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CHAPTER 7

The Directions of Diversification

THIS section of the study explores the nature of the industries which firms enter when they diversify. It was reported earlier that diversifying firms enter some industries far more frequently than others. The discussion that follows examines which of the wide array of economic characteristics that distinguish one industry from another have a decisive role in attracting entrants.

First, several hypotheses are tested, using one explanatory variable at a time and data for number of product additions in each 4-digit industry. Second, they are tested using multiple regression analysis and data for frequency of additions in each 2-digit industry. Third, the hypotheses are re-examined, once again using multiple regression analysis, on the basis of aggregative data which show the proportion of total employment in each industry[1] contributed by firms whose primary activities are outside the industry. A final section of the chapter concerns the effects of diversification on changes in the composition of leading firms in the entered industries.

Summary

The manufacturing product additions of the 111-firm sample, when classified by 4-digit industry, were heavily concentrated in industries characterized by rapid growth, high increases in labor productivity, and a high ratio of technical[2] to all employees (hereafter referred to as the "technical personnel ratio"). For reasons given in this chapter, the latter two variables are rough indicators of the rate of technological change. The industries chosen for entry were not characterized by high cyclical stability in sales—a conclusion that raises doubt about the importance of short-run stability as a factor in diversification decisions. In choosing activities for diversification, the 111 companies showed no tendency to avoid industries in which the average investment per firm, as measured by average plant and firm size, was high. Thus relatively large capital requirements apparently were not a critical barrier to entry.

Analysis of additions by 2-digit industry showed that the number of products added was strongly correlated with the technical personnel ratio. Indeed, when the technical personnel ratio was used as an explanatory factor, additional variables contributed little toward explaining the

[1] The level of industry detail was the modified 3-digit level described in Chapter 2.

[2] In the data used, technical employees consisted of engineers, chemists, and surveyors.

variance in frequency of product additions. The results were substantially the same for each of the three periods examined, 1929–39, 1939–50, and 1950–54.

Employment in an industry contributed by firms whose primary activities are outside the industry is defined in this study as "external" employment. It measures approximately the volume of activity contributed by firms that have diversified into an industry. The ratio of external to total employment, therefore, indicates the attractiveness of an industry as a diversification outlet. This variable was also strongly correlated with the technical personnel ratio. In this respect the results based on data for frequency of product additions are confirmed.

In the 1929–39 interval, the 111-firm sample added 158 manufacturing products that, by 1954, were primary to at least one plant. Of these 158 additions, 60 led to the inclusion of the companies in the class of eight largest producers in 1954 in the industries in which the products were added. Of a similar list of 218 product additions in the 1939–54 period, 56 led to the inclusion of the companies in the group of eight largest producers in 1954. A substantial percentage of both the 60 and the 56 instances fell in industries in which the eight largest firms accounted for a relatively large fraction of total shipments. In these industries, a new entrant which captures enough of the market to become a leading producer will, in the process, materially affect competitive relations among sellers. Consequently, diversification has probably altered significantly the competitive position of firms in a number of industries.

Analytical Framework

A firm can be expected to undertake new activities rather than grow within the scope of its existing product structure if the former alternative promises a higher prospective return. The prospective return on investment (whether for diversification or for homogeneous growth) is, in turn, generally a function of growth in demand and technological change, for without these forces net investment would tend to reduce the prevailing rate of return. Another purpose of diversification may be that of reducing the variability of earnings—an objective best served by entering cyclically stable industries. Cyclical stability can thus affect the attractiveness of an industry as a diversification outlet. The role of the above influences on diversification, as well as that of possible barriers to entry, is examined more fully below.

Diversification, except insofar as it is achieved by shifting existing resources from one use to another, is a form of growth. Growth may be sought because it leads to greater earnings, or as an end in itself (an objective which could stem from the personal ambitions of managers to direct large enterprises). Both purposes, however, are best served by entering a rapidly growing industry; one, because rapid growth permits an earlier attainment of large size, and the other, because an industry characterized by rapid growth in demand, and hence in output, is one which may normally be expected to show a higher profit rate than that for the economy as a whole. Indeed, the relatively higher profit rate provides an inducement to capital formation which, in turn, generates growth in output. In consequence, the growth rate of an industry should be positively correlated with the frequency with which firms diversify into it.

Another variable that indirectly affects expectations of earnings from diversification is the rate at which technology changes. First, industries with rapidly changing technologies are likely to be growing rapidly. Second, some time will normally elapse between the introduction of new products or lower-cost production processes and the adjustment of supply, and hence price, to the new conditions—a circumstance that leads to higher than average profit rates. Third, when technology changes rapidly there will tend to be significant modifications of existing products. This leads to a greater variety of products within an industry and thus to a larger number of specialized submarkets in which competition, at least initially, is likely to be less intense than in the broader markets. Fourth, a rapidly changing technology generally affords greater opportunity for a new firm to overcome the competitive disadvantage of later entry and thereby to encroach upon the market of an older firm in the industry. A changing technology generates either new and superior products or lower-cost productive processes, but in either case, the innovator in the industry may be an established firm or a new entrant. Assuming, however, that random forces partly influence which firm will discover a new process or product, it is unlikely that the innovator will always be the established firm. To the extent an entering firm succeeds in adopting new products or production processes earlier than the older firms in the industry, it experiences a competitive advantage it would not have with a stable technology. In short, industries with rapidly changing technologies offer strong inducements to entry in the form of opportunities for gains to innovating firms.

Technological change does not lend itself readily to direct measurement. An indirect measure consists of the ratio of technical to all employees to be found in an industry (the technical personnel ratio). Although a substantial proportion of technical employees perform routine administrative functions, and most are not engaged in research and development, the number so engaged is likely to vary with the total number employed. It seems highly plausible that the rate at which technology changes is related to the volume of resources employed in producing the change. Conversely, the number of technical employees engaged in an industry is likely to reflect opportunities for technological change as determined by advances in the underlying sciences. A more intensive use of technical staffs frequently results from a more rapid development in the sciences that have direct application to an industry, even when such developments are generated outside the industry.

Another measure of technological change is the rate of change in labor productivity. Labor productivity indexes are related to a broad range of technological factors and reflect both changes in total unit costs and the substitution of capital for labor. From the standpoint of measures relevant for our hypothesis, they suffer from the defect that they are not designed to gauge technological change which takes the form of new and improved products.

Another frequently offered reason for diversification is the desire to stabilize earnings and sales. Since a wide range of random influences affects the sales and earnings from particular products, increases in the number of industries in which a company operates will, by diversifying risks, tend to reduce the chance of sharp declines in total company earnings arising from unpredictable changes in the economy. However, cyclical as distinct from random sources of instability lend themselves to prediction. Thus a mere increase in the number of activities without reference to their cyclical patterns is not an effective method of reducing cyclical instability. Indeed, for firms in industries with a relatively stable demand, the addition of a product for which demand is volatile may serve to destabilize total earnings and sales.

The addition of products even in cyclically unstable industries may stabilize aggregate sales for the company if the timing of peaks and troughs in demand for the newly added products tends to offset fluctuations in the older ones of the firm. To an extent, this advantage of diversification is present even for randomly selected products since diverse industries are unlikely to have perfectly synchronous peaks and troughs. A systematic selection of industries for offsetting fluctuations is, however, usually an unpromising course to follow, as the sequence of expansions and contractions in demand for particular industries is usually not sufficiently stable for this purpose. A far more effective indicator of the contribution of a new product to cyclical stability is the amplitude and frequency of fluctuations in its demand. Therefore, if cyclical considerations were decisive in diversification decisions, one would expect to find relatively high frequencies of entry in the cyclically stable industries.

