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ABSTRACT

The modern multiunit enterprise has been touted by historians and economic historians as a major and important phase of organizational change and a significant source of growth. However, no systematic record of the prevalence and patterns of multiunit activity has yet been established. This paper provides a systematic record of the rise and spread of the multiunit firm and examines the causes of its rise in U.S. manufacturing using data from the census bureau's enterprise statistics and other census sources.

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I. Introduction.

The modern multiunit business firm is one of the most prominent and significant organizational innovations in manufacturing production of recent times.[1] For most of the eighteenth and the nineteenth centuries, manufacturing enterprises were organized as traditional single-unit firms.[2] These enterprises operated in a local or regional market, produced a single line of product, and were owned and managed by a single individual or a partnership. During the last two decades of the nineteenth century, the multiunit business firm emerged and began to displace the single-unit firm in a number of industries. These multiunit enterprises operated plants in many regions, produced different lines of products, and were controlled by a hierarchy of managers. During the twentieth century, the predominance of multiunit firms in manufacturing activities grew domestically and internationally in the form of multinational firms.

For the business historian Alfred Chandler, the rise of the modern multiunit firm was an epochal event in the history of the modern world. It signaled the coming of managerial capitalism where economic growth is dependent upon the 'visible hand' of multiunit firms rather than the Smithian 'invisible hand' of markets. In his classic work, the *Visible Hand* (1977), and more recently in *Scale and Scope* (1990), Chandler provides a magisterial analysis of the sources of modern economic growth based on the modern business firm. For Chandler, modern economic growth is based upon high volume production technology which takes advantage of economies of

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[1] The multiunit firm is defined as a firm that controls and manages production establishments in at least two different localities. Multiunit firms are usefully categorized into the following three types: horizontal, vertical, and conglomerate or diversified. Horizontal firms produce the same product in different locations, vertical firms use outputs of some of their plants as intermediate inputs to some of their other plants, and conglomerate or diversified firms manage plants in unrelated industries.

[2] See Sokoloff (1984a,b, 1986) and Atack (1977, 1987) for analysis concerning the rise of single-unit firms in the United States. Also see Sokoloff and Dollar (1996).

scale and scope. However, economies of scale and scope cannot be realized by firms organized in traditional single-unit firms. Chandler argued that it was necessary for firms, in order to realize these economies, to vertically integrate forward into distribution to ensure sales of sufficient volume and vertically integrate backward into raw materials to ensure a constant flow of inputs. The vertical multiunit firm also necessitated innovations in the management structure. Whereas activities of single-unit firms were coordinated and monitored by the market mechanism, those of modern multiunit firms were coordinated and monitored by middle managers.

For economists, the analysis of the rise of the modern multiunit firm, and of firm size in general, is based on transaction cost theory of the firm.[3] This theory, originating from Coase (1937), revived and popularized by the works of Williamson (1975, 1985), Alchian and Demsetz (1972), and Klein, Crawford, and Alchian (1978), argues that firms internalize production because they incur greater transaction costs when they use markets.[4] According to Coase (1937), the costs of using the price mechanism were that of obtaining information on relevant prices in exchanges,

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[3] The traditional industrial organization literature based on the "structure-conduct-performance" perspective, usually identified with Joe Bain, explains the existence of the multiunit firm using economies of management, distribution, and pecuniary economies of large-scale buying from suppliers. See Bain (1968, 166). Other important sources of multiplant economies are research and development, management services, risk spreading, finance, and sales promotion. Although numerous estimates of single-unit economies (minimum efficient scale) have been made, few empirical studies exist which attempt to estimate the importance of multiunit economies. See Scherer (1975, 1980).

[4] As noted earlier, for historians and economic historians, the analysis of the rise of the multiunit firm has been influenced by the works of Alfred Chandler (1977, 1990). Chandler combined the elements of the traditional industrial organization literature and the transaction cost literature to explain the rise of the modern business firm. Chandler (1990, 17-18) argued that firm size is determined by transaction costs, but that these costs are, in turn, linked to technology. He wrote, "Transaction cost economies are, of course, closely related to those of scale and scope. The economies of scale and those of scope within a single unit of production or distribution permit that unit to expand the output of goods and services, which in turn, increases proportionately the number of recurring commercial transactions and contractual relations the enterprise may carry on with other operating units."

of negotiating and concluding a contract, and of signing long-term contracts when all possible contingencies cannot be specified.[5] However, production is not organized in one giant firm because there are costs of organizing production within a firm as well. Workers on a fixed wage may not have the incentive to exert the optimal level of effort unless firms expend resources to monitor their employees.

The transaction cost theory of the firm explains the boundaries of firms, but the theory must be modified to explain the boundaries of multiunit firms. The multiunit firm differs from other firms in that it owns and operates plants in at least two different localities. The international trade literature, in an attempt to explain the multinational firm, a subspecies of the multiunit firm, explains why multiunit firms exist by combining the theory of trade with transaction cost theory of the firm. First, the theory of trade explains why there is one or more plants operating in different localities. The location of plants depends upon factors such as advantages of location due to geographic variation in resources, local externalities, or nearness to markets.[6] Second, the theory of transaction cost explains whether firms will be single-unit or multiunit firms (i.e. whether plants in different locations should be owned by separate firms or by one firm.)[7] This paper is mainly concerned with this second issue.

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[5] Although a transaction involves both exchanges and contracts, the literature on transaction cost since Coase has focused on the contractual approach. For Williamson (1975, 1985), the costs of contracting in a vertical relationship are associated with the holdup problem. The problem arises under the following conditions: firms must make asset-specific or relationship-specific investments which are only valuable within the relationship, the investments must be sunk before the state of uncertainty is resolved, and firms cannot write a complete state contingent contract.

[6] These issues are addressed in Kim (1995, 1997a, 1997b).

[7] The recognition of the importance of ownership advantages in explaining multinational firms was first explored by Hymer (1976). Also see Dunning (1977, 1981).

Although the modern multiunit enterprises have been heralded by Chandler (1977, 1990) and others as a major and important phase of organizational change, and as a significant source of growth, no systematic record of the prevalence and patterns of multiunit activity has yet been established. The perception that complete data on firms are unavailable, or that they are too costly to construct, has deterred most scholars from undertaking a systematic analysis of the modern business firm. This paper provides a systematic record of the rise and spread of the multiunit firm using data from the census bureau's enterprise statistics and other census sources. From these sources, the paper furnishes information on the relative importance of multiunit and single-unit firm activities, plant and firm sizes of single-unit and multiunit firms, the level of vertical integration in multiunit firms, and the managerial intensity of multiunit firms by industry. Finally, the data is used to examine the causes of the rise and continued to growth of multiunit firms in U.S. manufacturing.

The multiunit firms which emerged during the last two decades of the nineteenth century grew steadily over the twentieth century. Although most establishments continued to operate as single-unit firms, the employment in plants of multiunit firms surpassed that of plants in single-unit firms by the second quarter of the twentieth century. The multiunit firms became more important than single-unit firms in terms of employment because the multiunit firms were significantly larger than single-unit firms. Multiunit firms were larger than single-unit firms since they owned and operated many establishments and because these establishments were significantly larger. The data also indicate that the relative importance of multiunit activity was disproportionately concentrated in a few industries and in a small percentage of very large firms.

The data on firm organization provide some evidence for Chandler's hypothesis that firms

emerged and grew by vertically integrating forward into distribution but provide little evidence that they did so by vertically integrating backward into raw materials. By 1929, the first year for which systematic data on distribution are available, manufacturers' sales branches were already responsible for almost a third of the distribution of the nation's manufactures. However, the proportion remained surprisingly constant over the second half of the twentieth century. In many industries, the traditional channels of distribution continued to handle the products of multiunit as well as single-unit firms. There is less evidence for the proposition that multiunit firms are vertically integrated backward into raw materials. Data from the enterprise statistics reveal that most multiunit firms concentrated their employment in a single industry. Thus, multiunit firms were predominantly organized as horizontal rather than as vertical or conglomerate firms.

While multiunit firms were often vertically integrated forward into distribution, they did so to take advantage of multiunit economies in marketing rather than to take advantage of economies of scale and scope in production. Since brand names, trade marks and reputation are difficult assets to transfer from one plant to another through the use of contracts, it was often optimal for plants which produced similar lines of products to operate under a common ownership. Similarly, multiunit economies in research and development also played an important role in explaining the rise and growth of modern multiunit firms.

The growth of multiunit activity in U.S. manufacturing was accompanied by growth in the employment of central administrative organizations which monitored and coordinated the activities of the various establishments of multiunit firms. In fact, the employment in central administrative organizations grew at twice the rate as employment in multiunit firms during the second half of the twentieth century. Data suggest that the costs of monitoring and coordinating

the activities of multiunit firms rose with firm size, number of establishments, involvement in non-primary industries, and geographic dispersion of establishments.

The remainder of the paper is organized as follows. Section II presents systematic information on single-unit and multiunit firms. Sections III and IV examine data on the organizational structure of multiunit firms as well as data on their central administrative organizations. Section V estimates the determinants of multiunit activities and examines the various explanations concerning the rise of multiunit firms. Section VI concludes with a summary.

II. The Extent of Multiunit Activity in U.S. Manufacturing, 1919-1987

This section documents the growth of the multiunit firm in U.S. manufacturing between 1917 and 1987 using data from the census of manufactures and the enterprise statistics. These two sources report information based on different classifications; the basic unit of measurement in the census of manufactures is the establishment whereas, in the enterprise statistics, it is the company or the firm.[8] In principle, the data used to construct the enterprise statistics can be used to reconstruct information contained in the census of manufactures and vice versa. However, the task is almost impossible to carry out using the reported data. If all firms were single-unit firms, then the information provided by the two sources would obviously be identical. On the other hand, if firms are multiunit, multi-industry firms, then the information reported by the two sources

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[8] The census of manufactures classifies data by establishment which is defined as follows: "As a rule, the term 'establishments' signifies a single plant or factory. In some cases, however, it refers to two or more plants operated under a common ownership and located in the same city, or in the same county but in different municipalities or unincorporated places having fewer than 10,000 inhabitants. On the other hand, separate reports are occasionally obtained for different lines of manufacturing carried on in the same plant, in which event a single plant is counted as two or more establishments. In every industry, however, the difference between the number of establishments and the actual number of plants or factories is negligible." (Census of Manufactures, 1935, p.5.) The enterprise statistics classifies data by firm or "company". For details, see Appendix I.

will differ. For example, suppose that ninety percent of a firm's production or employment is carried out in nine chemical establishments and that the remaining ten percent is devoted to one food establishment. The census of manufactures will categorize the nine chemicals and the one food plant in separate industries, noting that they all are part of a multiunit firm. However, the enterprise statistic will classify the food establishment as part of the chemicals industry, noting that ten percent of the production of the firm is in a non-primary industry.

