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CHAPTER 5
Integration

How much integration is there in the product structures of large enterprises? Within the universe of multiestablishment manufacturing firms, is size of firm related to integration? Does integration exert a positive influence upon diversification or do the two forms of growth represent competing demands on scarce resources, with the result that one tends to increase at the expense of the other? These and related questions are examined in the present chapter.

Summary

In 1954, employment associated with integration averaged 25.2 per cent of total employment for the sample of 111 large enterprises. In the same year, 21 per cent of the manufacturing activities in which the firms maintained one or more plants were classified as integration. One hundred and three of the companies maintained establishments in more than one manufacturing industry. For this group, the second largest activity in terms of payrolls could be classified as integration in roughly 23 per cent of the cases.

For the 111 firms, integration was positively related to size of firm, but only to a moderate degree. For a larger sample of 589 multiestablishment manufacturing firms,[1] integration could only be roughly approximated by the ratio of "value added" to shipments or sales. A higher ratio of value added to shipments generally signifies greater integration. The ratio of value added to shipments did not appear to be related to company size. This, therefore, tends to support the conclusion, reached on the basis of the 111-firm sample, that there is no strong positive relation between size of firm and integration.

There are indications that greater integration is achieved at the expense of diversification—that is, that the two tend to be primarily competing rather than mutually reinforcing forms of growth. In 1954, among the 111 firms, those that were characterized by greater integration generally seemed to have fewer diversifying activities.

Variations in the magnitude of administrative activities as firm size changes indicate the presence of administrative economies or diseconomies of scale. It is frequently alleged that the volume of administra-

[1] The 589 firms were drawn from the sample of 595 multiestablishment manufacturing companies which, in turn, were part of the 721 firm sample described in Chapter 2. For six of the 595 companies, information had to be suppressed.

tive activities rises more than proportionately to the size of an enterprise as size increases. The data, however, notwithstanding a statistical bias that should have operated in favor of this hypothesis, offered no support for it. Generally speaking, increases in the size of multiestablishment firms did not lead to materially higher ratios of central office to other employees. Thus the evidence is consistent with the hypothesis that as a firm increases in size, it incurs at most only proportionate increases in administrative costs.

Differences in Integration Among Industries

Integration was defined in Chapter 2 as the combination under single ownership of several stages in the production and distribution of a common product or service. Two or more productive processes associated with a common final product were deemed to be separate stages in production if they were identified with separate 4-digit industry classes. When a firm was engaged in production at two or more stages, the largest of the stages in terms of the firm's employment was deemed a "major" activity, while the other stages were identified as "auxiliary." A diversified firm would, by definition, have more than one major activity; but to be considered integrated as well, at least one of its major activities must be associated with auxiliary stages within the output structure of the firm. Integration was measured by the ratio of employment in auxiliary activities to total employment for the firm. Table 29, based on the sample of 111 companies, shows average ratios of auxiliary to total employees for each of thirteen industry groups. The lowest average ratio was 9.7 per cent for transportation equipment companies, and the highest was 67.3 per cent for petroleum companies.[2]

Within industry classes, variability in degree of integration differs considerably among the thirteen groups of firms. Somewhat surprisingly, the coefficients of variation for the 2-digit industry groupings of firms were not closely related to whether the groups were composed of companies with the same primary 4-digit industries. For example, relatively high coefficients of variation were associated with such comparatively homogeneous industry groups as primary metals and textile mill products, as well as with the heterogeneous groupings represented by transportation

[2] The ratio for petroleum companies would have been lower had the measure for all of the companies in this group been computed in accordance with the above definition of auxiliary employment. The difficulty in measurement arose from the fact that the major industry for the companies was specified as petroleum refining, even though for some of them employment in the production of crude petroleum exceeded that associated with manufacturing activities.

TABLE 29

THE RELATION OF INTEGRATION EMPLOYMENT TO TOTAL EMPLOYMENT FOR 111 LARGE ENTERPRISES, 1954

Primary Industry of Company	Number of Companies	*Integration Employment as Percentage of Total Employment*	
		Mean	Coefficient of Variation
Food products	12	30.3%	33%
Tobacco manufactures	5	16.7	55
Textile mill products	4	16.1	89
Paper products	8	27.1	50
Chemicals	14	19.6	79
Petroleum	10	67.3	8
Rubber products	5	18.6	43
Stone, clay, and glass products	7	19.3	69
Primary metals	10	21.2	67
Fabricated metal products	5	15.0	27
Machinery	13	30.5	50
Electrical machinery	5	12.8	72
Transportation equipment	13	9.7	98

SOURCE: Special census tabulation.

equipment and chemicals. Conversely, relatively low coefficients of variation were associated with both the heterogeneous food products group and the highly homogeneous petroleum group.

