically efficient than the firm employing the latest process. A very narrow view is that it is only meaningful to speak of efficiency in relation to the performance of one firm and then only when the detailed figures of the budget plan for a specified period of operation are compared with the actual achievements. That is a firm may be efficient in terms of its own objectives but insufficient in the sense discussed in this study. It follows that any implications for public policy in relation to manufacturing technology should be very carefully considered with the above discussion in mind.

VI. Overall efficiency – profitability

A notable study by Hall and Weiss (1967) examined Baumol's contention that large firms

TABLE III
Industries for which $-1 >= d > -3$ percentage points

ASIC No.	Industry title (abbrev.)	Mean technical efficiency			Corre. with emp. size
		Large %	Small %	Difference(d) %	
2175	Prep. animal	87.56	89.85	−1.29	−0.058 (0.23)
2188	Wine and	75.26	77.74	−2.49	−0.043 (0.24)
2351	H. hld textiles	77.13	83.20	−6.07	−0.056 (0.21)
2352	Textile floor.	92.32	94.19	−1.87	+0.086 (0.19)
2354	Canvas and	83.77	85.16	−1.39	−0.010 (0.04)
2443	Knitted goods	91.24	92.51	−1.27	−0.105 (0.40)
3151	Metal contain.	91.43	93.13	−1.70	−0.034 (0.87)
3163	Nuts, bolts	78.89	81.62	−2.73	−0.063 (0.27)
3165	Non-ferrous	91.70	94.21	−2.51	−0.207 (1.01)

could earn higher rates of profit than small firms, even under long-run competition (Baumol, 1959). Hall and Weiss concluded that "size does tend to result in high profit rates as Baumol proposed." However, their methodology and the nature of the data they employed differ significantly from that used in this present study. This section of the paper investigates Baumol's hypothesis for Australian manufacturing industries.

While technical efficiency or minimum production cost is a necessary condition for profit maximization it is not a sufficient condition. The firm must also be "efficient" in relation to its decisions on product pricing and/or levels of output if maximum profits are to be attained.

It is assumed in this study that profit maximization is a goal in relation to which the performance of firms may be assessed. Furthermore, it is proposed that a sales-based price-cost margin discussed below may be employed as an appropriate proxy for comparing the profitability of firms (Phillips, 1978).

a. *The price-cost margin (PCM)*

For the purposes of this study the PCM for the ith enterprise (FEG) has been calculated as a percentage of industry turnover, using the ABS data base discussed above.

$$\mathrm{PCM} = (\mathrm{TO} - (\mathrm{SO} - \mathrm{SC}) - \mathrm{PE} - \mathrm{WS} - \mathrm{RL})/\mathrm{TO},$$

where TO = turnover;
SO = opening stock;
SC = closing stock;
PE = purchases and selected expenses (selected expenses include: charges for fuels, electricity and water, outward freight and cartage, motor vehicle running expenses, repairs and maintenance and commission and sub-contract work expenses);
WS = wages and salaries paid;
RL = rent and leasing expenses.

Because of the uncertainty surrounding the measures of capital usage derived from the Censuses data a figure for the fixed capital costs has not been deducted in the calculation of the PCM for the purposes of this part of the study.

A possible advantage in measuring the PCM with the element of fixed capital cost excluded is that the likely direction of the bias is known *a priori*. If labour intensities do differ for small and large firms in the same industry then the small firms are typically more labour intensive (Johns *et al.*, 1975). The capital to output ratios of the larger firms are therefore likely to exceed that for the less capital intensive smaller firms. Since the omitted costs are largely the capital costs, it would be expected, other factors being equal, that the average PCM calculated for the large firms could be marginally higher than for the small firms (Ornstein, 1975). Thus a higher average PCM for the large firms would not necessarily be indicative of higher profitability, but a higher average PCM for the smaller firms would suggest a superior performance on their part. If the means of the differences are approximately the same it suggests that the small firms perform at least as well as their large counterparts.

b. *The results*

In order to assess the relative efficiency of the size groups, each industry was sub-divided into the large and small firms and the means and standard deviations of the PCM's were found for each of the two size sub-groups and for the industry as a whole. The percentage point difference, for the ith industry, between the mean PCM's for the sub-groups (e_i) was recorded:

e_i = Average of PCM of large enterprises − average of PCM of the small enterprises.

