

The Effect of Firm Size on the Structure
of Profitability - The Experience of 1655
Japanese Manufacturing Firms 1966-1976*

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Introduction

The effect of firm size on the economic performances of the firm has been of some interest to economists. Thus Baumol (1) has stressed the role of firm size as the capital requirement barrier to entry and Hall & Weiss (5) supplied supporting empirical results based on the 500 largest U.S. firms. Jacquemin & Saez (7) examined, "the bigger, the better" hypothesis or myth, as they put it, with regard to European and Japanese firms and suggested that firm size had negative, significant effects on performance especially for the European firms. So far the argument about the effect of firm size has not been settled and we need more empirical as well as theoretical investigations of this problem.⁽¹⁾ The purpose of this paper is to inquire empirically on the role of firm size in the determination of profitability of Japanese industrial firms.

The paper is divided into two parts. In the former part, every firm in our sample is classified into one of twenty size categories and its performance is observed in its size class. Under this categorization, all other industrial characteristics are disregarded, though every firm belongs to a certain industry and has its particular kind of management. By this procedure we intend to test whether firm size, as measured by our size class, will yield any significant traits concerning the structure of profitability. In the latter part, we proceed to identify some factors which are influential in the determination of the profit rates of firms by regression analysis. There, our sample is divided into two subsamples corresponding to the bigger and the smaller size classes according to the findings presented in the first part.

Our sample consists of Japanese manufacturing firms and is based on the Japan Development Bank Financial Data set. The number of firms selected is 976 and are all listed firms in the major stock markets in Japan. The period of observation ranges from 1966 to 1976 and is divided into three subperiods, period I : 1966-68, period II : 1969-72 and period III : 1973-76.

14. Distribution of firms according to size

In this section we are going to study a characteristic of our selected 976 manufacturing firms : firm size, which is measured by total assets. The facts presented here, will underlie the analysis of the following sections.

In figure 1 the distribution of firm size is depicted by the graphs for the years 1964, 1968, 1972 and 1976. The abscissa is the ranking of 976 firms in terms of total assets and the ordinate is the natural logarithm of their total assets. The downward sloping curves show how great the differences are among firms with respect to their total assets. We naturally expect shifts in the curves from year to year because of the increase in prices and the expansion of productive capacities during those periods. Looking at the curves, it appears that there exists two kinks in each curve, viz., at the ranking of ± 100 and ± 900 . Between 100 and 900 the curvature of the curves is more moderate than at the two tails. Figure 1 shows that the distribution of firm size is highly skewed and its share remains almost unchanged during our periods of observation. Another convenient way of looking at size distribution is to draw a Lorenz curve as is done in Figure 2. The average amount of assets of firms taken 50 at a time and its share in the total assets of 976 firms are given in Table 1. The shapes of the Lorenz curves for the three periods are quite similar and in Figure 2 the curve for period III (1973-1976) is depicted. It is clear that the distribution is extremely concentrated on the biggest size classes. The biggest 50 firms account for more than 50 % of the total 976 firm's assets and the accumulated shares of the biggest 400 firms are around 90 %. This kind of skewness in the size distribution may have some effects on the economic performances of the firms.

In Table 2, we have classified our firms according to industry. We can see the shares of so called heavy industries are relatively high - chemical & allied products 13 %, steel & allied products 16 % and transportation machinery 15 %. In the righthand side of Table 2 we show the shares of industries of the biggest 400 firms and observe that there is not much difference between the 976 and the 400 firms,

