ENTRY, MARKET STRUCTURE, AND INTERNATIONAL TRADE: AN EMPIRICAL STUDY OF TAIWAN'S MANUFACTURING INDUSTRIES

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CHAPTER I

INTRODUCTION

Since Bain's 1951 pioneering work, considerable effort has been devoted to studyingthe relationship between profitability and market structure. However, the influence of import competition on the structure-performance relationship, and more generally the role of international trade in the determination of domestic market performance had been for the most part ignored, until the 1970s.

In recent years, as a result of the increasing importance of international trade in all market economies, many studies have been undertaken regarding both the theoretical foundations and the appropriate empirical specifications for the interface between international trade and industrial organization. Four surveys of these studies have been made by Lyons (1979), Pugel (1980), Jacquemin (1982), and Caves (1985). The major findings of these studies can be summarized as follows.

It is predicted that, in most cases, as a source of competitive discipline, import intensity exerts a negative influence on the domestic industrial profitability. (See Pugel (1980), Caves, Porter and Spence (1980), Geroski and Jacquemin (1981), and Jacquemin (1982).) Empirical results are consistent with theoretical predictions. Negative and significant signs are found for import intensity in profit equations [Esposito and Esposito (1971), Pagoulatos and Sorensen (1976), Pugel (1978, 1980), Turner (1980), Caves, Porter and Spence (1980) and Chou (1986)].

However, the effect of export opportunities on market performance is much less straightforward. A general presumption is still absent. It depends on the ability of domestic sellers in segmenting the domestic and world markets, the cost function of domestic producers, the price elasticity of demand in both the domestic and world markets, and whether or not the domestic market is sheltered. (See White (1974), Caves (1972, 1973), Pugel (1980), Jacquemin, De Ghellinck and Huveneers (1980), Huveneers (1981), and Jaquemin (1982).) Diverging signs with varying levels of significance are obtained for export shares. (See Pagoulatos and Sorensen (1976), Caves, Porter and Spence (1980), Neuman, Bobel and Haid (1979), Geroski (1982), Gan and Tham (1977), Pugel (1978, 1980), Katrak (1980), and Chou (1986).)

While many structure-performance studies have been undertaken, the vast majority of U.S. studies and all the studies on lesser developed countries have tended to focus on profit studies and ignored the role of entry. There is a large body of theoretical literature that suggests that a rational policy for oligopolistic firms is the maximization of long run profits. In order to achieve this objective the threat from entry de novo has to be taken into account. Kamien and Schwartz (1971), and Baron (1973), in their dynamic-stochastic models, suggest that the fear of entry does play a direct role in oligopolistic firms' profit calculations. These firms, according to Kamien and Schwartz, will opt for °the optimal profits', i.e., profits that are maximized over the long run and take into account the signalling effect of prices on potential entrants.

The major objective of this study is to examine the structure-performance relationship in a small, open, and newly industrialized economy--Taiwan, with a particular emphasis on entry. Three specific areas will be emphasized in this study:

1. To complete the specification of the structure-performance relationship in a small open economy, the influence of international trade on industrial profitability should be taken into account. The effect of import competition and export opportunities on domestic profitability will thus be examined in this study.

2. Masson-Shaanan's (1982) empirical model of limit pricing is applied to examine the structure-performance relationship in Taiwan. Such an approach will enable us to examine both the determinants of industry profitability and the incentives to enter an industry, and overcome some statistical biases of previous studies.

3. Because of the large role played by government in Taiwan's manufacturing sector, it will be interesting to examine the structure-performance relationship in both the public and private sector and to analyze the possible ramifications of differing results.

There are several applications of the structure-conduct-performance analysis to developing economies (e.g. House (1973, 1976), Sharwani (1976), Gan and Tham (1977), Katrak (1980) and Chou (1986)). But Caves, Porter and Spence (1980) have warned that economic models appropriate to an analysis of U.S. economy are not always applicable to other economies.

We apply a modified version of the conventional structure-conduct-performance analysis in our study on Taiwan's manufacturing sector, because we believe that (1) Taiwan's economy is basically a market economy. It has liberal regulations regarding trade and foreign investment and can be described as free-market capitalism with government economic control through ownership of some basic industries.

(2) Business and government are working together to achieve technological goals through research institutes. As a result of the efforts, domestic high-tech industries are successfully developed and some American companies, such as Wang Laboratories, are now using Taiwan as a technological base from which to compete with Japan. So, we think that the level of technology in Taiwan's manufacturing sector is closer to that of the U.S. than its counterparts in many other developing economies. (3) The portion of the U.S's foreign direct investment in total foreign direct investment in Taiwan was 35 percent in 1982. American firms in Taiwan, as mentioned by Chou (1987), are domestic-market-oriented, large and capital-intensive. The presence of these large U.S. multinationals in Taiwan's manufacturing sector may exert certain influence on the domestic market. Therefore, similarity rather than disparity between Taiwan's manufacturing sector and manufacturing sectors in western industrial economies can be inferred and the application of the S-C-P analytical framework on Taiwan's manufacturing sector would be appropriate.

The empirical results of this study can be summarized as follows.

1. By applying Masson and Shaanan's (1982, 1987) empirical model to examine the limit pricing behavior in Taiwan manufacturing industries, we find support for limit pricing theory and especially for the applicability of the stochastic-dynamic limit pricing model to the analysis of the structure-conduct-performance relationship in Taiwan. High preentry profit rates attract entry. It is strong explanatory factor of entry. The advertising barrier is found to discourage entry. Concentration has a significant positive effect on entry, in other words,

high concentration induces entry. Growth have a positive effect on entry.

2. Market power (concentration) exerts a strong and positive influence on industrial profitability. Entry barriers, especially the advertising barrier, enhance industrial profitability. Market growth has a positive effect on profits. Imports constrain domestic industrial profitability. The effect of exports on domestic industrial profitability is not clear. Public enterprises exert a negative influence on industrial profitability.

3. As expected, the advertising barrier and concentration are significant explanatory factors in the entry forestalling equation.

4. In accordance with the predictions of stochastic/dynamic limit pricing, optimal profits exceed entry forestalling profits. Both rise with entry barriers and converge to the short run profit maximizing level.

Empirical results of regressions with alternative functional forms and different samples show that our findings are not highly sensitive to sample selection and forms of model specification. These results are listed in the Appendix.

CHAPTER II

REVIEW OF PREVIOUS STUDIES

This chapter is devoted to a presentation of the major theoretical and empirical studies in five areas of Industrial Organization upon which our study is based; (1) Performance structure studies; (2) Theoretical and empirical studies of the effect of international trade on domestic industrial profitability; (3) Theoretical studies of the theory of limit pricing; (4) Empirical studies dealing with entry; and (5) Empirical studies of the theory of limit pricing.

Performance-Structure

A large number of empirical studies have investigated the structure-performance relationship.[1] We survey only a few of these studies.

Bain's (1951) pioneering article dealt with the relationship between seller concentration and industrial profitability. A positive relationship between the two variables was found. Later [see Bain (1956)], Bain extended his study by including entry barrier variables in the structure-performance relationship for the years 1936-1940 and 1947-1951 and found a positive effect of concentration on profits for each level of entry barriers. The relationship was found to be significant when barriers were high.

Similar results were found by Mann (1966) when he repeated Bain's analysis for the years 1950-1960. Weiss (1971) applied regression analysis to Bain and Mann's data and confirmed their findings.

George (1968) extended Mann's (1966) study by adding a growth variable. He regressed profit rates on concentration, entry barriers and growth and found that these variables significantly affected profits.

Comanor and Wilson's study (1967) revealed that as a proxy for product differentiation, advertising has a positive and significant effect on profits. Other explanatory variables included in their multiple regression analysis (economies of scale, capital requirements and growth) were also found to be significant in the determination of industrial profitability.

Weiss (1974) surveyed major concentration-profits studies from several countries--for the years from 1936 to 1970. He notes that the majority of these studies show a positive and significant effect of concentration on profits.

While the majority of studies found a positive and significant relationship between concentration and profit rates and therefore supported the market power hypothesis, Demsetz (1973) argued, however, that firms with superior efficiency will tend to be large firms and have high profits. High profits are actually caused by better efficiency, not by market power. The fact that high profits generally appear in concentrated industries is not because high concentration (market power) cause profits, but rather because superior efficiency causes both.

Stigler (1963) and Brozen (1971) and several other studies found no evidence of a positive relationship between the two variables for certain time periods.

While the four-firm concentration ratio is used as a structural variable in many structure-performance studies this is due to data availability. There is no theoretical justification for using four firms. Kwoka (1978) tried various market share variables and concentration variables in profit equations and found that: (i) the size distribution of sellers is indeed an important determinant of industry profitability, (ii) the two largest market shares are generally decisive for industry profits, (iii) the explanatory power of profit equations will increase if detailed distributional traits are used.

Most empirical studies of structure-profitability relationship employed single-equation models and ignored the simultaneity problem. Strickland and Weiss (1976) estimated a three-equation model in which price-cost margins, seller concentration and advertising intensity are simultaneously determined for 408 four-digit U.S. industries in 1963. It is found that concentration and advertising intensity are not significant determinants of price-cost margins. Martin (1979) noted an econometric error in SW's. He extended and improved SW's model and estimated it by three-stage least squares estimation technique for a sample of 209 U.S. industries in 1967. Concentration was found to have a positive but insignificant effect on price-cost margins.

Geroski (1982) discusses simultaneous estimation and suggests a simple test for exogeneity which was developed originally by Engle, Hendry and Richard (1979). He applied the test to a sample of 52 U.K. industries. He finds that simultaneity exists between profits and two international trade variables, i.e. imports and exports.

International Trade

In addition to the traditional aspects of market structure and behavior in the structure-performance analysis, one important aspect which has been examined by many studies recently is the role of international trade.

We will survey some of these studies which investigate the effect of imports and exports on the domestic industry profits.

Import Competition

It is expected that imports which represent the entry of foreign suppliers would increase the number of suppliers and total sales volume in the domestic market and therefore reduce the sellers' concentration in the market. A lower seller concentration would lead to a more competitive price.

It is also anticipated that the existence of actual and potential foreign competition may constrain the domestic price to an entry forestalling level which is closer to the competitive price. Therefore, imports are generally expected to exert a negative influence on industrial profitability.

Rigorous models which include interactions between imports, market structure and industry conduct were constructed by Pugel (1980), Jacquemin (1982) and Geroski and Jacquemin (1981) to demonstrate the effect of imports on domestic market performance.

Pugel (1980) formulates a model to show the negative relationship between imports and domestic price-cost margins and the interactions between imports and the structural variables. Assuming that,

(i) imports and domestic products are differentiated, (ii) the domestic supplier is a monopolist, (iii) the monopolist is assumed to maximize his profit, (iv) foreign suppliers are competitive, and solving for the first order condition of the monopolist's profit equation, the profit maximizing price-cost margin can be obtained as

$$PCM_d = \frac{P_d - C_d}{P_d} = \frac{P_m Q_m}{P_d Q_d} \cdot \left[\left(\frac{\varepsilon_{md}}{\varepsilon_{ms}} + \varepsilon_{md}\right)/(\varepsilon_{dd} - (\varepsilon_{dd}\ \varepsilon_{mm} - \varepsilon_{dm}\ \varepsilon_{md})/\varepsilon_{ms})\right] + 1, = \left(\frac{P_m Q_m}{P_d Q_d} \cdot \varepsilon^*\right) + 1 \qquad (2.1)$$

where PCM_d is the domestic price-cost margin,

ε_{mm} is own price elasticity of demand for the domestic product,

ε_{dd} is own price elasticity of demand for the imported product,

ε_{md} and ε_{dm} are cross-price elasticity of demand,

ε_{ms} is the price elasticity of the supply of the imported good,

Since $\varepsilon^* < 0$, therefore $\dfrac{d\left(\frac{P_d - C_d}{P_d}\right)}{d\left(\frac{P_m Q_m}{P_d Q_d}\right)} < 0$,

where $\dfrac{P_m Q_m}{P_d Q_d}$ is the import share.

He further demonstrates that, PCM_d varies between zero (the profit in a perfectly competitive market) and the monopoly value according to the state (S) of competition in the domestic market,

$$PCM_d = \left(1 + \varepsilon^* \cdot \frac{P_m Q_m}{P_d Q_d}\right) \cdot S \qquad (2.2)$$

Assuming a multiplicate interaction between structure variables in deciding the state of competition, equation (2.2) can be written as

$$PCM_d = (1 + \varepsilon^* \cdot \frac{P_m Q_m}{P_d Q_d}) \cdot b_i \cdot CR_4 \cdot B_i \tag{2.3}$$

where b_i are positive parameters,

CR_4 is producer concentration,

B_i are entry barriers.

It is shown, in equation (2.3), that in oligopolistic markets, import shares interact with market structure variables in the determination of the industry price-cost margins and have a negative influence on profit rates.

Interactions between imports and market structure have been included in Pugel's (1980) model, but the industry conduct which is important is ignored. Jacquemin (1982) took into account the industry conduct in his model. He assumed a Cournot case with n non-collusive domestic oligopolistic producers and solved for the first order condition for profit maximization for each firm. The maximizing condition obtained by Jacquemin, at the industry level, is

$$L_d = \frac{H_d}{\varepsilon_d} (1 - t_m) \tag{2.4}$$

where L_d is the Lerner index for the industry,

H_d is the Herfindhal index,

t_m is the rate of import,

ε_d is the elasticity of industry domestic demand.

If MC = AC = constant, then L_d = PCM. The rate of import has a negative relationship with the price-cost margins and it interacts with concentration in determining L_d (i.e. PCM).

Geroski and Jacquemin (1981) varied the definition of the dominant cartel and industry conduct and derive different conclusions about the influence of imports on industry profits.

When it is assumed that the domestic market forms the cartel and the foreign producers are treated as the competitive fringe, a negative influence on profits is found as expected by other theorists. But in the opposite case, when it is assumed that foreign producers who do not produce in the country in question form the cartel and domestic producers are the competitive fringe, the direction of the competitive discipline is reversed. Thus the more imports the weaker the discipline is. Consequently, imports are expected to have a positive influence on domestic profits in this case.

They further assume that in a mixed case when the cartel and the competitive fringe are composed of both domestic and foreign producers. No clear expectation about the relation between imports and industrial profitability can be found.

Several empirical studies confirm that the imports' share of domestic market sales exerts a negative influence on industry profitability.

Esposito and Esposito (1971) and Pagoulatos and Sorensen (1976) found that the level of imports has a significant and negative effect on industry profitability.

Interactions between imports and structural variables and the negative effect of imports on domestic industrial profitability are confirmed empirically by Pugel (1980), Turner (1980), and Jacquemin, De Ghellinck and Huveneer (1980).

Pugel (1980) extended his previous study on U.S. manufacturing industries and showed that the imports variable interacts with seller concentration and entry barriers in determining profit margins. Turner (1980) examined the influence of import competition on the profitability of 32 U.K. manufacturing industries. He confirmed Pugel's finding that the effect of import competition is greater in highly concentrated industries. Jaquemin, De Ghellinck and Huveneer (1980) estimated a two-equation model of Belgian manufacturing industries in which seller concentration and price-cost margins are both determined by international and domestic variables. They found interactions between imports and seller concentration and also a negative effect of import competition on profit margins.

<u>Export Opportunities</u>

We lack a general presumption about the effect of exportson industry profits. Any change in the following conditions would alter the direction of the effect of exports on profits: (i) the ability of domestic firms to practice price discrimination between domestic and foreign markets, (ii) the demand elasticity in both markets, (iii) domestic producers' cost functions, and (iv) whether or not the domestic market is sheltered.

Based on Pugel (1980) and Jacquemin's (1982) analysis we present some cases suggested by them to help determine the effect of export opportunities on industry profits.

Case 1. If the domestic producers cannot segment the domestic market and the world market and they have no market power in the world market, then they would become price takers in the competitive world market. Openness to the world market would constrain the domestic price-cost margin to the competitive level.

Case 2. If domestic producers cannot segment the markets, but obtain some monopoly power in the world market. The inability to segment markets and the existence of foreign competitors would still compell the domestic producers to set a more competitive price in both markets.

Case 3. If markets can be segmented, but the demand in the world market is more elastic. Domestic producers would dump in the world market. The lower world market margin would be averaged with the higher domestic margin, hence the export sales would depress the averaged margin.

Case 4. If markets can be segmented, and the demand in the world market is less elastic, export sales would expand the average price-cost margin.

Case 5. Other things being equal, exporting may lead to a reduction in the products' unit cost by spreading fixed costs over large production volumes. This reduction in the unit cost may be more than enough to compensate for a depressed world market price and thus enhance profitability.

The empirical results of previous studies are mixed. While Pagoulatos and Sorensen (1976), Gan and Tham (1977), and Neumann, Bobel and Haid (1979) reported a negative relationship between exports and profit rates, Katrak (1980), Pugel (1980) and Geroski (1982) found a positive influence of exports on profitability.

