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CHAPTER III

PLANT CONCENTRATION AND FIRM CONCENTRATION

In the preceding chapter the level of concentration has been described and analyzed in terms of "firms"—groups of plants in an industry under common ownership. In this chapter the relation between concentration by firms and concentration by plants will be investigated.

The multi-plant firm plays an important role in discussions of antitrust policy. The degree to which firm concentration diverges from plant concentration must be considered in evaluating proposals to reduce concentration by breaking up large firms or to limit concentration by restricting mergers.

In addition to the light it sheds on these issues of public policy, a discussion of the relation between plant and firm concentration has other important uses. Much of the statistical information from industrial censuses, in the United States and Great Britain as well as in Canada, is available for plant-size distribution but not by size of firm. Hence plant size data have frequently been used where firm size data would have been more relevant. It is therefore important to study the degree to which plant and firm concentration diverge in different classes of industries.

1. *Measurement of the Difference between Plant and Firm Concentration*

Table 20 shows the cumulative distribution of industries and employment by plant and firm concentration, and measures the difference between the two distributions in both absolute and relative terms. The table shows, for example, that nearly half the employment in the sample (48.3 per cent) is in industries in which fewer than 24 *firms* account for 80 per cent of employment, but little more than one-third of employment (34.7 per cent) is in industries in which fewer than 24 *plants* account for 80 per cent of employment. Hence 13.6 per cent of employment is in industries in which fewer than 24 firms but more than 24 plants account for 80 per cent of employment (column

4). This is less than one-third (28.2 per cent, column 5) of the total employment in industries in which 80 per cent of employment is concentrated in fewer than 24 firms. The other rows of Table 20 supply corresponding information for other concentration levels.

The table answers directly a much debated question. Suppose a given level of concentration is desired for satisfactory performance of the economy. How many industries have higher concentration, what is their total relative size, and to what extent will this excess be reduced by making all plants independent? Column 5 shows that if any concentration index between 3 and 24 is sought, employment in more highly concentrated industries would be reduced by between one-third and one-half by making all plants independent.

TABLE 20

Divergence between Plant and Firm Concentration, 96 Canadian Manufacturing Industries, 1948

CONCENTRATION INDEX [a] (1)	PERCENTAGE OF INDUSTRIES WITH HIGHER CONCENTRATION [b] THAN THE GIVEN INDEX: *Concentration by Firms* (2)	*Concentration by Plants* (3)	DIFFERENCE COL. (2) — COL. (3) (4)	RELATIVE DIFFERENCE COL. (4) ÷ COL. (2) × 100 (5)
3	20.8	10.4	10.4	50.0
6	40.6	31.2	9.4	23.2
12	56.2	46.7	9.5	16.9
24	70.8	64.6	6.2	8.8
100	85.4	83.4	2.0	2.3
	PERCENTAGE OF EMPLOYMENT IN INDUSTRIES WITH HIGHER CONCENTRATION [b] THAN THE GIVEN INDEX			
3	9.8	6.0	3.8	38.8
6	24.1	13.0	11.1	46.1
12	32.7	18.0	14.7	45.0
24	48.3	34.7	13.6	28.2
100	63.6	60.8	2.8	4.4

[a] Number of largest plants or firms required to account for 80 per cent of employment in an industry.

[b] Higher concentration measured by lower numerical value of concentration index.

Source: Appendix A, Table A-4.

Table 20 includes the industries with separate regional markets and those with high imports and exports. When these are omitted there remains a group of 58 industries with "national" markets in which some correlation between concentration and the degree of monopoly can reasonably be expected (cf. Chapter I). Table 21 gives

the information corresponding to Table 20 for this more limited group of industries. The figures are of the same order of magnitude as those in Table 20 except for the fourth row. Among the industries with "national" markets (Table 21), the proportion of employment in industries with a concentration index lower than 24 is reduced by only 10 per cent when plant concentration is substituted for firm concentration. The corresponding figure for all industries (Table 20) is 28 per cent.