Direct information on economies of scale is not, at present, available for most industries. Accordingly, two indirect measures—average size of plant and average size of firm in the industry—were used. Assuming both the presence of competition and gradual, as distinct from drastic, changes in technology, an industry with a larger average size of plant or firm is one which will normally be associated with a larger optimum size. This follows from competitive pressures to adjust the size of a plant or a firm to its most efficient scale.[3] Thus, in the long run, a tendency will exist for the most efficient size of plant or firm to expand in relative importance in its industry and for average size to change in the direction of optimum size. These relationships, of course, are likely to exist only as broad tendencies. Competitive forces may be restricted or technological change too rapid to allow time for adjustment of average to optimum size. The analysis presumes, however, that a strong positive relation exists between the two for a large majority of industries.

An industry which is associated with large economies of scale with respect to firm or plant size is commonly regarded as having high barriers to entry. These barriers result from the high capital requirements needed by the new entrant to compete successfully with other firms. Moreover, if large economies of scale are present, an important segment of the total market may have to be captured to enable operations at an efficient level of output. Rapid growth in demand, however, makes it easier to achieve a sufficient output without significant encroachment upon the markets of the older firms in the industry, thus reducing the importance of the barrier.

The industry characteristics which serve as barriers to entry for most firms may actually prove to be inducements to entry for some. Barriers to entry resulting from large capital requirements may, by reducing the number of actual and potential rivals, reduce the intensity of competition for firms which can raise capital on favorable terms. Hence high economies of scale in an industry may operate as inducements to entry for large firms.

The proportion of total sales accounted for by the leading producers in an industry is sometimes regarded as an indicator of barriers to entry. Once again, however, the implicit barriers may be more severe for small than for large firms. The role of leading producers in an industry was

[3] By efficiency, any advantage associated with scale is meant, whether related to marketing, financing, production, and so on.

measured by the proportion of industry shipments contributed by the four largest producers (the concentration ratio).

How does technical propinquity between primary industries and those into which firms diversify affect the directions of diversification? Earlier in the study, two types of technical propinquity were distinguished. Type 1 referred primarily to similar products or production processes and generally characterized activities within the same 2-digit industry categories.[4] Type 2 referred to similarities in the nonphysical resources employed—that is, similarities in managerial and technical skills. The two types of propinquity, however, frequently overlap in that the presence of Type 1 renders the presence of Type 2 more likely.

Obviously, when faced with a choice among activities that would be equally attractive if they were technologically equidistant from the primary one, a firm will usually undertake those for which technical propinquity to the primary activity is greatest. First, when prospective new products are similar to those already produced, the managers are far more likely to be aware of the attractiveness of such products as diversification outlets. Second, the managers' prior experience should give the firm an advantage in the new activities over firms in other sectors of the economy. Third, when old and new products are technologically related, existing plant, equipment, and personnel may be sufficient to produce the new ones. As an aspect of this, firms may wish to diversify in order to utilize excess capacity. Even entry in a declining industry can prove attractive if it makes possible the use of excess capacity or raw materials otherwise wasted. It is not surprising, therefore, that a substantial percentage of product additions made by the companies in our sample were characterized by Type 1 propinquity to the primary activities of the firms. In Chapter 3, it was shown that product additions falling within the primary 2-digit industries of the 111 companies contributed, depending upon the period selected for study, from 32 to 43 per cent of all manufacturing additions made by these companies.

The fact that technical propinquity was present in a large proportion of product additions does not, however, mean that it was decisive in determining the industries entered by diversifying firms. Except for joint products or by-products, where incremental cost approaches zero, no firm would choose to diversify simply because technological relations were present between its primary activity and others that could be initiated.

[4] Two-digit categories are, however, fairly broad, so that activities within the same categories often are only loosely related technologically. Conversely, Type 1 propinquity sometimes crosses 2-digit boundaries.

Indeed, all industries are adjacent to the primary activities of some firms, yet the frequency with which they serve as diversification outlets has been shown to differ markedly. Conversely, the primary activities of diversifying firms are technologically related to a vast range of products, yet these firms undertake to produce only a small fraction of this range. Clearly, influences other than technical propinquity must be at work. In this connection, the economic characteristics (e.g., growth, technological change) of the entered 4-digit industries were substantially the same whether or not they fell in the 2-digit categories of the firms' primary activities (that is, whether or not they were closely related in technology to the primary activities).[5] Thus it appears that technical propinquity did not materially affect the character of the industries chosen for diversification. The existence of technological relations between primary activities and those into which firms diversify reflects rather the role of technical propinquity in determining *which* firms diversify. Firms with primary operations technologically related to the industries that are intrinsically attractive as diversification outlets tend to diversify more than other firms in the economy. This is confirmed by evidence presented in Chapter 8.

Data and Methods

Analysis of the character of changes in product composition was based primarily on the record of additions and abandonments of products in the 1929–54 period. This part of our study was restricted to manufacturing activities. Added and abandoned products were classified into industries and measures for these industries were developed for the several variables discussed in the summary section of this chapter.[6] Table 40 indicates the periods for which estimates were made of the variables used to analyze product additions and abandonments in 1929–39, 1939–50, and 1950–54.

A priori, it seems plausible that the relation between frequencies of additions and the character of industries is multivariate. Hence multiple regression analysis is especially suited to the problem. The characteristics of data at the 4-digit level, however, did not permit this approach. Because of limitations of sample size, the frequencies of additions were too thin at the 4-digit level of detail to yield reliable estimates of the distribution of additions by 4-digit industry for the universe of firms.

For this reason, regression analysis with frequency of product additions

[5] As shown in the tables that follow, activities outside primary 2-digit industries displayed the same characteristics as all product additions, including those within the primary 2-digit groups.

[6] Sources and methods used in estimating the explanatory variables are indicated in Appendix D.

TABLE 40

PERIODS FOR WHICH ESTIMATES OF EXPLANATORY VARIABLES WERE DEVELOPED

Variable	Used with Product Changes in: 1929–39	1939–50	1950–54
Growth[a]	1929–39	1939–54	1939–54
Productivity change	1929–37	1937–53	1937–53
Cyclical variability (amplitude)	1923–41	1947–55	1947–55
Technical personnel ratio	1930	1940	1950
Concentration ratio	[b]	1947	1947
Size of plant	1935	1947	1947
Size of firm[c]	—	1947	1947
Cyclical variability (frequency of turning points)	1923–41	1923–41	1923–41

[a] Data on growth at the two-digit level of industry detail were for the periods 1929–37 and 1937–53.

[b] For the 1929–39 period, 1947 ratios were again used as the primary source of information. However, in some instances, 1935 ratios were used for those industries for which 1935 data had been reconciled to a 1947 Standard Industrial Classification Code basis.

[c] At the 2-digit level of detail, firm size was measured on the basis of total assets for the years 1938 and 1948, the former year being used to study product changes in 1929–39 and the latter in 1939–50 and 1950–54.

as the dependent variable was carried out only for nineteen manufacturing industries at the 2-digit level of detail. Use of 2-digit data has the disadvantage that measures for the relevant explanatory variables do not accurately represent the characteristics of specific activities in which individual product additions fall. The problem increases as the degree of industry detail is reduced. On the other hand, use of 2-digit data largely eliminates another difficulty present in 4-digit data, namely, that at the latter level frequencies of product additions are sometimes nonindependent. That is, entry into one 4-digit industry increases the likelihood of entry in adjacent industries. This problem is far smaller for data at the 2-digit level.

The discussion first deals with the relation between frequencies of additions and other variables, taken one at a time, at the higher level of detail. It then proceeds with multiple regression analysis at the 2-digit level. In the first part of the analysis, each industry for which data on explanatory variables were available was classified by deciles, based on the value for the industry of each variable.[7] This permitted the computation of frequencies with which our sample of companies added or

[7] The industries that were so classified were not restricted to those in which our sample of companies added or deleted products, but also included those for which the frequency of additions or abandonments was zero.

abandoned products in each decile and for each of the variables.[8] Information for frequencies of additions and abandonments on the basis of these deciles is presented in Appendix Table E–1. To simplify the analysis, the data were then compressed into three classes.[9] Thus, in each period, the frequencies in deciles 1 through 3, 4 through 7, and 8 through 10 were summed to form three classes for each variable; expected frequencies on the null hypothesis were then computed for the three classes.[10] Actual frequencies were compared with expected frequencies. The analysis was carried out on two bases: first for all product additions, and second for all additions outside the primary 2-digit industries of the companies. Generally, the results developed on the basis of three classes show substantially the same patterns of product additions as those indicated on the basis of deciles.