Pagoulatos and Sorensen (1976) applied the multiple regression analysis to a sample of 88 U.S. manufacturing industries and found that in most cases the coefficient of the export share variable was negative but it was never significant. Gan and Tham (1977) tested a model which includes structure variables, international trade variables and a foreign direct investment variable for a sample of forty-two Malaysian manufacturing industries. Evidence indicated a negative effect of export shares on profitability. Neumann, Bobel and Haid (1979) investigated the determination of the mean rates of return of West German industries for the years 1965 to 1973. It was reported that exports reduce profitability.

Several other studies found evidence of a positive relationship between exports and profit rates. Pugel's (1980) evidence suggested that exporting tends to enhance profitability. Katrak (1980) examined the effect of industry concentration, foreign trade and protection on price-cost margins in Indian manufacturing industries. His evidence led him to conclude that the margins are higher in industries with relatively higher exports. Geroski (1982) used a nonlinear specification for the relationship between profits and concentration and treated imports and exports as endogenous variables. His results showed a very strong positive effect of exports on the profit margins.

Theoretical Studies on Limit Pricing

Conventional microeconomic theory predicts that existing firms in oligopolies would adopt a pricing policy which maximizes short run profits and positive economic profits would induce entry. Bain (1949, 1956) and Labini (1962) introduced the theory of limit pricing and suggest that in a concentrated industry with substantial entry barriers, existing firms would adopt a limit pricing policy which will entail a lower rate of return than the short run profit maximizing rate in order to deter entry. It is believed that firms adopt this limit pricing policy because they think, in the long run the profits from a limit pricing policy are greater than the profits from the myopic short run profit maximizing policy. Four specific entry barriers were introduced by Bain (1956): (1) Economies of scale; (2) Capital requirements; (3) Product differentiation; and (4) Absolute cost advantage.

Modigliani (1958) showed that the level of the limit price is determined by: (1) the absolute market size; (2) the price elasticity of demand; and (3) the minimum optimal scale in absolute terms. It was demonstrated that the minimum optimal scale has a positive effect on the limit price and the absolute size of the market exerts a negative influence on it. The more elastic the demand curve is the lower the limit price would be.

Models mentioned above are static models in which existing firms are expected to use one of the two extreme pricing policies: (1) to price at the short run profit maximizing level and let entry erode future profits and (2) to price at the entry forestalling level to deter all entrants.

Gaskins (1971) in his dynamic/deterministic model assumes that entry is a function of the difference between the actual price and the entry forestalling price.

When barriers are low, firms would price at a higher than entry forestalling level and as entry barriers become higher, the price will decline and converge to the entry forestalling level. After this point, price will rise with entry barriers and converge to the short run profit maximizing level. Gaskins proved that the optimal price level will always be lower than the short run profit maximizing price and higher than or equal to the entry forestalling price.

Kamien and Schwartz (1971) and Baron (1973) constructed stochastic/dynamic limit pricing models where existing firms are expected to charge an "optimal price" which is lower than the short run profit maximizing level but higher than the entry forestalling level.

Recently, the "rational limit pricing" models, developed by Milgrom and Roberts (1982), Saloner (1982) and Matthews and Mirman (1983), discuss the effect of information on incumbents' pricing policy. Previous limit pricing theory considered only the incumbents' behavior without studying the potential entrants' rational reactions to limit pricing. The "rational limit pricing" models take into account behavior of both sides and analyze equilibrium behavior when there are information asymmetries. It is expected that incumbents anticipating entry behave like the firms in the stochastic/dynamic models.

Entry

Few empirical studies have dealt with entry. Mansfield (1962) investigated four U.S. industries: the steel, petroleum, rubber tire and automobile industries. He defined entry as number of firms that entered and survived until the end of a certain period as the proportion of the original number of firms and then regressed it on profitability and a capital requirement variable. The results indicated that entry is positively related to profits and negatively related to capital requirements. McGuckin (1972) defined entry as the percentage change in the number of firms in an industry over a given time period and found a negative relationship between entry and concentration.

Harris (1973) used a sample which consists of 48 4-digit industries and regressed seven different measures of entry on entry barriers. His findings revealed that product differentiation and economies of scale had a negative influence on the number and market shares of entrants. The profit rate was the strongest explanatory variable of entry. Growth also has a positive influence on entry. The capital requirement variable did not have a significant effect on entry. He also found that entry lowered leading firms' profit rates.

Orr (1974) presented a model which consists of two equations, the entry equation and the long run profit equation, to examine the determinants of entry into Canadian manufacturing industries for the years 1963-1967. The entry measure employed in his study is based on the number of entrant firms beyond a given size. Capital requirements, advertising intensity and high concentration were found to be significant barriers to entry. Research and development intensity and risk were modest barriers. Past profit rates and past industry growth had a positive influence on entry. Berry (1975) employed two measures of entry and exit in his study: one based on the estimated market share and the other used the absolute number of firms. The two measures of entry were regressed on concentration, value of shipments, growth and an index of diversification to examine the determinants of entry and exit for 461 large corporations into 4-digit industries. It was found that there was nosignificant relationship between entry and industry concentration. Berry was unable to distinguish between entry de novo and entry by aquisition.

Duetsch (1975) used the percentage change of firm numbers, in 134 4-digit industries in the years of 1958-1963 and 307 industries in the 1963-1967 time period, as a measure of entry. Diversification and product promotion were found to be effective entry barriers. Concentration and growth were positively related to entry.

Gorecki (1975) examined the entry into U.K. manufacturing industries for the period 1958-1963 by using two measures based on the absolute number of firms: (1) number of firms whose main line of production was outside the specific industries and (2) "specialist" firms, enterprises classified to the particular industries. His main finding was that growth exerts a strong influence on entry.

Khemani and Shapiro (1984) explored alternatives in specifying and estimating the entry equation. It was found that the semi-logarithmic specification is the most appropriate for single-equation estimation. Based on the semi-logarithmic specification, and employing a more appropriate definition of entry it was confirmed that economies of scale, investments in advertising and high capital requirement are entry barriers. Concentration and high tariff also deter entry. These results suggest that in the certain time period De novo entry was unlikely to be a major source of deconcentration in Canadian manufacturing industries.

Shapiro and Khemani (1987) examined empirically the hypothesis that there is a symmetrical relationship between entry and exit barriers. A considerable degree of symmetry between barriers to entry and barriers to exit is observed. Both entry and exit are deterred in industries where the minimum efficient plant size and capital requirements are high and where multi-plant firms are prevalent. The results suggest that de novo entry is unlikely to be a source of significant short term deconcentration. Entry is deterred in highly concentrated industries.

Empirical Studies of the Theory of Limit Pricing

There are only a few empirical studies on the limit pricing theory in 1960s and early 1970s. Osborne (1964) examined three industries and denied the existence of limit pricing. Mann, Haas and Walgreen (1965) challenged Osborne's findings. Blackstone (1972) found that Xerox adopted the type of pricing predicted by the stochastic/dynamic models. Kamerschen (1968) tested Bain's theory of limit pricing and the alternative based on Stigler's theory and found that Stigler's theory is more appealing.

These studies investigated only the existing firms' side and did not offer a direct test for limit pricing.

Masson and Shaanan (1982) constructed an empirical model for the simultaneous determination of both profits and entry. In their model the existence of entry barriers can be tested from the entry side.

The entry forestalling profit equation can also be derived from the entry equation. The entry forestalling profit rate is distinguished from the optimal profit rate which is derived empirically from the actual profit equation (the existing firms' side). By comparing and testing the entry forestalling profit equation and the optimal profit equation, the validity of alternative limit pricing theories can be tested.

Applying regression analysis to a sample of 37 U.S. manufacturing industries, they find support for the theory of limit pricing and the dynamic/stochastic version in particular.

Masson and Shaanan (1986) also constructed an empirical model of oligopoly capacity and pricing decisions and of entrant responses. They applied this model to a sample of 26 industries. Their empirical results support limit pricing and suggest that limit pricing firms may raise their limit prices if there exists unintended excess capacity. There is no evidence to support the hypothesis that oligopolies deliberately install excess capacity to deter entry.

Masson and Shaanan (1987) examine limit pricing behavior in Canadian manufacturing industries. Their results are again supportive of the stochastic/dynamic limit pricing models of Kamien and Schwartz (1971) and of Baron (1973).

ENDNOTE

[1]See Leonard W. Weiss, "The Concentration-Profits Relationship and Antitrust," in Harvey J. Goldschmid et al., Eds., Industrial Concentration: The New Learning (Boston: Little Brown, 1974), pp. 201-220; Leonard W. Weiss, "Quantitative Studies of Industrial Organization," in Michael D. Intriligator, Ed., Fronties of Quantitative Economics (Amsterdam: North-Holland, 1971), pp. 362-411; and John M. Vernon, Market Structure and Industrial Performance: A Review of Statistical Findings (Boston: Allyn and Bacon, 1972).

CHAPTER III

I.O. IN THE CONTEXT OF TAIWAN'S ECONOMY

Taiwan is an "island economy." It has very few natural resources and is highly dependent on exports and imports. The trade dependency of the Taiwan economy grew significantly over the past three decades. The percentage of exports in GNP increased from 9 percent in 1952 to 50 percent in 1979, that of imports, from 15 percent to 46 percent. In 1982, Taiwan's two-way trade amounted 45.7 billion dollars; exports were 24.2 billion and imports totaled 21.5 billion. A third of the Republic of China's exports go to the United States. In more recent years, Taiwan has been the sixth or seventh leading trading partner of the United States and the twentieth or twenty-first largest trading country in the world.

Led by the rapid growth of exports, the Republic of China has experienced one of the world's fastest economic growth. Real gross national product grew at a high annual rate of 9.2 percent on the average over the past three decades and doubled every seven years after 1963. The rapid growth was characterized by a relatively higher growth in the industrial sector. As a result of industrialization the economy has shifted from agriculturally oriented to industrially oriented production and raised to a improved status with much higher average productivity.

The rapid growth was accompanied by the emergence of many large scale private enterprises and enterprise groups. As a result, Taiwanese manufacturing industries have become rather concentrated since the 1970s. Entry is not blockaded in most Taiwanese industries, except some which are monopolized by the government. Evidence provided by Chou (1986), Hsu (1986) and Yu (1986) shows that the minimum efficient scale barriers and advertising barriers may exist in Taiwan's manufacturing industries.

A distinguished characteristic of most less developed economies is the large presence of public enterprises in the industrial sector. Taiwan, with no exception, has many public enterprises. These public enterprises accounted for around 15 percent of total sales, 19.2 percent of gross value added, and 29.4 percent of total working capital in the manufacturing sector in 1976. The existence of these public enterprises probably affects the structure and consequently the performance of Taiwan's industries.

With the above facts, we think that a complete model of the structure-conduct-performance relationship in Taiwan's economy needs to include imports, exports, growth, government participation, industrial concentration and entry barriers as independent variables to explain the inter-industry variation of profit rates and entry rates. We will discuss these variables briefly in the following sections.

Imports

In an open economy, imports from foreign countries will constrain domestic market power and result in more competitive prices in the domestic market. As with the effect of imports on domestic market performance, the existence of a competitive world market tends to compel domestic producers to be more competitive in pricing, if they cannot discriminate between domestic and foreign markets. Since Taiwan is highly dependent on imports and exports, we regard them as structural characteristics and will examine their effect on the S-C-P relationship in Taiwan's manufacturing industries.

Following two sections are a brief discription of imports and exports in Taiwan's economy.

In the early 1950s, the government made a great effort to encourage substitution of imports to improve the balance of payments and to stimulate industrialization. The capital goods and raw materials required for the substitution policy had to be imported from foreign countries. Hence, in the early years the total import value of those goods increased rapidly. Later, the increasing population and national income accelerated the increase of imports. The degree of dependence on imports increased from 19.14 percent in 1956 to 46.35 percent in 1976. The total value of imported industrial product was 27.2 percent of the total sales in manufacturing industries in 1976. This reveals a high import content in the manufacturing sector.

Taiwan has a protectionist policy regarding imports. The government ensures that domestic industries will have sufficient unit sales to lower the unit cost of export products. Therefore, high customs duties are imposed on imported products. The government also monopolizes the importation of alcoholic beverages and tobacco products.

With the advent of large trade surpluses during 1976-1979 (the trade surplus of 1978 in fact was 6.2 percent of GNP), and the resulting concern about monetary effects and price stability, the government has taken various import liberalization measures.

Exports

Taiwan's manufactured products are dependent on the world market due to the small domestic market. As internal markets became increasingly limited and the need for foreign exchange earnings increased there was a shift in policy to export promotion in the early 1960s.

Exports as a percentage of GNP increased from 18.64 percent in 1966 to 49.81 percent in 1976. In ten years the percentage of exports more than doubled. Export expansion has become an important source of growth for national income expansion and manufacturing. In the period 1971-1976, export expansion accounted for 80.6 percent of the manufacturing output growth. Moreover, in 1976, 37.6 percent of the total sales in manufacturing sector were derived from exports.

With the transformation of the economic structure, the composition of exports has also changed. Exports of agricultural products decreased from 92 percent of total exports in 1952 to 9 percent in 1979, while exports of industrial products increased from 8 percent to 91 percent. In 1952, rice and sugar accounted for 74 percent of total exports, however, rapid industrialization in the 1960s brought this share down to 3 percent in 1970.

Economic Growth

The Republic of China has had one of the world's fastest economic growth. An important source of the rapid growth in the 1960s and 1970s, was the U.S. military and economic aid to the Republic of China. U.S. economic aid to Taiwan, amounting to 1.5 billion dollars began in 1950 and ended in 1956. This money was used very effectively by Taiwan's government and this set the stage for the subsequent fast rate of economic growth.

At the close of World War II, per capita income in Taiwan was about \$70 (U.S.). Since then per capita income has increased rapidly reaching \$2280 by 1980. The average rate of growth of real GNP was 9.2 percent in the past three decades. It doubled every seven years after 1963. As a result, real GNP in 1980 was eleven times the real GNP of 1952. The growth of the manufacturing sector was also impressive. By 1976 the total revenues in the manufacturing sector was more than 380 percent higher than in 1970.

Rapid growth of market demand should affect industry profits and entry. Therefore, we will also take into consideration effects of growth on the S-C-P relationship in Taiwan's economy.

Industrialization

As a result of rapid industrialization in the past three decades, the structure of Taiwan's economy, especially the structure of Taiwan's manufacturing sector had become rather similar to those of some western economies. This in part justifies our application of the S-C-P analytical framework to Taiwanese manufacturing industries.

Taiwan's economic structure changed appreciably over the past three decades. During 1952-1979, the share of agriculture in gross domestic product dropped from 32 percent to 9 percent while the share of industrial sector rose from 22 percent to 52 percent. The industrialization of Taiwan's economy, in the 1960s, was characterized by the rapid expansion of labor-intensive light manufacturing, especially of the food processing, textile and electrical machinery industries. After

1971, the share of the three industries in manufacturing expansion started to decline. Instead, more capital- and skilled-intensive industries, such as petrochemicals, metals and machinery, had relatively greater share in manufacturing expansion. The emphasis has shifted from labor-intensive light manufacturing to more capital- and skilled-intensive manufacturing.

Public Enterprises

In the early 1950s more than 50 percent of Taiwan's industrial output was produced by public enterprises, a consequence of the Chinese takeover of Japanese assets at the end of world War II. During the early 1950s, the government began transferring four public enterprises to private ownership: Taiwan Cement Corporation, Taiwan Pulp and Paper Corporation, Taiwan Industrial and Mining Corporation, and Taiwan Agriculture and Forestry Development Corporation. In 1953, large parts of government assets were transferred to private owners under the land-to-tiller program.

As a result of the transfer and the rapid growth of private industry, in 1964 the government share of total industrial production fell to 43.7 percent in 1964. But the government still owned or dominated industries which are considered to be of vital economic or strategic importance. Industries remaining in the public sector included utilities, railroads, shipbuilding, and iron and steel. Therefore, despite a substantial decrease in public ownership, public enterprises continued to be important. Unfortunately, many of these firms were initially plagued with problems of public enterprises such as inefficiency, overstaffing, rigid pay structures, and bureaucratic interference.

Because of their inherent chracteristics and the important role in Taiwanese economy, public enterprises are expected to have an effect on market performance. We thus include a variable for government owned firms in our analysis to examine its effect on industry profitability.

Industrial Concentration

Industrial concentration is a conventional structure variable. It has been included in most S-C-P models as a proxy of market power. Evidence provided by Hsiao (1980) and Chen (1982) calls for the inclusion of a concentration variable in a S-C-P model of Taiwan.