Single-unit and Multiunit Firms by Industry, 1958-1987

The census of manufactures' Type of Organization reports, 1947-1987, Thorp (1924), and Thorp et. al. (1941), together provide the most complete information yet available on the extent of multiunit activity by industry in terms of establishments and employment.[9] The data in Table 1 show that the modern multiunit enterprise, which emerged in a number of manufacturing industries during the late nineteenth century, continued to grow during the twentieth century. The data also indicate that the relative importance of the multiunit over the single-unit firm depends upon the method of measurement. If one measures the importance of multiunit activity by establishments, then the data in Table 1 demonstrate that single-unit firms dominate multiunit firms by a wide margin. In 1919, only 7.4 percent of establishments belonged to multiunit firms.[10] In 1929 and 1937, the percentage of establishments in multiunit firms was 12.0 and 15.4 respectively, and the percentage grew steadily from 14.6 percent and 21.9 percent between 1947 and 1987. On the other hand, if multiunit activity is measured in terms of employment, then the

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[9] Thorp (1924) and Thorp et. al. (1941) used the original census returns to construct data on multiunit activities for 1919 and 1937.

[10] However, this estimate is likely to be biased downwards since several industries, paper, petroleum, rubber, machinery, and electrical machinery, were omitted in Thorp's (1924) 1919 study.

multiunit firms overtook the single-unit firms early in the twentieth century. In terms of employment, 48.0 and 51.4 percent of employees worked in establishments belonging to multiunit firms in 1929 and 1939 respectively; this figure rose from 56.0 percent to 73.1 percent between 1947 and 1987.

The data in Table 1 show that the multiunit activity by establishments in 1919 was the highest in the chemicals industry followed by textiles.[11] Multiunit activity in the primary metal industry was relatively high, but was it was lower than in stone, clay and glass, and was only slightly higher than in the leather industry. Multiunit activity in food and lumber and wood industries was near average, while it was the lowest in the transportation industry. However, the clustering of multiunit activity in certain industries did not stay constant over time. By 1958, the industries characterized by the highest proportions of multiunit firm employment were petroleum, tobacco, transportation, chemicals, and primary metals and were closely followed by electrical machinery, instruments, and paper. On the other hand, the industries which fell below average in multiunit activity in terms of employment were apparel, lumber and wood, furniture, printing, leather, and fabricated metal. Between 1958 and 1987, the pattern of industry clustering remained relatively stable, except for a few changes. The importance of multiunit activity in the food and textile industries rose relatively more rapidly whereas it declined for rubber and plastics and machinery.

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[11] The multiunit activity was clustered in a number of industries, but the information on industry clustering differs from that given by Chandler (1977). Using industry distribution of manufacturing firms with assets of $20 million or more in 1917, Chandler claims that multiunit firms were clustered in primary metals, food, transportation, machinery, petroleum, and chemicals industries since 171 out of the 236 firms were clustered in these six industries. However, in assessing the significance of multiunit activity in an industry, it is necessary to compare how much of the activity in that industry was organized by multiunit rather than by single-unit firms.

Multiunit activity measured in terms of employment was significantly more important than activity measured in terms of establishments because multiunit firms were significantly larger than single-unit firms. Table 2 shows that the size of single-unit firms was 21.8 and 17.8 employees per firm whereas for the multiunit firms it was 1002.1 and 852.7 employees per firm for 1958 and 1987 respectively. As the figures indicate, the average firm size of both single-unit and multiunit firms fell over the second half of the twentieth century. Multiunit firm sizes in primary metal, rubber and plastics, leather, and electrical machinery industries declined substantially, while they decreased more moderately in transportation, machinery, fabricated metal, petroleum, miscellaneous, stone, clay and glass, and textiles industries. However, there were some exceptions to this declining trend. The size of multiunit tobacco firms showed the greatest increase, almost quadrupling between 1958 and 1987. Multiunit firm sizes of food, apparel, lumber and wood, furniture, paper, printing, chemicals, and instruments industries also increased.

Multiunit firms were larger in terms of employment than single-unit firms because they owned and operated many plants and because the plants that they operated were significantly larger in size.[12] Data in Table 3 show that the overall number of establishments operated by multiunit firms remained relatively stable at 10 between 1958 and 1987. However, a few industries had a significantly larger number of establishments. The firms in the petroleum industry

[12] The data show that firm sizes of multiunit firms changed for the following two reasons. For tobacco and food industries, firm sizes increased significantly when both the number of establishments and plant size increased. Firm sizes of the petroleum, rubber and plastics, leather, primary metal and electrical machinery industries fell when both the number of establishments and plant size decreased (see Table 2 and Table 4). However, the firm sizes of furniture, paper, printing, and chemicals industries increased despite a fall in plant size because the number of establishments rose. Firm sizes of the transportation and stone, clay and glass industries decreased despite the acquisition of more establishments because their plant sizes fell significantly.

operated 163 plants per firm in 1958, but that number fell to 71 by 1987. On the other hand, the firms in the tobacco and transportation firms increased their number of establishments during this period from 12 to 55 and 10 to 20, respectively. Data in Table 4 show that plant size of multiunit firms were significantly larger than plant size of single-unit firms. In general, the plant size of multiunit firms were seven to ten times the size of plants of single-unit firms.

Single-unit and Multiunit Firms by Employment Size Class, 1958

The study of firms by employment size distribution shows that employment was concentrated in very large firms. Although the majority of firms were organized as single-unit firms, these firms accounted for only a small proportion of the work-force in manufacturing in 1958. Table 5 shows that even though more than 90 percent of all firms were organized as single-unit firms, these firms were responsible for only one fifth of all employees. Data in Table 5 show that the distribution of manufacturing employment among firms was highly skewed toward the largest multiunit, multi-industry firm. Multiunit firms which operated in only one industry accounted for 1.7 percent of firms, 4.0 percent of establishments, and 7.9 percent of employment. On the other hand, the multiunit, multi-industry firms which represented only 2.6 percent of all firms accounted for 28.1 percent of establishments and 59.5 percent of all employees. Furthermore, even within the multiunit, multi-industry firms, a small number of firms whose firm size was larger than 5,000 accounted for the majority of employment. The 363 multiunit, multi-industry firms whose firm sizes were over 5000 accounted for 67.4 percent of the total multiunit, multi-industry employment. Thus, these 363 firms or 0.013 percent of all firms accounted for almost 40 percent of all employment.

The very large firms accounted for almost 40 percent of employment because they

operated significantly more plants when compared to firms in other size categories. The multiunit, multi-industry firms whose firm sizes were between 20 and 5000 operated between 2.2 and 29.1 units per firm. However, the firms whose sizes were between 5000 and 10,000 owned 63.6 plants per firm while firms whose sizes were greater than 10,000 (averaging 31,828 employees per firm) owned 287.6 plants per firm. Surprisingly, the average plant size of the multiunit firm shows relatively little variation across firm sizes of above 1000 employees per firm.[13] Thus, firms increased their firm sizes predominantly through increasing their number of establishments rather than by operating larger establishments.

III. The Organization of Multiunit Firms.

This section examines the extent to which multiunit manufacturing firms are vertically integrated forward into distribution and backward into raw materials. The importance of vertical integration forward into distribution is calculated using data from the census of distribution which provides information on the proportion of wholesale trade accounted for by manufacturers' sales branches and offices as compared to that accounted for by wholesale merchants and jobbers and other wholesale middlemen such as agents, brokers, and commission merchants. The importance of vertical integration backward into raw materials is calculated using data from the enterprise statistics which reports information on a multiunit firm's distribution of employment in its primary industry and in other industries. The inverse of a firm's specialization in its primary industry provides an upper bound estimate of vertical integration backward into raw materials since the other industry category also includes completely unrelated industries.

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[13] Note that the plant size of multiunit firms in Table 5 are not comparable to plant sizes in Table 2. The figures in Table 5 are categorized by company whereas the figures in Table 2 are categorized by establishment.

The data in Table 6 provide some evidence for Chandler's hypothesis that multiunit firms emerged and grew by vertically integrating forward into distribution. By the early twentieth century, roughly a third of distribution of goods was handled by manufacturers' sale branches and offices. Although manufacturers' sales branches accounted for only 12.5 percent of establishments, they accounted for 27.5 percent of sales in wholesale trade in 1929.[14] However, the proportion grew only slightly over the twentieth century and manufacturers' sale branches were responsible for 34.3 percent of total sales in 1987. Thus, while some industries relied on their own marketing distribution, most multiunit firms continued to rely significantly on a variety of wholesale middlemen to distribute their products.

There is little evidence for the proposition that multiunit firms grew by vertically integrating backward into raw materials. The enterprise statistics data in Table 7 indicate that firms were predominantly organized as horizontal rather than vertical or conglomerate firms.[15] In

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[14] The relative importance distribution accounted for by manufactures' sales branches varied across industries and over time. In 1929, distribution through manufacturers' sales branches was significantly higher in the rubber and plastics, primary metals, electrical machinery, instruments, tobacco and machinery industries whereas it was relatively low in the petroleum, lumber and wood, textiles, transportation, printing and food industries. In 1987, distribution through manufacturers' sales branches was relatively more important in the chemicals, transportation and chemicals industries. The census bureau also provides a slightly different picture of the distribution of manufacturers' sales. The figures reported in Table 6 are based on canvassing of wholesale establishments. The census bureau also asked manufacturing establishments to report on the distribution of their sales for 1929, 1935 and 1939. The percentage of sales accounted for by manufacturers' own branches or offices were 17.5%, 21.7%, and 23.8% for those respective years. See Census of Business, Volume V, Distribution of Manufacturer's Sales, 1939.