The median values of the explanatory variables differed markedly among the three classes of industries (lower 30 per cent, middle 40 per cent, and upper 30 per cent) for all the variables and in each period (with the possible exception of growth in 1929–39). Thus absence of differences among frequencies of additions in the three classes could not be attributed to an absence of significant variations in the explanatory variables. The range of variation in these variables can be readily derived from the tables in Appendix D and from other tables to which reference is made in this appendix.

Product Additions and Characteristics of Industries: 4-Digit Industry Data

Patterns of product additions with respect to individual variables were examined at the 4-digit level of detail. Since a number of the explanatory variables are interrelated, one cannot assess, on the basis of the analysis that follows, the net contribution of a given variable toward explaining the variance in frequencies of product additions. Nevertheless, the association of frequency of product additions with individual variables is of considerable interest. For example, a conclusion that firms diversify largely into high-growth industries suggests that the process of diversification, by increasing the supply of resources in rapidly growing industries, con-

[8] Since information was not available for all of the industries in which companies added or deleted products, for each variable a limited but differing set of industries had to be left out of the analysis.

[9] Since the data were originally prepared on the basis of deciles, it was not possible, for example, to use quartiles without extensive recomputation.

[10] The null hypothesis assumes that the likelihood of a product being added is unrelated to the explanatory variables.

tributes to the latter's growth. If entry is frequent in industries characterized by high concentration ratios, diversification may be an important source of potential competition in these industries. A conclusion that companies diversify into cyclically stable industries would suggest that diversification generally reduces cyclical instability in the total sales of companies. All these inferences are not affected by the presence of correlation between the several variables used to analyze product additions. For this reason, analysis with one variable at a time contributes to our understanding of the consequences of diversification. Moreover, should the results point to absence of relationship between product additions and particular variables, one would normally be justified in concluding that the latter do not exert a strong influence on diversification.

Tables 41 through 48 show for each of three periods the frequency with which product additions (first for all manufacturing additions, and second for all those that were outside the primary 2-digit industries) fell within each of three classes on the basis of the relevant variables. The tables show theoretical frequencies based on the null hypothesis and, also, the corresponding chi-squares.[11]

As Table 41 indicates, the frequency of additions in the highest growth class (Class III) was in all three periods greatly in excess of that which could be expected in the absence of association between growth and entry. Both Class I and Class II, covering the lower 70 per cent of industries as measured by growth, showed frequencies of additions considerably smaller than those expected on the null hypothesis. The results were essentially similar, and only moderately less striking, when product additions outside the primary 2-digit industries were examined. Consequently, the high concentration of product additions in high-growth industries cannot be explained by the growth rate of activities technologically adjacent to the companies' primary activities. The pattern is somewhat more pronounced in the two post-1939 periods as compared with the pre-1939 period, particularly for additions outside the primary 2-digit industries. In short, growth, while significantly related to product additions in all three periods, was less closely related to the latter during the 1930's. Taking all additions and combining the three periods under analysis, 602 additions fell in the top 30 per cent of industries in terms of growth, while only 433 fell in the lower 70 per cent.

In the analysis two measures of technological change were used. In-

[11] Theoretical frequencies were computed by multiplying total actual frequencies of additions for our sample of companies by the proportion of all industries that fall into each of the three classes. (E.g., 30 per cent would be expected to fall in a class consisting of three deciles.)

TABLE 41

Relation of Frequency of Product Additions to Industry Growth

Industry class[b]	Aggregate Additions: Frequencies: Actual	Aggregate Additions: Frequencies: Theoretical	Aggregate Additions: Chi-square[c]	Additions in Nonprimary Industry Group[a]: Frequencies: Actual	Additions in Nonprimary Industry Group[a]: Frequencies: Theoretical	Additions in Nonprimary Industry Group[a]: Chi-square[c]
			1929–39			
I	56	104.1		36	54.9	
II	112	138.8		72	73.2	
III	179	104.1		75	54.9	
			81.291			13.886
Total	347			183		
			1939–50			
I	41	109.5		25	67.5	
II	100	146.0		51	90.0	
III	224	109.5		149	67.5	
			177.073			142.063
Total	365			225		
			1950–54			
I	28	96.9		23	60.3	
II	96	129.2		51	80.2	
III	199	96.9		127	60.3	
			165.101			107.483
Total	323			201		

Source: Described in text.

[a] Outside of primary 2-digit group of company.

[b] Class I comprises deciles 1–3, Class II deciles 4–7, and Class III deciles 8–10 on the basis of growth. Class III represents highest growth.

[c] All chi-squares are significant at .01 level.

dustries were classified, first, by the ratio of technical to all employees; second, by the change in labor productivity indexes. Tables 42 and 43 reveal a strong relation between the frequency with which products were added in particular industries and both of these variables. However, while the technical personnel ratio was positively related to the frequency of product additions in all three periods, labor productivity showed a strong positive relation only in the two post-1939 periods, the 1929–39 interval showing some concentration of frequencies around the center rather than at the extremes with respect to the measure of change in productivity.[12] Product additions outside the primary 2-digit industries reveal

[12] However, when only product additions that could be classified according to productivity change at the 3- or 4-digit level were considered (that is, when information that was only available at the 2-digit level was ignored), the concentration of frequencies in the highest productivity-change class showed up markedly for the 1929–39 period. On this basis, the pattern for 1939–50 showed a more strongly positive relation than that indicated in Table 43.

TABLE 42

RELATION OF FREQUENCY OF PRODUCT ADDITIONS TO TECHNICAL PERSONNEL RATIO

INDUSTRY CLASS[b]	AGGREGATE ADDITIONS *Frequencies* Actual	Theoretical	Chi-square[c]	ADDITIONS IN NONPRIMARY INDUSTRY GROUP[a] *Frequencies* Actual	Theoretical	Chi-square[c]
			1929–39			
I	31	142.5		20	80.4	
II	159	190.0		105	107.2	
III	285	142.5		143	80.4	
			234.801			94.161
Total	475			268		
			1939–50			
I	34	133.5		25	85.2	
II	121	178.0		75	113.6	
III	290	133.5		184	85.2	
			275.874			170.223
Total	445			284		
			1950–54			
I	41	120.3		36	79.5	
II	105	160.4		63	106.0	
III	255	120.3		166	79.5	
			86.489			135.361
Total	401			265		

SOURCE: Described in text.

[a] Nonprimary group of company.

[b] Class I comprises deciles 1–3, Class II deciles 4–7, and Class III deciles 8–10 on the basis of the technical personnel ratio. Class III comprises the highest ratios.

[c] All chi-squares are significant at .01 level.

similar patterns to those for all additions, though, on the whole, in a slightly less accentuated form. For all additions and with the three periods combined, the upper 30 per cent of industries in terms of the technical personnel ratio accounted for 830 cases, compared with 491 for the lower 70 per cent of industries. For the aggregate of product additions in the two post-1939 periods, the upper 30 per cent of industries in terms of increase in labor productivity accounted for almost as many cases as the lower 70 per cent (the counts being respectively 402 and 448).