The analysis of industrial concentration in Taiwan's manufacturing sector in 1976, conducted by Hsiao (1980), reports that there were 14 industries with a higher than 80 percent four-firm concentration ratio in Taiwan's manufacturing sector, or 10.7 percent of the total number of manufacturing industries. This compares with 6 percent in the U.S. but 16.5 percent in the U.K. In the same year, 46 industries had an above 50 percent concentration ratio, comprising 35.1 percent of total manufacturing industries. It is higher than U.S.'s 31.7 percent but lower than U.K.'s 45.4 percent (see Table I.) These figures show that Taiwanese manufacturing industries are rather concentrated.

It is reported by Chen (1982) that in 1976 there were 69,517 firms in Taiwan's manufacturing sector of which 89 are public enterprises and 69,428 are private companies.

TABLE I

THE COMPARISON OF INDUSTRIAL CONCENTRATION BETWEEN TAIWAN, USA, AND UK

Concentration	Taiwan (1976) Number of Industries	%	USA (1972) Number of Industries	%	UK (1973) Number of Industries	%
Above 90	10	7.6	6	3.3	10	6.6
80-89.9	4	3.1	5	2.7	15	9.9
70-79.9	5	3.8	10	5.5	13	8.6
60-69.9	11	8.4	15	8.2	11	7.2
50-59.9	13	9.9	22	12.2	20	13.1
40-49.9	19	14.5	27	14.8	26	17.1
30-39.9	20	15.3	29	15.8	27	17.8
20-29.9	26	19.9	35	19.1	14	9.2
10-19.9	18	13.7	28	15.3	14	9.2
Below 10	5	3.8	6	3.3	2	1.3
Total	131	100.0	183	100.0	152	100.0

Source: Feng-Hsiung Hsiao, "Measuring and Analyzing the Industrial Concentration: Republic of China," Monthly Journal of the City Bank of Taipei, Vol. 13 (1980), p. 46.

The share of total assets of the largest 100 private firms in the manufacturing sector had increased from 1972's 29.16 percent to 1979's 44.37 percent while their share in total sales decreased from 26.44 percent to 25.88 percent. It seems that the aggregate concentration in Taiwan's manufacturing sector had increased over time.

In the 134 manufacturing industries in 1976, Husking, Cleaning, and Polishing of Rice Industry had the lowest four-firm concentration ratio of 3.96 percent. Tobacco Manufacturing and Petroleum Refineries had the highest 100 percent. The average four-firm concentration ratio, excluding public enterprises, was 34.47 percent. It is lower than U.S.'s 39.2 percent in 1972.

Entry and Barriers to Entry

Only one study, Hsu (1986)[1], investigated empirically the determinants of entry into Taiwanese manufacturing industries. He found that in Taiwan's manufacturing sector, profits, as expected, have a positive influence on entry.

Evidence provided by Hsu (1986) also suggests that minimum efficient scale and capital requirements act as entry barriers. But the role of product differentiation in the determination of entry is not discussed. A negative relationship between concentration and entry is shown in his study. The effect of growth on entry into Taiwanese manufacturing industries was found to be positive.

He found a positive but insignificant coefficient for the profit variable in the entry equations. He pointed out that in the period 1971-1976 when the manufacturing sector was expanding rapidly, the strongest incentive of firms to enter an industry may be the expectation of future growth and/or future profits of an industry.

In summary, minimum efficient scale, capital requirement, and high concentration are found to be barriers to entry into Taiwanese manufacturing industries in the period 1971-1976. A negative but insignificant relationship between the level of risk and entry was also found.

Chou (1986) examined the role of foreign trade in the analysis of market structure and performance and the determinants of trade intensity in a simultaneous four-equation system where profits, import intensity, export intensity and industrial concentration are jointly determined. He found that, in 1976, public enterprises significantly influence industrial profits in a positive direction. Minimum efficient scale and concentration are found to affect industry profits positively and significantly. Imports and foreign direct investment have a significant negative relationship with profits.

Yu (1986)[2] evaluated the influence of advertising on industry profits in Taiwan'smanufacturing industries. Evidence suggests that advertising may affect industrial profitabililty in a positive direction. Minimum efficient scale variable was not included in his study. Concentration and growth were found to affect profit rates positively while imports had a negative effect.

Empirical results provided by previous studies on the S-C-P relationship in Taiwan'smanufacturing industries conform with theoretical expectations regarding the effects of concentration, minimum efficient scale, growth and imports on profits in Taiwan's manufacturing sector in certain time periods.

ENDNOTES

[1]He defined entry in 1976-1981 as the change in the number of firms, i.e., the number of firms in 1981 minus the number of firms in 1976 and employed a semi-logarithmic specification for the single equation estimation on a sample of 99 industries. Positive coefficient estimates for the profit variable were obtained in all equations. However, these estimates are not significant at the 90 percent level.

[2]Yu (1986) examined the influence on industry profits of concentration, advertising intensity, export intensity, capital labor ratio, capital output ratio, and a dummy variable distinguishing light industries from heavy industries, in 1981. He used a three equation model where profits, concentration and advertising are jointly determined. His sample consists of 106 four-digit manufacturing industries classified under the Chinese SIC. A positive but insignificant advertising coefficient in the profit equation is obtained by 2SLS but with the OLS estimation technique the coefficient is significant at the 90 percent level.

CHAPTER IV

HYPOTHESES

It is predicted by microeconomic theory that in the long run there are no economic profits for firms in perfectly competitive industries. But firms in imperfectly competitive industries can earn excess economic profits because of the exertion of market power. Therefore, high persistent profit rates in some industries can be used as an index of monopoly market power and consequently an indicator of the degree of monopolistic industry performance.

It is one of the major goals of industrial organization to relate market characteristics to the earning of excess economic profits. Accordingly industrial profitability has been related to various market structure variables in the structure-conduct-performance analysis.

Recently several structure-conduct-performance studies have introduced international trade variables to account for the greater exposure to international influences of modern economies.

According to limit pricing theories, an additional determinant of industrial profitability should be included. It is the effect of the threat of entry on firms' pricing behavior.

Limit pricing models developed by Bain (1949, 1956), Modigliani (1958), Sylos Labini (1962), Gaskins (1971), Kamien and Schwartz (1971), and Baron (1973), discuss the interactions between potential entry, entry barriers, market power, and market price. The common assumption of all these limit pricing models is that firms are maximizing their long-run profits--profits of future n periods of time discounted to the present value, rather than short run profit maximization.

It is believed that in the face of entry, under certain conditions, oligopolistic firms would lower their prices to prevent or reduce entry.

Bain's (1956) static limit pricing model predicts that with low entry barriers, a monopolist would maximize his short-run profits, but with high entry barriers, he will limit his price to an entry forestalling level and this entry forestalling price will rise with increases in the height of entry barriers.

Gaskins' (1971) dynamic deterministic model predicts that when there are no barriers the monopolist will charge a short-run profit maximizing price. As entry barriers become higher, price will decline to an entry forestalling level, beyond that point, he will charge the entry forestalling price which is rising with the height of entry barriers.

In Kamien and Schwartz's (1971) and Baron's (1973) stochastic/dynamic models, the monopolist's optimal price (the price which maximizes his long-run profits or his present value) is always above the entry forestalling level when the entry forestalling price is less than the short-run profit maximizing price. This optimal price will rise and converge to the entry forestalling price as barriers become higher. Only, at the point where entry is blockaded by entry barriers, the optimal price and entry forestalling price are equal to the short-run profit maximizing price.

We follow the stochastic/dynamic limit pricing model and extend Masson and Shaanan's empirical approach to construct our theoretical framework, our model will be tested against other models of limit pricing and of course the hypothesis that there is no limit pricing behavior at all.

Conventional structure-performance studies have related industry profits to characteristics of market structure such as concentration, barriers to entry and growth of demand. These structural features are sufficient to explain the inter-industry variation in profitability in a closed economy. But in an open economy like Taiwan, the role of international trade in the determination of domestic market performance is important. Therefore, we need to take into consideration the influence of international trade on domestic profitability.

Since Taiwan is highly dependent on imports and exports, we include these two international trade variables, in our model to examine the influence of international trade on the structure-conduct-performance relationship in Taiwan's manufacturing sector.

An additional factor that has to be considered in an I. O. study of Taiwan is the effect of public enterprises on industrial profitability.

In 1976, they dominated more than 10 manufacturing industries and had a 16 percent share of total revenues in manufacturing. It is therefore important in an empirical study of Taiwan's industries, to take this into account and a government participation variable will be included in our model.

The inclusion of these three variables (international trade variables and public enterprise) will help adapt the model to the specific characteristics and dimensions of Taiwain's industrial organization.

To summarize our model, profitability is hypothesized to be a function of market power and market power is a function of market structure, including international influences and potential entry. In the face of potential entry an optimal price which maximizes firms' long run profits will be chosen as aresult of the interactions between market structure, international trade and the threat of entry. It is unlikely that either the short run profit maximizing price or the entry forestalling price will be adopted by firms, since these are just two extreme prices along a continuum.

To account fully for limit pricing, we need to consider both the existing firm side and the potential entrant side in our analysis.

We assume that the pricing/entry process is recursive that in time period t-1 existing firms select an optimal price which maximizes their long-run profits and determines an actual profit level in the industry. Potential entrants may respond by entering in period t. Recognizing the entrants' reaction function, again the existing firms select an optimal price in period t and potential entrants may respond by entering in period t+1.

The Existing Firm Side

The pricing process of incumbents can be illustrated by three functions: the entry forestalling profit function, the optimal profit function and the actual profit function. We substitute profits for prices in the following analysis as is usually the practice in industrial organization. The entry forestalling profit rate, for example, corresponds to the entry forestalling price.

It is predicted by Kamien and Schwartz (1971) and Baron (1973) that existing firms will optimally set their price at a level between the short-run profit maximizing level and the entry forestalling level. In other words, the optimal profit rate is nearly always above the entry forestalling level. Hence, the optimal profits consists of two components, (1) the entry forestalling profits, π_t^f; and (2) the difference between the optimal profits and the entry forestalling profits, $\pi_t^0 - \pi_t^f$.

The optimal profit function can be written in its general form:

$$\pi_t^0 = \pi_t^f + (\pi_t^0 - \pi_t^f)$$

$$= \pi_t^f + D$$

$$= f_1(B , GR_t, C_t) + f_2(C_t, B , GR_t, T_t, G_t)$$

$$= f_3[f_1(B, GR_t, C_t), C_t, B, GR_t, T_t , G_t] \qquad (4.1)$$

The entry forestalling profit rate is the highest profit rate that existing firms can obtain without inducing entry. It is a function of entry barriers, industry growth rate, and industrial concentration ratio. It can be written as

$$\pi_t^f = f_1(B , GR_t, C_t) \qquad (4.2)$$

where π_t^f is the entry forestalling profit rate for an industry in period t,

B is a vector of entry barriers (BA,BS), BA is the advertising intensity variable, BS is the minimun efficient scale plant for an entrant firm,

GR_t is the industry growth rate in period t, and

C_t is the concentration ratio for the industry in period t.

It is demonstrated by the limit pricing theory that entry forestalling prices are a function of barriers to entry. The two entry barrier variables are thus included in the entry forestalling profit function. They are expected to have a positive effect on the entry forestalling profit rate. Since growth attracts entry, an inverse relationship between growth and the entry forestalling profit rate can be expected. This inverse relationship has been shown theoretically by Bhagwati (1970). [For other possibilities see Ireland (1972), and for a more detailed disscusion on the relationship between entry and growth see Masson and Shaanan (1982).] Growth has been found to have a positive effect on entry by Harris (1973), Orr (1974), Duetsch (1975), Gorecki (1975), and Masson and Shaanan (1982, 1987).

We assume that high concentration induces entry because potential entrants may think that entry into a concentrated industry may be more profitable. Hence high concentration would reduce the entry forestalling profit rate.

Statistical results regarding the role of concentration in the determination of entry is mixed. Orr (1974) and Masson and Shaanan (1987) found high concentration to be a significant barrier to entry while Duetsch (1975) found a positive relationship between concentration and entry.

We write the functional form of D_t as

$$D_t = f_2(C_t, B , GR_t, T_t, G_t) \qquad (4.3)$$

where T_t is a vector of international trade variables, (IMP_t, EXP_t),

IMP_t is the import intensity for the industry in period t,

EXP_t is the export intensity for the industry in period t,

G_t is the government participation in the industry in period t.

We expect that international trade variables (imports and exports) have a negligible effect on the incentive to enter and do not affect the level of the entry forestalling price significantly.[1] Therefore, T_t is not included in the entry forestalling profit function. But it is expected that T_t has a direct effect on the optimal profit rate, thus it is included in f_2.

G_t is included in the optimal profit function. We believe that public enterprises in Taiwan were initially plagued with problems typical to public enterprises like inefficiency, overstaffing, rigid pay structures, and bureaucratic interference, and thus operated inefficiently with high costs. Therefore, G_t is expected to affect optimal profits negatively.

Traditional market structure characteristics which determine industrial profitability, concentration, advertising intensity, economies of scale and growth are also included in f_2.

The presence of C_t, B and GR_t in both f_2 and f_1 reflects the dual effect of these variables on the optimal profit rate, i.e. besides their direct effect on the optimal profit rate, they also affect the optimal profit rate indirectly through their effect on the entry forestalling profit rate.

The fourth function to be considered is the actual profit function. The actual profit rate, π_t^a , is basically a function of the optimal profit rate. An additional determinant C_t, industry concentration, should also be included in the function. C_t determines the ability of existing firms to collude, thus the feasibility of limit pricing.

The actual profits also consists of two components, π_t^0 and $\pi_t^a - \pi_t^0$,

$$\pi_t^a = \pi_t^0 + (\pi_t^a - \pi_t^0)$$

$$= \pi_t^0 + P_t \qquad (4.4)$$

The functional form of P_t can be written as

$$P_t = f_4(C_t) \qquad (4.5)$$

The actual profit function takes the following form

$$\pi_t^a = \pi_t^0 + P_t$$

$$= f_3[f_1(B, GR_t, C_t), C_t, B, GR_t, T_t , G_t] + f_4(C_t)$$

$$= f_5 \{ f_3[f_1(B, GR_t, C_t), C_t, B, GR_t, T_t , G_t] C_t \} \qquad (4.6)$$

If we assume that f_1, f_2, f_3, f_4 and f_5 are all linear, then in explicit functional form, π_t^a and π_t^0 can be written as

$$\pi_t^0 = f_1(B, GR_t, C_t) + f_2(C_t, B, GR_t, T_t, G_t)$$

$$= a_0 + a_1 BA + a_2 BS + a_3 GR_t + a_4 C_t + d_0 + d_1 BA + d_2 BS + d_3 GR_t + d_4 C_t$$

$$+ d_5 IMP_t + d_6 EXP_t + d_7 G_t \qquad (4.7)$$

$$\pi_t^a = f_5(\pi_t^0, C_t)$$

$$= a_0 + a_1 BA + a_2 BS + a_3 GR_t + a_4 C_t + d_0 + d_1 BA + d_2 BS + d_3 GR_t + d_4 C_t$$

$$+ d_5 IMP_t + d_6 EXP_t + d_7 G_t + d_8 (C_t - 100)$$

$$= (a_0 + d_0 - 100\ d_8) + (a_1 + d_1)BA + (a_2 + d_2)BS + (a_3 + d_3)GR_t$$

$$+ (a_4 + d_4 + d_8)C_t + d_5 IMP_t + d_6 EXP_t + d_7 G_t \qquad (4.8)$$

where $\frac{\partial \pi_t^a}{\partial BA} = a_1 + d_1$, $\frac{\partial \pi_t^a}{\partial GR_t} = a_3 + d_3$,

$\frac{\partial \pi_t^a}{\partial BS} = a_2 + d_2$, $\frac{\partial \pi_t^a}{\partial C_t} = a_4 + d_4 + d_8$,

$\frac{\partial \pi_t^a}{\partial IMP_t} = d_5$, $\frac{\partial \pi_t^a}{\partial EXP_t} = d_6$, $\frac{\partial \pi_t^a}{\partial G_t} = d_7$.

We include $(C_t - 100)$ in f_5 because we assume that the optimal profit rate will be fully realized by existing firms only when the concentration ratio is 100 percent, i.e.

$$\pi_t^a = \pi_t^0 + d_8\ (C_t - 100)$$

$$= \pi_t^0 + d_8\ (100 - 100)$$

$$= \pi_t^0$$

and when C_t is less than 100 percent, the actual profit rate will be lower than the optimal profit rate, e.g.

$$\pi_t^a = \pi_t^0 + d_8\ (60 - 100)$$

$$= \pi_t^0 - 40 d_8 < \pi_t^0$$

where d_8 is assumed to be positive and the positiveness of d_8 will be verified.

We will see, in the next chapter, that all the coefficients of the independent variables in the π_t^0 and π_t^a equations are the same. But π_t^0 has a higher intercept.