TABLE 21

Divergence between Plant and Firm Concentration, 58 Canadian Manufacturing Industries with National Markets, 1948

CONCENTRATION INDEX [a] (1)	PERCENTAGE OF INDUSTRIES WITH HIGHER CONCENTRATION [b] THAN THE GIVEN INDEX: *Concentration by Firms* (2)	*Concentration by Plants* (3)	DIFFERENCE COL. (2) — COL. (3) (4)	RELATIVE DIFFERENCE COL. (4) ÷ COL. (2) × 100 (5)
3	20.7	10.3	10.4	50.2
6	39.6	32.8	6.8	17.2
12	60.4	50.0	10.4	17.2
24	72.4	68.9	3.5	4.8
100	89.7	87.9	1.8	2.0
	PERCENTAGE OF EMPLOYMENT IN INDUSTRIES WITH HIGHER CONCENTRATION [b] THAN THE GIVEN INDEX			
3	11.9	8.2	3.7	31.1
6	24.8	13.4	11.4	46.0
12	34.0	18.8	15.2	45.0
24	41.4	37.3	4.1	9.9
100	62.8	58.4	4.4	7.0

[a] Number of largest plants or firms required to account for 80 per cent of employment in an industry.

[b] Higher concentration measured by lower numerical value of concentration index.

Source: Appendix A, Table A-4. Industries listed in Table 8 are excluded.

It is difficult to judge how closely the results of this investigation of a sample of industries would be applicable to the total of manufacturing industries. The 96 industries investigated include all those for which the "industry" can be identified with a "product" or group of substitutable products (see Chapter I). They constitute 52 per cent of all manufacturing industries by number and account for 72 per cent of output and 66 per cent of employment. The group of 58 industries shown in Table 21 accounts for 31 per cent of all manufac-

turing industries by number and for 33 per cent of employment. The average size of industries, in terms of employment, is 6,200 for all industries, 7,900 for the larger sample, and 6,500 for the smaller group.

There is reason to believe that, in the sector of manufacturing omitted from this study, concentration in terms of both plants and firms tends to be higher, and the divergence between plant and firm concentration less pronounced than in the sample. The reasons for expecting a higher level of concentration in the omitted sector have been discussed in Chapter II (section 2). A rough idea of the divergence of plant and firm concentration in the omitted sector, as compared with the sample, can be obtained by comparing the average number of plants per firm in the two groups. The decile values [1] are as follows:

	NUMBER OF PLANTS PER FIRM	
DECILE	*Sample*	*Omitted Industries*
1	1	1
2	1	1
3	1.01	1
4	1.02–1.03	1
5	1.05	1
6	1.09	1.01
7	1.17–1.18	1.03
8	1.31–1.32	1.05–1.06
9	1.75–1.81	1.14

It is evident that the number of plants per firm is lower in the omitted industries, and this suggests that the divergence between plant and company concentration, as measured in the last two columns of Tables 20 and 21, is probably lower.

2. *The Role of Multi-Plant Firms*

The difference between plant and firm concentration in an industry depends both on the number of plants per firm and on the difference between inequality of plant size and inequality of firm size. The latter in turn depends on the degree to which, within the industry, plant size is correlated with the number of plants per firms. For any given degree of plant-size inequality, firm-size inequality will be higher if large plants are members of multiple-plant units while small plants are not.

The majority of firms in the Canadian manufacturing industries have only one plant each, and this is probably also true of other

[1] Ten per cent of the observations have values less than the first decile, 20 per cent have values less than the second decile, etc.

countries.[2] The importance of multi-plant firms is, however, much greater than their relative numbers would suggest since they are, in general, considerably larger than single-plant firms. In almost all the sampled industries in which there are more plants than firms, the average number of plants per firm increases with an increase in firm size.