Natural log of total
assets

Figure 1

The distribution of firms accord-
ing to their rankings of total
assets

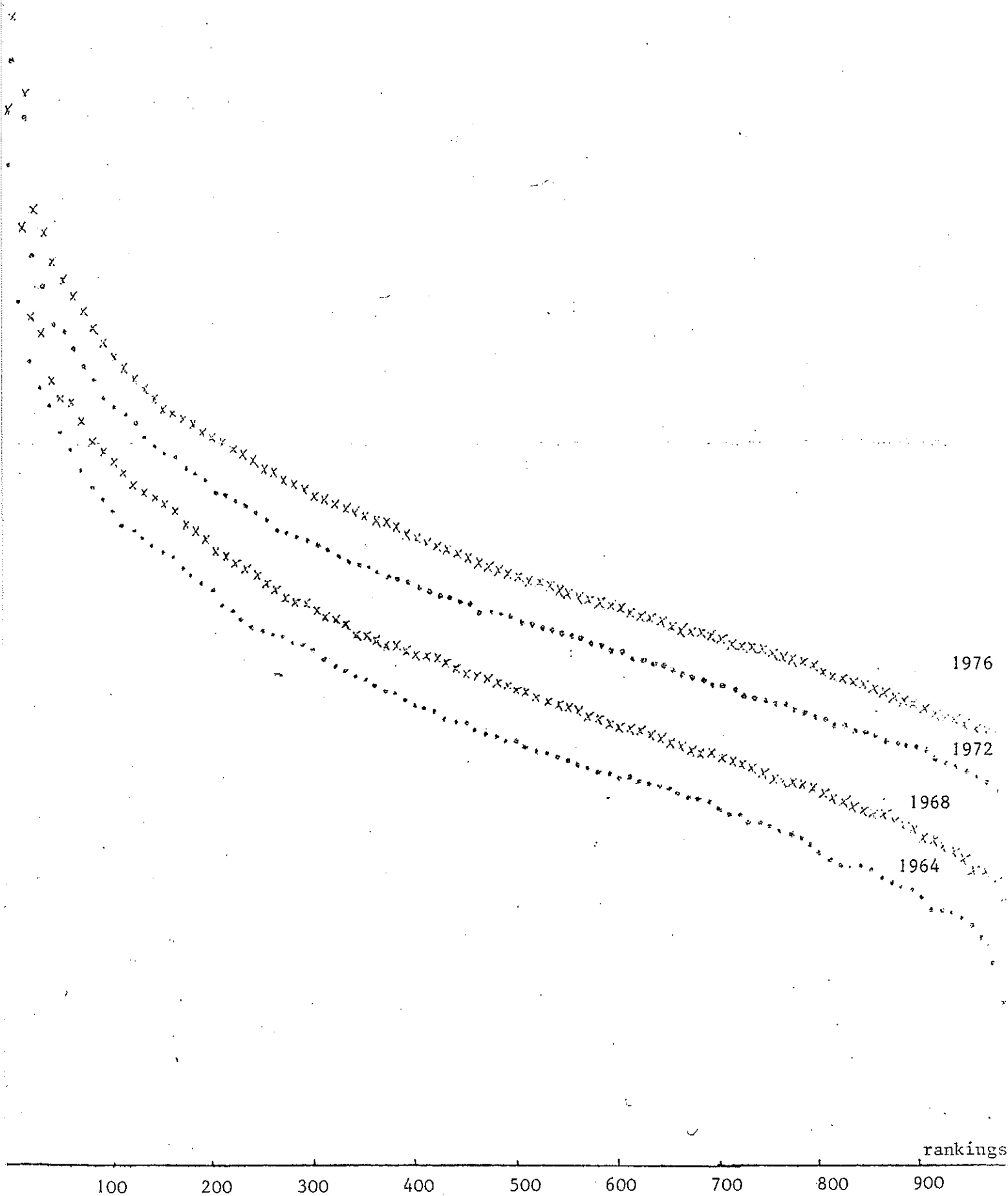


Figure 2 : Lorenz curve for 1973-76

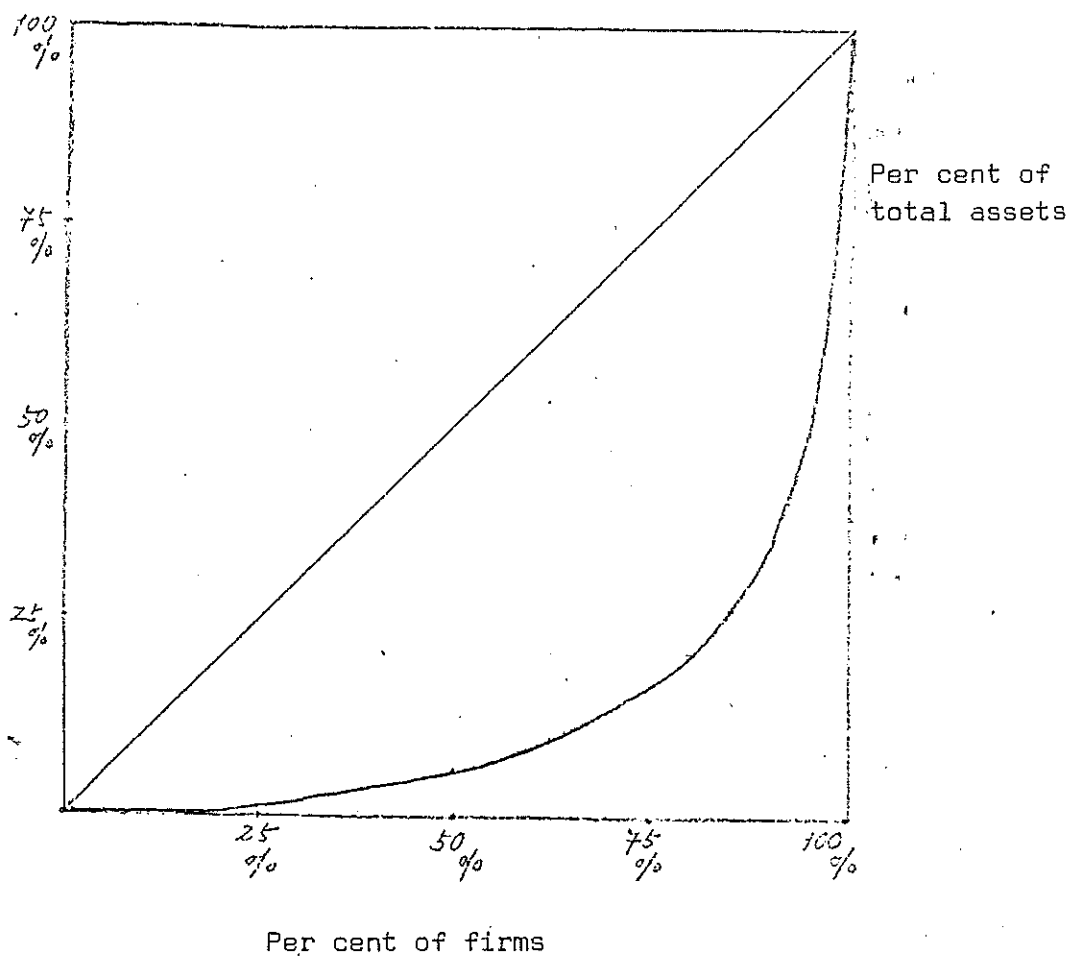


TABLE 1

The distribution of total assets (millions of yen)

		1966-1968 (I)		1969-1972 (II)		1973-1976 (III)	
		Average Assets Size	% of Total Assets	Average Assets Size	% of Total Assets	Average Assets Size	% of Total Assets
1	1- 50	243,720	50.5	421,604	51.5	680,243	50.7
2	51-100	68,771	14.2	114,281	14.0	195,800	14.6
3	101-150	40,751	8.4	66,402	8.1	107,650	8.0
4	151-200	27,689	5.7	45,354	5.5	75,309	5.6
5	201-250	20,211	4.2	32,796	4.0	56,189	4.2
6	251-300	15,014	3.1	25,117	3.1	41,888	3.1
7	301-350	11,966	2.5	20,232	2.5	34,488	2.6
8	351-400	9,789	2.0	16,722	2.0	27,780	2.1
9	401-450	8,191	1.7	13,891	1.7	22,835	1.7
10	451-500	6,809	1.4	11,822	1.4	18,843	1.4
11	501-550	5,727	1.2	9,936	1.2	16,303	1.2
12	551-600	4,925	1.0	8,355	1.0	13,607	1.0
13	601-650	4,294	0.9	7,161	0.9	11,708	0.9
14	651-700	3,667	0.8	6,118	0.8	9,998	0.7
15	701-750	3,085	0.6	5,129	0.6	8,294	0.6
16	751-800	2,569	0.5	4,239	0.5	6,815	0.5
17	801-850	2,199	0.5	3,624	0.4	5,585	0.4
18	851-900	1,767	0.4	2,057	0.3	4,405	0.3
19	901-950	1,336	0.3	2,021	0.3	3,103	0.2
20	951-976	731	0.1	1,043	0.1	1,678	0.1
Total	Average	24,737		41,916		69,736	

TABLE 2

The Industry Classification of sample firms

	1966-1968 (I)			1969-1972 (II)			1973-1976 (III)			% of total assets of the biggest 100 firms (the number of firms is in the parentheses)		
	number of firms	Average Assets Size (millions of yen)	% of Total Assets	number of firms	Average Assets Size	% of Total Assets	number of firms	Average Assets Size	% of Total Assets	(I)	(II)	(III)
food & kindred products	80	14,361	4.76	80	21,035	4.12	80	36,758	4.38	(38) 9.5	(37) 9.3	(40) 10.0
textiles	80	25,768	0.54	80	30,745	7.47	80	58,089	7.02	(32) 8.0	(30) 7.5	(29) 7.3
lumber & wood products	5	6,695	0.14	5	14,003	0.17	5	29,375	0.22	(1) 0.3	(1) 0.3	(1) 0.3
paper & pulp	35	24,010	3.47	35	37,907	3.25	35	63,773	3.33	(20) 5.0	(20) 5.0	(20) 5.0
printing	7	15,144	0.44	7	29,644	0.51	7	57,098	0.60	(3) 0.8	(3) 0.8	(3) 0.8
chemicals & allied products	134	24,406	13.55	134	39,496	12.94	134	63,959	12.78	(68) 17.0	(66) 16.5	(62) 15.5
petroleum products	9	76,278	2.92	9	134,326	2.96	9	306,561	4.11	(8) 2.0	(8) 2.0	(8) 2.0
rubber products	17	16,067	1.13	17	25,943	1.08	17	43,712	1.11	(10) 2.5	(8) 2.0	(9) 2.3
ceramic, stone & products	59	16,350	4.00	59	25,003	3.62	59	42,570	3.74	(24) 6.0	(23) 5.8	(24) 6.0
steel & allied products	58	64,283	15.44	58	114,126	16.10	58	192,796	16.67	(34) 8.5	(30) 7.5	(20) 7.3
non ferrous metals & products	40	34,269	5.10	40	52,565	5.14	40	83,907	5.00	(19) 4.8	(20) 5.0	(21) 5.3
fabricated metal products	43	6,602	1.10	43	10,870	1.14	43	18,485	1.18	(6) 1.5	(5) 1.3	(7) 1.8
general industrial machinery	144	16,327	9.74	144	29,544	10.40	144	46,374	9.95	(36) 9.0	(44) 11.0	(44) 11.0
electrical machinery	112	27,048	12.55	112	40,701	13.35	112	74,479	12.43	(40) 10.0	(41) 10.3	(37) 9.3
transportation ma- chinery	87	41,044	13.79	87	72,577	15.43	87	115,825	15.03	(44) 11.0	(46) 11.5	(45) 11.3
precision instru- ments	29	7,371	0.89	29	13,240	0.94	29	22,634	0.98	(8) 2.0	(8) 2.0	(10) 2.5
miscellaneous manufacturing	37	8,426	1.20	37	14,384	1.30	37	26,614	1.47	(9) 2.3	(10) 2.5	(11) 2.6
TOTAL	976	24,737		976	41,916		976	68,736				

though the shares of heavy industries are a little higher in the biggest 400 firms.

