COMPARATIVE PROFIT RATES

OF U.S. MANUFACTURING

FIRMS BY CITY SIZE

By

LARRY LEONARD JANSSEN

Bachelor of Science

University of Nebraska

Lincoln, Nebraska

1971

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
MASTER OF SCIENCE
May, 1974

COMPARATIVE PROFIT RATES

OF U.S. MANUFACTURING

FIRMS BY CITY SIZE

Thesis Approved:

Thesis Adviser

Dean of the Graduate College

ACKNOWLEDGEMENTS

I wish to express my appreciation to Dr. Luther G. Tweeten, my major adviser, for his guidance and many suggestions in conducting the study and preparing this thesis. I wish to also thank Dr. Gerald Doeksen and Dr. Paul Hummer, members of my graduate committee, for their constructive suggestions and criticisms on every phase of this thesis. Special appreciation is extended to Mrs. Meg Hedrick and her programming staff for the many hours of assistance and direction they gave me in preparing the data storage files. Appreciation is also expressed to Mrs. Pat Schaeffer and her staff for the many hours of coding and key-punching assistance they gave me. I am indebted to Dr. James Plaxico, Chairman of Department of Agricultural Economics, and to the Agricultural Economics Department for providing financial assistance during my graduate program.

I wish to thank Mrs. Linda Howard and Miss Jeanne Ray for typing the rough and final drafts of this thesis. I also wish to thank my parents, Mr. and Mrs. Harry Janssen, for their encouragement given during all parts of my graduate program. I wish to thank my wife, Marcia, for her encouragement in completing the latter stages of this thesis.

TABLE OF CONTENTS

LIST OF TABLES

Table | | Page

Table		Page

Table		Page

CHAPTER I

INTRODUCTION

Rural industrialization, the policy of dispersing industries to micropolitan (non-metropolitan) growth centers or open countryside within commuting distance of rural residents, is promoted by some research, business, and political leaders as a viable means to reduce rural underemployment and metropolitan concentration. It offers micropolitan regions the means to increase their export base now based heavily on agriculture, forestry, or mining and to retain or revitalize a service sector. It offers metropolitan regions an opportunity for slower growth rates and time to better assimilate and redirect new growth. The thesis of interrelated development problems has been articulated by national leaders as a means of gaining support and acceptance for major social programs. In 1966, President Johnson stated,[1]

> ...Not just sentiment demands that we do more to help our farms and rural communities, I think the welfare of this nation demands it. And strange as it may seem, I think the future of the cities of America demands it too...
>
> The cities will never solve their problems unless we solve the problems of the towns and the smaller areas. So consider the problem of urban growth. If the present trend continues, by 1985 as many people will be crowded into our cities as occupy the entire Nation today in 1960. ...I don't think it has to happen. Modern industry and modern technology and modern transportation can bring jobs to the countryside rather than people to the cities. And modern government could also help.

Actions for decentralization through federal policies and programs directing industry to rural areas have never matched the political rhetoric.[2] This disparity between rhetoric and reality in part stems from lack of commitment growing from doubts whether the goal of industrial dispersion is really attainable within economically and politically acceptable costs. Statements advocating industrial dispersion implicitly assume that the social costs outweigh social benefits of increased industrial concentration.

Metropolitan areas would supposedly benefit through reduced inmigration of rural people ill-equipped for industrial jobs, reduced demands for education and welfare services, reduced pollution, etc. Conversely, micropolitan areas would benefit from reduced underemployment of present human capital, reduced outmigration of young people, and would maintain a larger economic base for private and governmental services. These specious arguments are all conditioned on the assumption that private firms (especially manufacturing) can locate, survive and expand in micropolitan areas. The central issue is to identify industries that can profitably locate in smaller cities within commuting distance of rural residents living outside of metropolitan areas.

Efficient location of industries is one aspect of optimal place of residence. The issue has several dimensions including (a) where people have decided to live as evidenced by growth patterns by place of residence, (b) where people vote to live as evidenced by opinion polls, (c) attitudes and satisfactions where people now live, (d) efficient provision of public goods and services, and (e) efficient provision of private goods and services by place of residence as evidenced by comparative profit by industry by location.

In general, population growth rates in the 1960's were faster for suburbs than elsewhere and for population centers between 10,000 and 2,500,000 residents. Even if people vote with their feet to maximize well-being, they will not in fact accomplish this for society if institutional rigidities and externalities distort the incentives of firms (and individuals) in making location decisions.