Multi-plant firms are not only larger than other firms in the same industry, but also have larger plants. The sampled industries containing multi-plant firms show, with very few exceptions, an increase in average plant size with increasing firm size, as well as an increase in the number of plants per firm. Obviously, a large firm must have either larger plants or more plants than a small one, but the data suggest that very frequently is has both.[3]

A possible explanation of the generally observed correlation of plant size and number of plants per firm may be found in a theory

[2] The Canadian tabulation for 1948 lists only a firm's plants in the same industry, so that, strictly speaking, we only know that the majority of plants belong to firms that have no other plants in the same industry. It is most likely, however, that the statement would still be true when "vertical" and "conglomerate" integration of plants is taken into account. In 1947, 62.5 per cent of all plants belonged to unincorporated firms, and it is not likely that many of these operate more than one plant. In the United States in 1937, only 15 per cent of all manufacturing plants belonged to "central office groups" (*The Structure of Industry*, Temporary National Economic Committee, Monograph 27, 1940, p. 111).

[3] While the results seem to indicate that multi-plant firms have, on the average, larger plants than single-plant firms, they do not actually prove this conclusively, because the data is grouped by firm-size classes. It is conceivable that averages for each size class like those described above could be obtained even where multi-plant firms have smaller plants than single-plant firms. Suppose, for example, that in each firm-size class there are multi-plant firms with relatively small plants and single-plant firms with relatively large plants. Suppose that the multi-plant firms in any firm-size class have *more* plants than those in the class of smaller firms while the single-plant firms have *larger* plants than those in the class of smaller firms. The averaging within each size class would then make it appear that the "average" firm in the larger class had *both* more and larger plants than the average firm in the smaller class.

Such a pattern is however so unlikely that it can be safely ruled out. It can only occur if large firms of a given size exhibit a very great variation in plant size, and this would hardly be consistent with the classification of these firms in the same industry. Moreover, the larger plant size for multi-plant firms is also exhibited by United States data. In TNEC Monograph 27, it is shown that according to data from the *Census of Manufactures, 1937* (Bureau of the Census), the average employment in establishments operated by central office groups was 170, while the average for independent establishments was 30, and the same pattern was shown for each industry group, though with considerable variation in the differential (Table 8, p. 127). We shall therefore interpret the statistical findings discussed above as indicating that multi-plant firms in each industry tend to have larger plants than single-plant firms.

expounded in the works of J. M. Clark [4] and elsewhere. According to Clark, large plants are more frequently associated with a multi-plant firm than small plants because they are more likely to have exhausted the possibilities of cost reduction by economies internal to the plant, so that further growth of the firm is likely to take the form of a multiplication of plants rather than an expansion of the plant.

In applying this theory to our findings the relation between plant size and costs per unit of output must be considered in some detail. Certain costs for a given output may be minimized when production is carried on in a number of separately located plants. The costs of transporting materials or products, discussed in Chapter II, are in this category, and in addition labor costs, rents, or taxes may be lower when production is spread among plants located in smaller centers of population. Other costs, however, may be at their lowest when production is centralized in one plant. The economies associated with such centralization are not only those internal to the plant, but also external economies arising from specialization of suppliers, skilled labor, and subsidiary services.

It is reasonable to assume that increases in efficiency of production (if any) associated with a larger scale of plant must decline after a certain scale is reached, even if they do not give way to decreasing efficiency. It follows that when output reaches a certain size the savings in transportation costs and other location economies to be gained by increasing the number of plants will begin to outweigh the cost reductions, if any, to be achieved by a larger centralized plant. This critical size will, of course, not be the same for all firms in an industry, since the conditions of production and factor-supply confronting different firms are not identical. Among the large firms there will, however, be a higher proportion for whom multi-plant operations are profitable than among small firms. Hence, when averages are struck for each firm-size class, there will tend to be both larger plants and more plants per firm among the larger firms.

One cannot, of course, expect all firms at any one time to have the plant and equipment required for the lowest-cost production of their output—the conditions of long-run equilibrium are generally not attained as market conditions change and firms grow. One firm may have more, and smaller, plants than the optimum because its original plant could not easily be enlarged and its market has grown rapidly in relation to the life of buildings and equipment. Another firm may have too large a plant because its management has been reluctant to

[4] *Studies in the Economics of Overhead Cost,* University of Chicago Press, 1923, p. 140 ff.

face the risks and problems involved in undertaking production in a new locality.