Two aspects are germane to measuring the degree of cyclical stability: first, how frequently does the movement of sales change direction over time; and second, when a change in direction occurs, how sharp is the consequent rise or fall? The frequency of cyclical fluctuations was measured by the number of changes in direction in annual-output indexes for particular commodities. The amplitude of cyclical fluctuations was

TABLE 43

RELATION OF FREQUENCY OF PRODUCT ADDITIONS TO PRODUCTIVITY CHANGE

	AGGREGATE ADDITIONS			ADDITIONS IN NONPRIMARY INDUSTRY GROUP[a]		
	Frequencies			Frequencies		
INDUSTRY CLASS[b]	Actual	Theoretical	Chi-square[c]	Actual	Theoretical	Chi-square[c]
			1929–39			
I	80	141.9		42	80.4	
II	281	189.2		183	107.2	
III	112	141.9		43	80.4	
			77.843			89.335
Total	473			268		
			1939–50			
I	71	135.3		50	86.1	
II	166	180.4		106	114.8	
III	214	135.3		131	86.1	
			77.484			39.226
Total	451			287		
			1950–54			
I	55	119.7		33	79.2	
II	156	159.6		113	105.6	
III	188	119.7		118	79.2	
			74.023			46.477
Total	399			264		

SOURCE: Described in text.

[a] Nonprimary group of company.

[b] Class I comprises deciles 1–3, Class II deciles 4–7, and Class III deciles 8–10 on the basis of productivity change. Class III is the class of highest productivity change.

[c] All chi-squares are significant at .01 level.

measured by averaging trough-to-peak and peak-to-trough changes in the above indexes.

With respect to number of cyclical turning points, the record in all three periods for total product additions shows greater frequencies than expected on the null hypothesis in the lowest class of industries (Table 44).[13] The frequencies in Class III (the class with the highest number of turning points) are consistently less than would be expected in the absence of association between entry and the number of cyclical turning points. This pattern is somewhat more pronounced for the 1929–39 period than for the two later periods. Product additions outside the primary 2-digit industries reveal a similar pattern. However, for these additions, deviations of actual from expected frequencies were significant at the .01 level only for the

[13] As indicated in the table, the data were segregated into three classes with absolute class limits rather than into deciles compressed subsequently into three classes. It was not possible to use deciles for this variable because of the large number of tied ranks on the basis of number of turning points.

TABLE 44
RELATION OF FREQUENCY OF PRODUCT ADDITIONS TO NUMBER OF TURNING POINTS IN OUTPUT

INDUSTRY CLASS[b]	AGGREGATE ADDITIONS *Frequencies* Actual	Theoretical	Chi-square	ADDITIONS IN NONPRIMARY INDUSTRY GROUP[a] *Frequencies* Actual	Theoretical	Chi-square
			1929–39			
I	189	114.9		63	52.6	
II	189	174.8		110	80.0	
III	13	101.3		6	46.4	
			125.909[c]			48.482[c]
Total	391			179		
			1939–50			
I	181	148.7		98	96.8	
II	180	180.7		135	117.6	
III	83	114.6		56	74.6	
			15.732[c]			7.226[d]
Total	444			289		
			1950–54			
I	169	134.3		102	89.4	
II	142	163.2		100	108.7	
III	90	103.5		65	68.9	
			13.481[c]			2.693[e]
Total	401			267		

SOURCE: Described in text.
[a] Nonprimary industry group of company.
[b] Three classes were selected with absolute class limits. Class III comprises industries with the largest number of turning points.
[c] Significant at the .01 level.
[d] Significant at the .05 level.
[e] Not significant at the .05 level.

first of the three periods, and at the .05 level for the first two but not for the third period. Absence of statistically significant results for the 1950–54 period for product additions in the nonprimary industry categories casts some doubt on the relation between the variables. However, a stronger relation for 1929–39 than for the two later periods has, perhaps, a plausible explanation. Because of the severity of the depression of the early 1930's, greater concern about cyclical stability in selecting industries for diversification would not be surprising in that period. Direct evidence on conscious motives of company managers, however, was not available.

The absence of convincing evidence that industries were systematically selected for diversification with a view to their cyclical stability is most sharply reflected in the analysis of association of additions with amplitude of cyclical fluctuations. Unlike the measure of frequency of turning points, that of cyclical amplitude was at least partially adjusted so as to eliminate the effects of trend. The results show deviations of actual frequencies of product additions from those expected on the null hypothesis that were significant at the .01 level in all three periods, both for all product additions and for those outside primary 2-digit industries (Table 45). The results, however, in all instances reveal a high concentration in the middle four deciles, with substantially smaller frequencies of entry in the deciles at both of the extremes. This would appear to suggest that cyclical stability was not a dominant consideration in the selection of industries for diversification; for if it were, the low-amplitude industries would hardly have been avoided.

The measure of the relative role of large firms in an industry (the "concentration ratio") was based on the ratio of the shipments of the four leading producers in each industry to total industry shipments. The pattern of product additions after 1939 did not deviate with respect

TABLE 45
Relation of Frequency of Product Additions to Cyclical Amplitude

Industry Class[b]	Aggregate Additions: Frequencies: Actual	Theoretical	Chi-square[c]	Additions in Nonprimary Industry Group[a]: Frequencies: Actual	Theoretical	Chi-square[c]
			1929–39			
I	47	116.7		2	49.5	
II	296	155.6		159	66.0	
III	46	116.7		4	49.5	
			211.146			218.449
Total	389			165		
			1939–50			
I	81	132.0		36	84.3	
II	240	176.0		169	112.4	
III	119	132.0		76	84.3	
			44.257			56.992
Total	440			281		
			1950–54			
I	59	117.9		30	79.5	
II	224	157.2		170	106.0	
III	110	117.9		65	79.5	
			49.858			72.107
Total	393			265		

Source: Described in text.
[a] Nonprimary industry group of company.
[b] Class I comprises deciles 1–3, Class II deciles 4–7, and Class III deciles 8–10 on the basis of cyclical amplitude. Class III is the class of highest cyclical amplitudes.
[c] All chi-squares are significant at .01 level.

to this variable from one that could be expected on the null hypothesis (Table 46). In the 1929–39 period, however, frequencies for nonprimary and for all additions deviated significantly from those expected on the null hypothesis. The deviations pointed to lower-than-expected frequencies in the lowest class with respect to the concentration ratio. The most important fact is that in all three periods frequencies of additions were not significantly lower than those expected in the class of industries with high concentration. This appears to show that the forces which produced high concentration were not severe obstacles to entry for our sample of firms. Three factors contribute to explaining these results. First, some of the more concentrated industries are in new and rapidly growing sectors of the economy, and thus offer better than average opportunities for investment. (Older industries tend to have lower concentration ratios.) Second, barriers to entry that stem from large capital requirements may—by

TABLE 46
RELATION OF FREQUENCY OF PRODUCT ADDITIONS TO CONCENTRATION RATIOS

INDUSTRY CLASS[b]	AGGREGATE ADDITIONS Frequencies Actual	Theoretical	Chi-square[c]	ADDITIONS IN NONPRIMARY INDUSTRY GROUP[a] Frequencies Actual	Theoretical	Chi-square[c]
			1929–39			
I	128	155.7		54	87.7	
II	187	155.7		109	87.7	
III	152	155.7		100	87.7	
			11.308			19.848
Total	467			263		
			1939–50			
I	116	134.7		76	86.1	
II	210	179.6		123	114.8	
III	123	134.7		88	86.1	
			8.758			1.813
Total	449			287		
			1950–54			
I	115	117.0		73	78.0	
II	175	156.0		115	104.0	
III	100	117.0		72	78.0	
			4.818			1.944
Total	390			260		

SOURCE: Described in text.
[a] Nonprimary industry group of company.
[b] For 1929–39, each class comprised a third of all industries. For 1939–50 and 1950–54, Class I comprises deciles 1–3, Class II deciles 4–7, and Class III deciles 8–10 on the basis of concentration ratios. Class III is the class of highest concentration ratios.
[c] Only the chi-squares for the 1929–39 period are significant at .01 level.

reducing entry of smaller firms (and hence competition)—contribute to inducing rather than restricting entry on the part of large firms. Third, a number of product additions were achieved through merger and thus were not subject to the usual barriers to entry.