National opinion polls show that people are unable to locate in places consistent with their preferences. The principal reasons stated by respondents for not carrying out their preferences were economic. The wishes of people appear to be secondary--the location of people depends on the location of jobs (and public assistance) which in turn depend on the decisions made by firms and public officials.[3]

Before we rush into premature policies to permit people to live in the place of their choice, it is well to examine further the empirical evidence. Four attitudes that relate to well-being were found to be for the most part unaffected by place of residence but were instead a function of education, income, and occupation. The implication is that place of residence, per se, need not be the focal point for policies of balanced growth, population redistribution and decentralization. People's satisfactions will be improved only if opportunities for income, occupation and education attend a change in place of residence. People will only be made worse off if public policy sends them to sparsely populated rural areas that are unable to provide adequate economic opportunity.

At least two important economic dimensions exist in the location of economic activity so that the limited resources of this nation can provide the greatest real output. One is provision of public goods and services; the other is provision of private goods and services.

The cost of providing a given quality of a large number of public services have been estimated for cities of various sizes by Morris.[4] After accounting for externalities, the least cost per capita is in cities of 20,000 to 1 million residents. Costs in smaller cities and open country are exceedingly high because of the large per capita cost for schools, roads, health care, utilities and fire protection. Costs in larger cities are high because of the large per capita cost for crime prevention, pollution control and traffic decongestion.

Although a given quality of community services can be provided most efficiently in cities of 20,000 to 1 million residents, some other place of residence may be optimal if private enterprise is unable to operate efficiently and make a profit in such places. So we must look to another dimension of location, namely efficient provision of private goods and services. The issue of efficient provision of private goods and services conceptually can be viewed as a problem in maximizing the real output of the private economy, given transport costs, manpower, technology and demand. In reality no such optimizing model is operational, and it is necessary to revert to second best empirical procedures. This study examines efficient location of private firms by estimating profit rates by industry by place of residence.

Economic theory stresses that firms locate where profits are greatest and not where labor is most productive or demand most robust. Focusing on profits, instead of separate cost and market demand factors, provides a complementary if not theoretically superior analytical framework to analyze industry productivity by city size. This approach does not invalidate the need for research on separate cost or demand factors-it is useful to know their individual contribution to firm profits.

The major objective of this thesis is to measure industry location performance as evident in manufacturing firms' profit rates--whether they differ significantly and systematically by city size. Associated objectives are to:

1) Examine the actual level and trends in U. S. manufacturing activity and profits by residence sector (metropolitan-micropolitan), industry and city size. These data reveal (a) the importance of manufacturing by size and type of urban areas, and (b) industries dispersing toward smaller cities in recent times.

2) Analyze patterns of plant location and profit rates of manufacturing firms by city size groupings using multiple regression analysis to hold factors other than city size constant.

The procedure for this last objective is to apply the multiple linear regression models to firms in each of eleven two-digit manufacturing Standard Industrial Classification (SIC) activity codes and employ statistical inference to detect differences in profit rates among cities. The sample consists of 760 medium sized U. S. manufacturing firms reported in Standard and Poor's Corporation Records for 1970. The raw plant location and profit data from the sampled firms are grouped by city size classes and descriptively analyzed to achieve objective (1) and to draw comparisons with the regression results. Empirical studies analyzing absolute and relative manufacturing growth by city size are summarized. These studies are used to compare trends in manufacturing with those in the primary and service sectors. The studies identify manufacturing industries undergoing spatial location changes, analyzing absolute and relative manufacturing growth by city size. The industries undergoing dispersion or associated with smaller cities are identified and the results are interpreted in relation to the findings from the regression analysis.

Static regression results do not always indicate higher profits in the locations to which the empirical studies reveal industry location is shifting. If regression results indicate no profit differential by city size, the meaning could be that a) there is actually no comparative profit advantage among city sizes and plants can locate anywhere and make profits--an obviously untenable conclusion or b) profit rates do vary systematically by city size but the sample is too small, error too large or firm location adjustments are too rapid to permit identification of profit differences in the statistical model. Statistically insignificant differences in profit rates in the study are interpreted as an indication that industry performance in selecting plant locations is satisfactory. A satisfactory performance provides evidence that observed, existing trends in industry location reveal where firms and plants can go to operate most efficiently.

Organization of the Thesis

The balance of this chapter contains a short review of location and agglomeration theory. In Chapter II the economic and statistical model is developed. Chapter III contains the data selection procedures with descriptive analysis of plant location and profit rate distribution by city size for the sampled firms. Further discussion centers on bias encountered due to data and sample methodology. In Chapter IV the specific variables are listed and discussed and the empirical regression results are presented. Although more industries are included in the empirical analysis, the need for brevity confined discussion of results to six industries: Fabricated Metals, Electrical Machinery, Furniture, Printing, Food and Apparel. Chapter V covers empirical studies showing the dimensions of U. S. manufacturing employment change by city size, while the final Chapter VI summarizes highlights along with shortcomings in the thesis and directions for further research.