[15] The enterprise statistics assigns firms to one of the 3-digit company industry categories by the level of its primary activity, but it also reports data on the firms' activities in other industries. In addition to non-primary manufacturing industries, the list of other industries includes minerals, public warehousing, wholesale trade, retail trade, services, and other out of scope industries such as agriculture, forestry, fisheries, construction, transportation, communication, electric gas, finance, insurance, and real estate. The firms' activities in central administrative organizations, which include manufacturer's sales branches and sales offices, are not included in the primary or other industry category. Unfortunately, it is extremely difficult to determine from the published sources whether industries are vertically or conglomerately related

1958, the specialization ratio, primary industry activity divided by total firm activity, when calculated by establishments and employment, was 82.4 and 78.5 percent respectively; in 1987, the ratio was 81.9 and 71.3 percent respectively.[16] However, the extent of activity outside the multiunit firms' primary industries was high for firms in some industries. In 1958, the firms in the petroleum industry operated only 6.6 percent of their establishments and 57.3 percent of their employment in their primary industry. In 1987, the firms in the tobacco industry operated 19.7 percent of their establishments and 28.7 percent of their employment in their primary industry.

The enterprise statistics also provides a more detailed list of other industry activities in 1958. In addition to the aggregate firm specialization ratio, the enterprise statistics reports data on firms' activities in each of the 135 industries. According to this data, only 13 of 91 industries employed more than 30 percent of their employees in vertical or unrelated industries.[17] Table 8 examines in greater detail the extent of diversification in these 13 industries. A closer examination

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to the primary industry. Thus, the other industry category provides an upper bound estimate on the importance of vertical integration and economies of scope. See Appendix I.

[16] Using a similar data set, Thorp and Crowder (1941) classified industries into the following categories: uniform, divergent, convergent, successive and unrelated. The firms in the first category are horizontal multiunit firms whereas firms in other industries are either vertically or conglomerately related. Adelman (1955) and Hoover (1942) also provide alternative indirect measures of vertical integration: the ratio of income to sales or the ratio of value added to value of products respectively. If firms in an industry are completely integrated, then the ratio of income to sales would equal unity as there would be no sales except to final consumers. As firms become less vertically integrated, interfirm transactions would increase and the ratio would fall below unity. Also see Stuckey (1983) for measures of vertical integration in the aluminum industry.

[17] The industries for which the specialization ratio was less than 70 percent by employment were 26A pulp, paper, board, 28A basic chemicals, 29A integrated petroleum refining, 30A rubber, 33A blast furnaces and steel mills, 33A metal cans, 35A engines and turbines, 35G office machines, 36B other electrical machinery, 37A motor vehicles, 37B aircraft, 37C aircraft engines, and 38C photographic equipment (Enterprise Statistics, 1958, part 1, General Report, Table 4). These data do not include employment in sales branches, sales offices, central administrative offices and auxiliaries.

of the data indicate that if horizontal integration is measured by two-digit rather than three-digit industries, the level of diversification falls sharply for firms in three industries: pulp paper and board, engines and turbines, and aircraft engines and propellers. For most firms that are diversified, vertical or unrelated employment occurred in other manufacturing rather than in non-manufacturing industries. The major exceptions were the integrated petroleum industry which employed 25 percent of its employment in mineral and transportation industries and 17 percent in wholesale and retail trade, and the office machines industry which employed 24 percent of its employment in wholesale and retail trade.

IV. The Visible Hand.

The emergence of the modern multiunit firm was accompanied by the growth in the central administrative organization which controls, monitors and coordinates the production decisions of establishments often located in different regions. The multiunit ownership advantages could not be realized by merely changing ownership patterns from single-unit to multiunit firms. Establishments in a multiunit firm did not operate independently through the market. Rather, the decisions concerning materials purchasing, production, pricing and marketing were administered from the firm's central administrative offices through a managerial hierarchy.

As the importance of multiunit activity increased during the twentieth century, the level of employment in central administrative organizations (CAOs) increased as well.[18] In fact, the

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[18] The census bureau's enterprise statistics defines the central administrative offices (CAO) as an establishment that is primarily engaged in general administrative, supervisory, purchasing, accounting, and related management functions performed centrally for other establishments of the same company. An auxiliary is an establishment which provides a supporting service - central warehouse, research laboratory, etc. - to the operating establishments of the same company, generally located separately from the establishment served.

increase in multiunit activity in manufacturing was accompanied by an even greater increase in the work force of CAOs. The level of multiunit employment in manufacturing rose by 31%, from 10.1 to 13.8 million employees between 1958 and 1987. However, over the same period, the number of CAO establishments and employment increased by 78.9% and 68.9% respectively.

The majority of CAO employees were involved in management and fewer than 20 percent were involved in research and development (Table 9). Moreover, the importance of research and development was concentrated in a few industries. In 1958, more than 80 percent of all employees in research and development in central administrative organizations were accounted for by just four industries: electrical machinery, transportation, chemicals and petroleum; in, 1987, the number increased to six industries: chemicals, transportation, machinery, electrical machinery, paper and instruments.

The costs of internalizing market functions with an administrative hierarchy is reflected in the costs of management of CAOs. The management costs of multiunit firms, estimated using the salary costs of CAOs, grew significantly over the latter half of the twentieth century. In 1958, the salary cost of CAOs was $4.48 billion or 3.62 per cent of manufacturing gross national product; in 1987, the respective figures rose to $46.7 billion or 5.47 percent. The salary cost of the CAOs also rose significantly with firm size.[19] In 1958, each multiunit company which had less than 20

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[19] The management costs per firm is calculated as follows. CAO employment per firm is calculated from Enterprise Statistics, part 2, CAO and Auxiliaries, Table 11. The management cost per firm is calculated by multiplying CAO employment per firm and the average CAO employee salaries of industries calculated from Enterprise Statistics, part 2, CAO and Auxiliaries, Table 2. The average salaries used are: 20 Food $6,975; 21 Tobacco $6,258; 22 Textiles $6,732; 23 Apparel $6,804; 24 Lumber and wood $6,194; 25 Furniture and fixtures $7,415; 26 Paper $7,241; 27 Printing $6,002; 28 Chemicals $7,748; 29 Petroleum $7,943; 30 Rubber and Plastics $7,530; 31 Leather $5,047; 32 Stone, clay, and glass $7,557; 33 Primary metal $8,575; 34 Fabricated metal $7,039; 35 Machinery $7,491; 36 Electrical machinery $7,304; 37 Transportation $7,609; 38 Instruments $7,253; and 39 Miscellaneous $7,468.

employees only expended on average $46,000 on CAO employees while a firm with more than 10,000 employees expended $24.5 million (see Table 10).

Managerial intensity (or management costs) in multiunit firms rose as firm size increased, but increased most significantly with the number of establishments. Thus, the cost of coordinating the activities of plants located in different regions was significantly higher than the cost of managing a similar sized firm with only one plant. Managerial intensity also rose with a firm's activities in industries other than in its primary activity.[20] For firms in industries such as apparel, lumber, furniture, textiles, printing, and paper, management costs per firm were low and rose moderately as firm size increased, and for others in the food, tobacco, rubber and plastics, leather, stone, clay and glass, fabricated metal, machinery, instruments and miscellaneous industries, management costs increased more moderately with firm size. However, for the firms in the petroleum, transportation, and to a lesser extent in instruments, chemicals, and primary metal industries, the management costs per firm escalated significantly with firm size.

The CAO employment was geographically concentrated in two regions, the Middle Atlantic and East North Central, and, more specifically, in large cities in those regions.[21] The

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[20] A simple regression of managerial intensity (CAO employee per company) on firm size (employee per company), number of establishments per firm, and percentage of employment in industries other than a firm's primary industry is reported below.

	Managerial Intensity				
Constant	Firm Size	Num. of Est.	Other Ind.	R^2	N
-49.3	0.017	4.87	2.48	0.93	91
(0.63)	(6.14)	(23.3)	(3.27)		

Note: t-statistics are in parenthesis.

[21] Thorp (1924, 144-9) found that, in 1919, three-fifths of the central offices which operated ten or more establishments were in cities of over 500,000 in population, and more than four-fifths in cities of over 100,000. The two leading cities were New York and Chicago. For the smaller 792 central offices which operated three to five establishments, 37.9 percent were located in the 12 large cities as compared to 62.7

geographic concentration of CAO employment was considerably greater than that of manufacturing. In 1954, more than 70 percent of CAO employment was located in these two regions as compared to 55 percent of manufacturing employment. In 1987, the geographic concentration of both CAO and manufacturing employment in the Middle Atlantic and East North Central regions declined to 54 and 37 percent respectively (see Table 11).[22]

V. The Determinants of Multiunit Activity.

This section examines the transaction cost theory of multiunit firms by constructing cross-sectional data from the enterprise statistics, 1958, the census of manufactures, 1958, and the census of transportation, 1963. The basic unit of observation is the ninety-one, 3-digit industry categories from the enterprise statistics. Since the enterprise statistics' 3-digit definitions differ slightly from those of the other two sources, comparable figures were constructed from the reported 4-digit level data for the census of manufactures and the census of transportation. The importance of multiunit activity as a dependent variable is captured by the percentage of industry employment in multiunit firms.[23] The independent variables include measures of research and

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percent for the larger central-office combinations.

[22] The enterprise statistics reported limited information on headquarter activities for the first time in 1987. The figures indicate that the Middle Atlantic and East North Central regions accounted for 47.6 percent of headquarter establishments and 54.5 percent of headquarter employment. Geographic information on research and development expenditures for 1963 shows a significant concentration of research activities in the Middle Atlantic and East North Central regions as well. In 1963, these two regions accounted for 66.5 percent of central administrative employment and 72.4 percent of research and development expenditures. In general, the total research and development expenditures of CAOs represented approximately 20 percent of all research and development expenditures in manufacturing (see Table 12).

[23] One potential problem with this measure is that two industries which have the same percentage of multiunit activities, but which differ in their number of establishments, are treated as if they are identical. For example, industries A and B may both have 70 percent of their employees in plants that are organized in multiunit enterprises, but firms in industry A may have, on average, three establishments whereas firms

development (R&D) intensity, managerial intensity, sales intensity, plant size, non-primary industry activity, capital intensity, energy intensity, raw material intensity, industry localization, and a proxy for transportation costs of final goods. Table 13 provides descriptive statistics of these variables.

For Chandler (1977, 1990), the fundamental source of transaction costs, which cause firms to organize in multiunit form, is driven by technology. In his framework, technology determines the rate of throughput which in turn determines transaction costs. Chandler argues that the two most important factors which determine the rate of throughput in manufacturing production are economies of scale and scope. These economies are measured by plant size and non-primary industry activity variables respectively. However, since Chandler believes that other factors such as capital, energy, management, and raw material intensities also influence the rate of throughput in production, these variables are also included in this study.

