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The Interdependence of the Life Cycle and Strategic Group Concepts: Theory and Evidence

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ABSTRACT

A life cycle theory of investment is developed by adapting models presented by Kmenta and Williamson (1966). Data for firms from two diverse industries (textiles and petroleum) are used to determine the life cycle stage of each of the two industries, as well as the life cycle stage of each strategic group within the industry. These results are first generated for the strategic group designation suggested by Porter (1979). Then, an alternative strategic group designation suggested by the author was used for the same purpose. Porter's designation developed superior results for the textile industry; however, the alternative approach generated better results for the petroleum industry.

The research results have important implications for future strategic management research, particularly subsequent studies dealing with the strategic group and life cycle concepts. These implications are elaborated upon in the paper.

INTRODUCTION

The strategic group concept and the industry life cycle are both firmly established in the strategic management literature but they were introduced at different times as independent ideas. Yet, by their nature, they relate to each other in some important ways and are, indeed, quite interdependent. The main purposes of this study are: first, to examine the theoretical reasons for interdependence between these two concepts, and second, to examine data which actually reflect this mutual interdependence and to determine what this relationship means for empirical research.

PREVIOUS STUDIES

Strategic Groups

Although a germ of the idea can be found in earlier writing, Porter (1979: 215) credits Hunt (1972) with coining the term strategic groups. Later, Newman (1978: 417-27) and Porter (1979: 214-227) undertook further empirical studies and added to Hunt's original contribution. Porter (1979: 215) emphasized the interdependence of members within a strategic group in the following statement.

> An industry can be composed of clusters or groups of firms, where each group consists of firms following similar strategies in terms of the key decision variables. Such a group could consist of a single firm, or could encompass all of the firms in the industry. I define such groups as strategic groups. Firms within a strategic group resemble one another closely and, therefore, are likely to respond in the same way to disturbances, to recognize their mutual dependence quite closely, and to be able to anticipate each other's reactions quite accurately. Between strategic groups, however, the situation is different.

Mobility barriers tend to prevent a firm from moving from one strategic group to another and barriers to entry tend to protect members of a strategic group from entry by an outside firm. Porter (1980: 133).

The Life Cycle

There is some controversy about whether the life cycle applies to individual products or to whole industries. (Porter 1980: 157). Rink (1979) points out that the life cycle concept has been widely applied to products and Porter (1980: 157) takes the position that the life cycle concept also applies to industries. Sasser et. al. (1978), Boulding (1962), and James (1974) further extend the life cycle notion to the firm level. Some others who have discussed the life cycle concept include: Patz (1981: 127-30), Rumelt (1979: 204-206; 208-209; 211-212; 215), Cooper (1979: 318-325). The propositions presented in this study are quite compatible with the metamorphosis models presented in Pugh, et. al. (1969), James (1974), Scott (1971), Salter (1970), Stopford (1968), and Franko (1974).

The industry life cycle concept presents the idea that growth of an industry follows an S shaped curve which results from the innovation process and new product diffusion. Porter (1980: 157) explains that the life cycle concept has attracted some criticism. The first main criticism argues that individual industries are different from one another and that the length of life cycle stages varies significantly from industry to industry: it is often not clear what stage of the life cycle an industry is actually in. (Porter 1980: 158).

The second criticism has to do with the certainty that the industry will proceed from one stage to the next. It is argued that industry growth does not always go through the S shaped curve. Stages are sometimes skipped and after a period of decline growth sometimes revitalizes. (Porter 1980: 158).

The third criticism is concerned with the effect of firm activities on the industry life cycle. The argument is that companies can affect the shape of their growth curve through product innovation and repositioning. (Porter 1980: 162). Obviously, individual firm action could affect the industry life cycle; this fact illustrates that the second and third criticisms are closely related.

The above criticisms, at first thought, seem quite significant; yet, a number of researchers have taken the position that life cycles are vital constructs and must be used to develop correct analyses of business problems. For some examples of these studies see Kimberley (1980), Faziane (1968), Grabowski and Mueller (1975), Mueller (1972), Kmenta and Williamson (1966), and James (1974).

The life cycle and strategic group models are both mentioned by Rumelt (1979: 204-206; 208-209) as fruitful areas for further research. The strategic group concept, according to Rumelt, constitutes a beginning of a movement away from equating structure with concentration. He explains, however, that further research on the subject is required. Rumelt (1979: 212), in discussing the life cycle, says that the application of Hatten (1974) and Patton (1976) methods to a competitive group in the growth phase and then again in the maturity phase of the life cycle would be worthy of study. Although this particular study is somewhat different from the research called for by Rumelt, it does examine life cycles and strategic groups, together, in the same analysis.