Review of Location Theory

Location theory is still evolving from a series of partial theories emphasizing variation in production costs, transport costs, market demand, agglomeration, and personal factors as primary location determinants to a generalized theory incorporating all these elements. Its evolutionary direction has been to incorporate geographical space as a dimension into existing general economic equilibrium theory, as opposed to separately explaining spatial location phenomena. This latter route, pursued by economic geographers, contributed little to theoretical advancement but provided descriptive studies outlining factors (such as population size and density, power facilities, transportation arteries, and related industries) associated with the location of various manufacturing industries.

Two theories advanced from these studies emphasize the maturity stage of an industry and the changing role (but predictable cycle) and importance of manufacturing in the economic structure of the spatial unit. The theories are evident in transformation of older industrialized areas of the Northeastern United States.[5] As the Northeast industrialized, the manufacturing mix shifted from low value-added bulky products to high value-added products. This was due to increased relative demand for these products and a substantial pool of skilled labor, technical expertise and management capable of producing these goods more efficiently than other regions. Extension of these results to other regions at least partly explains systematic changes in manufacturing plant location through time.

Another theory stressed the importance of previous spatial patterns of the industry on subsequent location decisions, with emphasis on the land use intensity for manufacturing. Previous concentration of related industries near a central site formed the nucleus of urban-industrial areas which subsequently provided a greater variety of services external to the firm. Such concentrations restrained industrial relocation from the region. This complements the development of agglomeration theory, discussed later.

The major ingredients of present day location theory were developed by economists. Most are based on the assumption that firms locate plants to maximize profit. During the 1950's, Greenhut visualized location theory of the firm in the following equation system.[6]

(1) $L = \phi\ (R-C)$

(2) $C = \phi\ (SR \times Ca)$

(3) $R = \phi\ (SR \times M)$

where

L = location,

C = total cost,

R = total revenue,

SR = sales radius,

Ca = average production cost exclusive of freight, and

M = profit maximizing net mill (f.o.b.) price.

Location equilibrium existed when for each firm in the industry:

(4) $M = Ca$

(5) $\Delta R = \Delta C$.

Factors changing the unit cost are analyzed in the Ca component, while consumer demand changes are incorporated into M.

This conceptual location model under the profit maximization assumption explicitly incorporates cost and market demand factors into the model. However, location theory as it developed usually stressed cost or market demand factors separately. Von Thunen developed the first location theory in attempting to explain the location of 19th century German agricultural production.[7] His theory concentrated on the role of transportation cost and economic rent to land as the prime location factors. The predicted pattern of land use was a series of concentric rings around the central town of an isolated region with cultivation intensity declining with distance from the center. With the decline in transportation costs and reduced regional isolation, Von Thunen's theory became too simplistic. Its major contribution is the analysis of site competition for alternative uses based on the economic rent value accruing for each potential use.

Weber later developed an industrial location theory based on minimizing the cost of transport, labor, and agglomeration factors.[8] In his theory, variation in labor and transportation costs affected the industrial location choice between regions; variations in cost of land, other fixed capital, power, taxes, and interest were not deemed important location factors. Demand for industrial products was assumed constant irrespective of plant location.

Weber assumed product weight and shipment distance were the only variables influencing transport cost. Therefore the orientation of production location toward raw material sources varied directly to the proportion of localized material of total raw materials used and the weight loss proportion of localized materials to final products. Localized materials were deposits available at only a few sites compared to other materials produced over a large area. This analysis dropped the assumption of uniform production possibilities across space implicit in the Von Thunen agricultural model. It also contained the analytical seeds of greater emphasis on the relative locational "pull" of any production factor.

Labor costs were introduced as an alternative location factor that depended on the index of labor cost per material weight unit. If labor was a large proportion of manufacturing value-added per unit of weight, relative wage differences between regions could "pull" manufacturing plants to this labor source; the decrease in labor cost overshadowed the increase in transport cost. This began the marginal substitution analysis of production factors with different location.

Hoover extended Weber's work to explicitly treat the cost of institutional factors such as taxes and insurance and of special factors such as climate as components of production cost varying across space.[9] He further recognized two transport costs: terminal expense and shipping expense. The importance of shipping distance decreased as terminal costs increased relative to shipping costs. Hoover brought cost location theory closer to explaining reality and began the inquiry into the importance of market demand.

Market demand theory is based on the premise that a firm maximizing its market area or sales territory in effect maximizes profit and abstracts from variations across space.[10] This theory recognizes spatial locations have some monopoly value and constructs spatial location analyses in a framework of monopolistic competition instead of purely competition. The location of rival competitors becomes important; consequently the theory investigates their location patterns under differing assumptions concerning final product demand elasticity, conditions of new firm entry into the regions, and pricing policies.