For economists, the primary source of transaction costs are related to problems of contracting. Certain proprietary assets, such as knowledge gained from research and development or marketing and selling skills, may be difficult to transfer to other firms by sale due to the fact

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in B may have five. However, there is no a priori reason to believe that these two cases should be treated differently. Moreover, the dependent variable used in this study is likely to be superior to most alternative measures. For example, Scherer et. al (1975) regressed the census count of plants operated by the four largest firms (and other similar measures) on a number of industry characteristics such as index of freight costs, a dummy variable on whether products are perishable or not, industry value added, four firm concentration ratio, a measure of multi-industry activity, average sales share of plants comprising the top fifty percent of an industry's plant size distribution, and industry localization. In many instances, counting the number of plants may over estimate the importance of multiunit activity as production may be concentrated in one or two plants. Other measures used in international studies are also likely to be problematic. The two widely used dependent variables are foreign operations of firms in a source country's industry as a percentage of total operations (outbound investment) and foreign subsidiaries' share of activity in a host country's market divided by total transactions in those markets (inbound foreign investment). For a discussion on the potential problems of misspecification in econometric studies which use these dependent variables, see Caves (1996).

that they are, to some degree, public goods and are subject to opportunism.[24] The importance of these assets is measured by research and development intensity and sales intensity. While there are a number of other sources of transaction costs which may contribute to the rise of multiunit firms, measurement difficulties precludes their inclusion in the regression analysis.

This study includes two additional variables, managerial intensity and industry localization, whose interpretation depends upon the theoretical framework one adopts. In the standard industrial organization literature, managerial intensity and industry localization may capture the multiunit economies of management and economies of coordinating geographically spread activities. However, in the transaction cost literature, these variables may capture the cost of monitoring and coordinating multiunit plants which often are geographically dispersed. This study also includes a proxy for transportation cost of final goods.

The regression results reported in Table 14 appear to support Chandler's interpretation of the rise of modern multiunit firms. The Chandlerian variables, plant size, other industry activity (vertical backward integration and economies of scope), capital or energy intensity, and sales intensity (forward integration into distribution) are all statistically significant. However, a more

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[24] Caves (1996, 3-4) writes: "The proprietary asset might take the form of a specific property right - a registered trademark or brand - or it might reset in marketing and selling skills shared among the firm's employees. Finally, the distinctiveness of the firm's marketing-oriented assets might rest with the firm's ability to come up with frequent innovations; its proprietary asset then might be a patented novelty, or simply some new combination of attributes that its rivals cannot quickly or effectively imitates... They are things that the firm can use but not necessarily sell or contract upon. Either the firm can hold legal title (patents, trademarks) or the assets are shared among the firm's employees and cannot be easily copied or appropriated (by other firms or by the employees themselves.) They possess either the limitless capacities of public goods (the strict intangibles) or the flexible capacities of the firm's repertory of routines. Especially important for MNE (multinational enterprise), while the productive use of these assets is not tightly tied to single physical sites or even nations, arm's-length transfers of them between firms are prone to market failures. These failures deter a successful one-plant firm from selling or renting its proprietary assets to other single-plant firms and thereby foster the existence of multiplant (and multinational) firms."

correct interpretation of the regression results casts doubt on Chandler's hypothesis of the rise of modern multiunit firms.

Properly interpreted, the regression results provide some important clues as to why multiunit firms are horizontally organized. Since employment in industries other than a firm's primary industry is a form of multiunit activity, the other industry variable is significant by definition. The inclusion of this variable in the regression essentially removes the contribution of multiunit activity which is due to vertical and unrelated integration from the dependent variable. Thus, the remaining independent variables explain why firms are organized as horizontal multiunit firms.

The cross-section regression analysis suggests that the two types of proprietary assets, R&D and marketing, are important explanatory variables for determining horizontal multiunit activity. The estimates reported in Table 14 indicate a positive and significant correlation between the extent of multiunit activity and R&D and sales intensities for most specifications. The variables, managerial intensity and industry localization, seem to suggest little evidence for the existence of economies in management or of economies in coordinating geographically dispersed economic activities. Rather, the multiunit firms' managerial intensity is likely to be determined by the need for monitoring and coordinating multiunit establishments. Moreover, the establishments in multiunit firms were more geographically localized rather than dispersed suggesting that the costs of coordinating and monitoring multiunit establishments increased with distance. Other variables such as transportation costs of final goods and raw material intensity did not figure importantly in explaining whether firms were single-unit or multiunit.

VI. Conclusion

The modern multiunit firm emerged during the last decades of the nineteenth century and continued to grow and spread throughout the twentieth century. The multiunit firms were predominantly organized as horizontal rather than as vertical or conglomerate firms, and were clustered in industries such as petroleum, tobacco, transportation, chemicals, primary metal, electrical machinery, instruments, and paper. Multiunit employment was also skewed toward the largest firms and these firms accounted for a disproportionate share of multiunit employment because they owned significantly larger numbers of plants. The growth in the importance of multiunit activities was accompanied by an even greater increase in the employment in central administrative organizations which monitored and coordinated the geographically dispersed plants. These central administrative organizations were regionally more concentrated than production establishments and were often located in large cities.

The emergence of the multiunit firm in the late nineteenth century was aided by significant developments which lowered the costs of coordinating and monitoring multiunit firms for all industries. Numerous advances in communications technologies and innovations in management and accounting techniques significantly lowered the costs of operating geographically dispersed plants.[25] The telegraph and railroads lowered the costs of transmitting information and goods across space. The invention of the typewriter, duplicators of various types, and vertical filing systems, lowered the costs of generating, spreading, storing and retrieving information. Innovations in accounting principles and the development of systematic management methods

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[25] See Chandler (1977), Williamson (1985), Yates (1989, 1991), Levenstein (1991), and Johnson (1991).

increased the efficiency of monitoring, controlling, and coordinating the activities of geographically dispersed plants.

The analysis of multiunit firms provides little evidence for Chandler's hypothesis that multiunit firms vertically integrated forward into distribution and backward into raw materials in order to take advantage of economies of scale and scope. Data on firm size distribution and firm industry specialization provide little evidence of multiunit economies of scale and scope. The very large multiunit firms achieved their size not by operating a few very large plants, but by operating multiple establishments. Moreover, these establishments were more often likely to be in the same industry. Multiunit firms concentrated the majority of their employment in their primary single three-digit industry.

Even when multiunit firms integrated forward into distribution, they did so to take advantage of economies in marketing similar products rather than to take advantage of economies of scale and scope. Since advertising, brand names, and reputation could more easily be established for the selling of similar products, and since these proprietary assets associated with marketing are difficult to contract, horizontal multiunit firms integrated forward into distribution. On the other hand, multiunit firms did not integrate backward into raw materials since purchasing these supplies through the market was relatively easy. In addition to marketing, other types of proprietary assets such as research and development played an important role in the rise of horizontal multiunit firms in U.S. manufacturing.

The rise of the modern multiunit firm greatly increased the visibility of firms in the modern economy. However, it is unclear that the arrival of the multiunit method of organizing production in manufacturing was necessary for modern economic growth. While the evidence of the rapid

displacement of single-unit firms by multiunit firms in a cluster of industries may signal the relative efficiency of the latter organizational form, it unfortunately does not indicate the magnitude of the multiunit firm's superiority. The economic importance of multiunit firms depends upon whether multiunit and single-unit firms are reasonably good substitute means of organizing production. The evidence presented in this paper suggests that the contribution of modern multiunit firms on economic growth is likely to hinge on the magnitude of economies of marketing and research and development rather than those of economies of scale and scope.

While the analysis presented in this paper furthers our understanding of the causes of multiunit firms, the difficulty of measuring certain types of transaction costs presents serious obstacles for a more complete analysis. Other sources of transaction costs are likely to contribute to explaining the existence of horizontal and vertical multiunit organizations even if those transaction costs are difficult to measure. Transaction costs associated with discovering relevant market prices may help explain why the multiunit firms' central administrative organizations are concentrated in large cities and transaction costs associated with holdup problems may explain why firms in some industries are vertically integrated. Further efforts in identifying the importance of these and other types of transaction costs will undoubtedly contribute to furthering our understanding of the causes of the rise and continued growth of modern multiunit firms in the twentieth century.

Appendix I

Although the data on multiunit firms were collected as a by-product of census enumeration by the census bureau, they were not publicly released until the publication of the enterprise statistics in 1954. The enterprise statistics, unlike the census of manufactures, reports data classified by firm or "company."[26] The enterprise statistics' definition of the company consists of all operating establishments (such as factories, mines, stores, sales offices, etc.) including any administrative or auxiliary activities (such as central offices, central warehouses, research and development laboratories, and other support services) which were reported as being under common ownership or control.[27]

A number of factors were responsible for the development of the company statistics program: the conducting of economic censuses by mail instead of field enumeration, the integration of economic censuses of manufacturing, retail trade, wholesale trade, construction, minerals, and service industries, and the availability of high speed computers. The census bureau, for the purposes of administrative control in conducting a census by canvass mail, found it more

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[26] The rise of the multiunit enterprise presented enormous challenges for the census bureau. Since its inception in 1810, the census bureau's basic unit of observation for its census of manufactures was the establishment. The establishment was defined as a plant that operated in one locality for which a separate set of books or records was kept. For many purposes, such as examining the geographic distribution of manufacturing activities, the data on establishments were appropriate. However, when studying firms whose boundaries extended from single-unit to multiunit operations, data on establishments were inadequate. Thus, the census bureau, while it continued to use establishments as the unit of observation for the census of manufactures, started reporting systematic data at the firm level with its enterprise statistics in 1954 and every census year thereafter.

[27] To aid in identifying establishments under common ownership or control, the following set of questions were asked for each establishment report: (a) Does this company operate more than one place of business under the same Employer Identification Number (item on the Employers Quarterly Tax Report, Treasury Form)?; (b) Does this company own or control another company?; and (c), Is this company owned or controlled by another company?

convenient to obtain individual establishment reports on a centralized basis from the main office of each firm which owned and operated more than one establishment.[28] As a result, information on firms and their establishments were systematically collected.[29] However, information on firms was limited to each census type of activity until all the economic censuses were integrated. For example, until the coordination of all the censuses, a manufacturing firm's size was limited to its ownership and control of manufacturing establishments. With the coordination of all economic censuses, it became possible to construct information on firm activities in all sectors of the economy.[30] Finally, without the advent of computers, the information on firms could not be constructed and released on a timely basis.