For the next variable, average plant size,[14] Table 47 indicates a distinct concentration of frequencies in the high, as compared with the low, plant-size industries. The tendency toward more frequent product additions in industries associated with larger plants seemed more accentuated in the 1939–50 and 1950–54 periods than in 1929–39.

The conclusions with respect to firm size were essentially similar. As Table 48 shows, industries in the lower 30 per cent with respect to firm

TABLE 47

Relation of Frequency of Product Additions to Plant Size

Industry Class[b]	Aggregate Additions: Frequencies: Actual	Aggregate Additions: Frequencies: Theoretical	Aggregate Additions: Chi-square[c]	Additions in Nonprimary Industry Group[a]: Frequencies: Actual	Additions in Nonprimary Industry Group[a]: Frequencies: Theoretical	Additions in Nonprimary Industry Group[a]: Chi-square[c]
			1929–39			
I	67	120.3		33	65.4	
II	147	160.4		92	87.2	
III	187	120.3		93	65.4	
			61.716			27.963
Total	401			218		
			1939–50			
I	49	95.1		24	61.2	
II	96	126.8		76	81.6	
III	172	95.1		104	61.2	
			92.046			52.928
Total	317			204		
			1950–54			
I	31	80.1		19	51.6	
II	79	106.8		52	68.8	
III	157	80.1		101	51.6	
			111.161			71.992
Total	267			172		

Source: Described in text.

[a] Nonprimary industry group of company.

[b] Class I comprises deciles 1–3, Class II deciles 4–7, and Class III deciles 8–10 on the basis of plant size. Class III is the class of highest plant size.

[c] All chi-squares are significant at .01 level.

[14] It seems likely that in some industries a large number of low-efficiency small plants exist. These plants either serve a local demand where competing firms are not present or survive because of other special circumstances. To improve our measure of differences in optimum plant size, plants with fewer than twenty employees were excluded in computing averages.

TABLE 48
RELATION OF FREQUENCY OF PRODUCT ADDITIONS TO FIRM SIZE

INDUSTRY CLASS[b]	AGGREGATE ADDITIONS *Frequencies* Actual	Theoretical	Chi-square[c]	ADDITIONS IN NONPRIMARY INDUSTRY GROUP[a] *Frequencies* Actual	Theoretical	Chi-square[c]
			1939–50			
I	52	119.7		34	72.9	
II	175	159.6		108	97.2	
III	172	119.7		101	72.9	
			62.627			32.788
Total	399			243		
			1950–54			
I	46	106.8		32	66.9	
II	151	142.4		98	89.2	
III	159	106.8		93	66.9	
			60.645			29.256
Total	356			223		

NOTE: Information on firm size for 1929–39 was not available.
SOURCE: Described in text.
[a] Nonprimary industry group of company.
[b] Class I comprises deciles 1–3, Class II deciles 4–7, and Class III deciles 8–10 on the basis of firm size. Class III is the class of highest firm size.
[c] All chi-squares are significant at .01 level.

size were associated with relatively lower frequencies of product additions in both 1939–50 and 1950–54. Thus, it would seem, high capital requirements did not generate insurmountable barriers to entry for our sample of companies. However, because of the possible effect of other variables which may be correlated with plant and firm size, one cannot say that the latter exerted a positive influence on entry.

The analysis thus far in this chapter has been concerned with the nature of product changes irrespective of the importance of the change to the company in question. It is possible that different considerations apply to decisions to add new products on a large scale relative to total company size from those that are important in minor undertakings. For example, since the risks attached to investments that are large relative to total firm size are considerably greater than those for small undertakings, a more conservative policy may be followed for the former. This conservatism could be reflected in avoidance of very new industries which, though they may currently be growing more rapidly, have a less certain future than the older, more established ones. On the other hand, entry on a fairly large scale may prove difficult in the absence of rapid growth or technological change because of the obstacles to encroaching on the markets of existing producers. In the absence of rapid growth in the entered industry, entry on a large scale may necessitate capturing a significant share of the market of existing producers—a process that is frequently costly.

Information on the relation of growth to the selection of industries for the larger ventures was secured from a special census tabulation. This tabulation brought together all manufacturing plants under common ownership in 1947 and 1954 for our sample of 111 companies. By using 1954 information on plants in conjunction with our record of product additions in the 1939–54 period, it was possible to segregate the larger from the smaller ventures. If the industry appeared in the 1954 Census plant record for a company, and the product record indicated that the industry had been initially entered in the 1939–54 period, the importance of the new activities in 1954 could be measured by taking the ratio of payrolls in the indicated industry to total manufacturing payrolls for the company. In this way the ninety largest product additions (largest as a percentage of manufacturing payrolls for the individual companies) were isolated. Each of the ninety additions accounted in 1954 for at least 2 per cent of manufacturing payrolls of the companies that made the additions.[15]

Table 49 shows the high relative frequencies with which the ninety industries fell in the upper deciles with respect to growth and the technical personnel ratio.[16] The concentration was particularly high in the tenth or highest decile, which accounted for one-half of the industries classified on the basis of the technical personnel ratio and more than one-fourth on the basis of growth. The results for the two variables are substantially similar to the previously reported pattern for all product additions without reference to relative scale of new activities. There seems little doubt that most product additions, irrespective of scale of output, fell into rapidly growing and new industries.

Product Additions and Characteristics of Industries: 2-Digit Industry Data

Table 50 gives the simple correlation coefficients for the relation between frequency of product additions in nineteen industry categories and each

[15] The ninety cases represented *all* 1939–54 additions which, on the basis of establishment data, accounted for at least 2 per cent of manufacturing payrolls in 1954.

[16] The classification of the ninety industries according to deciles with respect to each variable was based on their relative position in the ordered list for *all* industries for which information could be secured. Thus, considerably more than one-tenth of the ninety industries could fall in a single decile, while none might fall in other deciles.

TABLE 49
DISTRIBUTION OF 90 INDUSTRIES ENTERED BY 111 COMPANIES, 1939–54, ACCORDING TO GROWTH AND TECHNICAL PERSONNEL RATIO

Deciles on Basis of 4-Digit Industry Growth, 1939–54	Number of 4-Digit Industries	Deciles on Basis of Technical Personnel Ratio, 1950	Number of 4-Digit Industries
1	1	1	2
2	7	2	10
3	3	3	3
4	1	4	2
5	4	5	4
6	3	6	5
7	12	7	7
8	17	8	4
9	16	9	7
10	26	10	46

NOTE: The plants of each of the industries accounted for at least 2 per cent of manufacturing payrolls in 1954 for the relevant companies. Decile 10 represents highest growth and technical personnel ratio.

SOURCE: U.S. Bureau of the Census, special census tabulation, and product record described in Chapter 2.

of five variables.[17] As may be judged from the table, in each of the three periods studied, the coefficient was highest for the relation between the dependent variable and the technical personnel ratio, being .708, .610, and .664 for the 1929–39, 1939–50, and 1950–54 periods, respectively.[18]

Table 51 shows the multiple correlation coefficients for the relation between frequency of total product additions and various combinations of independent variables. As the table indicates, the highest coefficients were those for equations in which the technical personnel ratio was an independent variable. The addition of a second and third variable to the technical personnel ratio contributed negligibly toward explaining the variance in frequency of product additions, and thus did not improve the predictive power of the hypothesis.

[17] The table also shows the coefficients for the relations between the explanatory variables. Data for cyclical amplitude, frequency of turning points, and the concentration ratio were not developed at the 2-digit level. Data at the 2-digit level were also not available for the 1929–39 period for the plant-size variable. For two of the twenty-one 2-digit industries, measures for some explanatory variables were not available. The analysis was, therefore, restricted to nineteen industries.