The product-moment correlation coefficients and corresponding t-statistics for the tests of significance were calculated to test for a relationship between profitability and employment size. These statistics were computed for both size sub-groups and for the industry as a whole. The industries for which $e > +3$, suggesting a markedly superior performance by the large firms, are shown in Table IV.

There were a further eight industries which have not been included in Table IV because the employment of the firms comprising each FEG was less than 100 persons. The coefficient of correlation between the profitability measure (PCM) and employment size was negative for all eight industries and significantly so for five of these industries (see Table V). A significant inverse relationship between profitability and size may indicate the presence of diseconomies of scale, discourage growth and place an upper limit on firm size. These factors may partly explain the absence of large firms in these industries. Of course, the underlying reason for the inverse relationship is another matter.

There are 25 industries, or 26.8 percent, for which the difference in the average PCM's between the small and large firms is between plus and minus one percentage point. If there is an upward bias in the PCM then approximately equal mean PCM's for the small and large firms would indicate higher profitability for the smaller firms. At least, the small firms may be assumed to perform as well on average as the large firms in these industries.

There were 28 industries for which the mean price-cost margin for the small firms exceeds that for the large by one or more percentage points, suggesting a superior performance on average by the small firms. The firms for which $e < -3$ are shown in Table VI. It is observed that the correlation of profitability with employment size is significantly negative in five of these industries.

c. *Comments*

i. *The magnitude of 'e'.* In those industries for which the gap between the profitability of the small and large firms is the most pronounced, the performance of the large firms is well above the average for large firms across all industries. The performance of the small firms in these industries is about the same as that for the small firms generally.

Table VII shows that the average profitability of the large firms in industries for which $e > +3$, (that is, industries in which large firms are markedly superior) is 19.12 percent, but is only 13.94 percent for the large firms across all industries. On the other hand there is little difference in the mean profitability of the small firms between the two groups in these same industries: 12.22 percent and 12.96 percent, respectively.

ii. *The variability of profitability with size.* The traditional theory and empirical evidence tend to support the proposition that the variability of profit rates of enterprises is inversely related to their size.

Samuels and Smyth (1968) found greater interfirm variability among the groups of firms in the smaller size categories. They reported "... the standard deviations declined as class size increased".

Whittington (1971) also examined the relationship between the variability of profit and firm size. He concluded:

TABLE IV
Industries for which $e > +3$ percentage points

ASIC No.	Industry title (abbrev.)	Mean price-cost margin			Corre. with emp. size
		Large %	Small %	Difference %	
2123	Cheese	23.53	8.86	+14.67	0.664 (1.99)*
2132	Vege. prod.	13.00	9.43	+3.57	0.452 (1.34)
2176	Other food	15.80	12.54	+3.26	0.191 (0.99)
2349	Textile fin	24.37	17.13	+7.24	0.331 (1.22)
2351	H. hld textiles	18.25	12.36	+5.89	0.240 (0.93)
2356	Textile prod.	15.44	12.34	+3.10	0.098 (0.36)
2533	Veneers	13.79	10.16	+3.63	0.580 (1.88)*
2635	Paper prod.	20.40	13.55	+6.85	0.423 (1.81)*
2752	Industrial gas	20.85	12.02	+8.83	0.274 (0.81)
2753	Synthetic res.	17.54	6.15	+11.39	0.326 (0.97)
2765	Soap	12.94	9.21	+3.73	0.172 (0.87)
2864	Ceramic goods	29.97	16.77	+13.20	0.369 (1.48) #
2872	Ready Mix. con.	18.81	14.14	+4.67	0.141 (0.73)
2882	Stone prod.	39.44	16.82	+22.62	0.627 (3.12)*
3151	Metal contain.	14.38	10.51	+3.87	0.006 (0.02)
3163	Nuts& bolts	21.45	14.79	+6.66	0.263 (1.16)
3168	Fabric metal	17.99	14.47	+3.52	−0.038 (0.45)
3241	Ships	15.16	9.97	+5.190	0.568 (2.39)*
3343	Measuring Equ.	20.40	13.67	+6.73	0.231 (1.06)
3363	Materials hand.	15.58	12.13	+3.45	0.109 (0.66)
3365	Pumps & comp.	18.55	11.76	+6.79	0.457 (1.99)*
3366	Comm. space	15.44	10.54	+4.90	0.612 (2.05)*
3461	Rubber tyres	16.72	11.87	+4.86	0.068 (0.25)