This study also attempts to establish a technique which will be useful for determining the phase of the life cycle an industry is in, at a particular time, without requiring previous or future information. This technique is essential for accomplishing the main purposes of the study.

THE THEORY

The Firm and Industry Life Cycle

Both firms and industries go through life cycles similar to the product life cycle which is frequently described in the marketing literature (Metzner et. al. 1975: 61-63; and Rink and Swan 1979: 219-242). This does not mean that a firm or industry moves sequentially from one stage to the next and ultimately dies as should be expected according to Penrose (1952: 805-806). Instead, as Porter (1980: 158) explains, sometimes stages of an industry life cycle are skipped and sometimes industry growth revitalizes after a period of decline. Of course, an industry is merely a collection of firms possessing very similar prescribed characteristics; consequently, changes in an industry occur because of changes which take place within firms in that industry. As mentioned earlier, Sasser et. al. (1978: 538-541), James (1974) and Boulding (1962) have developed analyses using a firm life cycle.

A Strategic Group--Life Cycle Theory of Investments

> The president of one of our largest oil companies, who was pushing through a program of drastic decentralization of management, stated recently that the last thing he would delegate would be decisions about capital expenditures. This is understandable because capital expenditure decisions form the framework for

> a company's future development and are a major determinant of efficiency and competitive power. The wisdom of these corporate investment decisions, therefore, has a profound effect upon a company's future earnings and growth (Dean 1954: 571).

This quote from one of the foremost business consultants and academic business economists indicates the significance of the investment decision. First, Dean indicates that it tends to be a top management decision; second, investment decisions form the framework for a company's future development; third, investment decisions determine firm efficiency and competitive power. It is important to point out that investment, as used in this study, refers to investment in capital equipment, such as plant and equipment, not financial investments, such as stock or bonds.

Certainly, investment is an important strategic decision variable as discussed by Hofer and Schendel (1978: 106-107) and Dean (1954: 571). Investment would qualify as a key decision variable in the discussion by Porter (1979: 215). From the work of these authors, and from the earlier discussion of the importance of corporate investment decisions, it follows that a collection of firms following similar strategies, in terms of their investment behavior, would constitute a strategic grouop. James (1974) concludes that a single investment model would be inappropriate for a given firm, all of the time. That is, investment behavior of firms changes as they move through what James calls a corporate life cycle.

The above discussion shows that firm investment decisions are influenced by two key determinants; first, their strategic group membership and second the corporate life cycle to which they belong. The above discussion reveals that there is significant interdependence, through investment decisions, between strategic group membership and the life cycle of a firm. That interdependence is the central focus of this research.

Overall, future earnings and growth of the business are affected in a significant way by the investment decisions of a firm. All of this leads to the conclusion that investment decisions impact upon firm strategy in very important ways; this fact is confirmed by Hofer and Schendel (1978: 106-107).

Strategic Groups Within an Industry

Primeaux (1983) argues that since industries are composed of strategic groups, that all firms within an industry are not necessarily in the same stage of the industry life cycle. Indeed, in the life cycle theory of investment, presented by Kmenta and Williamson, all firms within an industry do not react in the same way to particular events and conditions existing in their economic environment. These hypotheses are all consistent with the corporate life cycle theory presented by James (1974: 49-55).

The main point is, that individual firms within an industry are not all in the same position with respect to strength and opportunities, so they will follow individual strategies which may differ significantly from those employed by other firms within the same industry; yet, as Porter (1979: 215) explains, an industry is composed of a cluster of firms, each group following similar strategies in terms of key decision variables. These clusters of firms constitute strategic groups.

From the above it follows that the industry life cycle concept is really an average life cycle of all firms within the industry and all firms or strategic groups within an industry are not in the same stage of the industry life cycle. (Primeaux 1983).

Two questions emerge from the above discussion. First, whether any strategic group study should also simultaneously examine industry life cycle influences upon firms within the particular strategic group being examined. Second, should any industry life cycle study also consider influences of strategic group differences within the industry. Research results developed in the following section are useful for answering these two important questions.

THE MODELS

As mentioned earlier, James (1974) has established that firm investment follows a life cycle pattern as a business adjusts its capital expenditures to the circumstances in which it finds itself. These conclusions are consistent with earlier empirical results developed by Kmenta and Williamson (1966: 172-181). These researchers have shown that a single investment model is inappropriate for all stages of an industry's lifetime. Since an industry is merely a collection of firms of similar characteristics, the variation in industry investment behavior must originate from changes in firm investment behavior through time.