In contrast to the concept of integration implicit in the ratio of auxiliary to total employment, one might wish to measure the "intensiveness" of production within a single firm. This is measured by the ratio of value added to sales or shipments. Every intermediate productive process that is incorporated in a firm's activities necessarily increases the ratio of value added to sales. However, not all changes that combine separable stages of production under common ownership exert an equal influence on this ratio. If a stage associated with an intermediate product is added, in most instances the numerator of the ratio will rise without an increase in the denominator. On the other hand, if a new activity is added at a later point in the productive process than the older ones of the firm, both the numerator and the denominator of the value-added to sales ratio will usually rise equally. In short, when integration is measured by this ratio, both change in integration over time and differences among firms at a single point in time will depend upon the stage in the productive process at which auxiliary operations occur.

Another though related bias of the value-added to sales ratio as a measure of integration arises from the effect of differences in the value of

purchased materials. Thus, if two firms produce at successive stages of a given final product (for example, a manufacturer of automobile parts and one primarily engaged in assembly of the automobile), the value of the sales of one will be incorporated in the prices and sales totals of the other. If the two firms are characterized by roughly the same degree of integration (as measured, for instance, by the ratio of auxiliary to total employment), the one that produces at the earlier stages will necessarily show a higher value-added to sales ratio. This means that the value-added to sales ratio will, generally speaking, tend to be higher for firms producing raw materials or semifinished goods than for those engaged primarily in the production of consumer goods.

There is still a third characteristic that distinguishes the value-added to sales ratio from that of auxiliary to total employment. Value added may rise as the result of an increase in the amount of capital or labor employed in the primary activity. If the increase in inputs is directed towards producing a more valuable product rather than a larger quantity of the same product, the ratio of value added to sales would rise, though no rise will have taken place in the volume of auxiliary employment; in fact, the ratio of auxiliary to total employment will have declined.

Data showing the ratio of value added to shipments in 1954 were developed for the manufacturing establishments of 589 manufacturing companies in thirteen 2-digit industries.[3] Table 30 shows that the mean ratio of value added to shipments for the thirteen industry groupings varied only moderately. Nine of the thirteen mean ratios fell within the range of .4 and .6, and only in one case—petroleum—did the ratio fall far outside this range. Considering the heterogeneity of firms in the same industry groupings, it is perhaps also surprising that for nine of the thirteen groupings the coefficient of variation fell below 26 per cent.

The Relation of Integration to Size of Firm

When the 111 companies were ranked on the basis of the 1954 ratio of auxiliary to total employment, the Spearman coefficient of rank correlation for this ranking and one based on total asset size in 1954 was .37. Though statistically significant, the coefficient was relatively low inasmuch as investment in integration must contribute to the asset size of a firm. Moreover, the coefficient would have been even lower if, for some of the

[3] The sample is described in note 1 of this chapter and in Chapter 2. Census data on value added were available only for manufacturing and mining establishments. Our data, however, are restricted further to manufacturing establishments.

TABLE 30

RATIOS OF VALUE ADDED TO SHIPMENTS, 589 MANUFACTURING COMPANIES GROUPED ON THE BASIS OF INDUSTRY AND EMPLOYMENT SIZE, 1954

Primary Industry of Company	*Ratios for Size Classes*[a]										Industry Mean	Coefficient of Variation (per cent)
	(4)	(4)	(12)	(10)	(10)	(10)	(10)	(10)	(10)	(10)		
Food products	.209	.356	.309	.349	.404	.422	.377	.419	.342(8)		.364	43.1
Textile mill products	.339	.395	.386	.406	.455	.346	.402	.447(6)			.399	25.8
Paper products	.452	.367	.379	.435	.405(9)						.406	23.4
Chemicals	.553	.513	.496	.488	.529	.512	.404				.492	30.1
Petroleum and coal	.179	.145	.239	.147(7)							.193	56.5
Rubber products	.434	.468	.440(4)								.447	17.7
Stone, clay, and glass products	.617	.583	.577								.586	16.2
Primary metals	.370	.359	.338	.512	.481	.492					.436	28.2
Fabricated metal products	.446	.497	.554	.503(7)							.516	20.7
Machinery[b]	.479	.551	.554	.562	.572	.561	.654	.611	.580	.763(8)	.594	21.5
Electrical machinery	.535	.526	.445	.565	.571	.516					.522	23.4
Transportation equipment	.339	.529	.508	.475	.492	.476	.492(4)				.481	24.3
Instruments	.583	.582	.659(10)								.625	16.6

SOURCE: Special census tabulation.