* Significant at 5% and # significant at 10% on a one-tail *t*-test (*t*-values in parentheses).

TABLE V
Industries for which all the enterprises (FEG) are small

ASIC	Industry title (abbrev.)	No. of FEG	Corre. of empl. size:- with PCM
2534	Wooden doors	8	−0.464 (1.28)
2536	Wooden contain.	22	−0.491 (2.52)*
2538	Wooden prod.	65	−0.070 (0.58)
3242	Boats	59	−0.241 (1.88)*
3367	Dies, saws	82	−0.176 (1.60) #
3451	Leather tan	13	−0.038 (0.13)
3452	Leather goods	31	−0.350 (2.01)*
3482	Jewellery	45	−0.255 (1.75)*

* Significant 5% and # significant at 10% on a one-tail *t*-test (absolute values of *t* in parentheses).

The pattern of differences in variances between different size classes is usually one of variance of profitability being lower in the higher size classes ... although ... some industry groups do not conform to this pattern.

The results of this present study are consistent with previous studies and support the proposition that the variance of the profitability of the sub-group of the larger firms tends to be less than that of the small in Australian manufacturing industries. Some exceptions to this pattern were encountered.

iii. *The relationship between technical efficiency and profitabiliy.* The assessments of the relative efficiency of the small and large enterprises undertaken in this study have been made with respect to two different concepts of efficiency. The technical efficiency measure relates to the production process without regard to the alternative uses

TABLE VI
Industries for which $e < = -3$ percentage points

ASIC No.	Industry title (abbrev.)	Mean price-cost margin			Corre. with emp. size
		Large %	Small %	Difference(e) %	
2115	Meat	5.98	9.64	−3.66	−0.224 (2.01)*
2116	Poultry	4.94	11.92	−6.98	−0.199 (0.88)
2162	Cakes	12.85	16.06	−3.21	−0.179 (1.32) #
2175	Animal food	6.62	11.34	−4.72	−0.272 (0.97)
2185	Soft drinks	8.73	13.46	−5.73	−0.143 (0.82)
2354	Canvas	2.38	14.28	−11.90	−0.406 (2.67)*
2532	Resawn timber	10.59	14.97	−4.38	−0.189 (1.00)
2541	Furniture	6.66	10.04	−3.38	−0.022 (0.07)
2644	Print and book	11.57	15.14	−3.57	−0.162 (3.02)*
2963	Non-ferrous	5.51	15.14	−9.63	−0.373 (1.80)*
3143	Arch. metal	9.33	13.46	−4.13	−0.186 (1.24)
3161	Cutlery and	12.33	16.04	−3.71	−0.127 (0.37)
3167	Metal blinds	7.60	12.32	−4.72	−0.291 (1.05)
3462	Rubber prod.	11.62	15.16	−3.54	−0.273 (1.13)
3484	Signs and adv.	12.91	17.35	−4.44	−0.133 (1.06)

* Significant at 5% and # significant at 10% on a one-tail t-test (t-values in parentheses).

TABLE VII
The average of the PCM's for large and small enterprises: for all industries and for those industries where $e > +3$

	All industries	Industries for which
Average of PCM's		$e > +3$
Large firms	13.94	19.12
Small firms	12.96	12.22
Standard deviation		
Large firms	5.23	6.00
Small firms	2.65	2.81

to which the resources may have been directed. The PCM measure is a surrogate for profitability or overall efficiency.