Multiple regression analysis was used to develop the statistical results used in this research. Kmenta and Williamson's industry life cycle models were adapted for the firm strategic group--life cycle analyses which are central to this investigation. The entire theory upon which these adapted models are based is presented in the Appendix and only a very abbreviated discussion is presented here.

Kmenta and Williamson's empirical research found a three stage cycle as reasonable and logical; an initial stage of adolescence, a second period of maturity and a third stage of senility. Their analysis can be profitably extended to firms instead of industries. It is important to repeat that these stages need not occur sequentially; stages may be skipped, and a firm could reposition itself to an "earlier" stage by strategic action taken by its management.

Model of Adolescence Stage

The model of the adolescence stage follows:

(1) $$I_t^N = a_o + a_1X_{t-2} - a_2K_{t-2} + a_3(\pi^*/K)_{t-2} + a_4(\pi^*_{t-1} - \pi^*_{t-2}) + a_5r_{t-1} + a_6t + \hat{U}_t$$

where I_t^N = net investment.

X = operating revenue.

K = capital stock at the end of each period.

π^* = net operating income after depreciation.

r_{t-1} = interest rate proxy variable.

t = R&D proxy variables

$\hat{U}$ = error term

The constant term, a_0, provides for the existence of autonomous investment. A more extensive discussion of the variables used in equation (1) and the equations which follow is presented in an appendix.

Model of Maturity Stage

The model of maturity stage is:

(2) $$I_t^N = a_0 + a_1X_{t-2} - a_3K_{t-2} + a_4r_{t-1} + a_{5t} + \hat{U}_t$$

The variables in equation (2) are defined as in equation (1).

Model of Senility Stage

The model of the senility stage is as follows:

(3) $$I_t^N = a_0 + a_1K_{t-1} + a_3\pi^{**}{}_{t-1} + a_4r_{t-1} + a_5t + \hat{U}_t$$

The variables common to equation (1) are defined as in that equation; and π^{**} is net income (including non-operating income).

The statistical evidence developed from the above equations is presented in the following section.

THE EVIDENCE

Method

The statistical analysis used in this research is ordinary least squares regression analysis.

The three investment life cycle equations, presented in the above section, were run for firms in the textile and petroleum industries. The petroleum industry is certainly more capital intensive than the textile industry. It was thought that this diversity could affect investment strategies of the strategic groups within the industries and that the contrast would be worthy of examination. Moreover, the number of industries was limited to simplify exposition of the research results without only limiting this information to summary tables.

The research uses available data since World War II; 1961-1980, representing twenty years of operations. The raw firm data for the selected industries were taken from Compustat tapes.

Data for all firms included in the sample from a given industry were summed to obtain industry data; then, the three investment life cycle equations, adapted from Kmenta and Williamson (1966), were individually estimated with the same industry data. The model of the stage which best reflects industry investment behavior would identify the stage of the life cycle the industry is actually in. This method permits a researcher to gain a better understanding of the investment strategy and behavior of the industry as a whole and the life cycle stage of the industry is clearly identified through this procedure.

Textile Industry

Table 1 presents the multiple regression equation for the three stages of the textile industry life cycle. The industry equations are: (1), (4), and (7). The results show that equation (1), representing the adolescence stage of the life cycle, seems to best fit the data for the textile industry. That is, according to $\bar{R}^2$, the adolescence equation explains a greater percentage of change in net investment for the whole textile industry (.80) than either the maturity stage (.35) or the senility stage (.42). This procedure, therefore, identifies the textile industry (that is the aggregate of all firms) as being in the adolescence stage of the industry life cycle. Whenever autocorrelation was indicated to be present in these regressions and those presented throughout this paper, the problem was corrected by employing the Cochrane and Orcutt Interactive Least Squares Method as discussed in Murphy (1973: 314-316).

(Place Table 1 Here)

The above procedure identifies the life cycle stage the shoe industry is actually in but it does not establish whether or not all firms within the industry are in the same stage of the life cycle. The strategic group concept, in conjunction with the procedure discussed above, was used to generate further useful information in an attempt to answer this question.

Porter divided each industry in his sample into two parts, which he designated as leaders and followers and the relative size of a firm in its industry was used as a proxy for its strategic group membership (Porter 1979: 220). Firms in the textile industry were divided into two categories, leaders and followers, according to Porter's method of identifying strategic groups. Leaders were defined as the largest firms in the industry (accounting for approximately 30 percent of industry revenue); remaining firms constituted the follower group. Data from each subset of firms were summed to obtain the two strategic groups of the industry. The three life cycle investment equations were then run for each strategic group in the industry.