The signs of the first derivatives of π_t^a with respect to the various independent variables will be discussed below.

A. Industry Concentration

In the 1950s and 1960s, private enterprises in Taiwan were small relative to market size and fairly competitive. During the early 1950s, the government started transferring some large scale public enterprises to private ownership. In the 1960s, government policies encouraged private industry by making funds more available to private companies. As a result of the transfer, the availability of funds, the rapid growth of the economy, and increasing merger activities, large scale private enterprises appeared in the 1970s. Taiwanese manufacturing industries have become rather concentrated since then and hence there is a possibility that monopolistic power is being exerted in some industries.

Several theoretical studies have shown the positive relationship between the level of concentration and industry performance. Stigler (1964) stresses the relevance of the Herfindahl index in explaining the market performance. Saving (1970) demonstrates that within the confines of the competitive fringe or price leadership model, the k-firm concentration ratio can be related to both the Lerner index and Rothschild index. Cowling and Waterson (1976) demonstrate theoretically that the profit-revenue ratiois related directly to the Herfindahl index.

Not all I.O. economists agree that high concentration leads to high profits and that high concentration is a proxy for collusive action. Demsetz (1973) criticized the causal link of concentration, collusion, market power and monopoly profits. He argued that firms' superior efficiency actually cause both high concentration and high profits and this is why both phenomena appear together.

We follow the "market concentration doctrine" and believe that the causal relationship from concentration to monopoly profits exists. We expect that high concentration tends to make the collusive agreements more effective, and hence enables existing firms to charge a higher optimal price and consequently expect that $d_4 > 0$.

We expect that high concentration ratio will induce entry (hypotheses about the effect of industry concentration on entry will be discussed in detail later), therefore, an increase in concentration ratio is expected to cause a fall in the entry forestalling profit rate, i.e. $a_4 < 0$.

High levels of concentration increase the feasibility of limit pricing and lower costs for setting and monitoring agreements. Therefore, it is predicted that the direct effect of industry concentration on the actual profits is positive, i.e. $d_8 > 0$.

The total effect of concentration on profits can be written as

$$\frac{\partial \pi_t^a}{\partial C_t} = a_4 + d_4 + d_8 \; .$$

We assume that $d_4 + d_8 > |a_4|$, therefore we expect that

$$\frac{\partial \pi_t^a}{\partial C_t} = a_4 + d_4 + d_8 > 0.$$

B. Advertising Intensity

Product differentiation is one of the entry barriers, the source of this barrier is the loyalty or the preference of buyers for products of established firms over new products. Facing this entry barrier, potential entrants have to either (i) set a selling price lower than that of established firms, and/or (ii) spend a lot of money in promotion efforts to overcome the preference for established firms' products. [See Bain (1956) and Caves (1972).] Hence, the height of product differentiation barrier is positively related to industrial profitability.

Besides the disadvantages of high unit promotion cost and/or lower selling prices, entrants may also face the problem of scale economies in sales promotion efforts. When sales volume is expanded by large promotional efforts firms may enjoy a reduction in unit promotion cost resulting from rapid increase in sales volume or efficiency in promotional efforts. Therefore, entering firms with smaller sales volume and smaller scale of sales promotion activities may suffer the disadvantage of high unit promotion cost. [See Bain (1956).]

Telser (1964), however, believes that advertising is not an entry barrier with anti-competitive effects on market performance. Rather, it is a mean of entry with pro-competitive effects on market performance. We adopt Bain's hypothesis, which will be tested in our study.

Bain (1956) suggested that sales promotion cost can be used as a proxy for the height of the product differentiation barriers. In practice, advertising intensity, the ratio of advertising expenditures to total sales, is commonly used to approximate intensity of promotional efforts.

Therefore, as a proxy of product differentiation barrier, advertising intensity is expected to have a positive influence on profits.

The total effect of advertising intensity is

$$\frac{\partial \pi_t^a}{\partial BA} = \frac{\partial \pi_t^a}{\partial \pi_t^0} \cdot \frac{\partial \pi_t^0}{\partial BA} = \frac{\partial \pi_t^0}{\partial BA} = \frac{\partial (\pi_t^f + D_t)}{\partial BA}$$

$$= \frac{\partial \pi_t^f}{\partial BA} + \frac{\partial D_t}{\partial BA} = a_1 + d_1 ,$$

(We assume that $\frac{\partial \pi_t^a}{\partial \pi_t^0} = 1$.)[2]

As an entry barrier, advertising intensity deters entry. An increase in BA will allow existing firms to set a higher entry forestalling price, i.e. $a_1 > 0$. But the optimal profit rate will not increase as much, because d_1 is expected to be negative.

It is predicted by Kamien and Schwartz (1971) that π_t^0 will rise and converge to π_t^f as barriers become higher. In other words, at higher levels, D_t is smaller, i.e. an increase in BA will cause a decrease in D_t.

We thus expect that $a_1 > 0$, $d_1 < 0$, but $a_1 > |d_1|$, and consequently, $a_1 + d_1 > 0$.[3]

C. Minimum Efficient Scale

If the proportion of the industry output that is needed for a firm to gain all economies of scale is large relative to the entire market, then a new firm may face three problems: (1) producing at an inefficient scale with a higher average cost than existing firms; (2) keeping excess capacity which incurs high capital cost if it enters with optimal scale but produces at sub-optimal scale; and (3) the possibility of starting a price war which could exacerbate the above two disadvantages.

The larger the minimum efficient scale is, the harder it is for a potential competitor to enter the industry. Therefore, as an entry barrier, minimum efficient scale would have a positive effect on industrial profitability. Other things being equal, the larger the minimum efficient plant size is the higher the entry forestalling price, i.e. $a_2 > 0$.

But as discussed in (B), since the minimum efficient scale is an entry barrier, it is expected to have a negative effect on the difference of π_t^0 and π_t^f , i.e. $d_2 < 0$.

The effect of minimun efficient scale barrier on profits can be written as

$$\frac{\partial \pi_t^0}{\partial BS} = a_2 + d_2 ..$$

We expect that $a_2 > 0$, $d_2 < 0$, but $a > |d_2|$, therefore, $a_2 + d_2 > 0$.

D. Growth of Demand

We can expect that, other things being equal, growth rate of demand influences price-cost margins in a positive direction.

In an industry with rapid growth in sales, (i) existing firms feel less competitive pressure, they can maintain their market shares without using strategies like cutting prices or increasing promotion costs and (ii) the better utilization of excess capacity would reduce the cost, hence increase the price cost margins, if they are not at the minimum efficient scale.

But if the indirect effect of growth on profit rates via the threat of entry is accounted for, then the influence of market growth is less clear, because if growth attracts entry, (hypothesis about the effect of growth on entry will be discussed in detail later), then growth will have the effect of lowering entry forestalling profit rate.

We assume that growth will attract entry and cause a fall in the entry forestalling profit rate, i.e. $a_3 < 0$. But the direct effect of growth on the optimal profit rate should be positive and greater than the indirect effect through the entry forestalling profit rate, i.e. $d_3 > |a_3|$.

Overall, we expect that $\frac{\partial \pi_t^a}{\partial GR_t} = a_3 + d_3 > 0$.

E. Government Participation in Manufacturing Sector

Donsimoni and Leoz-Arquelles (1981) suggested that if the government takes over inefficient firms or government owned companies charge low prices--prices close to the competitive level, a negative effect of government ownership on profits can be expected. But if government owned companies operate efficiently or adopt high protected prices--prices close to the profit maximizing level, as suggested by Aharoni (1980), then a positive effect is expected.

Chou (1985,1986) finds that government owned companies in Taiwan adopt a high price policy for fiscal purposes, and this policy is protected by government, hence this would suggest a positive effect on profits.

Evidence provided by Lin (1981) reveals that, most of the public enterprises in Taiwan are operating inefficiently, for the following reasons.

1. Too many authorities exercise control over a single public enterprise.

Public enterprises belonging to the Ministry of Economic Affairs, for example, are under the control of the following nine government offices: Executive Yuan, Ministry of Economic Affairs, Ministry of Finance, Ministry of Audit, Ministry of Personnel, Examination Yuan, Personnel Affairs Bureau, Commission for the Discipline of Public Functionaries, and Directorate-General of Budgets, Account and Statistics. Bureaucratic interference restricts the administrative functions of management in public enterprises. This seems to be the major source of operation inefficiency of public enterprises.

2. Numerous complicated laws related to public enterprises cause operation inflexibililty.

For example, personnel matters of public enterprises are regulated by the following six laws: Public Functionary Appointment Law, Civil Service Law, Law of Efficiency Evaluation of Public Functionary, Law of Government Employee Salary System, Law of Government Employee Insurance, and Law of Public Functionary Retirement.

3. The personnel system of public enterprises is inefficient.

Overstaffing is a common phenomenon in all public enterprises.

Appointments to top management are, in most cases, a plum to officials retired from the government. Therefore, most of the public enterprises are led by "laymen" and consequently are at a disadvantage when they compete with private companies. [See Lin (1981).]

4. Public enterprises sometimes bear a heavy burden of accompishing non-economic policies.

For instance, in 1971 the Republic of China was expelled from the United Nations. After that, many countries severed diplomatic relationships with the Republic of China. R.O.C.'s diplomatic relationship with Spain appeared to become unstable at that time. Therefore, based on diplomatic considerations, the Ministry of Economic Affairs and the Ministry of Foreign Affairs asked Chung-Tai Fertilizer Corporation, a public enterprise, to purchase manufacturing equipment from Spain even though the equipment was not compatible with Chung-Tai's equipment. As a result, Chung-Tai incurred losses for many years.

Lin (1981) evaluated the operating efficiency of public enterprises and found that in the year of 1978 seven of the 14 public enterprises under the Ministry of Economic Affairs had a ratio of total liabilities over total capital above 70 percent. This shows that these public enterprises' financial structure is very inefficient. In the same year, in 13 2-digit industries[4] the average working capital turnover rate and the average commodity turnover rate of public enterprises were much lower than that of private companies.[5] The operating ability of public enterprises, in general, was thus found to be lower than that of private enterprises. Therefore, it is not surprising that in 1978, in ten 2-digit industries, the average profit rate of public enterprises was lower than private companies.

Following Lin's (1981) findings, we expect that government participation in Taiwan's manufacturing sector has a negative influence on industry profit rate.

$$\frac{\partial \pi_t^a}{\partial G_t} = d_7 \text{ is expected to be negative.}$$

F. Import Competition

It is suggested that imports which represent the entry of foreign suppliers would increase the number of suppliers and total sales volume in the domestic market and therefore reduce the seller concentration in the market. As discussed in (A), a lower seller concentration would lead to more competitive prices.

Recently, Pugel (1980), Jacquemin (1982), and Geroski and Jacquemin (1981) developed more rigorous models which include interactions between imports, market structure and industry conduct to demonstrate the effect of imports on domestic market performance.

The basic assumption adopted in all the models is that firms are maximizing their profits. Under this assumption, Pugel (1980) developed his model to demonstrate the negative effect of imports on industry profits. This model can be applied to markets with different degrees of market power. Jacquemin (1982) takes into account the domestic oligopolists' conduct and still predicts a negative effect of imports on profits. Although Jacquemin and Geroski (1981) add some complexity to this problem, in most cases a negative effect of imports on industry profit can be expected.

Taiwan has a protectionist policy regarding imports. The nominal rate of protection (NRP), weighted by exports, for the manufacturing sector as a whole was 0.36 in 1971. The high rate of nominal protection reflects a high degree of protection. We can expect that industries with lower than average NRPs will have more imports and face a higher level of foreign competition. Consequently, in these industries firms would be compelled to adopt more competitive prices. Thus we believe that in Taiwan's manufacturing sector imports, as a competitive fringe, would discipline the domestic market.

$\frac{\partial \pi_t^a}{\partial IMP_t} = d_5$, is expected to be negative.

H. Export Opportunities

It is not possible to make a general conclusion about the effect of export opportunities on domestic market performance, because it depends on (i) the ability of domestic firms in segmenting domestic and world markets; (ii) the demand elasticity in both markets; (iii) the cost function of domestic producers; and (iv) whether or not the domestic market is sheltered. Any change in the above conditions would lead to a different result. When several changes occur simultaneously the whole problem becomes more complex.

Taiwan's exports include products like textiles, plastic products, electronics, footwears, machinery, electrical appliance, toys, cosmetics, furniture, handicrafts, sports gear and accessories, metal products and agricultural commodities.

Most of these are labor intensive products. Prices of these products in the world market are even more competitive than before because new suppliers from other countries are producing at lower wage rates than Taiwan. Competition in the world market tends to force domestic producers to be more competitive in pricing.

Since 1960, Taiwan has established three export processing zones at Kaohsiung, Nantze, and Taichung. In the export processing zones, firms import raw materials and export finished goods without duties or tariffs. There are no commodity or sales taxes. Utilities are inexpensive. Labor is supplied at low cost. In these export processing zones, exporting firms are sheltered by the government and produce at very low costs.

Besides, export opportunities enable existing firms to overcome the constraint of a limited domestic market size and to attain economies of scale and produce at lower costs.

Exports seem to affect industry profits in opposite ways and hence a definite prediction regarding the effect of exports is not possible.

$\frac{\partial \pi_t^a}{\partial EXP_t} = d_6$, is expected to be either positive or negative.

The Potential Entrant Side

From conventional microeconomic theory we know that profits serve as the primary incentive to enter an industry, we therefore hypothesize that entry is a function of profits. We can hypothesize that the rate of entry into an industry in period t+1 is a positive function of the difference between the actual profit rate and the entry forestalling profit rate in period t. The greater the value of ($\pi_t^a - \pi_t^f$), the higher the rate of entry.

We can write the entry function as

$$ENT_{t+1} = g\ (\ \pi_t^a - \pi_t^f\ ) \qquad (4.9)$$

where ENT_{t+1} is the rate of entry into that industry in period t,

and $\frac{\partial ENT_{t+1}}{\partial(\ \pi_t^a - \pi_t^f)} > 0$.

Since it is formulated in Part A that

$$\pi_t^f = f_1(B,\ GR_t,\ C_t) \qquad (4.2)$$

We can write ENT_{t+1} as

$$ENT_{t+1} = g\ [\pi_t^a - f_1(B,\ GR_t,\ C_t)] \tag{4.10}$$

Assume that g is linear, then in explicit functional form,

$$\begin{aligned} ENT_{t+1} &= b_1(\ \pi_t^a - \pi_t^0\ ) \\ &= b_1[\ \pi_t^a - (a_0 + a_1BA + a_2BS + a_3GR_t + a_4C_t)] \\ &= b_1[\ \pi_t^a - a_0 - a_1BA - a_2BS - a_3GR_t - a_4C_t] \\ &= b_1\pi_t^a - b_1a_0 - b_1a_1BA - b_1a_2BS - b_1a_3GR_t - b_1a_4\ C_t \end{aligned} \tag{4.11}$$

where $\dfrac{\partial ENT_{t+1}}{\partial \pi_t^a} = b_1$, $\dfrac{\partial ENT_{t+1}}{\partial BS} = -b_1a_2$, $\dfrac{\partial ENT_{t+1}}{\partial GR_t} = -b_1a_3$,

$\dfrac{\partial ENT_{t+1}}{\partial BA} = -b_1a_1$, $\dfrac{\partial ENT_{t+1}}{\partial C_t} = -b_1a_4$.

Profit is assumed to be positively related to the rate of entry into an industry. Hence, the sign of b_1 is expected to be positive.

$$\frac{\partial ENT_{t+1}}{\partial \pi_t^a} = b_1 > 0\ .$$

The two barriers, BA and BS, are expected to deter entry and this is indeed the test to determine whether they are barriers. Therefore, they are expected to have a negative effect on ENT_{t+1}, i.e.

$$\frac{\partial ENT_{t+1}}{\partial BA} = -b_1a_1 < 0, \qquad \frac{\partial ENT_{t+1}}{\partial BS} = -b_1a_2 < 0\ .$$

Gaskins (1971) assumes that growth has no effect on entry. Kamien and Schwartz (1971), Ireland (1972) and Duetsch (1975) assume a positive relationship between growth and entry.

We expect that with rapid growth entrants will face less competition from incumbents because they do not need to capture market shares from existing firms and hence potential entrants are more likely to enter. A positive relationship between growth and entry is expected.

$$\frac{\partial ENT_{t+1}}{\partial GR_{t+1}} = -b_1 a_3 > 0.$$

Industry concentration is not included in Masson and Shaanan's (1982, 1987) entry functions. However, alternative hypotheses relating to the effect of concentration on the incentive to enter are discussed in their 1987 paper.