In this present study those industries for which the large firms are found to be technically more efficient, on average, than the small firms are not necessarily the same industries for which the large firms appear to be the more profitable. To demonstrate this relationship the industries were classified to a two-way contingency table on the basis of these two industry characteristics, d and e. A Chi-Square test of independence was conducted. The independence hypothesis was accepted with Chi-square = 4.38; and P(Chi-square > 12.6) = 0.05.

The Industries Assistance Commission (1974) has emphasized the importance of recognizing the difference between technical and economic efficiency in arriving at decisions concerning the appropriate levels of specific industry assistance.

> In the context of the Act (Industries Assistance Commission Act 1973), 'efficiency' includes much more than the technical efficiency with which particular production is undertaken — as measured by output per machine or per acre. For instance, the factories or farms in an industry might be managed in a way which is technically very efficient. But their use of the community's basic resources would nevertheless be inefficient from the community's point of view, if their production were relatively unsuited to local conditions — that is; to the general production and marketing environment and the resource endowment of Australia — and thus required relatively high levels of public assistance to support it. (p. 74)

A similar view may be taken of the size subgroups in each industry. Perhaps technical efficiency plays only a minor role in determining the relative profitability of the large and small firms (on average) in some industries and "... local conditions ... the general production and marketing environment ..." have much to do with determining economic performance. Small business lobby organizations may argue that "the general production and marketing environment . . ." includes elements of discrimination which work to the disadvantage of small firms in competition with the larger firms in the economy. Such argument may form the basis for a "special pleading" for public assistance for small businesses generally or for small business in specific industries.

iv. *Profitability and concentration.* A positive association between industry concentration and profitability has generally been supported by empirical research (Peltzman, 1977). It is argued *a priori* that higher concentration leads to greater market power, higher prices and higher profits. However, it has been suggested that the causal relations might be quite different and that the mechanism might be that the greater efficiency of a few large firms leads to higher profits, growth and higher concentration.

Demsetz (1973) has argued:

> . . . if efficiency is associated with concentration, there should be a positive association between concentration and the difference between the rate of return earned by the large firms and that earned by the small firms.

To test the Demsetz's hypothesis using Australian Manufacturing Industry data, the four-firm concentration ratios were calculated for each of the industries in this present study. The relationship between the differences in profitability of the large and small firms and industry concentration was examined. According to Demsetz a significant positive correlation between the variables, *e*, and the concentration ratio, CR_4, would support his efficiency hypothesis. The results for the Australian Manufacturing Industry data (1980—81) found that the correlation coefficient was not significantly different from zero and are consistent with the findings of Clarke *et al.* (1984). No significant relationship between the small and large firm profitability margin and industry concentration could be detected and the Demsetz hypothesis was not supported.

VII. Conclusion

The within industry performance of enterprises has been shown to be variable. The variability of the performance of the large enterprises is generally less than that for the small. This is true whether the performance is measured in terms of the technical efficiency or the profitability concept.

It could not be demonstrated conclusively that, within each industry, the efficiency of individual enterprises is a function of size. However, the technical efficiency of the sub-group of large enterprises tended to exceed that of their small counterparts in most industries. This is not the case for the profitability performance. The large firms were no more likely to have higher price-cost margins, on average, than were the small firms. Furthermore, the industries for which the large firms were more technically efficient than the small were not necessarily the industries for which the large firms were the more profitable.

It is clear that generalizations concerning the relative efficiency of the large and small firms are inappropriate. First, the concept of efficiency being considered must be defined — "technical efficiency" or "profitability", for example. Second, the group of enterprises being assessed must be specified. The relative efficiency will vary from industry to industry; and possibly from time to time.

This study has attempted to develop procedures to assess the relative efficiency of the small and large firms in an industry and show that there measures can be made operational and yield useful information concerning the performance of small firms in the four-digit ASIC industry classes. The qualifications concerning the limitations of the data — particularly the use of four-enterprise groups and the construction of capital variable — cannot be ignored. Further research to grapple with these problems should be undertaken. Nevertheless, the results are not inconsistent with what is known from other sources.

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