The same investment life cycle stage equation would best explain the investment behavior of both strategic groups, only if the two strategic groups are in the same stage of the life cycle. However, the conclusion would be that the two strategic groups are in two different stages of the industry life cycle if one life cycle equation best explains one strategic group's investment behavior and another explains the investment of the other strategic group.

Equations (2), (3), (5), (6), (8) and (9) in Table 1, present the results of the strategic groups multiple regressions for the textile industry, using the (30 percent-70 percent) designation presented by Porter (1979: 214-227). Equation (2) is the best equation for the leading firms, with $\overline{R}^2$ of .855. This indicates that the leading firms in the textile industry reflect investment behavior characteristic of the adolescence stage of the industry life cycle. The following firms, however, reflect investment behavior characteristic of the maturity stage; $\overline{R}^2$ for the following firms was .374. These results reveal that when Porter's strategic group designation is used, leaders and followers are not in the same stage of the life cycle. Consequently, their investment strategies are different. Moreover, they probably differ in several other important respects as suggested in the life cycle research such as James (1974), Sasser et. al. (1978), and Boulding (1962).

Moreover, the results also show that all strategic groups are not in the same stage of the <u>industry</u> life cycle. In this industry, the leader strategic group is in the adolescence stage as is the industry; yet, the follower group is in the maturity stage.

Porter (1979: 220) refers to his 30 percent-70 percent strategic group designation as arbitrary. Indeed, as McGee (1983) points out, a number of <u>possible</u> methods exist for determining strategic groups within an industry.

The appropriate designation of strategic groups is actually beyond the purposes of this research. The objectives here were to determine whether alternative strategic group designations would yield different statistical results and to tentatively determine whether the methods applied here could also be used for establishing appropriate strategic group designations in future research.

Toward accomplishing the major purpose of this research, assume the alternative strategic group designation suggested in Primeaux (1983); instead of Porter's 30-70 percent size designations, three strategic groups may exist, and the appropriate breakdowns should be, say, one strategic group accounting for 20 percent of sales, another accounting for 30 percent and another accounting for 50 percent.

Table 2 presents the life cycle equations for the 20-30-50 percent alternative strategic group designation for the textile industry. This assessment requires a comparison of equations (2) and (3) of Table 1, with (1), (2), and (3) of Table 2; a comparison of (5) and (6) of Table 1 with (4), (5), and (6) of Table 2; and a comparison of (8) and (9) of Table 1 with (7), (8), and (9) of Table 2. From the alternatives in the two tables, equations (3) and (6) of Table 1 are the best. In this instance, the results of Porter's designation surpass those of the suggested alternatives. The 20-30-50 percent strategic group designation does not provide regression results which are as good. However, the alternative designation does yield superior results for the petroleum industry which is discussed below.

(Place Table 2 Here)

Petroleum Industry

The same methods and procedures used to develop equations for the textile industry were also used to develop equations for the petroleum industry.

Primeaux (1983) has previously examined the petroleum industry using Porter's method of strategic group determination, and presented statistical results identical to that in Table 3. He reached the following conclusions for the petroleum industry as a whole:

> The results show that equation (1), representing the adolescence stage of the industry life cycle seems to best fit the industry data. That is, according to $\overline{R}^2$, the adolescence equation explains a greater percentage of change in net investment for the whole petroleum industry (.79) than either the maturity stage (.25) or the senility stage (.31).

(Place Table 3 Here)

Table 3, equations (1), (4), and (7) support the above statement; the petroleum industry seems to be in the absolescence stage of the industry life cycle ($\overline{R}^2$ = .79).

The strategic group designation developed by Porter, however, does not fare as well as the alternative designation for the petroleum industry. Primeaux (1983), using Porter's strategic group designation, identified the leading firms as being in the senility stage of the life cycle (Table 3, $\overline{R}^2$ = .43) and the follower as being in the adolescence stage (Table 3, $\overline{R}^2$ = .81). Table 4, however, reveals that Porter's strategic group designation (in Table 3) for the petroleum industry does not seem to be as effective as the Primeaux alternative.