[a] Included are all multiestablishment companies in the specified industries with total employment of 2,500 and over, except for six companies for which data could not be shown for reasons of disclosure of individual company information. Numbers in parentheses indicate the number of companies represented in the class. The first class consists of the largest four, the second, the next four, etc. Numbers in parentheses in the body of the table show the number of companies in a cell where the numbers differ from those in the column head.

[b] Except electrical.

petroleum companies, the "major" as distinct from auxiliary industry had been identified as crude petroleum production.[4]

Absence of a strong relation between size of firm and integration was further supported by examination of the ratios of value added to shipments. Table 30 does not show a positive relation between size of firm (measured on the basis of total manufacturing employment) and the ratio of value added to shipments. Indeed, in eight of the thirteen industry groupings, the highest size class was associated with a ratio that fell below the mean for the group. This may be attributable to a statistical bias in the value-added to shipments ratio noted earlier; namely, that firms whose auxiliary activities occur at an earlier point in the production process will, other things being equal, tend to show higher ratios of value added to shipments. Thus, if the larger firms are more active in producing final consumer goods and the smaller firms, in raw materials or semi-finished products, the value-added to sales ratio would be reduced for larger firms relative to that for the smaller ones. Nevertheless, if two companies have equal shipments, the one which shows a higher ratio of value added to shipments will necessarily be the larger of the two in terms of total inputs of resources. In most instances, it will also be the larger in terms of employment size. Accordingly, the absence of a positive relation between employment size and this ratio must be attributed to factors that offset the effect of greater integration (as measured by the ratio) upon company size.

Absence of a strong association between size of firm and integration, notwithstanding the positive effect that investment in integration must exert upon size, deserves further examination. The most plausible reason for the results is that investment in integration competes for scarce capital and managerial resources with both investment in diversification and in the primary activity of firms. This leads to a substitution of one form of investment for another.[5] Thus firms that are less integrated need not, on the average, be smaller in aggregate size.

The Relation of Integration to Diversification

The hypothesis that integration is related negatively to diversification is

[4] See note 2. This had the effect of increasing the ratio in question for a few companies. Since petroleum companies were among the largest in the sample, the effect of raising the ratio of integration to total employment had the effect of increasing the correlation.

[5] Of some relevance in this connection is the fact that the ranking of companies on the basis of the auxiliary to total employment ratio in 1954 appears to be negatively correlated, though only to a mild degree, with rankings of the same companies on the basis of growth in total assets in the period 1939–54. The Spearman coefficient of rank correlation was —.22. It was significant at the .05 level.

examined next. To test the relation between the two variables directly, the 111 companies were first grouped into deciles on the basis of the ratio of auxiliary to total employment. For each of the ten groups of companies, the number of industrial activities at the 4-digit level of industry detail was recorded (Table 31).[6] As may be judged from Table 31, the largest number

TABLE 31

RELATION OF INTEGRATION TO NUMBER OF MANUFACTURING PRODUCTS, 1954

Deciles Based on Ranking of Auxiliary to Total Employment Ratio[a]	Number of Companies	Number of Products in Manufacturing Industries	Average Per Company[b]
1	11	128	11.6
2	11	162	14.7
3	10	212	21.2
4	11	169	15.4
5	11	234	21.3
6	11	236	21.4
7	11	193	17.5
8	11	166	15.1
9	12	126	10.5
10	12	103	8.6
		1729	

SOURCE: 1954 product record and special census tabulation.

[a] The deciles are in ascending order with respect to the ratio.

[b] The ratio of the variance between classes to the variance within the class (decile) cells was 1.880 with $N_1 = 9$, $N_2 = 101$.

of industrial activities is to be found in deciles 5 and 6, with a fairly pronounced decline in number at both ends of the distribution.[7] These results lend support to the conclusion that, at least for the most highly integrated companies, there has been a tendency to substitute integration for diversification.