The stability of firm's position in their rankings is important from the dynamic viewpoint and we have made two transition matrixes for the period of I to II and II to III. They are given in Table 3-1 and 3-2. The trace of the matrix shows what percent of the firms stay in their old ranking. We can also observe the movement of firms among rankings. Here we point out some interesting facts. The stability of firms as measured by the probability of not changing its ranking is greater for the bigger firms than for the smaller ones. This is especially the case for the biggest 200 firms whose stability is remarkably greater than the rest. Comparing the two matrixes, it is clear that the stability of rankings is increased in the latter period (period II to III). This is most notable among the rankings of 201 to 600. In both tables, it is seen that the medium sized firms - the firms ranked 501 to 800 - are the most unstable. In these classes firms are more transient in their rankings and potentially bigger or smaller than other rankings. Generally speaking, the chance for a firm to outgrow its old ranking is more and more restricted if the firm is already big and this tendency is strengthened in the recent period.

Table 3 - 1

The transition matrix of rankings 1966-68 to 1969-72

[illegible]

Table 3 - 2

The transition matrix of rankings 1969-72 to 1973-76

[illegible]

2. Firm size and the distribution of profit rates

Based on our ranking of firms by size, we now look at the nature of the profitability of 976 firms for three periods. Here profitability is measured by the ratio of current profits (profits before taxes but after interests) to total assets or that of business profits (profits before taxes and interests) to total assets. Profits before taxes must be used because our sample includes of firms various sizes and the corporate tax structure is likely to produce a bias in the distribution of profits after taxes divided by total assets.⁽²⁾ Sometimes the rates of return on equity is preferred but the rate of profits with respect to total assets gives much better empirical results (this is also confirmed in Caves and Uekusa (2) and in Nakao (14) and we are going to use the latter concept of profitability. In our analysis current profits on total assets yields better results and this measure is used in the following analysis (but its correlation with business profits on total assets is always high : the correlation coefficients ranges from .93 to .97).

In Table 4 and Figures 3-1, 3-2, 3-3, two measures of profitability, the average profit rate and their standard deviation are given. Looking at these statistics, several remarks are possible. Firstly, there is a tendency for average profit rates to decline from period I to period III : the average rate in period I is 5.45 %, 4.44 % in period II and 2.79 % in period III. This may correspond to the general observation that in the course of economic growth, profit rates decline as the accumulation of capital increases. The sudden decline of profit rates from period II to III can be partly accounted for by the "Oil Shock". Secondly, looking at the fluctuations of average profit rates around the mean, we recognize different features for three periods. In period I the profit rates fluctuate around the mean in the bigger size classes as well as in the smaller ones ; but in period II, these fluctuations become less important especially in the big and medium size classes. In period III, the profit rates of the firms ranked from 1 to 10 are higher than or almost the same as the mean, whereas that of the others are lower except

Table 4
Average profit rates and their standard deviation among size classes

		1966-1968 (I)		1969-1972 (II)		1973-1976 (III)	
		Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation
1	1- 50	4.90	3.65	4.01	3.86	2.69	3.35
2	51-100	5.17	3.41	4.21	3.30	3.26	3.32
3	101-150	5.39	3.81	4.39	3.91	2.98	3.74
4	151-200	4.82	4.41	4.69	4.27	2.86	3.27
5	201-250	6.76	5.19	6.55	6.41	5.39	5.43
6	251-300	4.73	4.52	4.90	4.48	4.36	5.41
7	301-350	6.06	5.53	4.39	3.77	3.53	5.76
8	351-400	4.63	3.76	4.29	4.59	2.58	5.05
9	401-450	4.83	5.08	4.21	5.25	2.62	4.87
10	451-500	5.81	4.43	4.56	5.03	2.86	4.66
11	501-550	6.34	5.24	4.93	4.72	1.76	3.99
12	551-600	4.94	3.50	4.40	4.10	3.27	5.30
13	601-650	6.45	6.85	4.84	4.78	2.19	4.51
14	651-700	5.60	5.68	3.68	4.81	3.72	4.69
15	701-750	4.57	4.83	4.52	4.70	2.99	4.00
16	751-800	5.13	4.61	4.13	4.74	1.70	3.94
17	801-850	6.00	4.36	4.26	4.42	2.34	4.38
18	851-900	5.74	4.12	5.01	4.32	1.64	5.44
19	901-950	5.97	5.85	2.45	4.48	0.63	6.47
20	951-976	5.03	7.93	4.35	5.79	1.96	9.22
Total		5.45	4.86	4.44	4.62	2.79	4.92