Classifying multiunit firms by industry categories was slightly more problematic than classifying their separate establishments. The census bureau discovered that if the multiunit firms were categorized at the 4-digit industry level, only a small fraction of a firm's activities might be in

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[28] Thorp et. al (1941, 102-3): "The Census Bureau, when taking a census of manufactures, sends schedules by mail to all individuals or concerns which it believes eligible for enumeration. In order to insure the sending of the census inquiries to the proper sources of information, the Census Bureau has maintained for some time a central-office file. Records are kept of all instances in which an establishment, or establishments, are operated from an office other than that at the plant itself. The census procedure makes possible some check on the accuracy of these records by requiring certain central offices to return, in addition to the schedules for their constituent plants, a supplementary schedule known as the 'Administrative and General Office Schedule,' which states the expenses of the central office. These facts are necessary in order that the expense of the operating the central office may be properly distributed among the production costs of the constituent establishments." Thorp (1924) and Thorp et. al (1941) have used the mailing list record of the Census Bureau to analyze multiunit firms.

[29] Moreover, the identification of company-establishment relationships was also required in order to determine whether the tabulated totals could be published without disclosing confidential data from individual companies.

[30] In 1929, the first separate census of business on retail and wholesale trade and the first census of construction were taken. In 1933, various services were also included in the census of business. The integrated economic census began in 1954 covering the censuses of retail and wholesale trade, selected service industries, manufactures, and mineral industries.

a 4-digit industry and that the information would prove to be rather uninformative. Thus, rather than assigning firms to one of the census of manufactures 4-digit industry codes, the census bureau created a more aggregate set of industry categories for the enterprise statistics. The census bureau established several criterion for a company classification system which has changed only marginally over the years. One criteria was that at least 50 to 75 percent of a firm's activities were in a specific industry category. Thus, the classification system attempted to minimize multi-industry activities by construction. However, these criterion were not enforced to unreasonableness, and for many industries, one or several of the criterion were violated.[31] The industry categories for the firm resembles, in general, the 3-digit industry categories.[32] For

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[31] The following criteria were used to establish the 122 company industry categories in 1954: (1) the presence of 10 or more multiunit companies in the industry category; (2) employment of 20,000 or more in multi-unit companies in the industrial category; (3) employment in multiunit establishments should represent at least 20 percent of employment in all establishments classified in the industry category; (4) at least 50 percent of establishment employment reported by multiunit companies primarily engaged in the industry category should consist of their employment in establishments classified in the industry category; (5) similarity in establishment activity (process used, materials used, or end-use product) of the specific industries grouped within the industry category. The above criterion were modified and supplemented to create the 135 industry categories used in the 1958 company classification system: (1) minimum size of 50,000 employees for each industry; (2) "industry specialization" (primary employment divided by total employment excluding CAOs, auxiliaries, sales and branches) and "ownership specialization" (establishment employment in the industry category of those companies classified in the industry category divided by all establishment employment in the industry category, regardless of the classification of the owning companies) ratios of at least 75 percent; (3) compatibility with the 1954 system; (4) categories for which information would not be unduly limited because of Census disclosure rules. These criteria were used as general guide lines and not every industry met every criteria. For example, 16 industries failed to meet the minimum criterion for industry specialization in 1958. All 16 were in manufacturing and accounted for more than 5.3 million employees and almost a third of all employment reported by manufacturing enterprises. Included among these were five of the eight largest industry categories in manufacturing: 28A basic chemicals, 29A integrated petroleum extraction, 33A blast furnaces and steel mills, 36B other electrical machinery, and 37A motor vehicles and equipment.

[32] In manufacturing, 38 out of 91 industries correspond directly to the census of manufacture's 3-digit SIC category. Many of the remaining industry categories correspond to the census of manufactures' 4-digit industries, the sum of 4-digit industries (sometimes across the 3-digit categories), and the sum of 3-digit industries. All the company statistics categories are less aggregated than the SIC 2-digit categories (except for tobacco) and, in no instance were categories across the 2-digit industries aggregated to form a company

example, in 1958 there were 135 industry categories in the company classification system: 91 in manufacturing, 5 in mining, 11 in wholesale trade, 16 in retail trade, and 11 in other services. The industries that were out of scope of the census surveys were agriculture, forestry, fisheries, construction, transportation, communication, electric, gas, sanitary services, finance, insurance, real estate and miscellaneous services.[33] Once the firms were categorized using the company classification system, however, the establishments were categorized using the census's 4-digit industries.

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statistics category.

[33] If a firm's primary activity was in one of the out of scope activities, then it was excluded from the enterprise statistics. However, data on out of scope activities are included when examining the firms in the census scope industries.

Table 1

The Extent of Multiunit Activity in U.S. Manufacturing by Industry, 1919-1987

	Percent of Establishments Operated as Part of Multiunit Firms				Percent of Employees in Establishments of Multiunit Firms		
	1919	1937	1958	1987	1937	1958	1987
20 Food	7.4%	19.0%	21.5%	35.0%	47.9%	60.4%	78.5%
21 Tobacco	5.2	-	39.9	50.4	-	89.2	97.1
22 Textiles	9.9	13.1	23.6	31.0	41.1	65.9	78.1
23 Apparel	-	-	8.3	14.0	-	33.1	52.6
24 Lumber	7.1	14.0	5.6	10.0	33.4	33.2	45.3
25 Furniture	-	-	7.9	14.3	-	37.3	59.4
26 Paper	-	31.4	36.4	45.4	55.0	78.7	82.0
27 Printing	2.5	4.0	6.3	10.9	21.0	45.6	56.3
28 Chemicals	19.7	31.6	31.9	44.2	71.5	85.9	86.5
29 Petroleum	-	48.3	46.7	62.2	90.0	92.3	89.0
30 Rubber	-	23.0	17.3	29.5	68.2	71.3	67.6
31 Leather	7.7	15.0	15.8	22.0	43.5	50.8	66.7
32 Stone	8.8	21.8	22.1	31.8	54.3	66.0	68.7
33 Primary	8.0	18.2	27.0	36.7	64.0	84.7	80.6
34 Fabricated	4.2	8.9	11.8	19.6	49.1	55.3	61.1
35 Machinery	-	14.4	9.4	13.4	54.4	67.7	65.6
36 Electrical	-	-	23.3	26.9	-	81.4	80.4
37 Transportation	1.4	23.6	18.3	23.5	79.7	87.3	90.0
38 Instruments	-	-	16.7	25.1	-	79.3	84.7
39 Miscellaneous	6.3	8.5	7.7	8.6	40.6	60.4	45.7
All Industries	7.4	15.4	14.0	21.9	51.1	65.5	73.1

Sources: Thorp (1924), Thorp et al (1941), Bureau of Census: Type of Organizations, 1958, 1987.
Note: Data are classified by establishments.

Table 2

Firm Size for Single-unit and Multiunit Firms:
U.S. Manufacturing by Industry, 1949-1987

	Single-unit Firms		Multiunit Firms	
	1958	1987	1958	1987
20 Food	21.3	23.3	520.9	832.0
21 Tobacco	32.9	19.6	2243.8	8419.2
22 Textiles	55.7	35.2	1126.2	1056.3
23 Apparel	30.0	25.8	420.6	526.1
24 Lumber	11.2	12.5	271.2	280.0
25 Furniture	23.9	20.8	383.0	659.8
26 Paper	37.6	32.2	1172.0	1236.1
27 Printing	15.1	11.9	483.8	610.3
28 Chemicals	13.7	16.4	1073.0	1120.3
29 Petroleum	17.0	15.0	3212.4	2178.0
30 Rubber	29.1	26.2	1318.6	507.3
31 Leather	47.6	25.0	859.2	340.9
32 Stone	17.3	14.9	494.2	417.4
33 Primary	37.5	32.3	2885.9	975.6
34 Fabricated	22.5	19.6	656.3	369.7
35 Machinery	17.2	14.1	1060.7	615.6
36 Electrical	36.2	26.3	2336.5	1123.7
37 Transportation	39.8	22.7	5016.2	4190.1
38 Instruments	22.2	19.9	1309.6	1593.2
39 Miscellaneous	18.0	13.4	519.3	264.4
All Industries	21.8	17.8	1002.1	852.7

Note: Firm size is defined as the number of employees divided by the number of companies in each industry category. Data are classified by firms.
Sources: Bureau of Census: Enterprise Statistics: 1958, Bureau of Census: Company Statistics, 1987, Table 6.

Table 3

Average Number of Establishments per Company for
Multiunit Firms: U.S. Manufacturing by Industry, 1919-1987

	1919*	1937*	1958	1987
20 Food	4.2	5.8	9.2	12.9
21 Tobacco	4.6	-	12.2	55.4
22 Textiles	3.1	3.3	6.2	8.4
23 Apparel	-	-	4.1	6.7
24 Lumber	3.0	3.6	4.6	4.2
25 Furniture	-	-	4.3	7.7
26 Paper	-	4.6	8.1	12.2
27 Printing	3.4	3.5	4.3	8.0
28 Chemicals	3.8	5.7	11.7	14.8
29 Petroleum	-	6.5	162.2	71.1
30 Rubber	-	3.8	17.8	8.8
31 Leather	3.4	3.9	13.0	6.0
32 Stone	2.5	3.8	6.4	8.2
33 Primary	3.4	4.8	13.3	10.6
34 Fabricated	3.7	4.2	5.8	4.9
35 Machinery	-	3.6	9.6	6.8
36 Electrical	-	-	15.2	10.5
37 Transportation	4.4	6.2	10.3	20.1
38 Instruments	-	-	12.8	12.6
39 Miscellaneous	3.8	3.9	4.8	3.8
All Industries	3.7	4.6	10.5	9.7

Sources: Thorp (1924), Thorp et al (1941), Bureau of Census: Enterprise Statistics, 1958, Bureau of Census: Company Statistics, 1987.
*The figures for 1919 and 1937 only include manufacturing establishments.