(Place Table 4 Here)

The alternative strategic group designation, using 20 percent, 30 percent and 50 percent, identifies the top 20 percent group as being in the maturity stage ($\overline{R}^2$ = .78); the next 30 percent group as being in the adolescence stage ($\overline{R}^2$ = .95); and the remaining 50 percent group as also being in the adolescence stage ($\overline{R}^2$ = .46). These results are clearly superior to those developed with Porter's strategic group designation. These results, along with those developed for the textile industry, confirm two important facts. First, Porter's designation is, indeed, arbitrary as he suggested. That his, his 30-70 percent strategic group designation is not appropriate in every circumstance. Second, it is very likely true that different industries require a different strategic group designation. While Porter's designation is superior for the textile industry, it was clearly inferior for the petroleum industry. This does not claim that the alternative procedure provides the most appropriate strategic group designation; however, it does demonstrate how the statistical technique presented here can be used in future research to select the appropriate strategic group designation from among several reasonable alternatives.

CONCLUSIONS

This study shows that there is substantial interdependence between the strategic group and the life cycle concepts. Indeed, it actually seems impossible to discuss one without considering the other; these results seem to show that future research should deal jointly with these ideas.

The life cycle concept cannot be ignored; yet, it seems crucial that the concept be applied to strategic groups within an industry, rather than to an industry as a whole. The results show that, in the textile and petroleum industries, different strategic groups are in different stages of the life cycle. The analyses also show that the life cycle of an industry differs from the life cycles of the strategic groups within an industry. These findings do not diminish the value of the industry life cycle concept. Instead, they suggest that it is important to also consider strategic group life cycles whenever life cycles are discussed.

The strategic group concept is firmly entrenched in the strategic management literature. Yet, past research has not determined the most appropriate approach for determining strategic group membership. The results of this study shows that alternative strategic group designations yield significantly different results. The implications of these findings for future research are rather clear. It is crucial that future research be concentrated on methods of strategic group membership determination to enhance the value and integrity of future strategic management studies.

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APPENDIX

EXPLANATION OF VARIABLES USED IN REGRESSION MODELS

I_t^N is net investment deflated by q (in millions of dollars).

X is operating revenue deflated by q (in millions of dollars).

K is capital stock deflated by q (in millions of dollars).

π^* is net operating income before depreciation deflated by q (in millions of dollars).

π^{**} is total net income deflated by q (in millions of dollars).

$\frac{\pi^*}{K}$ in (1) is given in percentage rates.

r_{t-1} the interest rate proxy variable is the real corporate bond rate, lagged 1 year. Specifically, the industrial average was used for the industry equations; the triple A (AAA) rate was used for the leading firms; and the double A (AA) rate was used for the following firms.

t the R & D proxy. A time trend (1 for the first time period, n in the final time period.

q is the price deflator. (The implicit price deflator for producers durable equipment.) From the Economic Report of the President.

APPENDIX A

THEORY-LIFE CYCLE INVESTMENT

The following theoretical discussion of a three stage life cycle is an adaptation from the industry analyses presented in Kmenta and Williamson (1966: 175-177). These discussions draw heavily from their work and explain how the three life cycle stages differ from one another as well as the firm investment behavior characteristic of each stage. The industry and firm behavior, reflected in each stage, are discussed simultaneously. The theory presented here is the basis of the multiple regression models which are developed in the text of the paper.

Adolescent Stage

In the adolescent stage, entry of firms into the industry is relatively frequent. New investment is undertaken by firms already in the industry and in part from firms entering the industry for the first time. The "old" firms operate with a given quantity of fixed capital constructed in the past in anticipation of future long-run demands. Existing capital stock within the industry "...might be considered optimal for a given anticipated demand for output, which may include a certain degree of planned excess capacity." (Kmenta and Williamson 1966: 175). If the demand for the product or service increases, capacity will be inadequate to satisfy consumer needs. Provided excess capacity exists, absolute levels of profits and profit rates will increase. If a firm is already operating at full capacity, higher per unit cost must be incurred to satisfy increases in demand. Higher prices will then result, or firm profits will cease to grow or even begin to decline. The firm may attempt to charge higher prices and/or expand fixed capital by increasing investment. Increases in price are less likely to be made in theory. (This action comes from a strategy of attempting to restrict competition.) "Old" firms may not wait until all excess capacity is eliminated; instead, they may undertake new investment as capacity utilization increases and full capacity is approached. The investment decision of firms already in the industry will probably be based on the relationship "...of the existing stock of capital to that which would be optimal under prevailing output conditions." (Kmenta and Williamson 1966: 175).

One underlying assumption is essential to the above theory. This assumes that firms believe the increases in demand to be permanent; without this expectation, there would not be any rational basis for enlarging capital stock on the basis of past increases in demand.