Average Profit Rate

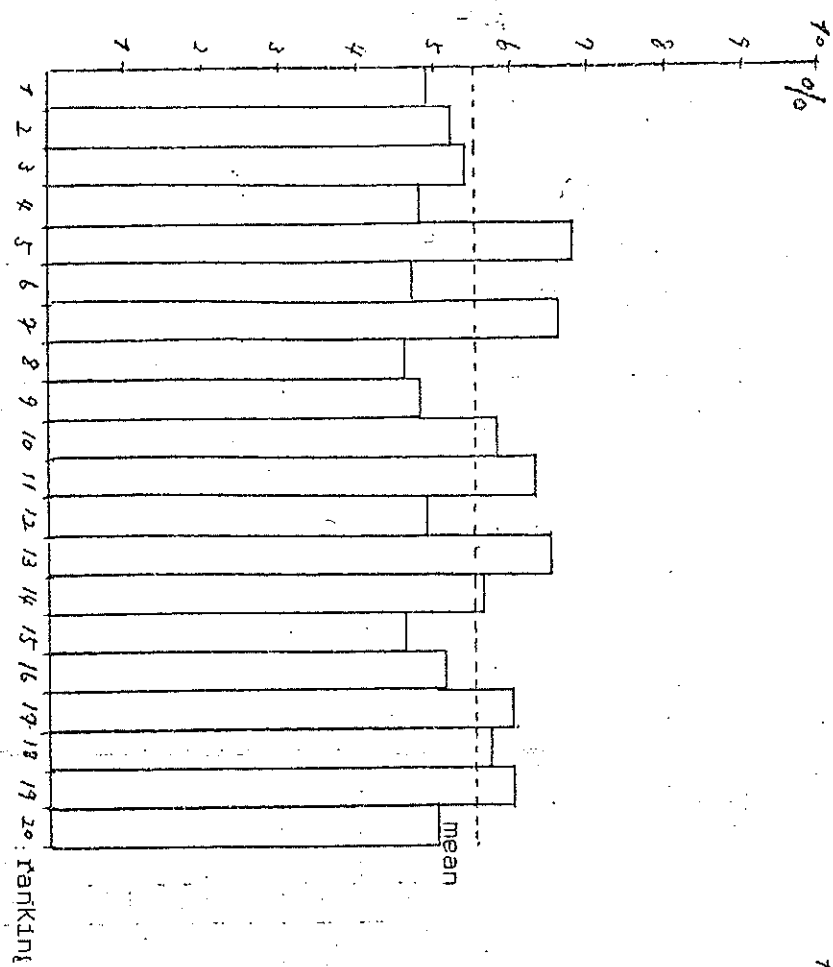


Figure 3 - 1

Period I 1966-1968

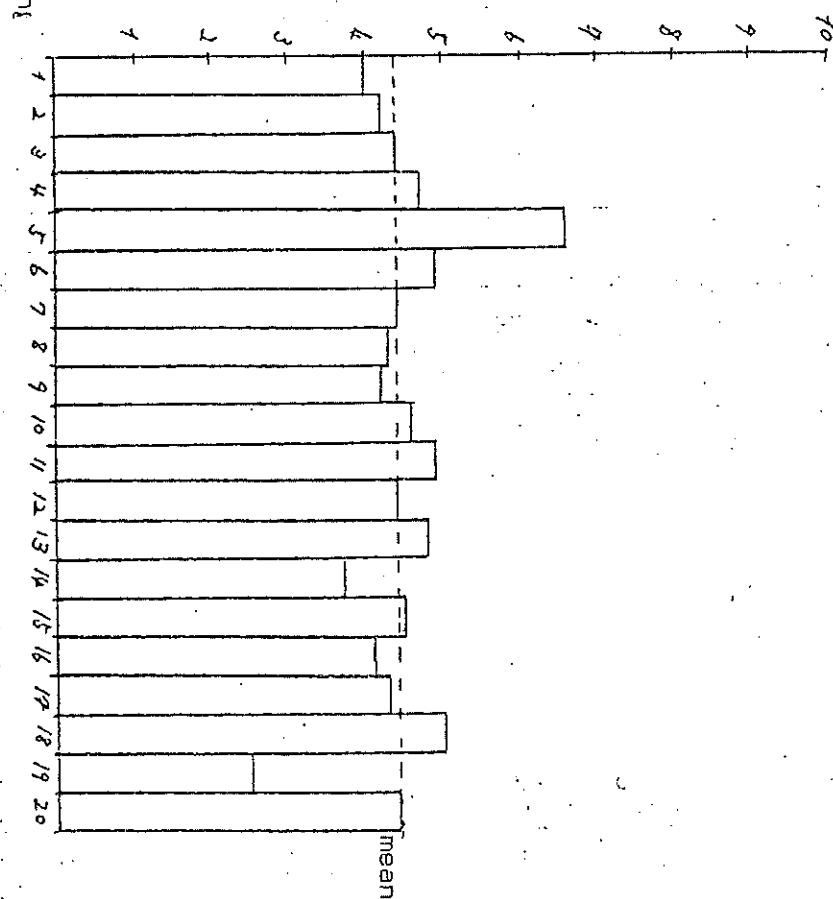
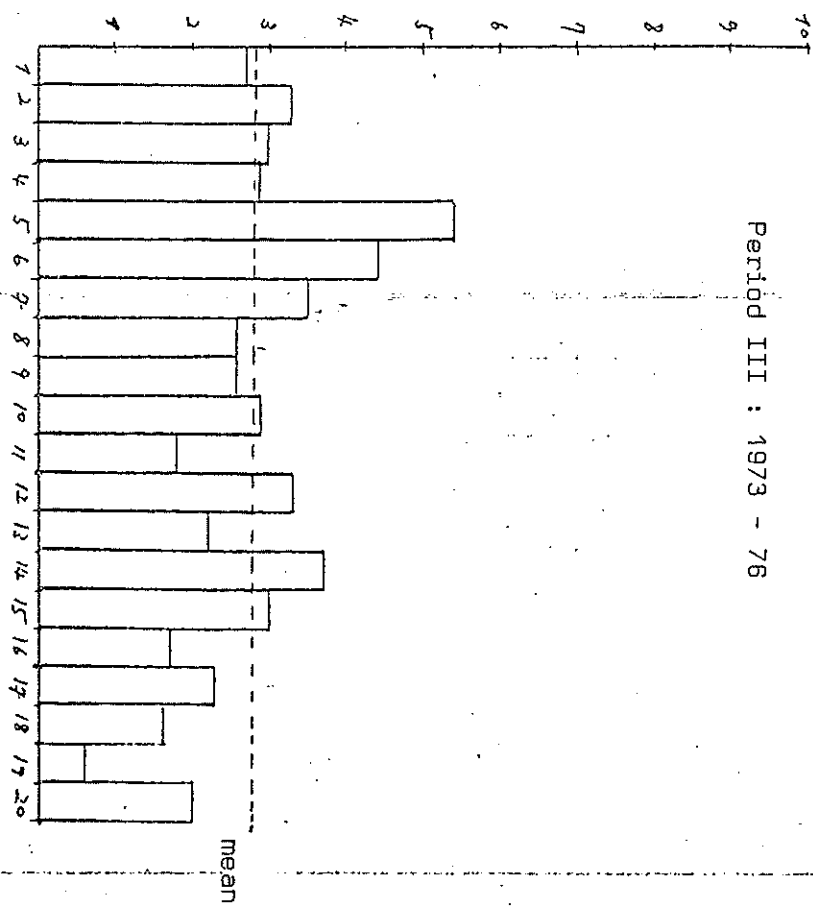


Figure 3 - 2

Period II 1969-1972

Figure 3 - 3

for three cases. In order to see whether there is a statistical difference in the distribution of profit rates between the bigger and smaller size classes, we have divided our sample into two groups : the biggest 400 firms and the rest. Then we have tested the null hypothesis that the average profit rate of each subsample is the same as the total average of the whole sample. The results of the test depend upon the observation periods : in period I, the hypothesis cannot be rejected even at the 70 % significance level for each subsample ; in period II, the hypothesis also cannot be rejected at the 80 % significance level ; however, in period III, the hypothesis is rejected at the 95 % significance level in both subsamples.⁽³⁾

Summing up, in the first period we do not find any particular pattern in the distribution of profit rates but in the second period the fluctuations of profitability around the mean becomes smaller in the bigger size classes. In the third period the distribution of profitability is different for the bigger and the smaller size classes : in the former, profit rates are usually above average whereas in the latter, they are below the mean. Based on these facts, the following presumption may hold : in period I, there is no merit or demerit for a firm in belonging to a certain size class from the viewpoint of profitability. In period II, among the bigger size classes profit rates are relatively higher and it would be favorable for firms to belong to bigger size classes. In period III, the general profit rates declined sharply and firm size is most influential in determining the distribution of profit rates among different size classes.

By examining the coefficients of variation (hereafter denoted CV), the above observations can be reinforced. Figure 4-1, 4-2 and 4-3 show the distribution of the CV's for the three periods. In period I no particular pattern appears in the distribution but the values of CV's are somewhat smaller for the bigger size classes. In period II the CV's level off except for the tail corresponding to ranks 19 and