[6] Operations associated with integration were not removed from the list of 1,729 manufacturing activities of the companies in the sample. However, the pattern of variation among deciles in number of activities would probably not have been materially altered had integration activities been removed, since the overwhelming majority of products were associated with diversification. In these data, the ratio of activities associated with integration to those associated with diversification is likely to be of roughly the same magnitude as that observed on the basis of census data for manufacturing activities, namely, .21.

[7] When analysis of variance was applied, the high degree of variability in the number of activities associated with companies falling within the same integration deciles produced an F ratio (the variance between deciles to that within the deciles) that was significant at only the .10 level.

Activities of Manufacturing Companies in Distributive Trades

Manufacturing companies sell a large proportion of their products through separate sales offices. Some of them also employ their own wholesale and retail establishments for this purpose. A wholesale establishment, as defined in the Standard Industrial Classification Code, differs from a sales office in that it must either be a part of a subsidiary separately incorporated from the parent firm or else must sell primarily the products of other firms. A retail establishment, as defined in the Code, may be devoted wholly, partially, or not at all to the sale of the firm's own products. Thus some wholesale and retail establishments offer services that are substitutes for those of sales offices in that they participate in the sale of their owner's products. In the same way, they may perform marketing services that might otherwise be procured outside the firm. Consequently, the wholesale and retail activities of manufacturing firms in part represent integration.[8] This is also true of the latter's activities in the service trades.

The data available for the sample of 111 firms showed the activities of each firm in the wholesale, retail, and service trades on a combined basis, but gave information for sales offices separately. Ratios of employment in sales offices to total employment and of employment in wholesale, retail, and service trades to total employment were developed for the sample of 111 large manufacturing companies. Table 32 shows that substantial differences between industry groups of firms characterized both sets of ratios. Petroleum companies show a smaller ratio of sales office to total employment than any of the other companies, and a markedly higher ratio of employment in wholesale, retail, and service trades to total employment.[9]

Generally speaking, the variability within industry groups appeared to be higher for the wholesale, retail, and service trades ratios than that for sales offices. This was, of course, to be expected since a large proportion of sales office activities consists of operations that are essential to all firms. Variability within industry groups in sales office ratios was, however, too high to be explained satisfactorily by differences between companies in the character of their products. It is likely that companies vary considerably in the extent to which sales personnel are attached to separate

[8] The sense in which sales office activities represent integration was discussed in Chapter 2.

[9] The low level of the ratio of sales office to total employment for petroleum companies may indicate that central administrative offices attached to petroleum bulk stations were performing largely a sales function. The ratio of central administrative office employment to total employment for petroleum companies, as tabulated in the 1954 Census, was unusually high. A large proportion of central office employment for petroleum companies emanated from offices attached to bulk stations.

TABLE 32
MAGNITUDE OF EMPLOYMENT IN SALES OFFICES AND WHOLESALE, RETAIL, AND SERVICE TRADES, 111 LARGE ENTERPRISES, 1954

Primary Industry of Company	Number of Companies	*Sales Office Employment as Percentage of Total Employment*[a] Mean	Coefficient of Variation (per cent)	*Employment in Wholesale, Retail, and Services Trades as Percentage of Total Employment*[a] Mean	Coefficient of Variation (per cent)
Food products	12	11.0–16.6	59	2.0–2.5	166
Tobacco manufactures	5	6.5– 8.0	72	0–2.0	[b]
Textile mill products	4	4.0– 6.5	174	6.5–8.0	157
Paper products	8	4.0– 6.5	147	2.0–2.5	207
Chemicals	14	6.5– 8.0	77	1.5–2.0	355
Petroleum	10	0– 2.5	2	18.1	36
Rubber products	5	4.0– 6.5	40	6.5–8.0	74
Stone, clay, and glass products	7	11.0–16.6	80	0–2.0	[b]
Primary metals	10	1.5– 3.0	65	0–2.0	115
Fabricated metal products	5	4.0– 6.5	93	0–2.0	[b]
Machinery	13	11.0–16.6	72	3.0–3.5	327
Electrical machinery	5	1.5– 3.0	139	3.0–3.5	98
Transportation equipment	13	2.5– 4.0	217	0–2.0	253

SOURCE: Special census tabulation.
[a] Expressed as percentage range to avoid possible disclosure of individual company data.
[b] Not computed in order to avoid possible disclosure of individual company data.

establishments identified as sales offices. Sales personnel affiliated with either general administrative offices or manufacturing plants were not reflected in data for sales office employment.