One hypothesis predicts that when potential entrants observe high profits in less concentrated industries, they may think that an "agreement" is the cause of high profits, but this agreement would not remain stable when new firms enter. On the contrary, high profits in concentrated industries are thought to be caused either by an agreement which is effective and will remain stable, post entry, or by the fewness of firms in a Nash Equlibrium. Therefore, potential entrants may think that it is more profitable to enter a highly concentrated industry. It is also predicted by Baron (1973) that potential entrants may think that in concentrated industries where only few firms are already in the market, entry is less likely to lead to production below the minimum efficient scale. Thus they may think that entry into a concentrated industry may be more profitable.

Another hypothesis leads to an opposite conclusion. It is postulated that potential entrants think that existing firms may collude to obstruct entry and collusion is impossible in any unconcentrated industry. Therefore, they may think that entry into a less concentrated industry is more profitable. [See Masson and Shaanan (1987).]

It is found by Duetsch (1975), however, that more entry occurred in concentrated industries than in unconcentrated industries.

We adopt the first hypothesis and assume that potential entrants in Taiwanese manufacturing industries believe that entry into a concentrated industry is more profitable.

Industry concentration is thus expected to have a positive relationship with entry.

$$\frac{\partial ENT_{t+1}}{\partial C_t} = -b_1 a_4 > 0.$$

ENDNOTES

[1]Masson and Shaanan (1987) indicate that the international trade variables may have an independent influence upon entry. But they think that trade variables should not add significantly to the information contained in the profit equation. Respecified entry equations which include an import variable and a nominal tariff rate variable were tried by them. Results show a significant negative effect of import on entry.

[2]A change in π_t^0 will cause a change π_t^a in the same direction. More accurately, we should write that

$$0 \leq \frac{\partial \pi_t^a}{\partial \pi_t^0} \leq 1.$$

But since the effect of π_t^0 on π_t^a is most likely positive and will not change the sign of $\frac{\partial \pi_t^a}{\partial B}$, for simplicity we assume that $\frac{\partial \pi_t^a}{\partial \pi_t^0} = 1$.

[3]It is hypothesized by the stochastic-dynamic limit pricing theories that both π_t^0 and π_t^a rise with barriers ($a_1 > 0$, $a_1 + d_1 > 0$) and converge to the short run profit maximizing level ($d_1 < 0$).

[4]There are 20 2-digit industries in the manufacturing sector. Fifteen of these industries have public enterprises.

[5]Commodity turnover rate = Annual total revenues / Total value of inventory at the end of the year. Working capital turnover rate = Annual total revenues / Total working capital at the end of the year. Profit rate = Total profits / Annual total revenues.

CHAPTER V

THE EMPIRICAL MODEL AND DATA

The Empirical Model

We present our empirical testing model in this chapter. A theoretical framework which is based on the stochastic-dynamic limit pricing theories of Kamien and Schwartz (1971) and of Baron (1973) was developed in the last chapter. Based on our theoretical framework, we follow Masson and Shaanan's (1982, 1987) statistical approach to construct our empirical testing model. The model is a simultaneous equation system which includes an entry equation and an actual profit equation.

This empirical testing model will be applied to test the following hypotheses:

1. Whether preentry profits attract entry.

2. Whether barriers discourage entry.

3. Whether optimal profits exceed entry forestalling profits, whether both rise with barriers and finally whether they converge at the short run profit maximizing level.

4. Whether market power (concentration) exerts a positive influence on industrial profitability.

5. Whether entry barriers enlarge price-cost margins.

6. The effect of market growth on profits and entry.

7. Whether imports, as a source of competitive discipline constrain the domestic price-cost margins.

8. The effect of market power (concentration) on entry.

9. Exports, enable domestic producers to overcome the small market size in Taiwan and to attain economies of scale, this should lower the unit cost of production and enlarge the price-cost margins.

10. Due to inefficiencies relating to the lack of competitive pressure, government controlled enterprises should exert a negative influence on industrial profitability.

The Actual Profit Equation

In Chapter II, a model is constructed for the existing firm side to show the incumbents' limit pricing process. The incumbents' actual profit function takes the following form

$$\pi_t^a = f_4(\pi_t^0, C_t)$$

$$= f_5\{f_3[f_1(B, GR_t, C_t), C_t, B, GR_t, T_t, G_t]\ C_t\} \qquad (4.6)$$

Assuming that f_1, f_2, f_3, f_4 and f_5 are all linear, the explicit functional form of π_t^a can be written as

$$\pi_t^a = (a_0 + d_0 - 100\ d_8) + (a_1 + d_1)\ BA + (a_2 + d_2)\ BS + (a_3 + d_3)\ GR_t$$

$$+ (a_4 + d_4 + d_8)\ C_t + d_5 IMP_t + d_6 EXP_t + d_7 G_t \qquad (4.8)$$

where π_t^a is the actual profit rate for the industry in period t,

C_t is the four-firm concentration ratio in period t,

BA is the advertising barrier,

BS is the minimun efficient scale barrier,

GR is the industry growth rate in period t,

IMP_t is the import intensity variable for the industry in period t,

EXP_t is the export intensity variable for the industry in period t,

G_t is a dummy having the value of one if government owned companies account for 50 percent or more of the industry total sales.

The estimating equation for the actual profit equation is

$$\pi_t^a = \alpha_0 + \alpha_1 BA + \alpha_2 BS + \alpha_3 GR_t + \alpha_4 C_t + \alpha_5 IMP_t + \alpha_6 EXP_t + \alpha_7 G_t + \varepsilon_t \quad (4.12)$$

where $\alpha_1 = a_0 + d_0 - 100d_8$,

$\alpha_1 = a_1 + d_1$,

$\alpha_2 = a_2 + d_2$,

$\alpha_3 = a_3 + d_3$,

$\alpha_4 = a_4 + d_4 + d_8$,

$\alpha_5 = d_5$,

$\alpha_6 = d_6$,

$\alpha_7 = d_7$.

The actual profit rates in period t are determined by industrial concentration, two entry barriers, growth, import intensity, export intensity and government intervention.

We can obtain π_t^0 by setting $C_t = 100$ and solving for $\pi_t^0 = \pi_t^a \mid C_t = 100$.

The coefficients of the independent variables in both π_t^0 and functions are identical, but π_t^a is expected to have a higher intercept. This will be explained in the estimation of π_t^0.

The Entry Equation

An entry reaction function was formulated for the potential entrant side to show the entry process.

The entry reaction function was written as

$$ENT_{t+1} = g(\pi_t^a - \pi_t^f) \tag{4.9}$$

Assuming that g is linear, we can write the explicit functional form of g as

$$ENT_{t+1} = b_1(\pi_t^a - \pi_t^f)$$

$$= b_1 \pi_t^a - b_1 a_0 - b_1 a_1 BA - b_1 a_2 BS - b_1 a_3 GR_t - b_1 a_4 C_t \tag{4.11}$$

where ENT_{t+1} is the industry rate of entry in period t+1.

The estimating equation for the entry reaction function is

$$ENT_{t+1} = \beta_0 + \beta_1 BA + \beta_2 BS + \beta_3 GR_t + \beta_4 C_t + \beta_5 \pi_t^a + \eta_{t+1} \tag{4.13}$$

where $\beta_0 = -b_1 a_0$,

$\beta_1 = -b_1 a_1$,

$\beta_2 = -b_1 a_2$,

$\beta_3 = -b_1 a_3$,

$\beta_4 = -b_1 a_4$,

$\beta_5 = b_1$.

Entry in period t+1 is a function of actual profits, growth, industrial concentration in period t and two entry barriers. π_t^a is used to present the influence of preentry profits on the incentive to enter.

Industrial concentration is not included in the entry equation in Masson and Shaanan's original model. We include concentration in our entry equation, because we believe that concentration has an influence on entry which is additional to the indirect effect of concentration via profits.

In both profit and entry equations, C_t, BA, BS, and GR_t are used to represent the characteristics of market structure. In the profit equation, IMP_t and EXP_t are used to present the foreign influence on domestic market performance.

The model is recursive and consists of two endogenous variables π_t^a and ENT_{t+1}. The sufficient condition for identification for equations (4.12) and (4.13) is $COV[\eta(t+1), \varepsilon(t)] = 0$. This condition will be checked by regressing residuals of equation (4.12) on residuals of equation (4.13) and examining the value of the regression coefficient and its level of significance. OLS procedure is appropriate for equation (4.12) and 4.(13) if the error terms across these two equations are not correlated.

The primary criticism of the conventional single equation estimation has been the failure to capture the simultaneous nature of interrelationship among structural variables. [See Greer (1971), Comanor and Wilson (1974), Phillips (1976), Martin (1979), Scherer (1980) and Pagoulatos and Sorensen (1981).] Statistically, the estimation of a single equation model when a simultaneous equation model is actually needed, will yield biased and inconsistent parameter estimates. The problem of simultaneity is therefore of great importance to the specification of our profit equation.

Four possible sources of simultaneity in our profit equation are: the simultaneity of profits and (1) advertising, (2) industrial concentration, (3) import intensity, and (4) export shares.

We intend to test for simultaneity between the four explanatory variables and profits in our sample by performing a test which is adopted from Wu (1974) and Engle, Hendry and Richard (1979) and has been used in an industrial organization study by Geroski (1982).[1]

Heteroscedasticity might be a problem as indicated by Comanor and Wilson (1967). We will examine the residuals from each equation to decide whether the variance of error terms is constant across industries or varies with industry size. If it is a problem, the weighted regression will be applied to our samples. [See Comanor and Wilson (1967).]

An interactive model of profit determination which is formulated by Pugel (1980) will also be estimated to see whether interactions exist between structural variables and international trade variables.

Estimation of the Entry Forestalling Profit Equation

We derive the entry forestalling profit equation from the entry reaction equation which was constructed for the potential entrants' side.

The entry reaction equation is

$$\begin{aligned} ENT_{t+1} &= b_1(\pi^a_t - \pi^f_t) \\ &= b_1\pi^a_t - b_1a_0 - b_1a_1BA - b_1a_2BS - b_1a_3GR_t - b_1a_4C_t \qquad (4.11) \end{aligned}$$

By definition, the entry forestalling profit rate is the rate at which no entry occurs, therefore we can set $ENT_{t+1} = 0$, and solve implicitly to derive the entry forestalling profit equation.

$$0 = b_1\pi^a_t - b_1a_0 - b_1a_1BA - b_1a_2BS - b_1a_3GR_t - b_1a_4C_t$$

Rearrange terms, we have

$$-b_1\pi_t^a = -b_1a_0 - b_1a_1BA - b_1a_2BS - b_1a_3GR_t - b_1a_4C_t$$

Divide both sides of the above equation by $-b_1$,

$$\pi_t^f = a_0 + a_1BA + a_2BS + a_3GR_t + a_4C_t \qquad (4.14)$$

where $a_0 = \frac{\beta_0}{-\beta_5} = \frac{-b_1a_0}{-b_1}$

$a_1 = \frac{\beta_1}{-\beta_5} = \frac{-b_1a_1}{-b_1}$

$a_2 = \frac{\beta_2}{-\beta_5} = \frac{-b_1a_2}{-b_1}$

$a_3 = \frac{\beta_3}{-\beta_5} = \frac{-b_1a_3}{-b_1}$

$a_4 = \frac{\beta_4}{-\beta_5} = \frac{-b_1a_4}{-b_1}$

<u>Estimation of the Optimal Profit Equation</u>

Setting $C_t = 100$ and solving for $\pi_t^0 = \pi_t^a \mid C = 100$, we have

$$\pi_t^0 = (a_0 + d_0 + 100a_4 + 100d_4) + (a_1 + d_1)\ BA + (a_2 + d_2)\ BS$$

$$+ (a_3 + d_3)\ GR_t + d_5IMP_t + d_6EXP_t + d_7G_t$$

$$= \alpha_0' + \alpha_1'\ BA + \alpha_2'\ BS + \alpha_3'\ GR_t + \alpha_5'\ IMP_t + \alpha_6'\ EXP_t + \alpha_7'G_t \qquad (4.15)$$

where $a_1 + d_1 = \alpha_1' = \alpha_1$

$a_2 + d_2 = \alpha_2' = \alpha_2$

$a_3 + d_3 = \alpha_3' = \alpha_3$

$d_5 = \alpha_5' = \alpha_5$

$d_6 = \alpha_6' = \alpha_6$

$d_7 = \alpha_7' = \alpha_7$

$$\alpha_0' = \alpha_0 + 100\alpha_4$$
$$= (a_0 + d_0 + 100a_4 + 100d_4) > (a_0 + d_0 - 100d_8) = \alpha_0 \,.^2$$

The π_t^a equation and the π_t^0 equation are identical except for the intercepts. The value of the intercept term of π_t^0 is higher than that of π_t^a.

A Test of Limit Pricing

It is postulated that optimal profits exceed entry forestalling profits, both rise with barriers and finally converge at the short run profit maximizing level.

We therefore expect that

$$\alpha_1 = a_1 + d_1 < a_1,\ \alpha_1 > 0,\ d_1 < 0,$$

$$\alpha_2 = a_2 + d_2 < a_2,\ \alpha_2 > 0,\ d_2 < 0,$$

and

$$a_0 + d_0 + 100a_4 + 100d_4 > a_0.$$

In Chapter III we assumed that entry barriers have a dual effect on actual profits. Since we expect barriers to deter entry. The higher the barriers are the higher the entry forestalling price. Therefore the indirect effect of entry barriers on actual profits through the entry forestalling profits is positive and can be expressed as

$$\frac{\partial \pi_t^a}{\partial \pi_t^0} \cdot \frac{\partial \pi_t^0}{\partial \pi_t^f} \cdot \frac{\partial \pi_t^f}{\partial B} > 0$$

where $\frac{\partial \pi_t^f}{\partial B} > 0$,

$$\frac{\partial \pi_t^0}{\partial \pi_t^f} > 0, \quad 3$$

$$\frac{\partial \pi_t^a}{\partial \pi_t^0} \mid \bar{C} = 1.$$

It is mentioned in Chapter III that π_t^0 will rise and converge to π_t^f as barriers become higher, hence an increase in B will cause a decrease in the difference between π_t^0 and π_t^f.

The direct effect of entry barriers on π_t^0 is negative and can be written as

$$\frac{\partial \pi_t^a}{\partial \pi_t^0} \cdot \frac{\partial \pi_t^0}{\partial B} < 0 \quad 4$$

where $\frac{\partial \pi_t^0}{\partial B} < 0$

$$\frac{\partial \pi_t^a}{\partial \pi_t^0} = 1.$$

Therefore, if our empirical results show that $\alpha_1 < a_1$, and $\alpha_2 < a_2$, i.e. $d_1 < 0$ and $d_2 < 0$, then we can conclude that our empirical evidence is supportive of hypothesis (3) regarding the dual effect of B on π_t^a.

Growth and concentration are also expected to have a dual effect on actual profits. Since these two variables are assumed to have an effect on entry, therefore, in addition to their direct effect on actual profits, they have an indirect effect on actual profits through entry forestalling profits.

In Chapter III, we hypothesized that growth attracts entry and cause a fall in the entry forestalling profit rate, therefore the indirect effect of GR_t on π_t^a is negative

$$\frac{\partial\pi_t^a}{\partial\pi_t^0} \cdot \frac{\partial\pi_t^0}{\partial\pi_t^f} \cdot \frac{\partial\pi_t^f}{\partial GR_t} < 0$$

and the direct effect is assumed to be positive

$$\frac{\partial\pi_t^a}{\partial\pi_t^0} \cdot \frac{\partial\pi_t^0}{\partial GR_t} > 0$$

where $\frac{\partial\pi_t^f}{\partial GR_t} > 0$

$$\frac{\partial\pi_t^0}{\partial\pi_t^f} > 0$$

$$\frac{\partial\pi_t^a}{\partial\pi_t^0} = 1.$$

The total effect of growth on actual profits is $a_3 + d_3 = \alpha_3$.

Concentration is assumed to induce entry and have a negative effect on the entry forestalling profit rate. The indirect effect of concentration on actual profits through the entry forestalling profit rate is therefore assumed to be negative

$$\frac{\partial\pi_t^a}{\partial\pi_t^0} \cdot \frac{\partial\pi_t^0}{\partial\pi_t^f} \cdot \frac{\partial\pi_t^f}{\partial C_t} < 0 .$$

High levels of concentration tend to make collusion more effective and lower costs for setting and monitoring collusive agreements. Therefore the higher the level of concentration the smaller the difference between π_t^a and π_t^0, i.e. the closer the actual profit rate is to the optimal profit rate.

Its direct effect on π_t^a is assumed to be positive

$$\frac{\partial\pi_t^a}{\partial C_t} > 0$$

The total effect of C_t on π_t^a is $a_4 + d_4 + d_8 = \alpha_4$.

Therefore, if $\alpha_3 > 0$, $\alpha_4 > 0$, $a_3 \leq 0$ and $a_4 \leq 0$, then our results support the hypotheses regarding the dual effect of GR_t and C_t on π_t^a.