Table 4

Plant Size of Single-unit and Multiunit Firms:
U.S. Manufacturing by Industry, 1947-1987

	Plant Size of Single-unit Firms				Plant Size of Multiunit Firms			
	1947	1958	1967	1987	1947	1958	1967	1987
20 Food	21.1	20.6	35.2	23.3	84.7	114.4	133.4	157.7
21 Tobacco	26.1	30.2	52.4	19.1	387.2	374.7	432.5	629.0
22 Textiles	85.4	52.5	64.9	35.2	375.2	327.8	323.8	278.9
23 Apparel	27.9	29.4	44.1	25.7	132.7	161.1	202.1	175.1
24 Lumber	18.2	10.9	25.6	12.5	56.3	91.6	105.5	92.6
25 Furniture	32.6	23.3	43.1	20.8	161.8	161.6	197.7	182.6
26 Paper	53.9	35.3	46.2	31.9	212.1	227.8	201.5	175.7
27 Printing	18.0	14.2	29.8	11.9	149.9	176.5	195.5	125.1
28 Chemicals	24.2	12.8	24.6	16.4	152.6	166.6	165.4	132.2
29 Petroleum	40.3	16.1	23.6	15.2	280.2	220.2	127.5	74.2
30 Rubber	93.8	27.1	41.8	26.2	1050.7	321.1	232.4	130.5
31 Leather	46.4	45.1	72.4	25.0	239.3	246.7	262.2	178.1
32 Stone	20.1	16.1	26.2	14.8	155.1	110.3	105.5	69.8
33 Primary	64.4	35.6	53.2	32.2	682.1	534.3	495.8	231.2
34 Fabricated	33.9	21.6	35.5	19.6	264.3	200.4	193.6	126.1
35 Machinery	44.3	16.1	28.0	14.1	464.7	325.0	325.8	172.9
36 Electrical	68.1	33.7	49.6	26.3	667.7	484.8	527.0	293.7
37 Transportation	75.0	36.7	50.0	22.7	1382.2	1126.6	981.8	662.4
38 Instruments	41.8	20.9	36.2	19.8	423.8	400.5	353.0	324.6
39 Miscellaneous	23.3	17.2	32.3	13.4	160.1	314.5	171.7	120.6
All Industries	30.6	20.7	36.3	17.7	227.4	240.7	250.8	177.7

Sources: Bureau of Census: Type of Organizations, 1947-1987.
Note: Plant size is defined as the number of employees divided by the number of establishments. The data are classified by establishments rather than by firms.

Table 5

Single and Multiunit Firms by Employment Size Class

Total Manufacturing	All	less 20	20-99	100-249	250-499	500-999	1000-2499	2500-4999	5000-9999	10,000+
Companies	269834	194750	57582	10674	3559	1604	955	333	196	181
Establishments	379896	195931	63655	17392	10313	8396	12321	9199	12038	50651
Employees	17273	1129	2430	1627	1231	1102	1468	1142	1386	5756
Est/Co.	1.4	1.0	1.1	1.6	2.9	5.2	12.9	27.6	61.4	279.8
Firm Size	64.0	5.8	42.2	152.4	345.9	687.2	1537.6	3430.4	7072.5	31802.8
Plant Size	45.5	5.8	38.2	93.5	119.4	131.3	119.2	124.2	115.2	113.6
(Percent)										
Companies	100	72.2	21.3	4.0	1.3	0.6	0.4	0.1	0.1	0.1
Establishments	100	51.6	16.8	4.6	2.7	2.2	3.2	2.4	3.2	13.3
Employees	100	6.5	14.1	9.4	7.1	6.4	8.5	6.6	8.0	33.3

Single Unit Manufacturing	All	less 20	20-99	100-249	250-499	500-999	1000-2499	2500-4999	5000+
Companies	258210	193795	54013	8049	1836	433	75	6	3
Establishments	258210	193795	54013	8049	1836	433	75	6	3
Employees	5625	1119	2238	1202	617	283	106	17	44
Est/Co.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Firm Size	21.8	5.8	41.4	149.3	335.8	652.6	1415.5	2761.8	14627.0
Plant Size	21.8	5.8	41.4	149.3	335.8	652.6	1415.5	2761.8	14627.0
(Percent)									
Companies	100	75.1	20.9	3.1	0.7	0.2	0.0	0.0	0.0
Establishments	100	75.1	20.9	3.1	0.7	0.2	0.0	0.0	0.0
Employees	100	20.6	39.3	21.1	10.7	5.1	1.9	0.4	0.9

Source: Bureau of Census, Enterprise Statistics: 1958, part 1, General Report, Table 8.

Table 5 - continued

Single and Multiunit Firms by Employment Size Class

Multiunit Single-industry Manufacturing	All	less 20	20-99	100-249	250-499	500-999	1000-2499	2500-4999	5000+
Companies	4448	294	1573	1247	726	412	197	28	11
Establishments	15008	653	3769	3587	2806	2057	1470	492	174
Employees	1371	4	85	202	253	284	280	91	172
Est/Co.	3.3	2.2	2.4	2.9	3.9	5.0	7.5	17.6	15.8
Firm Size	305.4	12.1	54.0	161.9	348.2	689.0	1422.6	3267.1	15630.9
Plant Size	91.3	5.4	22.5	56.3	90.1	138.0	190.7	185.9	988.2
(Percent)									
Companies	100	6.6	35.0	27.8	16.2	9.2	4.4	0.6	0.2
Establishments	100	4.4	25.1	23.9	18.7	13.7	9.8	3.3	1.2
Employees	100	0.3	6.2	14.7	18.4	20.7	20.4	6.7	12.5

Multiunit Multi-industry Manufacturing	All	less 20	20-99	100-249	250-499	500-999	1000-2499	2500-4999	5000-9999	10,000+
Companies	7136	661	1996	1378	997	759	683	299	187	176
Establishments	106678	1483	5873	5756	5671	5906	10776	8701	11898	50614
Employees	10278	7	107	223	362	536	1082	1034	1325	5602
Est/Co.	14.9	2.2	2.9	4.2	5.7	7.8	15.8	29.1	63.6	287.6
Firm Size	1440.3	10.2	53.7	162.0	362.9	705.9	1584.2	3459.1	7085.2	31828.2
Plant Size	96.3	4.5	18.2	38.8	63.8	90.7	100.4	118.9	111.4	110.7
(Percent)										
Companies	100	9.3	28.0	19.3	14.0	10.6	9.6	4.2	2.6	2.5
Establishments	100	1.4	5.5	5.4	5.3	5.5	10.1	8.2	11.2	47.4
Employees	100	0.1	1.0	2.2	3.5	5.2	10.5	10.1	12.9	54.5

Source: Bureau of Census, Enterprise Statistics: 1958, part 1, General Report, Table 8.

Table 6

Organizations Engaged in Wholesale Distribution of Manufactures, 1929-1987

1929

	Wholesale Trade		Mfg. Sales Branches		Merchant Wholesalers	
	Est.	Sales	Est.	Sales	Est.	Sales
		($ million)	(percent)		(percent)	
20 Food	42902	19048	9.6	19.2	53.0	41.2
21 Tobacco	2016	1692	11.5	45.8	78.1	48.6
22 Textiles	6601	4672	7.4	14.1	60.1	32.7
23 Apparel	6113	2140	10.6	20.6	61.4	49.6
24 Lumber	3311	1340	5.0	7.7	62.7	53.5
25 Furniture	1146	345	26.3	25.0	41.5	34.9
26 Paper	3103	1133	14.8	28.4	72.0	60.2
27 Printing	636	203	19.2	16.6	64.5	61.5
28 Chemicals	4473	2563	24.7	32.8	52.1	36.3
29 Petroleum	23008	3366	0.6	1.9	13.1	19.9
30 Rubber	747	508	63.9	89.3	32.4	7.5
31 Leather	2308	1018	12.1	33.7	71.2	46.7
32 Stone	3222	1010	20.0	39.4	63.2	49.7
33 Primary	2277	4440	43.0	64.0	35.0	9.2
34 Fabricated	4575	1686	18.8	20.2	63.1	70.8
35 Machinery	10855	2850	28.4	44.1	49.0	36.1
36 Electrical	3870	2435	24.6	53.1	55.5	34.3
37 Transportation	3945	1869	7.6	12.8	81.2	70.3
38 Instruments	2156	577	27.6	52.5	62.7	38.7
39 Miscellaneous	2833	669	9.4	23.3	65.1	50.3
All Industries	130097	53561	12.5	27.5	49.2	38.9

Source: Census of Wholesale Distribution, 1929, Tables 5-7.
Note: The remainder is accounted for by the following wholesale organizations: converters, exporters, importers, cash and carry, drop shippers, mail order wholesalers, wagon distributors, distributing warehouses, bulk tank stations, chain store warehouses, district and general sales offices, cooperative sales agencies, agents and brokers, assemblers and country buyers, and all other types.

Table 6 - continued

Organizations Engaged in Wholesale Distribution of Manufactures, 1929-1987

1958

	Wholesale Trade		Mfg. Sales Branches		Merchant Wholesalers	
	Est.	Sales	Est.	Sales	Est.	Sales
		($ million)	(percent)		(percent)	
20 Food	50483	57786	8.3	21.8	74.0	54.9
21 Tobacco	2953	5439	5.8	32.1	93.4	67.4
22 Textiles	5389	7512	5.5	23.8	81.8	44.8
23 Apparel	5822	5126	5.7	17.9	71.7	41.3
24 Lumber*	11689	10551	10.7	31.7	81.0	59.4
25 Furniture	6946	4814	10.6	30.8	77.2	52.1
26 Paper	6512	6659	14.6	36.8	79.6	53.5
27 Printing	-	-	-	-	-	-
28 Chemicals	10257	16577	24.4	67.4	69.2	28.0
29 Petroleum						
30 Rubber	2093	2068	14.6	66.3	83.6	31.6
31 Leather	803	936	9.6	43.8	76.7	44.2
32 Stone*	-	-	-	-	-	-
33 Primary	7466	22104	23.3	67.0	64.2	25.1
34 Fabricated	11485	7913	4.6	10.4	82.6	74.8
35 Machinery	36742	23460	16.9	39.1	73.4	48.2
36 Electrical	7852	8255	5.8	14.3	81.3	70.6
37 Transportation	20961	21420	5.2	64.8	91.0	30.1
38 Instruments	4881	2281	22.1	35.1	75.0	58.8
39 Miscellaneous	31008	22046	6.5	21.6	78.7	53.3
All Industries	223342	224947	10.7	36.8	77.4	47.6

Source: Census of Business, Wholesale Trade, 1939, Tables 1A.
Note: The remainder is accounted for by agents and brokers.
* Lumber and Wood industry includes Stone, Clay an d Glass products.