Size of company, as measured by total assets, was not significantly related to either of the above two sets of ratios. When companies were divided into two classes, those with total assets of over a billion dollars and those with assets of a billion dollars or less, the former class did show a lower ratio for sales office employment and a higher ratio for employment in wholesale, retail, and service trades. This, however, was wholly attributable to the effect of the petroleum companies in the sample, most of which had assets of a billion dollars and over in 1954.

The Relation of Employment in Central Administrative Offices to Company Size

An important subject in the study of integration is the relative size of central administrative office employment. Most central office activities are essential complements of the other processes of production for which they perform the supervisory, planning, and record-keeping

functions. Unless these services are purchased outside the firm, it is probable that the size and scope of most central office functions cannot be materially altered without complementary changes in the volume or composition of the firm's output.[10] Accordingly, if smaller companies require relatively fewer administrative employees, this would indicate the presence of diseconomies of scale with respect to the cost of administrative services. The converse would, of course, be true if large companies had relatively fewer administrative employees. It has been frequently argued that as the size of a firm increases, the number of supervisory functions needed increases more than proportionately; that is, the number of administrative employees increases relative to the number of "production workers" as the firm becomes larger, with a consequent diseconomy offsetting whatever technical efficiencies may result from larger size. Our data do not support this hypothesis.

An attempt to establish the nature of the relation between employment size of company and central office employment was made on the basis of data for 684 companies[11] grouped by 2-digit industries and by employment size class.[12] These groupings, and the average employment in each group, are shown in Appendix Table C–1; average central administrative office employment in each group is shown in Table C–4.

The relation between central administrative office employment and *all other* employment is specified by the following equation, where Y denotes central office employment and X total employment minus central office employment:

$$(1) \qquad Y = -77.4 + .0671X, \quad r = .869$$
$$(115.5) \quad (.0013)$$

The standard error (indicated in parentheses) for the regression coefficient was very small. That for the negative constant, however, was high and the latter was not significantly less than zero. A zero constant would indicate a ratio of Y to X that does not vary with company size. The equation explains roughly 75 per cent of the variance in Y.

[10] However, while the functions cannot be modified easily, these functions can frequently be performed within manufacturing establishments as well as within separate central offices. This leads to a bias in the data, discussed at a later point.

[11] Data for petroleum companies were excluded because information on their central office employment was, for reasons indicated earlier, probably defective.

[12] The size classes were the following: the first consisted of the four largest firms; the second, the next four largest; the third, the next twelve; and all subsequent classes consisted of successive groups of ten. There were ninety groups of companies so that the relation was examined on the basis of ninety observations. The reasons for using group averages rather than individual company information, and for the choice of groups, are indicated in Chapter 4 in the discussion of relation of firm size to magnitude of nonprimary employment.

If a second degree polynomial is fitted to the data, the resultant curve, as may be judged from Chart 2, approximates a straight line.[13] The equation is:

$$(2) \qquad Y = -100.7 + .0697X - 10^{-8} \times 1.7544X^2$$

The additional variance explained by equation 2 as compared with a straight line is negligible, the residual variance in Y being 24.525 per cent for equation 2 as compared with 24.544 per cent for equation 1.

When the data for petroleum companies were reintroduced and a straight line fitted to the logarithms of the values of Y and X, the resultant equation was as follows:

$$(3) \qquad \log_{10} Y = -1.9044 + 1.1430 \log_{10} X, \quad r = .810 \\ (.0862)$$

The regression coefficient was not significantly greater than unity at the .05 level of significance. A coefficient of one would indicate a constant ratio of Y to X as X increases. In this respect, equation 3 tends to support the conclusion reached on the basis of equation 1.

In summary, equations 1 and 3 are consistent with the hypothesis that the ratio of central office to total noncentral office employment does not vary much over the observed range of values, while equation 2 points, at least, to a relatively constant incremental ratio.[14] However, it is probable that the data used understate the role of administrative employees in the smaller companies relative to that in larger ones. A smaller company is likely to have a smaller proportion of its administrative employees in separate establishments; that is, such employees are less likely to be numerous enough to justify a separate central office.[15] For this reason,

[13] Chart 2, panel III, shows the scatter on a different scale for the highest values of X. Chart 2, panel II, reproduces on a larger scale the observations for companies with low noncentral office employment. The rectangle in panel I indicates the area reproduced in panel II.