Where a firm is the result of mergers aiming at market control it is particularly likely to have both large plants and many plants, even if this is not the lowest-cost pattern, since market control is most easily attained by combining the largest plants. This form of growth has been important in many Canadian industries, as indicated below.

3. *Variation in the Importance of Multi-Plant Firms*

Table A-3, Appendix A, indicates the importance of multi-plant firms in each of the sampled industries as measured by two averages:

1. The number of plants divided by the number of firms. Thus may be regarded as the number of plants in the "average" firm.

2. A weighted average number of plants per firm, weighting the average number of plants per firm in each firm-size class by the percentage of the industry's employment in that size class. This is the closest approximation possible with grouped data to an average weighting the plant-firm ratio for each firm by the percentage of the industry's employment in that firm. This index may be said to measure the number of plants per firm in the firm employing the "average" employee. It is perhaps a better measure than the straight average of the importance of the multi-plant firm in an industry's structure. Moreover, since it reflects both the number of plants per firm and the extent to which many plants per firm and large plants are correlated, it can be said to govern the relationship between plant and firm concentration.

TABLE 22

Distribution of 96 Canadian Manufacturing Industries by Industry Group, and Weighted Average Number of Plants per Firm, 1948

Weighted Average Number of Plants per Firm [a]	*Foods*	*Textiles*	*Wood*	*Paper*	*Metals*	*Minerals*	*Chemicals*	*Misc.*	*Total*
3 or more	6	1	0	1	2	1	2	0	13
2 to 3	4	0	0	1	1	2	1	0	9
1.5 to 2	7	2	1	0	0	2	2	0	14
1.25 to 1.5	1	3	1	1	1	0	3	1	11
Less than 1.25	4	18	6	0	8	5	5	3	49
Total	22	24	8	3	12	10	13	4	96

[a] Average number of plants per firm in each firm-size class weighted by percentage of industry's employment in that size class.

Source: Appendix A, Table A-3.

The unweighted average is in most cases well below two. The weighted average is higher than the unweighted average (except where no multi-plant firms are recorded or where there is only one size class) reflecting the association between plant size and number of plants per firm discussed above. But there are many industries in which even the weighted average is very low, and in over half the cases it has a value of less than 1.25 (Table 22).

The industries with a very low weighted average number of plants per firm are found in every industrial group, but the proportion is particularly high in textiles, wood products, and metal products. These industries exhibit a small divergence between plant and firm concentration (Appendix A, Table A-4).

At the other end of the scale are thirteen industries with a weighted average number of plants per firm of more than 3 and nine industries with a weighted average of between 2 and 3. These twenty-two industries (of which ten are in the food-processing group) exhibit a great divergence between plant and firm concentration, as shown in Table 23. For any given plant concentration level the industries in this group exhibit higher firm concentration than the other industries in the sample.

TABLE 23

Plant Concentration and Firm Concentration, Selected Canadian Industries, 1948

PLANT CONCENTRATION INTERVAL [a]	INDUSTRIES WITH WEIGHTED AVERAGE NUMBER OF PLANTS PER FIRM OF 2 OR MORE [b]			OTHER INDUSTRIES IN THE SAMPLE		
	Number of Industries	*Concentration Index* [c] *Plants* [a]	*Firms* [d]	*Number of Industries*	*Concentration Index* [c] *Plants* [a]	*Firms* [d]
1 to 2	2	1.8	0.9	3	1.6	1.5
3 to 4	2	3.4	1.1	7	3.6	3.2
4 to 5	2	4.2	1.6	5	4.4	4.3
7 to 9	3	7.8	3.6	3	8.4	7.3
11 to 17	3	13.5	3.7	9	13.4	12.1
20 to 30	3	25.9	7.6	3	28.0	23.6
50 to 60	1	50.3	22.5	1	53.0	49.4
100 to 200	4	163.7	111.6	3	132.4	127.7
400 to 500	1	442.0	369.9	1	478.6	469.8
800 to 900	1	836.7	732.5	0		

[a] Number of largest plants accounting for 80 per cent of employment.