We can summarize our expected results as following: (i) $\alpha_1 \leq a_1$, $\alpha_2 \leq a_2$, $a_1 > 0$, $a_2 > 0$, and $\alpha_0' > a_0$ would jointly support the theory of limit pricing in general, (ii) $\alpha_1 < a_1$, $\alpha_1 > 0$, $d_1 < 0$, $\alpha_2 < a_2$, $\alpha_2 > 0$, $d_2 < 0$ and $\alpha_0' > a_0$ together would support dynamic/stochastic models of limit pricing, (iii) $\alpha_1 = a_1$ and $\alpha_2 = a_2$ collectively would support the static theory of limit pricing, (iv) $\alpha_1 = a_1$, $\alpha_2 = a_2$ and a residual pattern with large residuals for very high and very low level of entry barriers would support the dynamic/deterministic theory, and (v) $\alpha_1 \leq 0$, $a_1 \leq 0$, $\alpha_2 \leq 0$, $a_2 \leq 0$, and $\alpha_0' = a_0$ would suggest a denial of any kind of limit pricing behavior.

The Data

A description of the variables employed in our study and the data sources is provided in the following.

1. π_t^a, industry profit rates on total assets for 1976: π_t^a = (Annual total value of production - Intermediate expenses[5] - Depreciation - Indirect tax - Compensation to labor - Net value of transferred expenditures - Compensation to property + Net value of interest) / Total assets at the end of the year where Compensation to property = (Net value of rent + Net value of interest).

2. C_t, four-firm concentration ratio for 1976: this is the conventional four-firm concentration ratio, i.e. the largest four firms' shares in total industry sales. Total industry sales include values of exports.

3. GR_t, market growth rate in 1971-1976: this is the percentage change in industry total revenue, i.e.

$$GR_t = \frac{\text{total revenue in 1976 - total revenue in 1971}}{\text{total revenue in 1971}}$$

4. BA, advertising intensity for 1976: it is industrial advertising as a percentage of sales multiplied by a convenience goods dummy.[6] It is indicated by Porter (1976) that:

> Because other forms of product differentiation activity by manufacturers offer little potential, direct advertising to the consumer is the dominant form of selling effort by the convenience goods manufacturers. As well as leading to product differentiation in the eyes of the consumer, advertising determines the manufacturer's power vis-a-vis the retailer and his ease of access to distribution. Where retailer power is high, the manufacturer's rate of return will be bargained down, ceteris paribus. Alternate means of product differentiation available to the manufacturer are likely to be ineffective. As a corollary, advertising is a relatively good measure of product differentiation for products sold through convenience outlets.

Advertising acts strongly as a product differentiation barrier in convenience goods industries. We thus multiply advertising intensity by the convenience goods dummy to capture more closely the role of advertising barrier in the determination of industrial profitability.

5. BST[7], a proxy of economies of scale based on Taiwan data for 1976: this is the average size of the largest plants accounting for 50 percent of industry sales divided by domestic market sales. BST is not divided by CDR ratio (cost disadvantage ratio) because the CDR data for Taiwan manufacturing industries is not available.

6. BSU[8], a proxy for economies of scale based on U.S. data for 1976: we first calculate the Comanor and Wilson (1967) proxy for minimum efficient scale, i.e. the average size of the least number of plants

producing 50 percent of U.S. value of shipments as a percentage of sales. Then we scale this measure by multiplying it by the ratio of U.S. value of shipments to Taiwan value of shipments, thus we obtain an MES measure for Taiwan based on the U.S. market. This scaled estimate is divided by U.S. CDR ratio.

$$CDR = \frac{\text{value added per worker of smallest plant which account for 50\% of employment}}{\text{value added per worker of largest plant which account for 50\% of employment}}$$

The measure is thus of the form

$$BS = (\text{U.S. MES} \times \frac{\text{U.S. V.S.}}{\text{Taiwan V.S.}}) \,/\, \text{U.S. CDR}$$

where V.S. is value of shipments.

We believe that a U.S. based BS measure (proxy for economies of scale) is more accurate than a Taiwan based measure because: (i) due to much more smaller markets, most firms in Taiwan's manufacturing sector operate at less than minimum efficient scale, but their counterparts in the U.S. manufacturing sector do not do so, (ii) the level of technology of some Taiwanese manufacturing industries is close to that of its U.S. counterparts because of the large presence of U.S. and Japanese multinationals, (iii) a statistical reason is that the measurement error of a U.S. based BS measure would be less correlated with that for concentration, and (iv) lack of CDR data (cost disadvantage ratio) for Taiwan manufacturing industries, the Taiwan based BS measure does not contain the information about the shape of the average cost curve or the diseconomies of scale that come about from operating at an output smaller than the minimum efficient scale.

7. IMP_t, import intensity for 1976: this is the ratio of current import to the sum of industry total sales (including values of exports) and current imports. This is used as a proxy for foreign competition.

8. EXP_t, export shares for 1976: it is the ratio of exports to industry total sales.

9. G_t, dummy variable: if 50 percent or more of an industry's total sales in 1976 are made by government owned companies, then a value of 1 is assigned to this industry, otherwise it is zero.

10. ENT_{t+1}, entry in 1976-1981:[9]

$$ENT_{t+1} = \frac{\text{number of firms in 1981 - number of firms in 1976}}{\text{number of firms in 1976}}$$

The data employed in our study are derived from the following sources:

1. The Report on 1981 Industrial and Commercial Census, Taiwan District, Republic of China: July 1983. Directorate - General of Budget, Accounting and Statistics, Executive Yuan, Republic of China.

2. The Report on 1976 Industrial and Commercial Census, Taiwan District, Republic of China: July 1978. Directorate - General of Budget, Accounting and Statistics, Executive Yuan, Republic of China.

3. The Report on 1971 Industrial and Commercial Census, Taiwan District, Republic of China: July 1973. Directorate - General of Budget, Accounting and Statistics, Executive Yuan, Republic of China.

4. Custom Import Tariff of the Republic of China, Revised Edition: September 1980. Inspectorate General of Customs, Ministry of Finance, Republic of China.

5. Custom Import Tariff of the Republic of China, Revised Edition: July 1976. Inspectorate General of Customs, Ministry of Finance, Republic of China.

6. Imported Manufacturing Products, Republic of China Custom Statistics, 1981, January - December.

7. Imported Manufacturing Products, Republic of China Custom Statistics, 1976, January - Dececember. Inspectorate General of Customs, Ministry of Finance, Republic of China.

8. Standard Industry Classification, Republic of China, Revised Edition: June 1983. Directorate - General of Budget, Accounting and Statistics, Executive Yuan, Republic of China.

9. Chen, Cheng-Tsang. "A Study on the Industrial Concentration: Taiwan District, Republic of China," Quarterly Review of Medium Business Bank of Taiwan, Vol.8 (1985), pp. 35-57.

10. Hsiao, Feng-Hsiung. "Measuring and Analyzing the Industrial Concentration: Republic of China," Quarterly Journal of the City Bank of Taipei, Vol.13 (1980), pp. 43-56.

11. U.S. Census of Manufacturers, 1977, Bureau of the Census, U.S. Department of Commerce. Washington, D.C.: U.S. Government Printing Office, 1981.

12. U.S. Census of Manufacturers, 1982, Bureau of the Census, U.S. Department of Commerce. Washington, D.C.: U.S. Government Printing Office, 1986.

There are 134 SIC four-digit manufacturing industries in Taiwan. Twenty-three industries are deleted from our sample, because the definition of these industries does not satisfy the basic criterion for market definition or industry boundary that firms included in an industry produce "close substitutes." [See, Needham (1969), Posner (1976), and Boyer (1979).] Thus those industries cannot represent an "industry" in an economic analysis. Examples are: other flavoring products manufacturing (2059), miscellaneous food preparing manufacturing (2099), other knitted apparel manufacturing (2206), and other textiles manufacturing (2209). Four industries are not included because of the unavailability of concentration data, these are spirits, wine and malt (2111), beer malt liquors (2112), railway rolling stock manufacturing and repairing (3702), and aircraft manufacturing and repairing (3706). Another four industries, slaughtering (2011), wooden furniture and fixtures manufacturing (2521), primary iron and steel industries (3311), and textile machine manufacturing and repairing (3504), were dropped for lack of minimum efficient scale data. Two industries, fur and fur products manufacturing (2402), and abrasive materials manufacturing (3292), could not be used because of deficient profit data.

The remaining 103 industries in our sample consist of 49 consumer goods industries and 54 producer goods industries.[10]

A subsample consisting of 70 industries is also used. It was determined by the number of industries for which we could obtain a proxy for minimum efficient scale based on the U.S. data.

The profit equation, equation (4.12), and the entry equation, equation (4.13), will be estimated in two versions:

Version A: the "103 industries" sample will be used to estimate equations (4.12) and (4.13) with a minimum efficient scale proxy (BS) based on Taiwan data.

Version B: the "70 industries" sample will be used to estimate equations (4.12) and (4.13) with a BS proxy based on U.S. data, and for purposes of comparison the "70 industries" sample will also be used to estimate equations (4.12) and (4.13) with a BS proxy based on Taiwan data.

ENDNOTES

[1]Geroski's test checks the consistency of the OLS estimates of a single equation model. Although he warns that consistency might not always imply exogeneity of the variables inquestion. See P. A. Geroski, "Simultaneous Equations Models of the Structure-Performance Paradigm," European Economic Review, Vol. 19 (1982), pp. 145-158.

[2]Since $a_4 < 0$, we have $|a_4| = -a_4$. If $d_4 + d_8 > |a_4|$, then $d_4 + d_8 > -a_4$ and thus $a_4 + d_4 > -d_8$. Multiplying both sides of the inequalilty by 100 we have $100a_4 + 100d_4 > -100d_8$. Adding $a_0 + d_0$ to both sides, we obtain $a_0 + d_0 + 100a_4 + 100d_4 > a_0 + d_0 - 100d_8$.

[3]It is predicted by the theory of dynamic/stochastic limit pricing that π_t^0 is nearly always above π_t^f and both rise with barriers. Therefore, π_t^0 will rise as π_t^f rises.

[4]Since it is predicted that π_t^0 will rise and converge to π_t^f as the level of barriers increases. Therefore, $\pi_t^0 - \pi_t^f$ at a higher level of barriers is smaller than $\pi_t^0 - \pi_t^f$ at a lower level of barriers.

[5]"Intermediate expenses" includes costs of raw materials and parts, electricity energy and fuel for power and heating, and miscellaneous intermediate inputs for production.

[6]Porter defines convenience goods as: Goods with relatively low unit price, purchased repeatedly, for which the consumer desires an easily accessible outlet. Probable gains from making price and quality comparisons small relative to consumer's appraisal of search costs.

[7]The data for the BS measure is obtained from Tein-Chen Chuo.

[8]The advantages of using a proxy based on U.S. data has been discussed by Masson and Shaanan (1987):

> If the factor price ratios for Canada are identical to those for the U.S.; if a de novo plant in Canada would have the same technology used in the U.S.; and if due to smaller Canadian markets most firms in some industries operate at less than MES, where they do not do so in the U.S., then a U.S. based Bs (proxy for economies of scale) measure maybe more accurate than a Canadian based measure. If factor prices are not identical, . . ., a U.S. based measure may not be as accurate but may still have an advantage because its measurement error should be less correlated with that for concentration.

[9]This particular measure is used because of the availability of data.

[10]We classified an industry to the consumer-goods category if CGV of that industry was equal to or greater than 0.5 in 1976. CGV equals the proportion of domestic production less exports going to consumers.

CHAPTER VI

EMPIRICAL RESULTS

In this chapter we present and evaluate the empirical results.

We first present the results of the OLS linear regression equations relating profit rates and entry to their determinants.

Results of a test for recursive identification and a test of limit pricing will then be presented.

The results of the test for endogeneity of some explanatory variables in the profit equation will be provided in the following section.

The regression results of profit equations with an interactive term and a nonlinear concentration variable are presented in an Appendix.[1]

Actual Profit Equation

In Table IV and Table V, regressions of actual profits on its determinants in version (A) and version (B) are presented.

The coefficients of these variables have the predicted signs except for exports and the economies of scale proxy based on Taiwan data (BST). Concentration, advertising and the government participation dummy variable are the most significant explanatory variables. The coefficient estimates of concentration are all significant at the 99 percent level in the three versions. Advertising times a convenience goods dummy

TABLE II

SIMPLE CORRELATION COEFFICIENTS OF PROFIT RATE AND DETERMINANTS OF PROFIT RATE (VERSION A)

	π	C	BA	BST	GR	IMP	EXP	G
π	1.00	0.20	0.20	0.10	0.14	-0.09	-0.02	-0.16
C		1.00	0.09	0.41	-0.15	0.18	-0.25	0.45
BA			1.00	-0.09	-0.12	-0.05	-0.18	-0.08
BST				1.00	-0.24	-0.20	0.07	0.18
GR					1.00	0.03	0.21	-0.15
IMP						1.00	-0.08	0.18
EXP							1.00	-0.12
G								1.00
N = 103								

N = number of observations.

TABLE III

SIMPLE CORRELATION COEFFICIENTS OF PROFIT RATE AND DETERMINANTS OF PROFIT RATE (VERSION B)

	π	C	BA	BSU	GR	IMP	EXP	G
π	1.00	0.35	0.25	0.22	0.01	-0.10	-0.12	-0.10
C		1.00	0.12	0.26	-0.19	0.19	-0.23	0.25
BA			1.00	0.18	-0.13	-0.06	-0.24	-0.08
BSU				1.00	-0.04	0.30	-0.14	0.21
GR					1.00	0.06	0.18	-0.12
IMP						1.00	-0.13	0.14
EXP							1.00	-0.04
G								1.00
N = 70								

N = number of observations

TABLE IV

REGRESSION ANALYSIS OF PROFIT RATES (VERSION A)
DEPENDENT VARIABLE: π

Equation Number	1a
Constant	1.9885 (2.253)***
C	0.0534 (3.523)***
BA	0.8781 (2.000)**
BST	-0.3957 (-0.461)
GR	0.003 (2.788)***
IMP	-0.0002 (-0.045)
EXP	0.0076 (0.73)
G	-3.36442 (-3.079)***
R^2	0.7948
$\bar{R}^2$	0.7775
F	45.993
N	103

t ratios are given in parentheses.

*, ** and *** indicates coefficient is statistically significant at the 90%, 95%, and 99% level respectively with a one tail test.

N = number of observations.

TABLE V

REGRESSION ANALYSIS OF PROFIT RATES (VERSION B)
DEPENDENT VARIABLE: π

Equation Number	2a
Constant	1.4372 (1.04)
C	0.0621 (3.16)***
BA	0.6480 (1.28)*
BSU	0.0195 (1.57)*
GR	0.0015 (0.93)
IMP	-0.0070 (-1.74)**
EXP	-0.0029 (-0.21)
G	-2.7336 (-1.58)*
R^2	0.2553
$\bar{R}^2$	0.1712
F	3.036
N	70

t ratios are given in parentheses.

*, ** and *** indicates coefficient is statistically significant at the 90%, 95%, and 99% level respectively with a one tail test.

N = number of observations.

variable is significant at the 95 percent level in version (A) and the 90 percent level in version (B). The government participation dummy is significant at the 99 percent level in version (A) and the 90 percent level in version (B).

A one percentage point increase in concentration causes about a 0.05 percentage point increase in actual profit rates. A 1.25 percentage point increase in advertising would result in a one percentage point increase in actual profit rates. Public enterprises exert a significantly negative influence on industrial profitability.

Growth is significant at the 99 percent level in version (A) and the import variable is significant at the 95 percent level in version (B) but they are not significant in version (B) and in version (A) respectively. Growth seems to have a positive effect on actual profits and imports seem to have a negative one.

The economies of scale variable based on U.S. data (BSU) is significant at the 90 percent level in version (B) while the same variable based on Taiwan data (BST) is not significant in version (A). The simple correlation (see Table II) between concentration and economies of scale (BST) was high in version (A). The weakness of BST in explaining profits may be attributed in part to multicollinearity. Other nonstatistical disadvantages of using it as a proxy for economies of scale in Taiwan manufacturing industries have been discussed in Chapter V.

Our results for the export variable are inconclusive. It displays a positive sign in version (A), but a negative one in version (B). In both versions the coefficient estimates for this variable are not significant.

A regression on the 70 industries subsample with the BS proxy based on Taiwan data, provided weaker results. (See Table XX.) Imports and government participation were found to be insignificant. BST had an expected positive sign, but it was not significant. The correlation between BST and concentration was also high in this subsample. Therefore, the insignificance of the coefficient estimate of BST seemed to be caused by the collinearity between BST and industry concentration.

Previewing our results for the entry equations, we find that our full sample results for the entry equations as well as the profit equations are generally better than those obtained from the subsample regressions.