Table 6 - continued

Organizations Engaged in Wholesale Distribution of Manufactures, 1929-1987

1987

	Wholesale Trade		Mfg. Sales Branches		Merchant Wholesalers	
	Est.	Sales	Est.	Sales	Est.	Sales
		($ million)	(percent)		(percent)	
20 Food	47910	430377	10.3	22.3	79.2	61.5
21 Tobacco	1813	25465	1.8	23.0	97.0	76.9
22 Textiles	5696	25668	5.7	32.4	82.1	53.1
23 Apparel	9545	44515	4.6	27.5	77.4	58.3
24 Lumber	8098	45878	5.9	12.5	86.9	81.2
25 Furniture	6819	18630	4.3	15.6	76.5	63.7
26 Paper	16808	83173	11.2	43.8	81.2	49.1
27 Printing	3935	14696	16.1	30.6	76.6	55.0
28 Chemicals	21274	165602	19.0	57.0	73.2	38.4
29 Petroleum	16726	234874	13.3	39.5	84.3	53.2
30 Rubber	3746	-	7.6	-	90.9	-
31 Leather	1694	11293	2.8	16.9	78.3	61.9
32 Stone	10977	34069	11.3	33.1	82.9	62.0
33 Primary	10261	101143	10.0	34.7	79.0	59.3
34 Fabricated	23097	57126	4.1	12.6	85.5	72.4
35 Machinery	103496	307379	9.4	36.3	82.7	56.9
36 Electrical	33509	173174	10.0	30.1	74.0	52.9
37 Transportation	36027	309389	3.5	46.8	92.8	46.7
38 Instruments	14316	53217	6.5	39.0	84.9	56.1
39 Miscellaneous	14273	62481	1.5	6.4	87.7	82.4
All Industries	390040	2198146	8.8	34.3	82.2	56.1

Source: Census of Wholesale Trade, 1987, Table 1.
Note: The remainder is accounted for by agents, brokers, and commission merchants.

Table 7

Industry Specialization Ratios in U.S. Manufacturing by Industry, 1958-1987

	Industry Specialization by Establishments		Industry Specialization by Employees	
	1958	1987	1958	1987
20 Food	81.8%	61.3%	88.9%	70.6%
21 Tobacco	84.5	19.7	90.5	28.7
22 Textiles	85.9	68.7	87.9	73.3
23 Apparel	96.3	86.0	96.9	93.2
24 Lumber	97.4	96.0	94.1	90.0
25 Furniture	97.1	83.5	96.1	83.8
26 Paper	76.5	60.3	72.5	60.2
27 Printing	97.2	91.5	93.6	85.5
28 Chemicals	75.5	59.0	72.1	59.5
29 Petroleum	6.6	12.2	57.3	28.1
30 Rubber	60.4	71.1	78.6	81.2
31 Leather	69.1	77.1	92.9	93.1
32 Stone	90.1	84.1	83.7	75.0
33 Primary	74.1	58.0	74.4	70.2
34 Fabricated	93.8	88.6	82.8	79.1
35 Machinery	92.8	89.5	79.5	76.6
36 Electrical	68.4	74.0	72.4	72.3
37 Transportation	82.8	52.6	72.0	56.4
38 Instruments	78.8	63.5	78.0	52.4
39 Miscellaneous	76.6	95.1	72.1	91.8
All Industries	82.4	81.9	78.5	71.3

Sources: Bureau of Census: Enterprise Statistics: 1958, pt 1, General Report, Table 4. Bureau of Census: Company Statistics, 1987, Table 8.

Table 8

Specialization and Diversification in U.S. Manufacturing, 1958
(Employment in Thousands)

	26A Pulp, Paper, Board		28A Basic Chemicals		29A Integrated Petroleum		30A Rubber		34A Blast Furnace	
All Company	304.6	100.0%	516.9	100.0%	508.2	100.0%	298.3	100.0%	720.8	100.0%
Primary 3-digit	177.4	58.2	285.3	55.2	0.0	0.0	209.3	70.2	474.2	65.8
Primary 2-digit	65.4	21.5	25.7	5.0	131.6	25.9	3.4	1.1	25.9	3.6
Other Mfg	34.8	11.4	98.9	19.1	17.6	3.5	44.0	14.7	95.7	13.3
Other Ind.	4.2	1.4	24.9	4.8	126.5	24.9	2.0	0.7	64.1	8.9
Warehouse	0.06	0.0	0.01	0.0	0.01	0.0	0.0	0.0	0.06	0.0
Wholesale-Retail	5.3	1.8	1.8	0.3	86.4	17.0	17.7	5.9	11.1	1.5
Sales	3.9	1.3	24.0	4.6	4.1	0.8	12.2	4.1	11.7	1.6
CAO	13.5	4.4	56.4	10.9	142.8	28.1	9.7	3.3	37.9	5.3

	34A Metal Cans		35A Engines and Turbines		35G Office Machines		36B Other Electric		37A Motor Vehicles	
All Company	107.3	100.0%	88.0	100.0%	251.3	100.0%	807.9	100.0%	938.1	100.0%
Primary 3-digit	47.8	44.6	46.0	52.3	113.2	45.1	498.1	61.7	539.3	57.5
Primary 2-digit	6.4	5.9	21.4	24.3	6.3	2.5	48.5	6.0	39.1	4.2
Other Mfg	41.7	38.8	15.8	18.0	50.6	20.1	158.8	19.7	223.1	23.8
Other Ind.	0.2	0.2	0.03	0.0	5.7	2.3	13.6	1.7	16.9	1.8
Warehouse	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.06	0.0
Wholesale-Retail	0.2	0.2	0.1	0.1	0.8	0.3	27.2	3.4	4.0	0.4
Sales	2.9	2.7	3.7	4.2	60.6	24.1	26.4	3.3	46.1	4.9
CAO	8.2	7.6	0.9	1.0	14.2	5.6	35.3	4.4	69.6	7.4

Source: Bureau of Census, Enterprise Statistics: 1958, part 1, General Report, Table 6.

Table 8 - continued

Specialization and Diversification in U.S. Manufacturing, 1958
(Employment in Thousands)

	37B Aircraft		37C Aircraft Engines		38C Photographic Equipment	
All Company	461.9	100.0%	390.6	100.0%	85.9	100.0%
Primary 3-digit	361.9	78.3	272.6	69.8	55.4	64.5
Primary 2-digit	19.8	4.3	25.0	6.4	1.1	1.3
Other Mfg	74.1	16.0	70.8	18.1	14.9	17.4
Other Ind.	3.6	0.8	4.5	1.1	4.6	5.4
Warehouse	0.0	0.0	0.0	0.0	0.0	0.0
Wholesale-Retail	0.8	0.2	3.5	0.9	1.3	1.5
Sales	0.06	0.0	1.1	0.3	5.0	5.8
CAO	1.8	0.4	13.1	3.4	3.6	4.2

Source: Bureau of Census, Enterprise Statistics: 1958, part 1, General Report, Table 6.

Table 9

Central Administrative Organization: U.S. Manufacturing, 1958

Industries	CAO Est.	CAO Employment	Administrative Employment	R&D Employment	Adm. Employment (percent)	R&D Employment (percent)	Other Employment (percent)
20 Food	873	63337	54454	1966	86.0%	3.1%	10.9%
21 Tobacco	54	7521	6632	375	88.2	5.0	6.8
22 Textiles	179	15367	13065	640	85.0	4.2	10.8
23 Apparel	182	7519	6446	10	85.7	0.1	14.1
24 Lumber & Wood	146	5677	5490	60	96.7	1.1	2.2
25 Furniture & Fixtures	63	3005	2745	0	91.3	0.0	8.7
26 Paper	183	22254	20465	501	92.0	2.3	5.8
27 Printing & Publishing	179	7118	5651	175	79.4	2.5	18.2
28 Chemicals	465	85635	63350	20556	74.0	24.0	2.0
29 Petroleum & Coal	233	68274	53006	12908	77.6	18.9	3.5
30 Rubber & Plastics	40	8267	7447	750	90.1	9.1	0.8
31 Leather	68	9319	7679	10	82.4	0.1	17.5
32 Stone, Clay & Glass	258	22268	18585	2930	83.5	13.2	3.4
33 Primary Metal	214	37585	32874	2306	87.5	6.1	6.4
34 Fabricated Metal	246	29774	26119	2155	87.7	7.2	5.0
35 Machinery	286	35524	29538	4512	83.1	12.7	4.1
36 Electrical Machinery	390	77838	36491	35780	46.9	46.0	7.2
37 Transportation	176	79431	46354	29545	58.4	37.2	4.4
38 Instruments	66	7436	6284	723	84.5	9.7	5.8
39 Miscellaneous	67	7637	7028	420	92.0	5.5	2.5
All Industries	4368	600786	449703	116322	74.9	19.4	5.8

Source: Bureau of Census, Enterprise Statistics: 1963, part 2, CAO and Auxiliaries, Table 3A. Bureau of Census, Enterprise Statistics: 1958, part 2, CAO and Auxiliaries, Table 2.

Table 9 - continued

Central Administrative Organization: U.S. Manufacturing, 1987

Industries	CAO Est.	CAO Employment	Administrative Employment	R&D Employment	Adm. Employment (percent)	R&D Employment (percent)	Other Employment (percent)
20 Food	1203	110244	77025	8345	69.9%	7.6%	22.6%
21 Tobacco	51	18643	9797	2326	52.6	12.5	35.0
22 Textiles	312	27203	16428	1601	60.4	5.9	33.7
23 Apparel	453	33893	20643	552	60.9	1.6	37.5
24 Lumber & Wood	325	13658	8506	617	62.3	4.5	33.2
25 Furniture & Fixtures	202	12006	8030	582	66.9	4.8	28.3
26 Paper	304	43420	28446	9652	65.5	22.2	12.3
27 Printing & Publishing	982	88077	54786	1585	62.2	1.8	36.0
28 Chemicals	1215	214317	120871	53621	56.4	25.0	18.6
29 Petroleum & Coal	233	40051	27144	6296	67.8	15.7	16.5
30 Rubber & Plastics	395	28711	17492	4720	60.9	16.4	22.6
31 Leather	83	6738	3746	130	55.6	1.9	42.5
32 Stone, Clay & Glass	533	31252	20775	3085	66.5	9.9	23.7
33 Primary Metal	420	28248	19245	3029	68.1	10.7	21.1
34 Fabricated Metal	584	41063	26118	3891	63.6	9.5	26.9
35 Machinery	1023	158985	103348	20901	65.0	13.1	21.8
36 Electrical Machinery	832	127953	74285	19343	58.1	15.1	26.8
37 Transportation	432	135531	59052	46312	43.6	34.2	22.3
38 Instruments	326	60306	36401	9054	60.4	15.0	24.6
39 Miscellaneous	156	11950	7365	1006	61.6	8.4	29.9
All Industries	10064	1232249	739503	196648	60.0	16.0	24.0

Source: Bureau of Census, Enterprise Statistics: 1987, Auxiliary Establishments, Table 1.