Coefficient of variation of profit rates

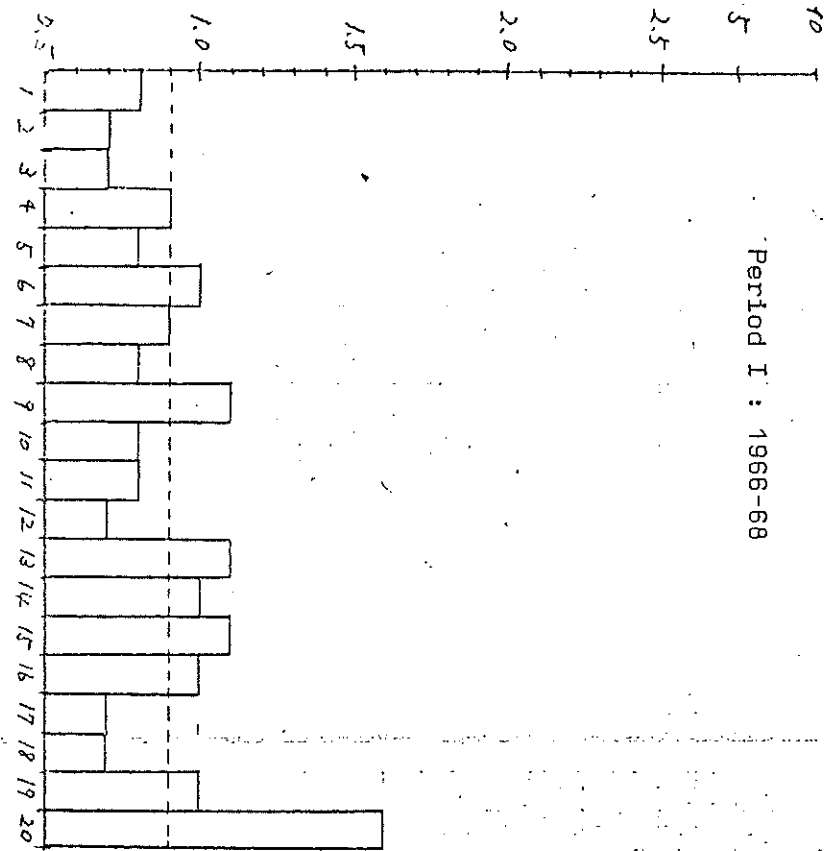


Figure 4 - 1

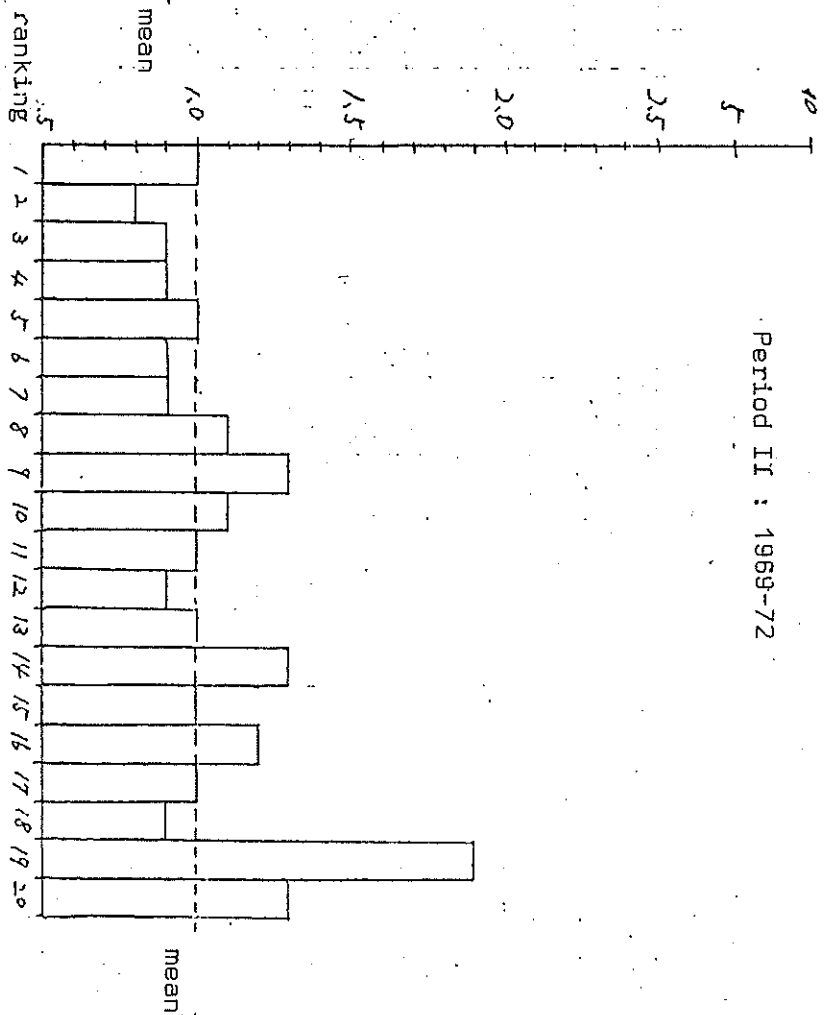
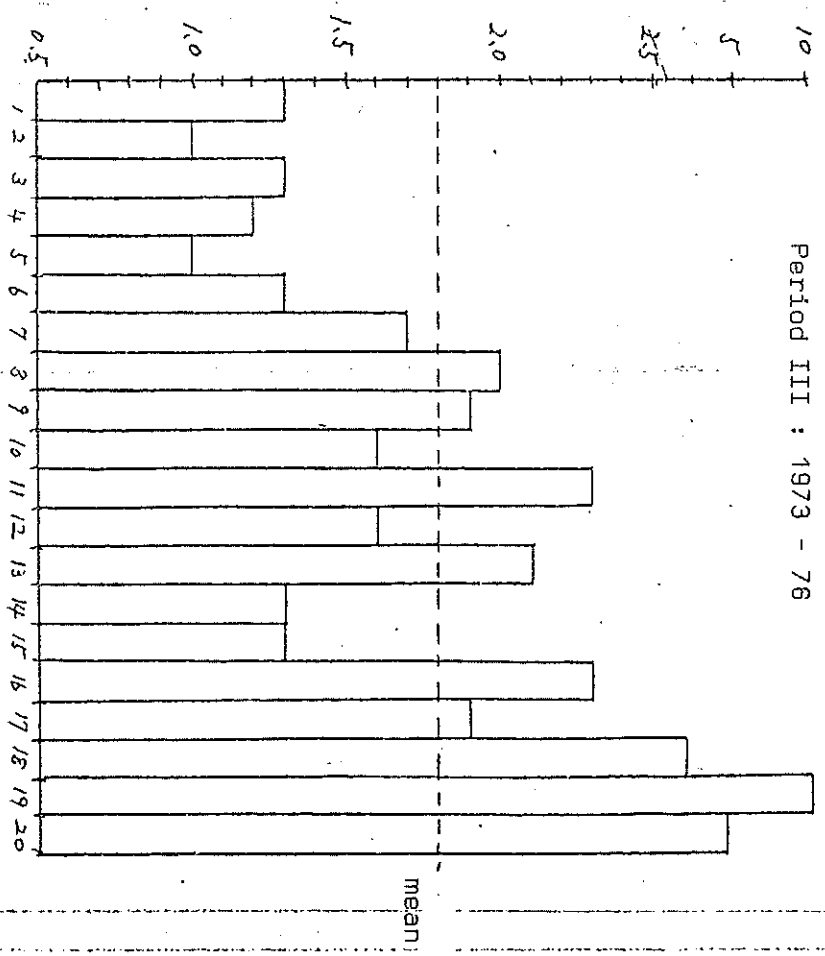


Figure 4 - 2

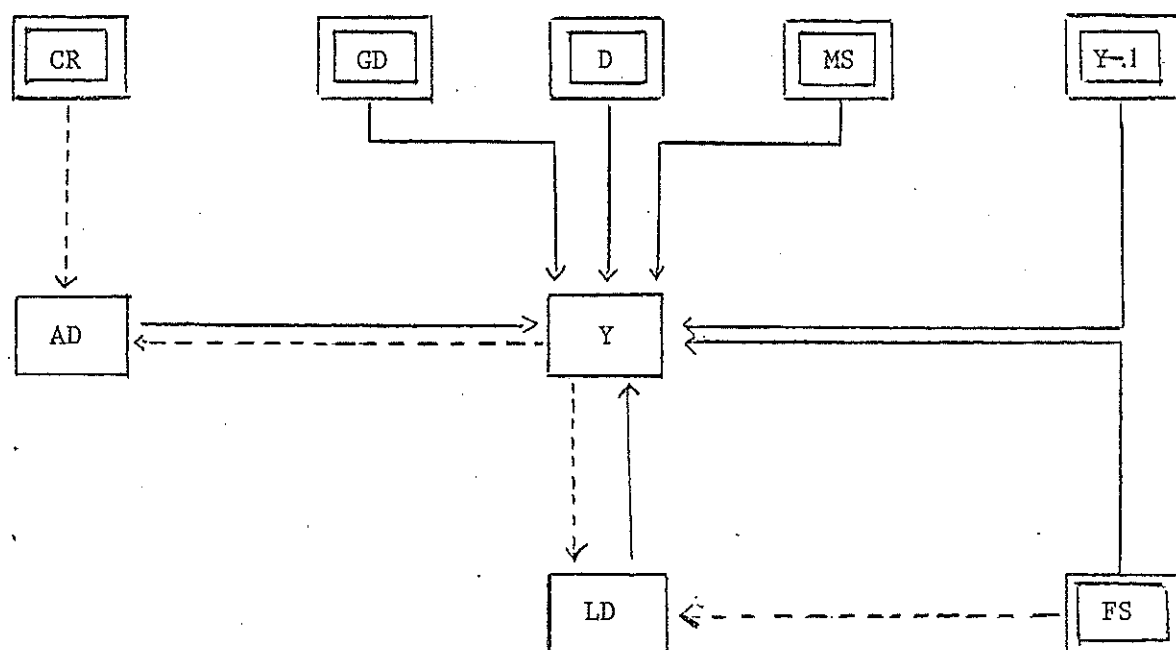


20 but their values are universally smaller in the bigger size classes. In period III, there is a striking difference between higher and lower rankings. In the bigger size classes the CV's are much lower than the mean and on the contrary in the smaller size classes they are larger than the mean.⁽⁴⁾ Looking at the figures carefully, we find one more interesting fact, viz., throughout all the periods, the firms of higher ranks 1 to 7 or the 350 biggest firms always have lower CV's than the mean (neglecting the only exception of rank 6 in period I). This seems to suggest, the capability of being a member of the bigger size classes guarantees the stability of profit rates to the firms. When we look at the accumulated share of total assets of these 350 firms, it is just around 90 %. Therefore, the biggest 350 (or rounding 400) firms which are decisively important in the distribution of total assets, are guaranteed stable profits over time.