[18] The regression equations, with X_1 standing for the number of product additions and X_2 for the technical personnel ratio (in units of number of technical employees per 10,000 of all employees), were as follows:

$$1929\text{–}39:\quad X_1 = 11.2996 + \underset{(.0206)}{.1346}\, X_2$$

$$1939\text{–}50:\quad X_1 = 7.2520 + \underset{(.0326)}{.1101}\, X_2$$

$$1950\text{–}54:\quad X_1 = 5.2442 + \underset{(.0041)}{.0775}\, X_2$$

TABLE 50
SIMPLE CORRELATION COEFFICIENTS FOR FREQUENCY OF PRODUCT ADDITIONS AND FIVE INDUSTRY VARIABLES

	1950–54[a]		*1939–50*[a]		*1929–39*[a]	
Variables	All Products	Nonprimary Products	All Products	Nonprimary Products	All Products	Nonprimary Products
1.2	.608	(.564)	(.583)	(.532)	.303	.103
1.3	.664	(.581)	.610	(.549)	.708	.452
1.4	.450	.420	(.488)	.442	–.104	–.150
1.5	–.138	–.186	–.146	–.169	–.161[b]	–.190[b]
1.6	.179	.086	.047	–.013	[c]	[c]
2.3	.698		.711		.409	
2.4	(.569)		[d]		.672	
2.5	–.157		[d]		.254[b]	
2.6	.422		[d]		[c]	
3.6	.362		.343		[c]	
3.4	.400		.425		.035	
4.5	–.055		[d]		.134[b]	

NOTE: The variables are denoted by the numbers 1–6 as follows: frequency of product additions (1), growth (2), technical personnel ratio (3), productivity change (4), firm size (5), plant size (6). Coefficients significant at the .01 level are underlined and those at the .05 level are in parentheses. The coefficients shown for nonprimary products are for data that exclude product additions in the 2-digit industry group of the company from the count of product additions.

[a] The number of observations is 19 in all cases except as indicated in note b.

[b] Results based on seventeen observations.

[c] Data on plant size not available.

[d] Same data used as for 1950–54.

It is possible that, because of technical propinquity, additions that fall in the primary 2-digit industry class of a company are not independent of the latter's primary activity. Entry in these industries may be partly affected by technical propinquity as distinct from the intrinsic attractiveness of the industries as diversification outlets. To free the results from the possible effects of this interdependence, Tables 50 and 51 also show correlation coefficients computed with such additions excluded. Generally, however, the correlations reveal substantially the same pattern whether primary industry product additions are included or excluded. The technical personnel ratio is strongly associated with frequencies of additions on both bases, though the coefficients are somewhat lower with primary industry additions excluded.

A possible bias in the data arises from the fact that the number of 4-digit industries varied among the 2-digit groups. Since additions within 2-digit categories were counted at the 4-digit level of detail, a category with more 4-digit subdivisions would, other things being equal, tend to show a

TABLE 51
MULTIPLE CORRELATION COEFFICIENTS FOR FREQUENCY OF PRODUCT ADDITIONS AND COMBINATIONS OF INDUSTRY VARIABLES

	1950–54[a]		*1939–50*[a]		*1929–39*[a]	
Variables	All Products	Nonprimary Products	All Products	Nonprimary Products	All Products	Nonprimary Products
1.23	.694	(.622)	(.646)	(.585)	.709	.460
1.24	(.621)	(.577)	(.613)	.558	.514	.031
1.25	(.609)	(.569)	(.586)	.539	.452[b]	.396[b]
1.26	(.614)	(.588)	(.623)	(.587)	c	c
1.34	.694	(.616)	(.661)	(.595)	.718	.481
1.36	.667	(.596)	(.634)	(.589)	c	c
1.234	(.705)	(.656)	(.671)	.607	.737	.483
1.245	(.623)	.582	.616	.566	.605[b]	.476[b]
1.236	(.705)	(.654)	(.689)	.589	c	c

NOTE: The variables are denoted by the numbers 1–6 as follows: frequency of product additions (1), growth (2), technical personnel ratio (3), productivity change (4), firm size (5), plant size (6). Coefficients significant at the .01 level are underlined and those at the .05 level are in parentheses. The coefficients shown for nonprimary products are for data that exclude product additions in the 2-digit industry group of the company from the count of product additions.

[a] Based on nineteen observations except as indicated in note b.

[b] Based on seventeen observations.

[c] Data on plant size not available.

larger number of additions. However, the strategic role of the technical personnel ratio is confirmed by the data used in the next section of this chapter. These data are not subject to the indicated bias.

Factors Related to the Magnitude of External Employment

External employment in an industry is that part of total employment contributed by firms external to it. That is, it represents employment in establishments classified in the industry but owned by companies whose primary activities are in other sectors of the economy. A larger external employment usually indicates more diversification *into* the industry. Exceptions, however, arise because companies sometimes shift the locus of their primary operations. Under these circumstances, high external employment will be associated with an industry out of which companies have moved rather than one into which they are moving. High external employment may also result from integration rather than diversification, the most notable examples of this being petroleum refining and crude petroleum extraction. For most industries, however, external employment is likely to measure the attractiveness of the industry as a diversification outlet.

TABLE 52
CLASS FREQUENCIES FOR THE RATIO OF EXTERNAL TO TOTAL EMPLOYMENT, 119 INDUSTRIES, 1954

Trade and Services External as Percentage of Total Employment	Number of Industries	*Manufacturing and Mining* External as Percentage of Total Employment	Number of Industries
0– 2.5	11	0– 5.0	11
2.6– 5.0	9	5.1–10.0	22
5.1–10.0	9	10.1–15.0	13
Over 10.0	5	15.1–20.0	13
Total	34	20.1–25.0	9
		25.1–30.0	6
		Over 30.0	11
		Total	85

SOURCE: Based on *Company Statistics*, Table 2.

In most industries external employment did not constitute a large percentage of total employment (Table 52).[19] There were, however, substantial differences between industries. In manufacturing and mining, the ratios of external to total employment were substantially higher than in trade and services. In fifty-two of eighty-five manufacturing and mining industries, external employment exceeded 10 per cent of total employment, as compared with only five of thirty-four trade and service industries.

Of the total of 119 industries, 105 showed a higher ratio of external to all activities combined on the basis of data for employment than on the basis of data for number of establishments (without reference to the size of the latter).[20] This clearly shows that in most industries, establishments associated with external employment were larger than average for their industries. Since the size of establishments is positively correlated with company size, the above result suggests that large companies contributed relatively more to external than to total employment.

Table 53, based on data restricted to manufacturing industries, shows the simple correlation coefficients for the ratio of external to total employment and each of five variables. It also shows the multiple correlation

[19] External employment was measured at a modified 3-digit level based on data in *Company Statistics: 1954 Censuses of Business, Manufacturing, Mineral Industries*, U.S. Bureau of the Census, Washington, 1958, Table 2. Since employment that crosses product boundaries within the 3-digit categories is not classified as external, industries that are broader than average in the scope of products they contain will have ratios of external to total employment subject, from this source, to a downward bias. This offsets an upward bias that arises from the fact that the larger the number of markets a 3-digit category contains, the greater is the chance of entry from firms in other sectors.
[20] *Ibid.*

coefficients for the ratio and various combinations of the five variables. The only simple correlation coefficient found to be statistically significant was that for the external to total employment ratio and the technical personnel ratio ($r = .608$).[21] All equations in which the latter ratio was one of two or more independent variables generated statistically significant multiple correlation coefficients. However, the contribution of a second, or a second and third, independent variable toward explaining the variance in the ratio of external to total employment proved negligible. In this respect, the results confirmed those based on frequency of product additions.