Research and development, of course, can be an important force affecting investment decisions within a firm. This effect is largely caused by the cost reducing effects of certain types of investments. This effect, of course, is not even. Kmenta and Williamson (1966: 176) found this effect to be unimportant in the railroad industry, however, it would probably be significant in most other industries.

The rate of interest, of course, affects investment decisions in most businesses. Firms must weigh the cost of anticipated additional investment against the expected rewards from that investment; interest costs cannot be ignored in this type of decision.

For the industry as a whole, investment is carried out both by firms already in the industry as well as new firms entering. New firms obviously face a greater risk element. "The firmest basis for estimates of future returns on capital is the profit experience of the existing firms. New firms will be induced to enter if the existing firms are exhibiting high profit rates, and especially if profits are showing an upward trend...because of the time needed for decision-making, capital raising and construction, a two-year lag is likely to be most appropriate." (Kmenta and Williamson 1966: 176). The two types of investment behavior, discussed above, can be combined into a single model of the adolescence stage of the industry life cycle.

$$(1)\quad I_t^N = a_0 + a_1X_{t-2} - a_2K_{t-2} + a_3(\pi^*/K)_{t-2} + a_4(\pi^*_{t-1} - \pi^*_{t-2}) + a_5r_{t-1} + a_6t + \hat{U}_t$$

where I_t^N = net investment

X = operating revenue

K = capital stock at the end of each period

π^* = net operating income after depreciation

r_{t-1} = interest rate proxy variable

t = R & D proxy variable

The constant term, a_0, provides for the existence of autonomous investment.

Maturity Stage

This stage of the industry life cycle "...is characterized by consolidation of the existing firms since there is now very little room for opening up of new territories, and thus only a limited opportunity for new entries." (Kmenta and Williamson 1966: 177).

In the maturity stage, significant reorganization takes place within the industry because of the new pattern of market distribution, mergers occur "...at a peak rate, and profits run at a relatively high and secularly stable level." "Old" firms within the industry still undertake new investment, if their existing capacity is inadequate. Disinvestment may take place if significant excess capacity exists. New entries are rare in this phase of the life cycle, "...the profit variables are less likely to be relevant." (Kmenta and Williamson 1966: 177). The investment function for the second stage (its middle age) of the industry's life cycle is:

$$(2) \quad I_t^N = a_0 + a_1X_{t-2} - a_3K_{t-2} + a_4r_{t-1} + a_5t + \hat{U}_t$$

The variables in equation (2) are defined as in equation (1).

Senility Stage

This stage is one of slow growth or even decline as substitutes are developed or consumers lose interest in the products produced within the industry. Some firms leave the industry; net investment is motivated by technological changes. In this stage growth is not the main concern, it is survival. External sources of funds become more difficult to obtain; moreover, firms are disinclined to go to capital markets for financing for fear of losing control. Profits are plowed back into the business to enhance survival possibilities and internal financing is of much importance in this stage of the life cycle.

Because of the overall conditions existing in this stage of the life cycle, changes in output and profitability "...are largely irrelevant for investment decisions because they have very little relation to the long-run prospects of the industry." (Kmenta and Williamson 1966: 177).

> The financial situation of firms will now become relevant since the firm's earning level is the major source of finance. The level of past profits thus assumes a new role. Instead of being an indicator of future profitability, profits now become an indicator of the availability of funds. (Kmenta and Williamson 1966: 177).

The investment function for the third stage of the industry's life cycle is:

$$(3) \quad I_t^N = a_0 + a_1K_{t-1} + a_3\pi^{**}_{t-1} + a_4r_{t-1} + a_5t + \hat{U}_t$$

The variables common to equation (1) are as defined in that equation; and π^{**} is net income (including non operating income). This modification was made in the third stage model because income from all sources is relevant when availability of finance becomes crucial. The lag is changed from two years to one year because in this stage there is probably a decline in the importance of investment of longer gestation and the investment planning horizon is probably shortened to the fullest extent possible.

TABLE 1

TEXTILE INDUSTRY

ADOLESCENCE STAGE

	a_0	a_1	a_2	a_3	a_4	a_5	a_6	$\bar{R}^2$	DW	DF
Industry (1)	335.12	-0.069	0.093	469.94	0.266	6.053	5.911	0.800	1.979	10
	(232.61)*	(0.058)	(0.129)	(353.27)	(0.101)*	(4.293)*	(6.857)			
(Leader) (2)	218.07	-0.093	0.145	90.318	0.333	3.306	2.372	0.855	2.347	10
	(175.08)	(0.068)	(0.133)	(275.26)	(0.111)***	(2.915)	(5.165)			
(Follower) (3)	17.973	-0.009	-0.017	258.94	0.269	0.368	0.208	0.298	2.063	11
	(78.195)	(0.075)	(0.194)	(169.26)*	(0.141)**	(2.963)	(3.794)			