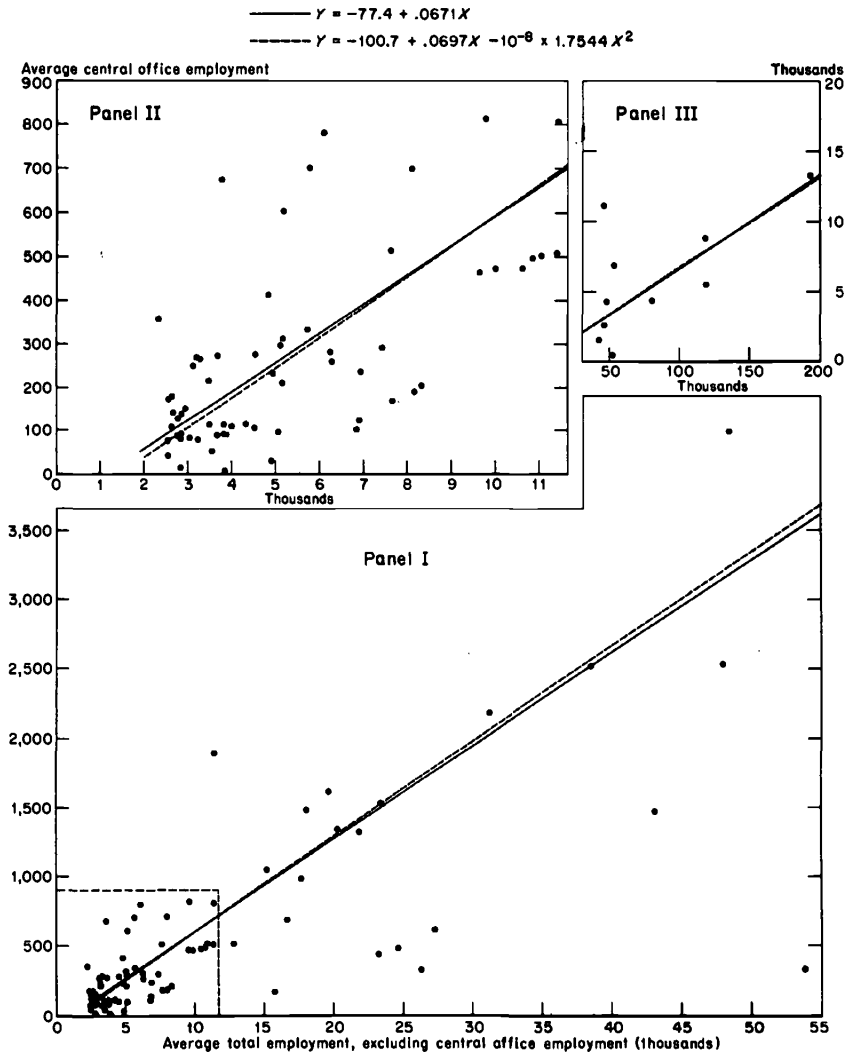
[14] Even if the negative constant in equation 1 is taken into account, the ratio does not vary materially over a wide range of company sizes. The equation gives an estimate of central office as a percentage of noncentral office employment of 5.9, 6.3, and 6.6 per cent for companies with respectively, 10,000, 20,000, and 50,000 noncentral office employees.

Equation 1 indicates that central office employment would be zero for a company with 1,153 noncentral office employees. While the negative constant was not significantly less than zero, very small companies would tend to show zero central office employment since they are unlikely to house their administrative employees in separate establishments. However, we do not know the nature of the relation between the two variables for small companies since our data are truncated.

[15] The variation in the ratio of central office to other employees was considerably greater for the smaller companies when companies were grouped by employment size. This seems to reflect the fact that the smaller firms in the sample differed considerably in their practices with respect to whether they housed their administrative employees in separate establishments.

CHART 2

Relation of Central Office Employment to Company Size, 90 Groups of Companies, 1954



the proportion of *all* administrative employees contributed by central offices probably increases with firm size. In consequence, since central office employment appeared to rise only proportionately to that outside central offices, one may infer that the share of a company's employment accounted by *all* administrative employees (including those that are not in central offices) is inversely related to firm size. This is a conclusion opposite to the one commonly assumed.

The hypothesis regarding administrative diseconomies arising from larger size does not depend exclusively upon the presence of a relatively larger number of employees engaged in administrative duties. It may well be that the effectiveness of central controls is reduced by larger size, thus leading to higher costs unrelated to the costs of administration. Nevertheless, one of the bases for the hypothesis that large firms incur administrative diseconomies appears to be inconsistent with our findings.