[b] Number of plants per firm in each firm-size class of an industry weighted by industry's percentage of employment in that firm-size class. See Appendix A, Table A-3.

[c] Unweighted average of concentration indexes for the industries in each group.

[d] Number of largest firms accounting for 80 per cent of employment.

Source: Appendix A, Tables A-3 and A-4.

These statistics are, of course, concerned with only one type of multiple-plant operation, namely, the operation by a firm of several plants within the same, narrowly defined, industry (see Chapter I). The operation of plants belonging to the same firm in different "industries" (e.g. vertical integration or "conglomerate" integration) is not shown by the data.

It must also be recognized that the accuracy of the statistics is limited by the grouping of firms into size classes, which eliminates the variation within each such class. Since the tendency is for the number of plants per firm to be correlated with firm size, the effect of this grouping must be to understate the weighted average used to indicate the importance of multi-plant firms. In the extreme cases (of which there are several) no breakdown by firm size is available, so that the weighted average number of plants per firm is, perforce, the same as the unweighted average.

4. *Reasons for the Variation in the Importance of Multi-Plant Firms*

The general theory outlined in section 2 can explain a good deal of the variation among industries in the importance of multi-plant firms (Tables 22 and A-3). The weighted average number of plants per firm tends to be high in industries in which the economies of geographical dispersion begin to outweigh the economies of centralized production at a point where there are still economies (e.g. of buying, selling, management) to be gained by further growth of the *firm.* Multi-plant firms are also important in industries in which growth by merger, often motivated by the desire for monopoly, has been significant.

Conversely, multi-plant firms are not important in two types of industries: First, those in which costs fall greatly with increasing plant size, up to a size that is large in relation to total output of the industry; second, those in which there are no significant economies internal to the firm.

Of the twenty-two industries with a weighted average number of plants per firm of 2 or more, nine are among those listed in Table 14 as having segregated regional markets for materials or products.[5]

In four of these, beer, soft drinks, prepared feeds, and bread, product markets are segregated, reflecting the high cost of transportation

[5] Breweries, slaughtering and meat packing, pulp and paper mills, fruit and vegetable canning, fish curing and packing, soft drinks, prepared stock and poultry feeds, butter and cheese factories, bread and other bakery products.

in relation to the value of the product, and in addition the time element (the product must be fresh) in the case of bread. In the other five industries, meat packing, fruit and vegetable canning, fish packing, butter and cheese factories, pulp and paper, the raw material is costly to transport and, in most of the industries mentioned, spoils if cheap methods of transportation are used.

Since in these industries the cost or difficulty of transportation limits the economical size of plant, large firms must operate a large number of plants. While multi-plant operation probably involves economies in financing and management, there are also economies in the large-scale purchase of *materials* where plant scale is limited by the regional separation of *product* markets (e.g. bakeries, and the integration of chain bakeries with flour-milling firms) and in large-scale selling on a national basis where plant scale is limited by the regional separation of material markets (e.g. canning). The latter are, moreover, by no means absent where regional product markets are in fact distinct. For example, soft drinks are bottled locally but are nationally advertised and sold subject to national pricing policies.

These economies do not, however, appear to be sufficient to make life intolerable for the small single-plant firm, since as mentioned in Chapter II, the vast majority of firms in these industries have only one plant. As a result the *unweighted* average number of plants per firm is, in most of these industries, quite low and firm concentration is low compared with other industries, even though it is a great deal higher than plant concentration.