MATURITY STAGE

	a_0	a_1	a_2	a_3	a_4	$\bar{R}^2$	DW	DF
Industry (4)	211.43	-0.004	-0.051	12.025	-0.916	0.358	2.059	13
	(126.44)*	(0.061)	(0.136)	(6.834)*	(6.234)			
(Leader) (5)	218.78	-0.128	0.200	6.199	3.326	0.738	1.993	12
	(59.721)***	(0.063)**	(0.128)*	(3.227)**	(3.057)			
(Follower) (6)	190.97	-0.008	-0.139	-0.094	-0.215	0.374	2.042	12
	(71.485)**	(0.044)	(0.106)	(0.279)	(2.307)			

SENILITY STAGE

	a_0	a_1	a_2	a_3	a_4	$\bar{R}^2$	DW	DF
Industry (7)	171.89	-0.118	0.374	13.423	-1.836	0.423	1.950	13
	(88.337)**	(0.068)*	(0.238)*	(52.188)**	(2.687)			
(Leader) (8)	93.737	-0.078	0.260	11.003	-1.434	0.457	1.983	13
	(69.825)	(0.094)	(0.270)	(3.731)***	(1.865)			
(Follower) (9)	61.628	-0.159	0.543	1.288	-0.470	0.364	1.999	13
	(39.750)	(0.056)***	(0.182)***	(2.311)	(1.335)			

Standard error in parentheses
***Significant at 1 percent level; **significant at 5 percent level; *significant at 10 percent level.

TABLE 2

TEXTILE INDUSTRY

ADOLESCENCE STAGE

	a_0	a_1	a_2	a_3	a_4	a_5	a_6	$\bar{R}^2$	DW	DF
(Top 20%) (1)	-107.03	-0.073	0.038	487.15	0.537	7.506	5.186	0.590	2.049	10
	(224.80)	(0.159)	(0.275)	(334.58)*	(0.318)*	(6.106)	(11.517)			
(Next 30%) (2)	157.39	0.045	-0.153	302.04	0.330	3.790	3.049	0.638	2.086	10
	(96.301)*	(0.098)	(0.243)	(183.97)*	(0.124)**	(2.497)*	(1.483)**			
(Remaining) (3)	50.208	-0.079	0.147	289.67	0.312	-0.719	2.760	0.351	2.062	11
	(69.740)	(0.073)	(0.170)	(128.59)**	(0.175)*	(2.512)	(3.260)			

MATURITY STAGE

	a_0	a_1	a_2	a_3	a_4	$\bar{R}^2$	DW	DF
(Top 20%) (4)	52.722	0.074	-0.156	11.352	-4.649	0.294	2.071	13
	(79.217)	(0.110)	(0.210)	(4.668)**	(6.757)			
(Next 30%) (5)	59.044	0.064	-0.274	2.837	0.192	0.205	1.986	12
	(87.493)	(0.067)	(0.156)*	(3.557)	(1.801)			
(Remaining (6)	183.68	-0.048	-0.054	-0.334	1.372	0.381	2.072	12
	(59.203)***	(0.050)	(0.111)	(2.385)	(2.351)			

SENILITY STAGE

	a_0	a_1	a_2	a_3	a_4	$\bar{R}^2$	DW	DF
(Top 20%) (7)	39.767	-0.157	0.479	10.023	-0.613	0.280	2.087	14
	(75.911)	(0.170)	(0.349)*	(4.223)**	(2.243)			
(Next 30%) (8)	28.203	-0.202	0.790	1.235	0.550	0.319	1.966	13
	(38.803)	(0.075)***	(0.256)***	(2.409)	(1.396)			
(Remaining) (9)	41.806	-0.151	0.059	1.604	-0.717	0.319	2.004	13
	(35.094)	(0.060)**	(0.228)**	(2.144)	(1.281)			

Standard error in parentheses
***Significant at 1 percent level; **significant at 5 percent level; *significant at 10 percent level.