3. The model and its variables

In the preceeding sections we found that the classification of firms into subsample may be effective in exploring the structure of profitability. According to our findings, there seems to be a structural difference of profitability between bigger and smaller size classes and it would be proper to draw a line at the rank of 7 or 8 (the biggest 350 or 400 firms). Hence we are going to divide our sample into two groups : the sample of the biggest 400 and the rest⁽⁵⁾ and apply, to these sample, regression analysis in order to discover factors which are important in the determination of profitability. In this section we discuss the model employed in the regression analysis. At the present state of knowledge, we do not have any general theory of the firm in common and so have to start with our own model of profit determination. Our model or philosophy on the determination of profit rates is shown in the flow chart below (Figure 5). We have paid attention to the causal relationships among variables and employed not only a single equation model of profit rate determination but also simultaneous equations systems. Here, however, we will concentrate our discussion on the determination of the profit rate. The variables which appear in the flow chart are divided into exogeneous and endogenous variables. We will explain the exogeneous variables first.

Figure 5
The determination of profitability



variables in endogeneous variables

variables in exogeneous variables

Exogeneous variables

1. Market share MS

We have introduced market share as a proxy of product differentiation or good will towards a firm and have treated it as a structural element of profitability.⁽⁶⁾ We have picked up a principal product of each firm (its share in a firm's total sales must be over 50 %) and calculated the firm's share in the market for that product each year.⁽⁷⁾ These figures are averaged over four years (except in period I over three years). We did not have data of the market share for all 976 firms and so had to reduce the number of sample firms to almost one fourth of the original.

2. Dummy for market position D

If a firm is in a position to set a price or at least not obliged to observe an unacceptable price, this will be favorable to the profitability of the firm. It is difficult to determine a good measure of the market position of a firm and we have tentatively introduced a dummy variable D, which takes the value 1 if the firm belongs to one of the biggest three in the market for its principal product and 0 otherwise.

3. Growth of demand GD

The growth rate of output of each industry (which approximately corresponds to the 3 digit industry of Standard Industrial classification) to which the firm belongs is calculated in real terms.

4. Firm size FS

Here we are going to see the effect of firm size in the multiplicative regression. Firm size is the four year (in period I three year) average of the total assets of each firm.

5. The profit rate of previous period Y_{-1}

The persistence of profit rates over time is usually strong (Jacquemin & Saez (7), Whittington (13)) and we must take this factor into account. Y_{-1} may be regarded as a proxy for good management or one for the intangible assets of the firm. In Japan, the movement of management among firms is usually exceptional and the art and skill of management is internally stored in a firm. If good management is inherited over time, it will show a positive effect on profitability over time.

We have listed five exogeneous variables and the first three are closely related to the structural elements of the market. We expect MS, D and GD to have a positive effect on profitability. The last two FS and Y_{-1} are related to the internal structure of the firm: FS may have a positive effect on profitability unless there are diseconomies of scale in management; Y_{-1} will also be positively linked with profitability as discussed above. Now we introduce several endogeneous variables in the determination of profitability.

Endogeneous variables

1. Advertising sales ratio AD

Advertising is often regarded as a barrier to entry but there exists a theoretical problem in using the advertising sales ratio as a proxy for the product differentiation barrier (Schmalensee (9)). In a profit maximizing model, profitability and advertising sales ratios are simultaneously determined. Here we are going to take this mutual interdependence into account and treat AD endogenously. At the same time, the three firm concentration ratio in the market for the firm's primary product is introduced in order to consider a structural influence on AD. This variable is denoted CR and appears in a simultaneous estimation as an exogeneous variable.

2. Long-run debt on tangible fixed assets LD

Profitability may be increased if a firm succeeds in making a good use of capital markets (Whittington's argument (12)) and external borrowing for expansion will contribute towards profitability. On the other hand, if a firm is profitable, it can easily and with favorable terms raise money for expansion from banks ; and profitability may stimulate external borrowing. For these reasons the ratio of long term debt to tangible fixed assets is calculated and its four year (three year in period I) average is introduced as an endogeneous variable.

Based on the model above, we have estimated single equation models of profitability and simultaneous equation systems. In the next section the estimation results of single equations and simultaneous equations are examined in turn.

4. Estimation results (I)

The main results of our estimation are summarized in Table 5. In order to penetrate the basic structure, we shall concentrate on the results for period II, because this period corresponds to moderate economic growth including recessions and can be considered as representative. It is also precedes the "Oil Shock" which seems to have had a substantial effect on every aspect of the Japanese economy.

Firstly we regard the variables which are related to the structural elements of industry, viz., MS, D, AD and GD. In the subsample of rankings 1 to 8, the coefficients of these variables are significant except for D and their signs fit a priori expectations. Market share, which represents the degree of product differentiation or the level of goodwill towards a firm, is high by significant and positive but a dummy for dominant market position is insignificant, though it has a positive sign. Because there is a not negligible correlation between MS and D (the correlation coefficient is .617), the estimated coefficients may be biased. But the effect of MS on profitability is strong enough (its simple correlation with profitability is .389). AD is also significant and in the simple equation model we can interpret it as the entry barrier of product differentiation being fairly

Table 5

Regression results of period II (1969-72)

(t-statistics in parenthesis)

(Coefficient of determination are adjusted for the degrees of freedom)

	Const.	LnFS	LD	MS	D	AD	GD	Y ₋₁	Coefficient of Determination	Number of Sample
(1) ranking 1-8	5.106	-.013 (.05)	-.040 (5.87)	.091 (3.37)	.159 (.27)	.353 (2.11)	.091 (2.85)	-	.368	184
(2) ranking 9-20	.859	.281 (.23)	-.019 (2.48)	-.013 (.68)	5.276 (2.50)	.015 (.05)	.170 (2.10)	-	.149	82
(3) ranking 1-8	2.823	-.150 (.81)	-.015 (3.12)	.014 (.74)	.271 (.68)	.009 (.08)	.014 (.62)	.761 (14.71)	.715	184
(4) ranking 9-20	.978	-.138 (.16)	-.001 (.25)	.130 (1.17)	1.147 (.76)	-.306 (1.32)	.057 (1.00)	.752 (9.30)	.602	82

high. The growth of demand GD has a positive and significant effect on profitability. Comparing these results with those of subsample corresponding to rankings 9-20, we note several differences. MS and AD are not significant but D is so and with a positive sign. GD is significant and has a positive sign. In the smaller size classes, the degree of product differentiation and the product differentiation barrier do not seem to play an important role in the determination of profitability. When we observe the correlation between MS and AD, its coefficient is .789 (in the subsample of ranking 1 to 7, it is .208). This is an interesting fact because it shows that among the smaller firms, market share can easily be changed by advertising efforts and MS and AD do not work as structural factors. As for the growth of demand, the value of the coefficient is .170 and this is about double that of the larger firms. We may interpret this fact in the sense that in the smaller firms the degree of diversification is less developed than in the larger firms and the effect of demand growth is stronger in the former than in the latter. In short, it is profitable for smaller firms to stay in a powerful market position and to select a highly growing industry but structural factors of industry are not influential.

Next, we shall examine the internal factors of the firm, FS and LD. Firm size does not have any significant influence on profitability in either of the subsamples. That is, there seems to be no favorable or unfavorable continuous effect of firm size on profitability. As we have already controlled our sample by firm size, this result by such a control of the shows the effect of firm size has been almost exhausted data. The long run debt to intangible fixed assets LD is significant and has a negative sign.⁽⁸⁾ This means that the less long term debt the firms have, the more profitable they are. It would represent an imperfection of capital market, that is the cost of external borrowing is greater than that of internal borrowing (Hall and Weiss (5)). But if profitable firms are likely to reserve their profits in the form of retained earnings and dislike interferences from outside, the direction of causation may be reversed. In this single equation model, we cannot speak much about the causal relationship between profitability and external borrowing.