Since the weaker results are generally qualitatively consistent with our full sample results, the weaker fit of our subsample regressions seem to be caused by sample selection rather than from sensitivity to variable definitions between BST and BSU. We also tried regressions on the 70 industries subsample with the BS proxy based on Taiwan data, i.e. in version (B/BST). Results obtained from regressions in version (B/BST) are generally weaker than those in version (B) and version (A). The weaker fit of regressions in version (B/BST) than those obtained in version (A) seem to suggest that the weaker results in version (B/BST) are caused by sample selection.

Results obtained in version (B/BST) for profit equations strenthening our findings that concentration and advertising are significant and important structural characteristics in Taiwan's manufacturing sector.

Heteroscedasticity, with a pattern characterized by large variance of the residuals in the smaller industries was detected in some previous profit studies [e.g. Comanor and Wilson (1967), Esposito and Esposito (1971) and Harris (1973)]. The Goldfeld and Quandt test was used to determine whether heteroscedasticity is a problem in our estimations. (Industries were ranked according to total sales for 1976.) With 33 degrees of freedom we could not reject heteroscedasticity at the 95 percent level in version (A). We correct for heteroscedasticity by using a weighted regression. The weight being used is total sales to the one fourth. With 20 degrees of freedom, heteroscedasticity was rejected at the 99 percent level in version (B).

In order to find whether our results were sensitive to the choice of different variable definitions. We used two alternative definitions of concentration.

First, we considered the possibility that concentration ratios may understate the level of market power of leading firms in Taiwanese manufacturing industries and should be adjusted to reflect market realities, because (1) four-digit industries may be too broadly defined in Taiwan, (2) meaningful markets for some products are regional or local rather than nationwide, and (3) in some industries public enterprises are protected by the government. Therefore, we tested profit equations with a nonlinear concentration variable, i.e. the square of C_t. The nonlinear concentration variable, C_t^2, appeared to be a strong explanatory variable in profit equations. Results for other variables were very similar to those derived from the linear specifications. (See Tables XIII, XIV, and XV for details.)

Second, since values of exports in some industries are very large, the concentration ratio may not reflect accurately the domestic market power exerted by leading firms. We therefore tried an interactive term for concentration and exports which is obtained by multiplying C_t by $(1 - EXP_t)$ in our profit equations. Estimation with this interactive term improved the explanatory power of BST and BSU. BST has the expected positive sign and is significant at the 95 percent level in version (A). This improvement seems to be a result of the elimination of the collinearity between concentration and BST. (See Tables XVI, XVII, and XVII for details.)

Following Pugel (1980) we also tried an interactive model. Results obtained are generally not significant.

In summary, our most striking finding is the strong effect of advertising and the government participation variable on industry profits. Advertising intensity, as a proxy for product differentiation, is found to be an important structural variable influencing industry profits positively in the 20 convenience goods industries in Taiwan's manufacturing sector. Government participation is seen to affect industry profits negatively as we expected. The significant positive sign of the concentration variable suggests that increases in industry concentration do result in greater industry profits in Taiwanese manufacturing industries.

Growth displays the expected positive sign. Imports with their consistently negative impact on profits, may lead to more competitive pricing in domestic markets and consequently a lower profit rate. The export variable is insignificant in all cases. The economies of scale variable is sensitive to model specification and measurement. The positive and significant sign of BSU suggests that our measurement of the economies of scale is more appropriate.

TABLE VI

SIMPLE CORRELATION COEFFICIENTS OF ENTRY AND THE DETERMINANTS OF ENTRY (VERSION A)

	ENT	π	C	BA	BST	GR
ENT	1.00	0.19	0.22	-0.11	0.20	0.06
π		1.00	0.20	0.20	0.10	0.14
C			1.00	0.09	0.41	-0.15
BA				1.00	-0.09	-0.12
BST					1.00	-0.24
GR						1.00
N = 103						

N = number of observations.

TABLE VII

SIMPLE CORRELATION COEFFICIENTS OF ENTRY AND THE DETERMINANTS OF ENTRY (VERSION B)

	ENT	π	C	BA	BST	GR
ENT	1.00	0.30	0.37	−0.14	0.03	−0.05
π		1.00	0.35	0.25	0.22	0.01
C			1.00	0.12	0.26	−0.19
BA				1.00	0.18	−0.13
BSU					1.00	−0.04
GR						1.00
N = 70						

N = number of observations.

TABLE VIII

REGRESSION ANALYSIS OF ENTRY (VERSION A):
DEPENDENT VARIABLE: ENT

Equation Number	1b
Constant	11.4852 (0.58)
π	3.2874 (1.55)*
C	0.5076† (1.55)*
BA	-14.1451 (-1.38)*
BST	19.7649 (1.16)
GR	0.0205 (0.73)
R^2	0.1121
$\bar{R}^2$	0.0664
F	2.452
N	103

t ratios are given in parentheses.

*, **, and *** indicates coefficient is statistically significant at the 90%, 95%, and 99% level respectively with a one tail test (a two-tailed test, if a "†" follows the coefficient estimate).

N = number of observations.

TABLE IX

REGRESSION ANALYSIS OF ENTRY (VERSION B):
DEPENDENT VARIABLE: ENT

Equation Number	2b
Constant	4.6841 (0.293)
π	3.6536 (1.862)*
C	0.9036† (2.913)***
BA	-15.4655 (-1.933)**
BSU	-0.0572 (-0.306)
GR	0.0096 (0.406)
R^2	0.5536
$\bar{R}^2$	0.5117
F	3.036
N	70

t ratios are given in parentheses.

*, **, and *** indicates coefficient is statistically significant at the 90%, 95%, and 99% level respectively with a one tail test (a two-tailed test, if a "†" follows the coefficient estimate).

N = number of observations.

Entry Equation

The results of regressions of the percentage change in firm numbers (ENT) on the determinants of entry are presented in Table VIII and Table IX. The explanatory variables included in our entry equations are concentration, advertising, economies of scale (BST and BSU), growth and pre-entry profit rates.

The pre-entry profits variable and the advertising variable have the expected signs. The pre-entry profit rate appeared to be a strong predictor of the change of firm numbers. It is significant at the 90 percent level in versions (A) and (B). A one percentage point change in the pre-entry profit rate results in about a three percentage point increase in the percentage change in firm numbers in the 1976-1981 period in Taiwan Manufacturing sector. Advertising also shows up as a strong and significant predictor of ENT. A one percentage point increase in the advertising intensity reduces the entry rate by about 14 percentage points. It is significant at the 95 percent level in version (A) and the 90 percent level in version (B), thus suggesting that advertising is a barrier to entry in the convenience goods industries in Taiwan.

The coefficient of concentration has a positive sign and is significant at 95 percent level (two-tailed test) in version (B) and the 90 percent level (two-tailed test) in version (A). It appears that in Taiwan's manufacturing sector during the period 1976-1981 high concentration induced entry and potential entrants found concentrated industries to be more attractive. In version (A) and (B), growth has the expected positive sign but it is not significant. The regression coefficient for the economies of scale variable (BSU) displays the expected negative sign in version (B). But the coefficient of BST in version (A) has a positive sign. The coefficient estimates of BST and BSU are insignificant in the two versions.

We also ran a regression with BST on the 70 industries subsample for the entry equation. The regression resulted a weaker fit. BST was insignificant with a wrong sign. Results for other variables were similar to those obtained in version (B). (See Table XXII for details.)

An examination of the residuals from the entry equations in version (A) and (B) (observations are ranked in ascending order of firm numbers) suggests the possibility of heteroscedasticity as larger residuals are associated with industries with small firm numbers and smaller residuals with industries with large firm numbers.

The Goldfeld and Quandt test was used to determine whether the variances of the residuals for industries with smaller firm numbers was greater. With 35 degrees of freedom in version (A) and 25 degrees of freedom in version (B), hetroscedasticity can not be rejected at the 95 percent level.

Weighted by the firm numbers to the one fourth, heteroscedasticity is corrected for entry equations in version (B). We failed to correct it for the entry equation in version (A) by applying weights based on firm numbers. Weights based on profit rates eliminate heteroscedasticity. We did not use it because it is correlated with the residuals from the profit equation and the sufficient condition for recursive identification is that residuals from the profit equation and the entry equation are uncorrelated. We present only the unadjusted results in Table VIII. Although inconsistent, these results are unbiased.

In summary, the coefficients for the profit varaiable, the advertising variable, and the concentration variable are all significant and have the hypothesized signs. The results suggests that in Taiwan's manufacturing sector a high profit rate would attract entry, that advertising is an effective barrier to entry and that high concentration is an inducement to entry. The results obtained for the economies of scale variable are inconclusive. Growth seems to have no effect on entry.

Test of the Recursive Identification

The sufficient condition for the identification of our recursive model is $COV[\eta(t+1), \varepsilon(t)] = 0$. Theoretically, we expect that entry in period t+1 has no effect on the actual profit rate in period t and the actual profit rate in period t has a positive effect on entry in period t+1. The recursive identification is thus expected to be satisfied. We regressed the residuals from the profit equation on the residuals from the entry equation and found that ε_t and η_{t+1} are not correlated.

The recursive identification is demonstrated and the OLS procedure is therefore appropriate for the estimation of our model.

A Test of Limit Pricing

The results of a test of limit pricing are presented in Table X and Table XI. We converted the entry equations to the entry forestalling profit equations by setting $ENT_{t+1} = 0$ and solving for profits.

The entry equations presented in Table VIII and Table IX are

$$ENT_{t+1} = 11.4852 + 3.2874\ \pi_t^a + 0.5076\ C_t - 14.1451\ BA + 19.7649\ BST + 0.0205\ GR_t \quad \text{(Version A)}$$

$$ENT_{t+1} = 4.68410 + 3.6536\ \pi_t^a + 0.9036\ C - 15.4655\ BA$$
$$- 0.05720\ BSU + 0.0096\ GR_t \text{ (Version B)}$$

Setting $ENT_{t+1} = 0$ and moving π to the left hand side of the equation we have the entry forestalling profit equation,

$$-3.2874\ \pi_t = 11.4852 + 0.5076\ C - 14.1451\ BA + 19.7649\ BST$$
$$+ 0.0205\ GR \text{ (Version A)}$$

$$-3.6536\ \pi_t = 4.68410 + 0.9036\ C_t - 15.4655\ BA - 0.05720\ BSU$$
$$+ 0.0096\ GR_t \text{ (Version B)}$$

The entry forestalling profit equations are therefore estimated to be:

$$\pi_t^f = -3.4937 - 0.1544\ C_t + 4.30280\ BA - 6.0123\ BST - 0.0062\ GR_t$$
(Version A)

$$\pi_t^f = -1.2821 - 0.2473\ C_t + 4.23290\ BA + 0.0157\ BSU - 0.0026\ GR_t$$
(Version B)

From Tables X and XI we see that advertising is again a strong and significant predictor in explaining π_t^f. In all versions, a one percentage point increase in advertising would raise the entry forestalling profit rates by about 4.3 percentage points (i.e. without the risk of inducing entry). It is significant at the 95 percent level in version (A) and the 90 percent level in version (B). The significance level of the coefficient estimates was derived from Fieller's Theorem as presented in Zerbe (1978). We obtained significance levels but not the explicit t values from the test for ratios.

Concentration has an adverse effect on π_t^f. The negative coefficient for the concentration variable is significant at the 95 percent level in version (A), however it is not significant in version (B).

TABLE X

RESULTS FOR A TEST OF LIMIT PRICING
(VERSION A)

Dependent Variable	π_t^f	π_t^0	$\pi_t^f - \pi_t^0$
Constant	-3.4937 *	7.3285 (6.22)***	-10.8222 (-1.5266)*
C	-0.1544 **	N.A.[2]	N.A.
BA	4.3028 **	0.8781 (2.00)**	3.4247 (0.9201)
BST	-6.0123 **	-0.3957 (-0.461)	-5.6166 (-0.8255)
GR	-0.0062	0.003 (2.788)***	-0.0092 (-0.8757)
IMP	N.A.[3]	-0.0002 (-0.045)	N.A.
EXP	N.A.	0.0076 (0.73)	N.A.
G	N.A.	-3.36442 (-3.079)***	N.A.
N	103	103	103

t ratios are given in parentheses.

*, **, and *** indicates coefficient is statistically significant at the 90%, 95%, and 99% level respectively with a one tail test.

N = number of observations.

N.A. means "not applicable".

TABLE XI

RESULTS FOR A TEST OF LIMIT PRICING
(VERSION B)

Dependent Variable	π_t^f	π_t^0	$\pi_t^f - \pi_t^0$
Constant	-1.2821 **	7.6472 (4.87)***	-8.9293 (-1.8473)**
C	-0.2473	N.A.	N.A.
BA	4.2329	0.6480 (1.28)*	3.5849 (1.3152)*
BSU	0.0157 **	0.0195 (1.57)*	-0.0038 (-0.0764)
GR	-0.0026 **	0.0015 (0.93)	-0.0041 (-0.5506)
IMP	N.A.	-0.0070 (-1.74)**	N.A.
EXP	N.A.	-0.0029	N.A.
G	N.A.	-2.7336 (-1.58)*	N.A.
N	70	70	70

t ratios are given in parentheses.

*, **, and *** indicates coefficient is statistically significant at the 90%, 95%, and 99% level respectively with a one tail test.

N = number of observations.

N.A. means "not applicable".

Since high concentration induces entry, the higher the concentration ratio is the lower the incumbent's entry forestalling profit rate could be. Our results indicate that a one percentage point increase in concentration would lower the entry forestalling profit rate by about 0.2 percentage point.

The role of the economies of scale variable in the entry forestalling profit equation is not clear. It is significant at the 95 percent level in the two versions, but only in version (B) does it have the expected sign. The wrong signs in version (A) may be attributed to the collinearity between BST and C_t. The negative coefficient for the growth variable is significant at the 95 percent level in version (B), but not significant in version (A). Our results suggests that growth in Taiwan's manufacturing sector may have a weak effect on the entry forestalling profit rate.

The actual profit equations in Tables IV and V were converted to the optimal profit equations by setting $C_t = 100$ to obtain π_t^0.

Setting $C_t = 100$, we have

$$\pi_t^0 = 7.3285 + 0.8781 \text{ BA} - 0.3957 \text{ BST} + 0.003 \text{ GR}_t - 0.0002 \text{ IMP}_t + 0.0076 \text{ EXP}_t - 3.3644 \text{ G}_t \quad \text{(Version A)}$$

$$\pi_t^0 = 7.6472 + 0.6480 \text{ BA} - 0.0195 \text{ BSU} + 0.0015 \text{ GR}_t - 0.007 \text{ IMP}_t - 0.0029 \text{ EXP}_t - 2.7336 \text{ G}_t \quad \text{(Version B)}$$

In Tables X and XI the coefficient estimates of the entry forestalling profit equations are compared with the coefficient estimates of the optimal profit equations. The advertising barrier coefficients in the entry forestalling profit equations are all positive and all greater than coefficients of the same variable in the optimal profit equations. The economies of scale variable does not appear as an effective entry barrier. It has inconsistent signs in the two estimating versions. In accordance with expectations the intercept terms of the entry forestalling profit equations are all smaller than the constants of the optimal profit equations.

A test for comparing the relative values of the coefficients in the entry forestalling profit equations and the coefficients in the optimal profit equations is also presented. The difference between the two intercept terms is significant at the 95 percent level in version (B) and the 90 percent level in version (A). The difference between the advertising barrier coefficients in the π_t^f equation and the π_t^0 equation is not significant in version (A) while it is significant at the 90 percent level in version (B). The differences between the coefficients of the economies of scale variable are all insignificant.

Our results of: (1) significantly different intercept coefficients for the π_t^f equations and the π_t^0 equations, (2) significant and positive slopes of advertising barriers in both π_t^f and π_t^0 equations, and (3) significantly greater intercept coefficients and advertising barrier coefficients for the optimal profit equations, jointly provide support for the stochastic-dynamic limit pricing theory which states that π_t^0 is always above π_t^f, both rise with barriers and finally converge at the short run profit maximizing level. The hypothesis of the dual effect of the advertising barrier on the actual profit rate is also confirmed by the above findings. (See Table XII for details.)

The negative and mostly significant coefficients of concentration in the entry forestalling profit equations and the significantly positive coefficients in the actual profit equations provide support for the hypothesis of a dual effect of concentration on the actual profit rate.

The hypothesis of a dual effect of growth on the actual profit rate is not supported by our results.

Test of Endogeneity

A test developed by Engle, Hendry and Richard (1979) and first used in an Industrial Organization study by Geroski (1983) was applied to determine whether simultaneity exists between profit rates, concentration, advertising, imports and exports. We could not reject the hypothesis that concentration, advertising, imports and exports are all exogenous in the profit equation with acalculated $F = 1.1045$ which is smaller than critical (at 95 percent significance level) $F(4,19) = 2.49$.