A limitation of the data for the ratio of external to total employment was that it pertained to a single point in time. External employment may have been generated in a period anteceding that for which the explanatory variables were measured. Since differences between industries in the

TABLE 53
RATIO OF EXTERNAL TO TOTAL EMPLOYMENT IN RELATION TO FIVE VARIABLES

Simple Correlation Coefficients		Multiple Correlation Coefficients	
1.2	.171[a]	1.23	$\underline{.619}$[a]
1.3	$\underline{.608}$[b]	1.24	.172[a]
1.4	.051[a]	1.36	$\underline{.617}$[b]
1.5	.113[b]	1.35	$\underline{.610}$[b]
1.6	.120[b]	1.56	.144[b]
		1.356	$\underline{.621}$[b]
		1.234	$\underline{.623}$[a]

NOTE: The variables are denoted by the numbers 1–6 as follows: the ratio of external to total employment (1), (2) growth, 1939–53; (3) technical personnel ratio for 1950; (4) productivity change, 1929–53; (5) plant size, 1947; (6) concentration ratio, 1947. Coefficients underlined were significant at the .01 level. The number of observations depended upon the number of industries for which measures of the several explanatory variables were available. These measures were available only for manufacturing industries.

[a] Based on fifty-six observations.

[b] Based on fifty-seven observations.

[21] The equation was $X_1 = 6.0193 + \underset{(.0081)}{.0494}\, X_2$, with $X_1 = 100 \left(\frac{\text{external}}{\text{total employment}}\right)$ and $X_2 = 1950$ technical personnel ratio (in units of number of technical employees per 10,000 of all employees). The widest deviations of observed values from those estimated on the basis of the above equation were for primary metals and petroleum—industries in which external employment was largely a consequence of integration rather than diversification.

technical personnel ratio are likely to be more stable over time than differences in growth, the problem is more serious when the latter is used in the analysis. The relation between the external employment ratio and other variables—for example, change in labor productivity—may also have been obscured. However, it is likely that the volume of external employment undergoes continuous adjustment in response to changes in the relevant variables. This has the effect of reducing the aforementioned limitation of the data.

The Relation of Product Additions to Industry Size

To what extent do differences in the size of industries affect our results? If, for example, industries with a high technical personnel ratio are, in some sense, larger than those with a low one, might not this explain the greater frequency of product additions in the former? An industry that is larger in terms of total output might be entered more frequently for at least two reasons. First, total demand may be growing by larger absolute increments (even when the *rate* of growth is slower); second, the absolute volume of turnover in the population of firms in the industry may be greater. (Assuming only random influences, more firms will be going out of existence in a larger industry, thus creating a larger absolute number of opportunities for new entrants.) There is reason to believe, however, that our results were not materially affected by differences in industry size. Industries characterized by rapid growth and technological change are likely to be newer and, hence, smaller than average. Since these are the industries in which product additions were most frequent, the bias, if any, was in an opposite direction from the observed relations and hence cannot explain the latter. Also, while it is possible that the *absolute* number of additions will be greater in a larger industry, there is no reason to expect that the *relative* magnitude of activities contributed by diversifying firms (as measured, for example, by the ratio of external to total employment) will be larger. It has already been shown that results based on the ratio of external to total employment generally confirm those based on frequency of product additions.

The size of an industry can also be defined in terms of the number of products it contains, with products identified on the basis of a more detailed classification system than that used for industries. In our data, however, the number of recorded product additions is likely to vary with the number of separate markets in which additions could have been made, but not with the number of subclassifications of markets. It is only the former that affects the likelihood an industry will be entered. It will be recalled that several product additions falling within the same 4-digit industry were counted as a single addition precisely to avoid a possible bias arising from differences in the number of 7-digit product classes that 4-digit industries contained. However, even if the extreme assumption were made that the likelihood of entry in an industry is proportional to the number of 7-digit product classes it contains, our results with respect to the two variables, growth and the technical personnel ratio, would not be materially altered. Although industries in the upper deciles with respect to these variables tend to have more 7-digit products, the frequency of additions in industries with high growth and a high technical personnel ratio was, as compared with other industries, far more than proportional to the number of 7-digit products the former contained.

Abandonments of Products

The pattern of product abandonments with respect to the various factors examined was somewhat puzzling in that it tended to be similar to that for product additions. The pattern was, however, considerably less distinct for the former. Similarities between the two have been explained by the fact that an activity cannot be abandoned unless it is first entered into by a company. If, for example, industries associated with a high rate of technological change are entered more frequently, and if, further, some attempts at diversification fail, product abandonments would necessarily fall frequently into industries with rapidly changing technologies. Thus it is to be expected that the pattern of abandonments with respect to industry characteristics will, to a large degree, reproduce that for additions. Appendix Table E–1 indicates by deciles the character of product abandonments with respect to the same variables used to analyze additions.

Diversification and Changes in the Composition of Leading Firms

The discussion thus far has stressed the effect of industry characteristics on the directions of diversification. The effects are, however, to some extent reciprocal. Thus entry into a high-growth industry by large established firms probably increases the total supply of resources in the industry at the prevailing rate of return, and thus accelerates the industry's growth. In the post-1947 period a large number of research laboratories were started by companies in newly entered industries.[22] This probably had the effect of increasing the ratio of technical to all employees in the in-

[22] Based on information for company activities derived from public records.

dustries concerned. An effect on competitive relations within industries is likely to result from the frequently large diversification ventures in the more concentrated industries. Indeed, it may well be that in industries with higher than average concentration ratios, threat of entry from potential competitors arises primarily from large established firms in other sectors of the economy. The magnitude of this effect on competitive structures is somewhat difficult to assess. The available information did not permit us to segregate systematically those undertakings which resulted from the construction of new facilities, or the diversion to new uses of existing facilities, from entry achieved exclusively through merger. Mergers and property acquisitions, while they change ownership patterns, need not affect the underlying competitive structure.

In the discussion that follows, two questions are examined. First, in what proportion of the industries entered by the 111 large enterprises did entry lead to a change in the composition of the largest producers? Second, in what types of industries did these changes occur?

There were 218 manufacturing product additions in 1939–54 that were primary to at least one plant in 1954. Of these, fifty-six brought the companies making the additions into the class of leading eight producers in 1954 in the entered industries. Of a list of 158 additions in 1929–39 (once again restricted to those that were primary to at least one plant in 1954), sixty brought the companies into the class of eight leading producers in 1954. These facts point to two important conclusions. First, in a substantial majority of instances, entry on the part of even large firms into industries that are new to them does not result in a leading role in the industry for the entering firm. This apparently was true even after a lapse of roughly two decades following initial entry—a conclusion which is all the more significant since some entries were achieved through merger. Second, comparison of the 1929–39 and 1939–54 records does suggest that the passage of time increases the likelihood that a large company will appear among the leading producers in an industry it has entered. This is further reflected in the fact that, of the sixty additions in 1929–39 which brought companies into the class of largest eight producers, forty also brought the companies into the category of the largest four. On the other hand, of the fifty-six additions in 1939–54 which brought companies into the class of leading eight producers, only 25 also resulted in the companies' appearing among the leading four.

Table 54 shows that a large majority of industries entered in both 1929–39 and 1939–54, in which companies entered the class of leading four or eight producers, fell into the high deciles with respect to the concentration

TABLE 54

CONCENTRATION RATIOS FOR ENTERED INDUSTRIES IN WHICH ENTRANTS WERE LEADING PRODUCERS IN 1954

	Industries Entered, 1929–39, in Which Entrants Were Among:		*Industries Entered, 1939–54, in Which Entrants Were Among:*	
Deciles Based on 1947 Concentration Ratios[a]	Four Largest Producers in 1954[b]	Eight Largest Producers in 1954[b]	Four Largest Producers in 1954[b]	Eight Largest Producers in 1954[b]
1	2	1	0	1
2	1	1	2	0
3	1	2	1	1
4	4	3	2	5
5	7	3	1	3
6	2	5	1	5
7	6	9	6	8
8	5	4	5	7
9	8	10	3	9
10	4	22	4	17
Total	40	60	25	56

SOURCE: Special census tabulation and product record described in Chapter 2.

[a] Deciles in ascending order with respect to concentration ratio.