Lastly we shall incorporate a variable Y_{-1} which may represent good or bad management in the past. It has already been pointed out that persistence of the profit rate is very strong in European and Japanese firms (Jacquemin and Saez (7)). In the equations (3) and (4) of Table 5 the multiple regression results including Y_{-1} are presented. Here we can see that the persistence of profitability is very strong and its numerical effect on profitability is almost the same in the two subsamples in period II (the coefficient is .761 and .752 respectively). But when we include Y_{-1} , the coefficient of other variables become insignificant. This is because there exists a strong correlation between Y_{-1} and MS, D, AD and GD. In the bigger firms sample, their correlation coefficients are .408, .287, .325 and .186 which are slightly bigger than the correlation between Y and other variables. This is almost the same as the sample of the smaller firms, though to a lesser degree. This seems to suggest that if Y_{-1} represents some quality of management, it greatly helps to enhance product differentiation, strategic market position, product differentiation entry barrier and to choose a growing industry.

Combining the results above, we can contend that firm size is important in determining the structure of profitability. By drawing a line of demarcation at the biggest 400 firms, we can see that the factors are working differently in each subsample. Among bigger firms, two important structural factors MS and AD are at work to raise profit rates. These variables represent the degree of product differentiation and the height of the entry barrier brought about by it, so that the role of product differentiation is essential in maintaining profitability for the established big firms. This fact can also explain the stability of highly ranked firms with respect to their rankings as discussed in section 1 and Tables 3-1 and 3-2. For the smaller firms, these structural elements are not significant enough to raise profitability and only their capacity to sustain a dominant market position is important.

5. Estimation results (II)

Now we shall pay attention to the problem of interdependence between variables, especially Y, AD and LD. In the single equation model AD is deemed as a proxy for entry barriers through product differentiation and LD represents the imperfection of capital markets in the sense that the cost of external and internal borrowing is not identical. But as we discussed above, the reversed causation is always possible and we should take this interdependence into account by building a simultaneous equations model. The model we are going to discuss here has the following specification :

$$\begin{aligned} Y &= f(LD, MS, AD, GD) \\ LD &= g(Y, FS) \\ AD &= h(Y, CR) \end{aligned}$$

By employing two stage least squares, we have estimated the coefficients and the results for period II are shown in Table 6. The coefficients of equation (1), which is just identified, are very contrasted compared with the single equation model. AD does not have a significant explanatory power and it is explained by Y and CR⁽⁹⁾. But MS is still highly significant and its coefficient is almost the same in the subsample of rankings 1 to 8. That is to say, when interdependence between Y and AD is taken into account, the advertising sales ratio does not enter into account in explaining profitability as a structural variable and it is better to see it as a decision variable simultaneously determined with profitability under a certain market structure. That is more evident in the subsample of the smaller firms where AD is not significant in equation (4) but is itself explained by more than fifty percents by Y and CR. With respect to LD, the interdependence between LD and Y is strong in the bigger firms and LD increases as firm size becomes greater. This suggests that in a capital market big firms have better chances of making use of capital markets than smaller ones.

Here we will throw a glance at the regression results of the other periods. The estimated coefficients for period I, where data for GD is not available, are given in (1) and (2) in Table 7. In the

Table 6

Regression results of period II

(Two Stage Least Squares)

	Const.	Y	FS	LD	MS	CR	AD	GD	Coefficient of Determination	Number of Samples
Ranking 1-8	(1) Y = 5.914			-.047 (1.75)	.096 (2.77)		.115 (.100)	.083 (1.16)	.178	184
	(2) LD = 101.170	-6.125 (3.79)	.337x10 ⁻⁴ (2.84)						.106	
	(3) AD = .135	.068 (.98)				.013 (2.18)			.039	
Ranking 9-20	(4) Y = 7.128			-.063 (.78)	.132 (.57)		.099 (.15)	.76 (.76)	.039	82
	(5) LD = 78.385	-3.438 (.67)	.534x10 ⁻³ (.24)						.000	
	(6) AD = -6.700	1.190 (8.80)				.063 (5.81)			.610	

bigger firms only MS and LD are significant. Market share or the degree of product differentiation is an important factor in explaining profitability but AD has an insignificant though positive effect. Looking at the coefficients of (2), no variables besides D are significant and the coefficient of determination is very low. This suggests that sustaining a dominant position in a market is essential for raising profitability but product differentiation is not effectively at work among the smaller firms. In period I, the variables are active in almost the same as period II in the determination of the structure of profitability. Period III is a special case, because of the "Oil Shock" in 1973 which had a serious influence on the Japanese economy. During the observation period 1973-76, adjustment to the new situation does not seem to have been completed. The fall in the economic growth rate and the rise in prices pressed for a change in consumption attitudes of the people who were accustomed to high economic growth and real as well as nominal wage increases. And at the same time businessmen could not anticipate in which direction the pattern of consumption would change. These situations seem to have some influences in the estimation results in (3), (4), (5), (6) of Table 7. The changes after the oil shock would have been greater, especially for the bigger firms because they had been supplying major manufactured products and the percentage of the firms producing consumer goods is considerable⁽¹⁰⁾. These would be reflected in the coefficient of MS and actually in (3), the coefficient of MS turned out to be insignificant. But other variables, AD, GD and LD are as significant as in period II. This shows that some kind of change on the side of consumer occurred and the probable shifts of demand from one differentiated good to another are suspected. The coefficient of AD is highly significant and its figure is fairly big. But we must consider the direction of causality again and this is examined in the simultaneous regression model. In (4), MS seems almost significant ; but there is still a strong correlation between MS and AD (their correlation coefficient is .68) and we should discount its effect on profitability. As for Y_{-1} , the coefficients are significant in the two subsamples. But we must note that the effect

Table 7

Regression results of period I and III

	Const.	LnFS	LD	MS	D	AD	GD	Y-1	Coefficient of Determination	Number of Sample
Period I (1) Ranking 1 ~ 8	1.092	.334 (1.24)	-.021 (2.40)	.082 (2.39)	.123 (.19)	.141 (.86)	-	-	.143	148
1966-68										
(2) Ranking 9 ~ 20	21.950	-1.798 (1.06)	-.037 (1.38)	-.187 (.54)	4.042 (1.53)	.056 (.08)	-	-	.022	52
(3) Ranking 1 ~ 8	1.362	.383 (1.34)	-.043 (7.21)	.011 (.38)	.491 (.70)	.645 (3.47)	.073 (1.74)	-	.377	192
Period III (4) Ranking 9 ~ 20	7.728	-.453 (.47)	-.029 (3.69)	.171 (1.77)	1.392 (.81)	.016 (.07)	.193 (2.65)	-	.337	72
1973-76										
(5) Ranking 1 ~ 8	-2.082	.278 (1.18)	-.016 (2.81)	-.011 (.47)	.494 (.86)	.181 (1.13)	.008 (.22)	.640 (9.50)	.580	192
(6) Ranking 9 ~ 20	8.654	-.727 (.81)	-.022 (2.93)	.138 (1.53)	1.042 (.66)	2.550 (.13)	.190 (.22)	.283 (9.50)	.433	72

of Y_{-1} is numerically greater in the bigger firms than in the smaller ones. This would mean that the stability of profitability is better assured in the bigger firms. Because the correlation between Y_{-1} and MS, D and AD are strong, Y_{-1} may represent the difference of market environment as a whole.

In Table 8, the results of the simultaneous estimation are given. The effect of AD is noticeable : it does not have explanatory power for profitability but is explained by Y and CR. Though MS is not significant enough in period III, we can say that the structure in which profitability is determined does not change in this period.

Lastly we must remark on the effect of firm size on profitability. In period I and III, firm size has a positive, though not significant enough, effect on profitability. Period I corresponds to ultra high economic growth (the annual growth rate is about 13 % in real terms) while period III corresponds to recession after the "Oil Shock". In period I diseconomies of scale due to big management may not matter so much and technical economies of scale may be prevalent owing to such high economic growth. Firm size may work in favor of profitability in this process. On the other hand, the firms encountered a long recession in period III and had to adjust this situation. The bigger firms were able to cut back several inefficiencies stored during rapid expansion but among the smaller firms such redundancies may not have existed. In this way firm size seems to work in support of profitability in hard times.