TABLE 3

PETROLEUM INDUSTRY

ADOLESCENCE STAGE

	a_0	a_1	a_2	a_3	a_4	a_5	a_6	$\bar{R}^2$	DW	DF
Industry (1)	5875.2	0.126	-0.163	-22454.	0.056	57.497	121.71	0.795	1.964	10
	(5332.4)	(0.041)***	(0.167)	(16050.)	(0.129)	(284.36)	(662.34)			
(Leader) (2)	1053.2	0.041	0.004	-4833.6	-0.128	-38.947	49.786	0.316	2.117	11
	(4566.9)	(0.084)	(0.334)	(4840.9)	(0.149)	(135.51)	(411.95)			
(Follower) (3)	6828.7	0.176	-0.398	-28422.0	0.145	6.912	423.16	0.810	2.018	10
	(3085.7)**	(0.047)***	(0.151)**	(17082.0)*	(0.170)	(221.03)	(402.84)			

MATURITY STAGE

	a_0	a_1	a_2	a_3	a_4	$\bar{R}^2$	DW	DF
Industry (4)	-290.67	0.047	-0.014	307.37	355.14	0.251	2.002	12
	(1545.9)	(0.037)	(0.179)	(159.80)**	(714.94)			
(Leader) (5)	-254.25	0.040	0.041	57.734	-24.734	0.356	2.088	13
	(3886.3)	(0.061)	(0.285)	(100.85)	(327.75)			
(Follower) (6)	-991.36	-0.034	-0.222	159.09	1671.0	0.230	2.017	12
	(1257.0)	(0.044)	(0.174)	(120.76)	(811.13)**			

SENILITY STAGE

	a_0	a_1	a_2	a_3	a_4	$\bar{R}^2$	DW	DF
Industry (7)	-5.742	-0.112	0.120	275.28	936.01	0.314	1.954	13
	(1711.8)	(0.200)	(0.250)	(161.01)*	(475.21)**			
(Leader) (8)	2719.0	-0.199	0.154	64.288	215.19	0.436	2.031	13
	(1638.5)*	(0.165)	(0.382)	(75.792)	(87.747)**			
(Follower) (9)	-4544.0	-0.180	0.303	263.41	45732.	0.189	1.790	13
	(5699.0)	(0.174)	(0.231)	(104.47)**	(56536.)			

Standard error in parentheses
***Significant at 1 percent level; **significant at 5 percent level; *significant at 10 percent level.

TABLE 4

PETROLEUM INDUSTRY

ADOLESCENCE STAGE

	a_0	a_1	a_2	a_3	a_4	a_5	a_6	$\bar{R}^2$	DW	DF
(Top 20%) (1)	-4033.0	0.095	0.447	-1938.8	-0.127	-17.636	-226.58	0.762	2.005	11
	(3417.0)	(0.035)***	(0.343)	(2138.2)	(0.095)	(81.001)	(206.19)			
(Next 30%) (2)	14154.0	0.018	-0.782	-10515.0	0.028	-98.368	604.45	0.950	2.296	10
	(2104.6)***	(0.027)	(0.105)***	(2371.8)***	(0.090)	(70.788)*	(98.227)***			
(Remaining) (3)	472.73	0.090	-0.116	10419.0	0.582	196.50	-42.047	0.469	2.034	10
	(5256.8)	(0.106)	(0.368)	(34446.0)	(0.462)	(262.63)	(825.69)			

MATURITY STAGE

	a_0	a_1	a_2	a_3	a_4	$\bar{R}^2$	DW	DF
(Top 20%) (4)	-5038.7	0.095	0.442	32.798	-255.90	0.782	2.035	12
	(3211.8)*	(0.034)***	(0.292)*	(43.784)	(177.13)*			
(Next 30%) (5)	2897.5	0.041	-0.471	225.87	342.44	0.751	1.976	12
	(1783.3)*	(0.050)	(0.177)**	(80.751)***	(173.46)**			
(Remaining) (6)	-389.97	-0.050	-0.282	31.506	1257.7	0.028	1.991	12
	(1169.30)	(0.054)	(0.244)	(105.67)	(725.65)*			

SENILITY STAGE

	a_0	a_1	a_2	a_3	a_4	$\bar{R}^2$	DW	DF
(Top 20%) (7)	3163.9	-0.568	0.156	46.272	372.67	0.492	1.864	13
	(2415.7)	(0.525)	(0.612)	(107.84)	(204.95)**			
(Next 30%) (8)	623.79	-0.373	0.267	216.05	378.37	0.252	2.018	13
	(973.57)	(0.231)*	(0.363)	(104.38)**	(143.79)**			
(Remaining) (9)	-1520.7	-0.409	0.743	192.62	2074.7	0.220	1.891	13
	(3794.3)	(0.217)**	(0.332)**	(84.570)**	(3409.7)			

Standard error in parentheses
***Significant at 1 percent level; **significant at 5 percent level; *significant at 10 percent level.