Geographical limitations to economical plant size are probably also significant in some of the other industries in which the weighted average number of plants per firm is very high. For example, in the railway rolling stock industry the location of repair shops at a number of strategic points on a company's network must be an important factor, and in the aluminum industry the importance of cheap hydro-electric power for the reduction process leads to the scattering of plants close to water power sites, the supply of power limiting the size of the plant. In the cotton yarn and cloth industry "the majority of Canadian cotton mills are located outside the large cities. This enables the mills to recruit labor at a slightly lower average wage, but it may on occasion create a problem when additions to the total labor force are being sought." [6]

An explanation must now be found for the fact that some of the

[6] *Report of the Royal Commission on Prices,* Ottawa, King's Printer, 1949, Vol. III, p. 131.

industries with separate regional markets for products or materials have a very low weighted average number of plants per firm, in contrast to the group considered above. Planing mills, feed mills, machine shops, iron castings, and cement products all have weighted averages of less than 1.25. In these industries the largest firms do have several plants, but the chains are not as "long" as those in the food processing group, and the one-plant firms are relatively more numerous and have a larger share of the market, thus bringing down the weighted average.

This contrast suggests that the economies or other advantages to be derived from running a string of plants are comparatively less pronounced in these industries, and that entry for the small one-plant firm is comparatively easier. We can suggest two factors that may account for this. In the first place, the food-processing industries selling to the consumer emphasize advertising; in many of these industries the leading firms sell on the basis of nationally advertised brand names, in some there are nationally uniform prices. These sales operations are very likely to involve economies internal to the firm, though they are "external" to the plant, and therefore encourage expansion of the firm by the acquisition of more plants. By contrast, the industries having few multi-plant firms sell to other producers, mostly on the basis of standardized and graded products (e.g. lumber) or custom work (e.g. machine shops).

In the second place, the industries in which the multi-plant firm is not important have lower capital requirements per unit of labor than the industries dominated by chains. This lower capital intensity may facilitate the entry of small one-plant firms and reduce the differential advantage of better credit terms enjoyed by a large firm. The difference in capital requirements is indicated by the following figures: [7]

	WEIGHTED AVERAGE NUMBER OF PLANTS PER FIRM	VALUE OF CAPITAL EMPLOYED IN PRODUCTION PER WAGE EARNER, 1942
Industries with Few Plants per Firm		
Machine shops	1.00	$2,860
Feed mills	1.03	9,622
Planing mills, sash and door factories	1.12	3,580
Cement products	1.12	4,240
Iron castings	1.21	3,940
Saw mills	1.39	2,700

(cont. on next page)

[7] The industries included in this tabulation are all those listed in Table 14 as having regionally separated markets for products or materials.

	WEIGHTED AVERAGE NUMBER OF PLANTS PER FIRMS	VALUES OF CAPITAL EMPLOYED IN PRODUCTION PER WAGE EARNER, 1942
Industries with Many Plants per Firm		
Prepared stock and poultry feeds	2.13	$10,680
Fish curing and packing	2.74	4,410
Pulp and paper mills	3.40	19,905
Butter and cheese factories	3.61	5,280
Soft drinks	3.64	5,580
Breweries	3.70	14,016
Slaughtering and meat packing	3.89	7,170
Bread and other bakery products	5.02	2,780
Fruit and vegetable preparations	8.08	5,180

Source: Appendix A, Table A-3; *Canada Year Book, 1945*, Ottawa, Dominion Bureau of Statistics, pp. 392 and 394; and *Food Products, Beverages, etc. 1942*, same agency, pp. 5, 12.

With the exception of bread baking and feed mills, capital requirements are uniformly higher in the second group. Five of the six industries in the first group used less than $5,000 capital per worker, but only two of the nine industries in the second group had such a low capital-labor ratio.[8]

A second significant factor making for a high weighted average number of plants per firm is the growth of the leading firms by a proces of merger. This has characterized many of the industries with both a high weighted average number of plants per firm and high firm concentration.

The ten industries with over 2 plants per firm (weighted average) which have not yet been discussed[9] have concentration indexes (number of largest firms accounting for 80 per cent of employment) of less than 7, and nine of them have concentration indexes of less than 3. In many of these industries, as well as in some of those men-

[8] In view of the small size of this sample of industries the significance of the difference in capital intensity between the two groups may be questioned. Variance analysis, applied to the logarithms of the capital-labor ratio, yields a value of "*F*" of 3.40 (with 1 and 13 degrees of freedom) indicating that the probability of obtaining such a large difference in a random grouping of industries is greater than 5 per cent but less than 10 per cent.