Table 8

Regression results of period III
(Two Stage Least Squares)

	Const.	Y	FS	LD	MS	CR	AD	GD	Coefficient of Determination	Number of Sample
Ranking 1 ~ 8	(1) Y = 13.640 (2) LD = 123.132 (3) AD = -.398	-10.898 (4.91) .323 (4.62)	$.106 \times 10^{-4}$ (1.06)	-.106 (1.95)	.043 (.88)	.009 (1.77)	-1.341 (.82)	.040 (.67)	.101 .113 .111	192
Ranking 9 ~ 20	(4) Y = 1.389 (5) LD = 104.966 (6) AD = -2.19	-3.959 (1.27) .679 (4.93)	-.001 (.965)	-.003 (.045)	.229 (.85)	.042 (2.15)	-.005 (.05)	-.251 (1.02)	.211 .015 .433	72

6. Summary and Conclusions

We began our analysis with an examination of the size distribution of the major 976 manufacturing firms in Japan. According to our investigation, this distribution is highly skewed and the biggest 400 firms account for about 90 % of the total assets of these industrial firms. Next, on dividing our sample into twenty size classes in terms of total assets, we observed the behavior of the profit rates in each size class. It was suggested that there exists a difference between the bigger and the smaller firm in the structure of profitability. While the profit rates declined over time, the dispersion of profit rates was almost the same among size classes in period I but profitability become relatively stable in the larger size classes in period II. In period III, it is apparent that the profit rates are higher and more stable in the bigger size classes.

Based on these findings, we divided our sample into two subsamples, ranking 1 to 8 and 9 to 20. Controlling our sample in this way, we applied regression analysis to the data and estimated not only single equation models of profit rate determination but also simultaneous equation systems.

When we employ a single equation model, the main results can be summarized as follows.

(1) By drawing a line of demarcation at the biggest 400 firms, we see that the influence of the variables are different for the two subsamples. Firm size plays a role of threshold in dividing firms analytically into the "big" and the other firms.

(2) Among the biggest 400 firms, the variables closely linked to market structure, namely market share and the advertising sales ratio have a positive and significant effect on profitability. We must say that the influence of product differentiation is impressive among these big firms. The growth of demand is also significant and has a positive sign.

(3) Among the small firms, no variables besides the growth of demand and a dummy, which stands for a dominant market position of the firm in its primary product, are significant. That is, it is important for

a firm to be a powerful member in the industry but the effect of product differentiation is not noticeable. The effect of the growth of demand on profitability is numerically big compared to the big firms.

(4) As for the internal factors of the firm, namely the long term debt and firm size, the former has a negative and significant effect on profitability while the latter is insignificant in both subsamples.

(5) The persistence of profit rates is great in both subsamples. The profit rate of the previous period is also correlated with market share, the advertising sales ratio and the growth of demand. If the quality of management corresponds to previous profitability, a beneficial circle may be at work among the big firms.

(6) When we look at the other observation periods, the basic structural factors work in the same way. But in period I and III, firm size has a positive, though not sufficiently significant, effect on profitability among the big firms. These periods include ultra high economic growth and recession. Firm size seems to work to encourage further expansion in good times and in hard times in support of profitability.

When we apply a simultaneous equations model, we remark certain differences. Among the big firms, the advertising sales ratio is not a significant variable in explaining profit rates, which is rather explained by profitability and a three-firm concentration ratio. Thus it would not be correct to lay a strong emphasis on the advertising sales ratios as a product differentiation barrier based on a single equation model. However, the degree of product differentiation, measured by market share, is still important in explain profitability.

Lastly we attempt some comparisons with other studies, though it is of course impossible to do so fully because of many differences in the character of data, observation periods and the approach.

(1) On the stability of profit rates, our results basically accord with the former studies (Jacquemin and Cardon (6), Jacquemin and Saez (7) and Samuels and Smyth (8)) in the sense that variability of profit rates is smaller among the bigger firms.

(2) On the effect of firm size on profitability, we cannot find a continuous and positively significant effect as in Hall and Weiss (5) but among the biggest 400 firms, firm size yields at least a non-negative effect on profitability. This seems to contradict the Jacquemin and Saez result ; however, their sample firms are limited to the 74 largest firms in 1972 and it is plausible that there are diseconomies of scale due to excessively big management⁽¹¹⁾. Our result corresponds to Caves and Uekusa (2), though they employed a quadratic form to examine the effect of firm size.

(3) The long term debt always has a negative and significant effect on profitability and this corresponds to the result of Hall and Weiss (5). It may be suggested that external borrowing for expansion does not have the effect of promoting profitability as Whittington (12) contends.

(4) The role of market share to raise profitability is impressive and this is comparable to the results of Gale (4), Shepherd (10) and Nakao (14). The advertising sales ratio in the single equation model is significant and this is almost the same as Caves and Uekusa (2).

Summing up our results, we cannot see any serious differences in the structure of profitability between Japan and the other industrialized states among the several hundreds of bigger firms. Firm size seems not to have a very robust and continuous effect on profitability but it is important as a threshold in letting us know where the structural elements of market begin to work effectively on profitability. From our study we can reconfirm the fact that the role of product differentiation is universally important in advanced capitalism.

Footnotes

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1. The other papers which deal with a related subject are the following Caves and Uekusa (2), Gale (4), Samuels and Smyth (8) and Stekler (8).
2. In Japan corporate tax structure is likely to yield a bias in calculating profits rates after taxes because big and small firms can benefit from several tax allowances but often medium sized firms do not have such opportunities. This is liable to overstate the profitability of the big and small firms after taxes.
3. The mean and standard deviation of each subsample are given below.

		period I	period II	period III
ranking	mean	5.31	4.54	3.46
1 ~ 8	standard deviation	.75	.80	.94
ranking	mean	5.53	4.28	2.31
9 ~ 20	standard deviation	.62	.68	.85
all firms	mean	5.45	4.44	2.79

4. Here we can also test the null hypothesis that the coefficient of variation of each subsample is the same with the total average of the whole sample. The results are similar to those of the average profit rates ; only in period III, the hypothesis is rejected at the 99 % significance level for the bigger size classes and at the 90 % significance level for the smaller size classes.
5. We have also divided our sample into groups of 100 firms and run regressions for these subgroups. The estimation results are usually poorer than those presented in the text.
6. Gale (4) argued that market share can be seen as a proxy for product differentiation and we give the same interpretation to our regression results. But at the same time market share may represent the pecuniary gains through price discrimination as was stressed by Shepherd (10). However we are not sure to what extent this factor is at work because we lack ample data and analysis about Japanese inputs and capital markets.

7. This is based on the following investigations : Kazuo Taki, "Market Share of the Primary Manufactured Products" (The Research Institute of Capital Formation of the Japan Development Bank, 1978 : in Japanese).
8. This may be naturally so because in the calculation of current profits interest payment is deducted from business profits. But when we run a regression using business profits, the estimation results remain almost same.
9. Comanor and Wilson (3) employed simultaneous regression and got the result that the advertising sales ratio is significant in the estimation of the profit rates equation. This may suggest that the height of the product differentiation barrier is different between Japan and United States.
10. The ratio of consumer goods producing firms is about 23 % in the biggest 400 firms and it is about 14 % in the smaller firms according to the characterization of firms by the Yearbook of Mining and Manufacturing Production Index (published by the Ministry of International Trade and Industry).
11. The estimation result of the profit rate equation for 67 firms among the largest 100 firms is as follows.

$$Y = 2.891 + .062FS - .034LD + .091MS + .238D$$

$$(0.13) \quad (3.49) \quad (2.82) \quad (.28)$$

$$+ .721AD + .122GD \quad R^2 = .448$$

$$(1.86) \quad (2.53)$$

(t-statistics are in parentheses).

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