Table 10

Firm Cost of Management by Employment Size Class, 1958
($ Thousand per Company)

Industries	All	Firm Size Categories								
		less 20	20-99	100-249	250-499	500-999	1000-2499	2500-4999	5000-9999	10,000+
20 Food	1249	30	74	128	280	548	1362	2476	5633	10905
21 Tobacco	2394	-	20	188	-	457	2347	548	4521	11734
22 Textiles	811	67	84	85	137	209	529	2103	1558	5698
23 Apparel	337	68	44	100	238	283	611	1219	1507	-
24 Lumber	250	29	51	110	209	291	382	1161	3097	-
25 Furniture	560	-	89	174	275	592	894	1391	1390	-
26 Paper	1577	72	57	127	191	525	951	1985	4603	6887
27 Printing	532	60	100	174	270	399	503	2052	1214	4502
28 Chemicals	3404	39	91	208	401	1000	1625	2573	7035	26532
29 Petroleum	16961	-	182	305	407	1784	1862	6658	18021	66085
30 Rubber & Plastics	2130	-	57	292	226	443	819	1057	9413	14646
31 Leather	1163	-	109	49	98	138	442	1893	-	11497
32 Stone	1089	61	85	146	283	419	914	1592	4195	13262
33 Primary Metal	4974	-	300	109	428	550	810	1080	3055	21205
34 Fabricated Metal	1247	70	54	182	249	441	901	3399	2157	16131
35 Machinery	2057	75	97	200	304	579	826	1285	3121	13513
36 Electrical	8101	73	146	109	331	1028	1137	2098	2732	59173
37 Transportation	7895	76	61	207	500	358	864	1493	3041	27397
38 Instruments	1580	73	73	96	1269	490	1041	783	5077	10290
39 Miscellaneous	1156	75	131	339	217	330	1087	1344	4506	9335
All Industries	2524	46	81	150	278	552	956	2026	4349	24567

Source: Bureau of Census, Enterprise Statistics: 1958, part 2, CAO and Auxiliaries, Table 11.

Table 11

The Geographic Distribution of Central Administrative Organizations

	1958				1987							
	CAO		CAO		CAO		Headquarters		CAO		Headquarters	
	Est.	Emp.	Est. (percent)	Emp.	Est.	Emp.	Est.	Emp.	Est. (percent)	Emp.	Est. (percent)	Emp.
NE	303	39194	6.9%	6.5%	461	57630	235	41062	6.6%	6.2%	7.8%	7.5%
MA	1423	230752	32.6	38.3	1297	230260	620	115364	18.6	24.7	20.5	21.2
ENC	962	176387	22.0	29.3	1595	273483	818	181630	22.8	29.3	27.1	33.3
WNC	283	31503	6.5	5.2	550	75881	259	56743	7.9	8.1	8.6	10.4
SA	405	40689	9.3	6.8	1065	117899	385	58016	15.2	12.6	12.8	10.6
ESC	159	16370	3.6	2.7	324	26663	118	11846	4.6	2.9	3.9	2.2
WSC	258	23345	5.9	3.9	646	52768	208	27362	9.2	5.7	6.9	5.0
MT	72	4032	1.6	0.7	230	12274	70	5991	3.3	1.3	2.3	1.1
PC	505	39912	11.6	6.6	821	86422	305	47177	11.7	9.3	10.1	8.7
U.S.	4370	602184	100	100	6989	933280	3018	545191	100	100	100	100

Source: Bureau of Census: Enterprise Statistics, 1958, part 2, CAO and Auxiliaries, Table 3. Bureau of Census: Enterprise Statistics, 1987, Auxiliary Establishments, Table 2 and Table 3. Note: NE - New England, MA - Middle Atlantic, ENC - East North Central, WNC - West North Central, SA - South Atlantic, ESC - East South Central, WSC - West South Central, MT - Mountain, and PC - Pacific.

Table 12

Research and Development in Central Administrative Organizations:
U.S. Manufacturing, 1963-1987
($ Million)

	CAO Research and Development		All Research and Development	
	1963	1987	1963	1987
20 Food	77	606	130	-
21 Tobacco	(D)	128	-	-
22 Textiles	11	63	30	-
23 Apparel	6	9	-	-
24 Lumber	5	73	11	-
25 Furniture	3	28	-	-
26 Paper	61	676	69	-
27 Printing	5	64	-	-
28 Chemicals	582	4997	1239	9635
29 Petroleum	203	773	317	1897
30 Rubber	22	213	156	-
31 Leather	(D)	3	-	-
32 Stone	70	218	100	-
33 Primary	109	134	183	-
34 Fabricated	65	155	153	-
35 Machinery	332	1226	958	-
36 Electrical	796	1130	2866	15848
37 Transportation	586	3778	5802	24458
38 Instruments	31	944	284	5222
39 Miscellaneous	19	126	54	-
All Industries	2983	15345	12630	92155

Sources: Bureau of Census: Enterprise Statistics, 1963, part 2, CAO and Auxiliaries, Table 3A. Bureau of Census: Enterprise Statistics, 1987, Auxiliary Establishments, Table 12.
(D) Withheld to avoid disclosing figures for individual companies.

Table 13

Descriptive Statistics for Manufacturing Industries, 1958

	Mean	Standard Deviation
Percent of Multiunit Industry Employment	61.9%	22.2
R&D Intensity	0.43%	0.90
Sales Intensity	4.42%	4.34
Managerial Intensity	4.06%	3.27
Plant size (workers per est.)	139.6	397.2
Percent Employed in Other Industries	15.8%	10.9
Localization	0.37	0.16
Capital Intensity ($ per worker)	11151.0	11703.0
Energy Intensity ($ per worker)	479.7	618.3
Raw Material Intensity ($ per worker)	19800.0	23400.0
Percent Transported Less than 200 miles	38.6%	16.9
Number of Observations	91	91

Note: R&D, sales and managerial intensities are the percentage of employees in these activities for multiunit firms. Plant size is defined as employment divided by establishment. Localization is Hoover's coefficient of localization calculated at the nine census division level (see Kim (1995)). Capital is the value of gross depreciable assets, energy is the total cost of purchased fuels and electric energy, and raw material is the cost of materials consumed in manufacturing. The intensities ($/labor) of these variables are derived by dividing them by production workers for each industry. Also note that the data on R&D intensity, sales intensity, and managerial intensity is categorized on company basis while the data on plant size, localization, capital intensity and energy intensity is categorized on establishment basis.
Sources: Bureau of Census: census of manufactures, 1958, enterprise statistics, 1958, and census of transportation, 1963.

Table 14
Estimates of the Determinants of Multiunit Activities, 1958

Independent variables	Dependent variable: Percentage of multiunit industry employment (1)	(2)	(3)	(4)	(5)
Constant	47.4***	43.4***	34.0***	33.8***	33.0***
	(13.3)	(13.0)	(11.6)	(11.6)	(11.9)
R&D Intensity	7.60***	6.95***	2.89*	3.00**	3.04**
	(3.17)	(3.20)	(1.60)	(1.68)	(1.78)
Sales Intensity	0.95**	1.16***	0.80**	0.91***	0.98***
	(1.99)	(2.70)	(2.34)	(2.63)	(2.97)
Managerial Intensity	1.73***	1.82***	0.70*	0.05	-0.08
	(2.58)	(3.02)	(1.41)	(0.08)	(0.15)
Plant size	-	2.11***	1.26***	1.23***	1.13***
		(4.57)	(3.31)	(3.24)	(3.11)
Other Industry Employment	-	-	1.17***	1.12***	1.16***
			(7.27)	(6.95)	(7.59)
Capital Intensity	-	-	-	2.89**	-
				(1.74)	
Energy Intensity	-	-	-	-	7.84***
					(3.35)
Localization	-	-	-	-	-
Raw Material Intensity	-	-	-	-	-
Transportation less 200 miles	-	-	-	-	-
R^2	0.28	0.42	0.65	0.66	0.68
# of obs.	91	91	91	91	91

*Significant at the 10 percent level.
**Significant at the 5 percent level.
***Significant at the 1 percent level.
Sources: See Table 13.

Table 14 - continued

Estimates of the Determinants of Multiunit Activities, 1958

Independent variables	Dependent variable Percentage of multiunit industry employment (6)	(7)	(8)	(9)
Constant	33.0***	22.8***	22.5***	17.8***
	(11.8)	(5.59)	(5.43)	(2.81)
R&D Intensity	3.01**	2.65*	2.50*	2.58*
	(1.76)	(1.64)	(1.50)	(1.55)
Sales Intensity	0.96***	1.12***	1.12***	1.15***
	(2.90)	(3.53)	(3.50)	(3.58)
Managerial Intensity	0.07	0.12	0.22	0.28
	(0.11)	(0.22)	(0.37)	(0.46)
Plant size	1.12***	0.75**	0.73**	0.73**
	(3.08)	(2.07)	(2.00)	(1.99)
Other Industry Employment	1.17***	1.16***	1.16***	1.18***
	(7.51)	(7.84)	(7.79)	(7.83)
Capital Intensity	-1.14	-1.14	-0.57	-0.54
	(0.54)	(0.56)	(0.24)	(0.23)
Energy Intensity	8.95***	8.51***	8.13***	7.31**
	(2.86)	(2.87)	(2.63)	(2.28)
Localization	-	27.9***	28.8***	31.2***
		(3.27)	(3.27)	(3.41)
Raw Material Intensity	-	-	-4.03	-3.99
			(0.46)	(0.45)
Transportation less 200 miles	-	-	-	8.56
				(0.98)
R^2	0.69	0.72	0.72	0.73
# of obs.	91	91	91	91

*Significant at the 10 percent level.
**Significant at the 5 percent level.
***Significant at the 1 percent level.
Sources: See Table 13.

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