This test assumes that the variable is normally distributed. An exact nonparametric test, based on the cross-classification of the two groups by the "capital intensity" classes—"over $5,000 per worker" and "under $5,000 per worker"—yields the conclusion that an (positive or negative) association as strong as that shown in the sample would be found with about 4 per cent probability if capital intensity and number of plants per firm were independent. This test is based on the exact computation of probabilities in a 2×2 table as described, e.g. in R. A. Fisher, *Statistical Methods for Research Workers* (10th ed., Hafner, 1948, pp. 96–97).

[9] Nickel, cement, petroleum products, gypsum products, compressed gases, coal tar distillation, distilleries, matches, roofing paper, cigarettes, etc.

tioned before, there is readily available evidence of the importance of mergers in the growth of the leading firms.

For example, the two leading distillery firms are Distillers Corporation-Seagram's Ltd., and Hiram Walker-Gooderham & Worts, Ltd., both of which, as their names imply, were the result of mergers, in 1928 and 1927 respectively. Both later acquired further plants in Canada, as well as extensive properties in the United States and Great Britain. The leading cotton firm, Dominion Textiles, was founded in 1905 as a merger of four companies and acquired further properties in the course of its subsequent growth.[10]

The manufacture of cigarettes, cigars, and tobacco is dominated by the Imperial Tobacco Company of Canada, the successor to a company formed in 1895 as a merger of several smaller firms. The company was reorganized in 1908, four more firms being added at this time, and again in 1912. Further acquisitions followed, a total of five recorded in the period 1921 to 1930.[11]

In the match industry the Eddy company pursued an active and successful policy of absorbing competitors.[12] The leading cement company, Canada Cement, was founded in 1909 as a merger of eleven producers and absorbed two or more concerns in the 1920's.[13] Mergers were also a prominent feature of the history of the leading companies in pulp and paper, gypsum products, coal tar distillation,[14] and other industries.

In summary, multi-plant firms are prominent in some industries mainly because it is costly or difficult to concentrate production in one spot; these industries tend to have small plants and low firm concentration. In other industries multi-plant firms are prominent because of a history of mergers, and these industries tend to have high firm concentration. There are, of course, industries in which both factors play an important role, such as pulp and paper mills, breweries, cement, and petroleum refining.

There is a similar variety of types among the industries at the other end of the scale, in which the multi-plant firm is of minor importance.

[10] *Moody's Industrials,* 1949, pp. 1942, 1948, and 2928.

[11] *Report of the Royal Commission on Price Spreads,* Ottawa, King's Printer, 1935, pp. 51 ff., 333. See also *Proceedings and Evidence,* House of Commons, Special Committee on Price Spreads and Mass Buying, Ottawa, King's Printer, 1934, Vol. II, p. 1443 ff.

[12] *The Combines Investigation Commission Report on Matches,* Ottawa, King's Printer, 1950.

[13] L. G. Reynolds, *The Control of Competition in Canada,* Harvard University Press, 1940, p. 177. See also *Report of the Royal Commission on Price Spreads,* p. 338.

[14] *Report of the Royal Commission on Price Spreads,* pp. 333–340.

Textiles and wood products have small plants and firms and low concentration, while the iron and steel and transportation equipment industries have large plants and fairly high concentration (with exceptions, such as cotton thread and shipbuilding).

In the secondary textile industries the typical firm is very small, while most of the firms are located in one of two cities. The cities of Montreal and Toronto have one-third of total employment in Canadian manufacturing, but 87 per cent of the employment in women's clothing factories, and 60 per cent of employment in men's clothing factories. Montreal alone has 18 per cent of total manufacturing employment, but 64 per cent of employment in women's clothing factories and 38 per cent of employment in men's clothing factories.[15]

The small size of the individual clothing firm suggests that internal economies are not of great importance, but the location pattern suggests that *external* economies are associated with location in one of the centers, and that transportation costs of the finished product are low in relation to its value. Moreover, the process of production is relatively simple, so that expansion of the plant is feasible as the firm grows. Hence there is little reason for the acquisition of more plants.