Therefore, our single equation specification is appropriate for estimating the determinants of profits.

TABLE XII

A TEST OF LIMIT PRICING

Theoretical Expectations	Empirical Findings (Version A)	Empirical Findings (Version B)	Conclusions
If $\alpha_i = a_i + d_i < 0$, $a_i < 0$, and $\alpha_i - a_i = 0$. We would reject limit pricing behavior.	$\alpha_1 = 0.8781 > 0$, $a_1 = 4.3028 > 0$, $\alpha_2 = -0.3957 < 0$, $a_2 = -6.0123 < 0$, $\alpha_0' - a_0 = 10.8222 \neq 0$.	$\alpha_1 = 0.6480 > 0$, $a_1 = 4.2329 > 0$, $\alpha_2 = 0.0195 > 0$, $a_2 = 0.0157 > 0$, $\alpha_0' - a_0 = 8.9293 \neq 0$.	Rejection of limiting pricing is unwarranted.
If $\alpha_i = a_i + d_i = a_i$, $\alpha_i = a_i > 0$, We would accept the static model.	$\alpha_1 = 0.8781 \neq a_1 = 4.3028$, $\alpha_2 = -0.3957 \neq a_2 = -6.0123$,	$\alpha_1 = 0.6480 \neq a_1 = 4.2329$, $\alpha_2 = 0.0195 \neq a_2 = 0.0157$,	We reject the existence of limit pricing behavior suggested by the static model.
If $\alpha_i = a_i + d_i = a_i$, $\alpha_i = a_i > 0$, and a residual pattern with high positive residuals for very high and very low values of the entry barriers. We would accept the dynamic/deterministic model.	$\alpha_1 = 0.8781 \neq a_1 = 4.3028$, $\alpha_2 = -0.3957 \neq a_2 = -6.0123$, We did not find a residual pattern as mentioned left hand side.	$\alpha_1 = 0.6480 \neq a_1 = 4.2329$, $\alpha_2 = 0.0195 \neq a_2 = 0.0157$, We did not find a residual pattern as mentioned left hand side.	We reject the existence of limit pricing behavior suggested by the dynamic/deterministic model.
If $\alpha_i = a_i + d_i < a_i$, $\alpha_i = \alpha_i > 0$, $d_i < 0$, $\alpha_0' > a_0$. We would accept the dynamic/stochastic models of limit pricing.	$\alpha_1 = 0.8781 < a_1 = 4.3028$, $\alpha_2 = -0.3957 > a_2 = -6.0123$, $\alpha_1 = 0.8781 > 0$, $d_1 = -3.4247 < 0$, $\alpha_2 = -0.3957 < 0$, $d_2 = 5.6166 > 0$, $\alpha_0' = 7.3285 > a_0 = -3.4937$,	$\alpha_1 = 0.6480 < a_1 = 4.2329$, $\alpha_2 = 0.0195 > a_2 = 0.0157$, $\alpha_1 = 0.0648 > 0$, $d_1 = -3.5849 < 0$, $\alpha_2 = 0.0195 > 0$, $d_2 = 0.004 > 0$, $\alpha_0' = 7.6472 > a_0 = -1.2821$,	We accept dynamic/stochastic models of limit pricing.

Note: Coefficient estimates demonstrated in this table are all statistically significant except those of BST, i.e., α_2 and a_2 in Version A.

ENDNOTES

[1]See Tables XIII through XVIII for details.

[2]We obtain the optimal profit equations by setting C_t = 100 in the actual profit equations and adding it to the intercept term. Therefore, C_t will not appear in the optimal profit equations.

[3]Since we convert the entry equations to the entry forestalling equations by setting ENT_{t+1} = 0 and solving for profits, variables which are not included in the entry equations will consequently not be in the entry forestalling profit equations.

CHAPTER VII

SUMMARY AND CONCLUSIONS

The major purpose of this study has been to test empirically the structure-performance relationship, especially the theory of limit pricing, in Taiwan manufacturing sector.

Based on Masson and Shaanan's statistical approach, we constructed a simultaneous equation system which includes a profit equation and an entry equation to test, from both the existing firms' side and the potential entrants' side: (1) the conventional structure-performance relationship, i.e. the determination of industry profits in Taiwan manufacturing industries, and (2) the determination of the rate of entry into those industries.

The results obtained provide support for the hypothesized relationship between industry profits and several traditional structural variables. As an entry barrier, advertising intensity exerts a positive and significant influence on industrial profitability. Concentration also has a strong and positive effect on profits. Growth has a weak positive effect on profits. An economies of scale measure based on U.S. data (BSU), influences profits significantly and positively. The insignificant and negative signs of the coefficients of the minimum efficient scale measure based on Taiwan data (BST) may be attributed to the collinearity between BST and industrial concentration.

The results for international trade variables are as expected. Import competition is theoretically expected to limit domestic market power and thus constrain domestic industry profits to a more competitive level and the empirical results indeed confirm this although the effect is weak. The role of exports in determining domestic industry profits is, however, not clear.

Public enterprises, as expected have a negative and significant influence on industry profit rates.

Statistical results pertaining to the determination of the rate of entry into Taiwan manufacturing industries indicate that profits as predicted by conventional microeconomic theory have a significantly positive relationship with entry. Advertising intensity has a significantly negative effect on the entry of domestic firms into convenience goods industries. Convenience goods industries with higher advertising intensity experience less entry. This leads us to conclude that the advertising barrier does exist in the Taiwan manufacturing sector. However, economies of scale can not be deemed as an entry barrier. It is not a significant explanatory factor in the entry equation.

The advertising barrier has the expected positive and significant sign in the entry forestalling profit equation which is derived from the entry equation. It can be interpreted to mean that an increase in the height of the advertising barrier would allow existing firms to charge higher prices without the risk of entry.

A test of limit pricing behavior was conducted by comparing and testing variables in the optimal profit equations and the entry forestalling profit equations. The coefficient estimates of the advertising barrier in the entry forestalling profit equations are all significant and greater than their counterparts in the optimal profit equations. The intercepts in the entry forestalling profit equations were all significantly smaller than the intercepts in the optimal profit equations. These results provide some support for the idea that in Taiwan's manufacturing industries, existing firms adopt limit pricing policies.

The significant and positive effect of concentration on entry indicates that potential entrants find highly concentrated industries to be more appealing. The effect of concentration on the entry forestalling profit rate was significantly negative.

Although mostly insignificant, growth had correct signs in all equations and influenced the entry forestalling profit rates significantly and negatively.

We may conclude that since growth and concentration induce entry, with an increase in growth or concentration, existing firms would have to charge lower prices to prevent entry.

Our statistical evidence provides a fair amount of support for the theory of limit pricing. Empirical findings suggest: (1) allocative efficiency is distorted by the exertion of market power (concentration) in Taiwan manufacturing sector; (2) in convenience goods industries advertising intensity is a significant barrier to entry; (3) profits induce entry; (4) entrants are attracted to concentrated industries; (5) imports have a mild disciplining effect on domestic markets; (6) government participation in manufacturing industries has a negative influence on industry profits; and (7) limit pricing behavior of the type proposed by dynamic/stochastic models may exist in Taiwan's manufacturing sector, especially in the convenience goods industries.

The impact of concentration on industrial profitability appears to be strong in Taiwan's manufacturing sector. It seems that a government monitoring of concentrated industries along the lines of western antitrust agencies might be called for to maintain a competitive environment. But one also has to remember that Taiwanese exporting firms are competing with giant foreign firms and confront very competitive prices in the world market, and the pressure from world markets ensure to some extent that Taiwan's industries remain competitive. The government also cannot adopt deconcentration policies, instead it needs to encourage large scale private firms in order to expand exports and maintain economic prosperity.

It is found by Masson and Shaanan (1984) that the existence of both actual and potential competition in a market has the effect of offsetting the potential of full monopoly welfare losses. Therefore, in the short run a limit pricing policy could be socially beneficial. But its long run effect is not clear and hence government intervention against limit pricing in the convenience goods industries is not warranted. However, government intervention is suggested to curb advertising activities which aim to deter entry into those industries.

The negative relationship between government participation and industrial profitability does not imply a pro-competitive effect of the existence of public enterprises. It is indicated by Chou (1986) that high prices are adopted by public enterprises and protected by the government, therefore lower profit rates in the pubic sector are obviously a sign of a wasteful use of economic resources which causes high production costs and shrink price-cost margins, rather than a sign of competition.

Our study has some policy implications. First, since import discipline improves allocation performance in Taiwan, further liberalization of tariff and import controls would create a more competitive industrial environment and enhance consumer welfare. Second, consumer welfare can be further improved by transfering more public enterprises, except those in the "strategic industries", to private ownership. Third, entry into the convenience goods industries should be facilitated to help overcome advertising barriers, if possible, to enhance competition.

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APPENDIX

TABLE XIII

A PROFIT EQUATION WITH A NONLINEAR CONCENTRATION VARIABLE (VERSION A): DEPENDENT VARIABLE: π

Equation Number	1a
Constant	81.7465 (2.794)***
C^2	0.0006 (4.075)***
BA	1.0753 (2.324)***
BST	-0.2023 (-0.222)
GR	0.0042 (4.061)***
IMP	0.0003 (0.056)
EXP	0.0156 (1.535)**
G	-3.5218 (-2.898)***
R^2	0.3682
$\bar{R}^2$	0.3217
F	7.910
N	103

t ratios are given in parentheses.

*, **, and *** indicates coefficient is statistically significant at the 90%, 95%, and 99% level respectively with a one tail test.

N = number of observations.

TABLE XIV

A PROFIT EQUATION WITH A NONLINEAR CONCENTRATION VARIABLE (VERSION B): DEPENDENT VARIABLE: π

Equation Number	2a
Constant	2.6512 (2.162)**
C^2	0.0005 (2.836)***
BA	0.6908 (1.351)*
BSU	0.0229 (1.827)**
GR	0.0015 (0.92)
IMP	-0.0062 (-1.545)*
EXP	-0.0049 (-0.35)
G	-2.7174 (-1.546)*
R^2	0.2344
$\bar{R}^2$	0.1480
F	2.712
N	70

t ratios are given in parentheses.

*, **, and *** indicates coefficient is statistically significant at the 90%, 95%, and 99% level respectively with a one tail test.

N = number of observations.

TABLE XV

A PROFIT EQUATION WITH A NONLINEAR CONCENTRATION VARIABLE (VERSION B/BST): DEPENDENT VARIABLE: π

Equation Number	3a
Constant	2.5918 (2.124)**
C^2	0.0005 (2.844)***
BA	0.6586 (1.286)*
BST	0.0238 (1.939)**
GR	0.0017 (1.065)
IMP	-0.0063 (-1.574)*
EXP	-0.0046 (-0.327)
G	-2.7761 (-1.582)*
R^2	0.2393
$\bar{R}^2$	0.1535
F	2.787
N	70

t ratios are given in parentheses.

*, **, and *** indicates coefficient is statistically significant at the 90%, 95%, and 99% level respectively with a one tail test.

N = number of observations.

TABLE XVI

A PROFIT EQUATION WITH AN INTERACTIVE TERM FOR CONCENTRATION AND EXPORTS (VERSION A): DEPENDENT VARIABLE: π

Equation Number	1a
Constant	110.45 (3.553)***
CEXP	0.00002 (0.013)
BA	1.2574 (2.519)***
BST	1.7689 (2.104)**
GR	0.0052 (4.695)***
IMP	0.0016 (0.306)
EXP	0.0036 (0.345)
G	-1.1306 (-0.974)
R^2	0.2578
$\bar{R}^2$	0.2031
F	4.714
N	103

t ratios are given in parentheses.

*, **, and *** indicates coefficient is statistically significant at the 90%, 95%, and 99% level respectively with a one tail test.

N = number of observations.

TABLE XVII

A PROFIT EQUATION WITH AN INTERACTIVE TERM FOR CONCENTRATION AND EXPORTS (VERSION B): DEPENDENT VARIABLE: π

Equation Number	2a
Constant	0.5918 (0.355)
CEXP	0.0791 (2.831)***
BA	0.5944 (1.157)
BSU	0.0225 (1.799)**
GR	0.0010 (0.622)
IMP	-0.0067 (-1.662)**
EXP	0.0298 (1.512)**
G	-2.6441 (-1.508)*
R^2	0.2341
$\bar{R}^2$	0.1476
F	2.708
N	70

t ratios are given in parentheses.

*, **, and *** indicates coefficient is statistically significant at the 90%, 95%, and 99% level respectively with a one tail test.

N = number of observations.

TABLE XVIII

A PROFIT EQUATION WITH AN INTERACTIVE TERM FOR CONCENTRATION AND EXPORTS (VERSION B/BST): DEPENDENT VARIABLE: π

Equation Number	3a
Constant	1.5966 (1.005)
CEXP	0.0705 (2.339)***
BA	0.9044 (1.738)**
BST	1.1333 (1.21)
GR	0.0016 (0.945)
IMP	-0.0034 (-0.838)
EXP	0.0220 (1.038)
G	-2.0178 (-1.153)
R^2	0.2127
$\bar{R}^2$	0.1238
F	2.393
N	70

t ratios are given in parentheses.

*, **, and *** indicates coefficient is statistically significant at the 90%, 95%, and 99% level respectively with a one tail test.

N = number of observations.

TABLE XIX

SIMPLE CORRELATION COEFFICIENTS OF PROFIT RATE AND THE DETERMINANTS OF PROFIT RATE (VERSION B/BST)

	π	C	BA	BST	GR	IMP	EXP	G
π	1.00	0.35	0.25	0.19	0.01	-0.10	-0.12	-0.10
C		1.00	0.12	0.38	-0.19	0.19	-0.23	0.25
BA			1.00	-0.12	-0.13	-0.06	-0.24	-0.08
BST				1.00	-0.27	-0.21	0.13	0.06
GR					1.00	0.06	0.18	-0.12
IMP						1.00	-0.13	0.14
EXP							1.00	-0.04
G								1.00
N = 70								

N = number of observations.

TABLE XX

REGRESSION ANALYSIS OF PROFIT RATES (VERSION B/BST):
DEPENDENT VARIABLE: π

Equation Number	3a
Constant	2.2533 (1.73)**
C	0.0596 (2.67)***
BA	0.8792 (1.71)**
BST	0.6641 (0.68)
GR	0.0018 (1.09)
IMP	-0.0044 (-1.08)
EXP	-0.0056 (-0.38)
G	-2.2111 (-1.27)
R^2	0.2313
$\bar{R}^2$	0.1446
F	2.666
N	70

t ratios are given in parentheses.

*, **, and *** indicates coefficient is statistically significant at the 90%, 95%, and 99% level respectively with a one tail test.

N = number of observations.

TABLE XXI

SIMPLE CORRELATION COEFFICIENTS OF ENTRY AND THE DETERMINANTS OF ENTRY (VERSION B/BST)

	ENT	π	C	BA	BST	GR
ENT	1.00	0.30	0.37	-0.14	0.24	-0.05
π		1.00	0.35	0.25	0.19	0.01
C			1.00	0.12	0.38	-0.19
BA				1.00	-0.12	-0.13
BST					1.00	-0.27
GR						1.00
N = 70						

N = number of observations.

TABLE XXII

REGRESSION ANALYSIS OF ENTRY (VERSION B/BST):
DEPENDENT VARIABLE: ENT

Equation Number	3b
Constant	0.6213 (0.041)
π	3.0627 (1.527)*
C	0.8311† (2.763)***
BA	-14.118 (-1.759)**
BST	18.4140 (0.988)
GR	0.0146 (0.610)
R^2	0.5596
$\bar{R}^2$	0.5184
F	2.666
N	70

t ratios are given in parentheses.

*, **, and *** indicates coefficient is statistically significant at the 90%, 95% and 99% level respectively with a one tail test (a two-tailed test, if a "†" follows the coefficient estimate).

N = number of observations.

TABLE XXIII

RESULTS FOR A TEST OF LIMIT PRICING (VERSION B/BST)

Dependent Variable	π_t^f	π_t^0	$\pi_t^f - \pi_t^0$
Constant	-0.2029	8.2133 (4.73)***	-8.4162 (-1.6114)*
C	-0.2714 **	N.A.	N.A.
BA	4.6097 **	0.8792 (1.71)**	3.7305 (1.1391)
BST	-6.0123 **	0.6641 (0.68)	-6.6764 (-0.8310)
GR	-0.0048 *	0.0018 (1.09)	-0.0066 (-0.7523)
IMP	N.A.	-0.0044 (-1.08)	N.A.
EXP	N.A.	-0.0056 (-0.38)	N.A.
G	N.A.	-2.2111 (-1.27)	N.A.
N	70	70	70

t ratios are given in parentheses.

*, **, and *** indicates coefficient is statistically significant at the 90%, 95%, and 99% level respectively with a one tail test.

N = number of observations.

N.A. means "not applicable."

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