[b] The ranking of industries (and hence the deciles into which industries fall) when concentration ratios are computed for the leading eight firms differs from that when the ratios are computed for the leading four firms. This explains why in some deciles the frequencies shown for the largest four producers are greater than those for the largest eight.

ratio.[23] For example, of the sixty industries entered in 1929–39 in which companies were among the leading eight producers in 1954, thirty-two fell into the two top deciles with respect to the concentration ratio. For industries added in 1939–54, there were twenty-six in the two top deciles out of a total of fifty-six. To an extent, this stems from the greater likelihood that firms will emerge among the leading producers in newly entered industries if the latter are small. Size of industry, on the whole, tends to be inversely related to the concentration ratio. Thus new entrants are more likely to become leading producers in the relatively concentrated industries. Nevertheless, it is significant that diversification frequently alters the relative position of leading firms in the more concentrated industries.

Table 55 indicates that, for the period 1929–54, companies in the electrical machinery, food products, and rubber products industries were

[23] Deciles were determined on the basis of all industries for which data on concentration ratios were available. The frequencies in the various deciles (shown in Table 54) for groupings of industries based on the ratio for the leading four producers are not altogether comparable with the frequencies in the same deciles but with industry groupings based on the ratio for the leading eight. This stems from the fact that a given industry need not appear in the same decile on the basis of the two ratios.

TABLE 55

RELATION BETWEEN INDUSTRY OF COMPANY AND NUMBER OF PRODUCT ADDITIONS THAT BROUGHT ENTRANTS INTO THE CLASS OF LEADING EIGHT PRODUCERS IN 1954

Primary Industry of Company	Number of Companies	Number of Industries Entered, 1929–54[a]	Number in Which Companies Appeared Among the Leading Eight Producers in 1954
Food products	12	54	22
Tobacco manufactures	5	2	1
Textile mill products	4	11	4
Paper products	8	26	9
Chemicals	14	62	18
Petroleum	10	8	0
Rubber products	5	32	9
Stone, clay, and glass products	7	25	2
Primary metals	10	24	5
Fabricated metal products	5	22	3
Machinery	13	23	9
Electrical machinery	5	41	15
Transportation equipment	13	46	19
Total	111	376	116

SOURCE: Based on record of product changes described in text and on data from special census tabulation.

[a] Product additions which show at least one plant in the industry and for the company in question in the 1954 Census.

responsible for the highest average frequency of additions leading to the emergence of the firms among the largest eight. For the electrical machinery and rubber products companies, however, this reflects primarily the fact that frequencies of total additions per company were high.

We next examine the relation of frequency with which companies were brought into the leading four or eight producers to asset size of company. While these frequencies do not systematically vary with size of firm, they do seem higher in the upper size classes for both the 1929–39 and 1939–54 periods when expressed as a ratio to the total number of industries entered (Tables 56 and 57).[24]

Still another interesting question concerns the rate of growth of newly entered industries in which companies appeared among the leading eight firms in 1954. Generally, one might have expected to find that in older industries—those associated with slower growth—the market structure would be more stable. In the newer industries, on the other hand, the position of the leading firms would seem easier to upset. The more

[24] Counts of the total number of industries entered were restricted to additions that were primary to at least one plant in 1954.

TABLE 56

RELATION OF 1929 ASSET SIZE OF COMPANY TO NUMBER OF ENTERED INDUSTRIES IN WHICH COMPANIES APPEARED AMONG THE LEADING FOUR AND EIGHT PRODUCERS IN 1954

			Number of Cases in Which Four-Digit Industries Entered, 1929–39, Brought Company into Leading:			
1929 Asset Size[a] (million dollars)	Number of Companies	Total Number of 4-Digit Industries Added[b]	Four Companies in 1954	Percentage of All Industries Entered	Eight Companies in 1954	Percentage of All Industries Entered
Under 50	31	41	9	22.0	14	34.1
50 and under 125	27	33	5	15.2	10	30.3
125 and under 250	20	30	9	30.0	12	40.0
250 and under 500	13	25	9	36.0	15	60.0
500 and over	12	15	6	40.0	6	40.0

SOURCE: Based on record of product additions described in text and data from special census tabulation.

[a] Based on total assets as shown in Moody's *Industrials.*

[b] Industries entered in the 1929–39 period which appear in 1954 census establishment data for the relevant companies.

TABLE 57

RELATION OF 1939 ASSET SIZE OF COMPANY TO NUMBER OF ENTERED INDUSTRIES IN WHICH COMPANIES APPEARED AMONG THE LEADING FOUR AND EIGHT PRODUCERS IN 1954

			Number of Cases in Which Four-Digit Industries Entered, 1939–54, Brought Company into Leading:			
1939 Asset Size[a] (million dollars)	Number of Companies	Total Number of 4-Digit Industries Added[b]	Four Companies in 1954	Percentage of All Industries Entered	Eight Companies in 1954	Percentage of All Industries Entered
Under 50	29	89	8	9.0	21	23.6
50 and under 125	32	40	5	12.5	10	25.0
125 and under 250	25	53	6	11.3	12	22.6
250 and under 500	10	10	2	20.0	4	40.0
500 and over	13	24	4	16.7	9	37.5

SOURCE: Based on record of product additions described in text and data from special census tabulation.

[a] Based on total assets as shown in Moody's *Industrials.*

[b] Industries entered in the 1939–54 period which appear in 1954 census establishment data for the relevant companies.

rapidly an industry grows, the easier it is to supplant the position of the leading firm without having to capture an important part of the latter's market. Table 58 shows the industries in which the group of 111 companies entered the class of leading eight producers, distributed according to three classes (lower 30 per cent, middle 40 per cent, and upper 30 per cent of industries) on the basis of growth.[25] It appears that there is a concentration of frequencies in the upper 30 per cent in the 1939–54 period, but not in 1929–39.

An attempt was made to distinguish the characteristics of industries in which entering companies became leading producers from those of newly entered industries generally. Accordingly, to ascertain the special characteristics of industries in which our sample of companies became leading producers, we compared the frequency with which they appear in each growth class with comparable frequencies for *all* the industries entered by the 111 companies. The analysis entailed comparing actual frequencies in each of the three classes for the more restricted group of industries (those in which companies became the leading producers) with null hypothesis frequencies computed on the assumption that the distribution of these industries by growth class was the same as for all those entered.[26]

TABLE 58

ACTUAL AND NULL-HYPOTHESIS FREQUENCIES FOR INDUSTRIES IN WHICH COMPANIES WERE BROUGHT INTO THE CATEGORY OF LEADING EIGHT PRODUCERS IN 1954

	1929–39		*1939–54*	
Growth Class[a]	Number of Industries	Number Expected[b]	Number of Industries	Number Expected[b]
I (lower 30 per cent)	15	9.7	12	5.7
II (middle 40 per cent)	24	19.4	15	15.9
III (upper 30 per cent)	21	30.9	29	34.4

SOURCE: Product record described in Chapter 2 and special census tabulation.
[a] Based on a grouping of all industries for which growth information was available.
[b] Chi-squares: 1929–39, 7.159; 1939–54, 7.862.

[25] The classification into lower, middle, and upper growth classes was made on the basis of all industries for which information on growth was available.

[26] The formula was $E_j = T_a \times \frac{A_j}{A_t}$, where E_j stands for the null hypothesis frequency in a specified class j, T_a for the actual number of industries in which companies entered the category of leading eight producers, and A_j and A_t respectively, for the actual frequencies in class j and for those in all three classes combined for *all* industries entered by the 111 companies.

The test produced values of chi-square significant at the .05 level in both the 1929–39 and 1939–54 periods. However, the results were opposite to those suggested in the hypothesis. The data show higher-than-expected frequencies in the low-growth industries and lower-than-expected frequencies in high-growth industries. Thus industries in which firms were brought through diversification into the group of leading producers were not among the youngest industries entered by the 111 firms—at least if age is measured by rate of growth.