In the industries based on iron and steel,[16] transportation rates are by no means an unimportant factor, so that one must look elsewhere for the explanation of the leading position of the one-plant firm. In these industries *internal* economies are important, in that there appears to be a lower limit to economical plant size which is high in relation to the total Canadian market (which, of course, is "small" compared with that of the United States or Great Britain). In the primary iron and steel industry there are economies in intergrating the successive stages of the production process in one place; the leading firms are one-plant firms only in the narrow sense adopted here; they have one plant at each of the primary stages.

While transportation costs are important, both the fabricating industries that constitute the market for iron and steel and the sources of iron ore and coal are concentrated geographically, so that large-scale production in one place does not necessarily involve transportation over greater distances then small-scale production. Hence the saving from a scattering of plants does not increase (per unit of out-

[15] Percentages computed from data in *The Manufacturing Industries of Canada, 1948*, Ottawa, Dominion Bureau of Statistics, 1951, pp. 21, 23, 112, 114, 115, 117.

[16] The eight industries in this group with weighted average number of plants per firm less than 1.25 are: pig iron, steel ingots and castings, iron castings, machine shops, shipbuilding, aircraft, bicycles, automobiles.

TABLE 24

Distribution of 96 Canadian Manufacturing Industries by Plant Concentration and Firm Concentration, 1948

Firm Concentration Index [a]	*Plant Concentration Index* [a]										
	0 to 1	*1 to 2*	*2 to 4*	*4 to 8*	*8 to 16*	*16 to 32*	*32 to 64*	*64 to 128*	*128 to 256*	*256 & over*	*Total*
0 to 1		1	2								3
1 to 2		3	2	2							7
2 to 4			11	3	2	1					17
4 to 8				13	3	1					17
8 to 16					12	7					19
16 to 32						6	2				8
32 to 64							4	2			6
64 to 128								5	2		7
128 to 256									4		4
256 & over										8	8
Total		4	15	18	17	15	6	7	6	8	96

[a] Number of the largest firms or plants required to account for 80 per cent of employment. Class intervals include lower limit.
Source: Appendix A, Table A-4.

put) with the increase in the scale of operations, and there is no incentive for multi-plant operation from this source.

The absence of geographical scatter and the predominance of one-plant firms can therefore be ascribed to the importance of external economies in the case of textiles, and to internal as well as external economies in the case of primary iron and steel.

In contrast to the primary iron and steel industry, the automobile industry does, of course, have a scattered market, since it sells to consumers. Hence multi-plant operation might be expected, and before World War II, Ford and General Motors did, in fact, have separate assembly plants in addition to their main plants in Ontario.[17] These plants were closed when civilian production was suspended during the war and were not reopened after the war.[18] While transportation costs are high in this industry the low density of population in Canada reduces the incentive to operate assembly plants.

There is an interesting contrast between these industries and the corresponding industries in the United States. The Canadian industries have borrowed technology from the United States so that plant sizes are comparable, but the much larger market in the United States has justified more geographical dispersion of plants, and the leading firms have more plants. There is also an interesting contrast with the pulp and paper industry, in which plant size is large and the Canadian market limited, but here the large export market has supported a multiplicity of plants, located close to raw materials and water power.

5. *The Correlation between Plant and Firm Concentration*

While the difference between plant and firm concentration is great in many industries, there is nevertheless a high correlation between the two variables in our cross section of industries. An industry with relatively high (or low) firm concentration generally also has relatively high (or low) plant concentration, as shown by a rank correlation coefficient of 0.947.[19] The correlation is illustrated by Table 24.

[17] *Canada Year Book, 1947*, Ottawa, Dominion Bureau of Statistics, p. 521 ff.
[18] Recently (1952) Ford has opened a second plant at Oakville, Ontario.
[19] For the 96 industries shown in Appendix A, Table A-4.