According to Greenhut's application of market demand theory, firms tend to spatially concentrate if:[11]

(1) Marginal cost of production and selling is less at outlying sites than added transport cost from an existing production center.

(2) Active price competition is restrained, price leadership concentrates industrial location toward the price leader's location regardless of the existence of unequal costs of alternative location or unequal population distribution.

(3) Market demand curve for the product is inelastic at the equilibrium selling price.

(4) Products within an industry are heterogenous.

Greenhut also introduces personal considerations into his conceptual model by classifying these factors as cost-reducing or revenue increasing.[12]

Factors cited include the:

(1) Value of frequent contact with buyers to further stimulate revenue.

(2) Value of friendship toward suppliers of raw material and capital which may reduce acquisition cost.

(3) Value of present living standards or "way of life" compared to

possible changes at other locations. This is imputing a reservation price to the present location.

The first two factors emphasize the value of varied business-social contacts while the third factor reinforces previous location decisions. In this framework these personal factors come into the orbit of agglomeration theories.

Review of Agglomeration and Economics of City Size Theories

Agglomeration theories help explain the tendency of individual firms to cluster together. Since these clusters of manufacturing firms usually occur in cities, agglomeration theory is directly connected to theories explaining the existence and economics of city size hierarchies. Agglomeration theories and economics of city size theories are less advanced than most location theories, reflecting their more recent origins and greater difficulty for empirical verification.

The initial outline of agglomeration theory appeared in Weber's _Theory of the Location of Industries_.[13] Agglomeration factors were considered production and marketing cost advantages resulting from the fact that production occurred in one place; conversely, deglomeration factors lowered cost through production dispersion. Weber considered these factors influenced the relative industrial concentration within a region, but not location among regions.

Weber analyzed the agglomeration factors in the context of "large scale (size) economies" that induced plant expansion at an existing site and "localization economies" gained by location proximity of production units within an industry. In either case, agglomeration factors reduced unit production cost through increased usage of specialized machinery and skilled labor at higher output levels sufficient to offset increased transport cost of assembling raw materials and shipping final products. Agglomeration factors were most important in industrial production where manufacturing value added comprised a large proportion of final output. Since variation in material and capital equipment costs across space were deemed unimportant in Weber's theory, the labor component of value-added essentially determined the agglomeration tendencies of firms and industries.

Other economists extended agglomeration theory to include "urbanization economies". The cost of these factors vary with city size and influence the firms' location choice among city sizes. The theory stresses that most urbanization economies (diseconomies) are external to the firm. The urbanization economies are those which:[14]

(1) Reduce uncertainty for the firm through close proximity to important and varied information sources. These sources include rival firms, financial and government agencies, trading boards, etc. Firms benefiting from this type of size economy are characterized by highly variable product demand and rapidly changing product design.

(2) Reduce direct production and marketing costs to the firm through availability of specialized facilities and services.

While the first type of urbanization economy is generally conceded, the second is discussed more as there are hopes of measuring these. A further breakdown of these economies separates some of the complex relationships:

(A) Economies resulting from higher usage levels of general urban infrastructure. These include transportation facilities for shipping raw materials, prefinished goods, and final products, and for worker commuting; utilities such as gas, water, electricity, sewage and garbage disposal; and police and fire protection.

(B) Economies resulting from contracting for specialized business facilities and services instead of including these in the firm's internal size economies. In principle, these economies would incorporate those listed in (A) for location in isolated regions where urban infrastructure facilities are unavailable; in practice the separate classification is valid. These services may include computer processing, equipment leasing, building rental and training schools. These services benefit most competing smaller firms within an industry, central administrative functions for firms regardless of size, and firms with high levels of interindustrial linkages.

Studies analyzing costs of different components of urban infrastructure generally find U-shaped cost curves as population increases for utilities, police and fire protection, and waste disposal activities. The population size where costs are minimized varies for each of these components, but usually occur between 250,000-500,000 population. Many of these components exhibit no significant diseconomies in cities from 20,000 to over 1,000,000. In most cases the population base required to minimize costs of these services is higher for physical activities used by the industrial sector than for minimum costs of providing education and medical services. These latter services may be considered to raise the quality and efficiency levels of human capital employed in the industrial sector. In a 1971 study, Morris found primary and secondary education economies were realized for cities of 10,000 people while hospital service economies were exhausted at 100,000. The costs computed for these services as well as police protection, fire protection, and air pollution and utilities were adjusted for constant quality where necessary over different output ranges.

Costs of specialized business services by city size have not been extensively studied, but Evans recently proposed a theory of city size for industrial economies based on costs of manufacturing and business services.[16] He noted how most industrial countries, including the U. S., have city size hierarchies approximating a rank size distribution. He contends central place theory based on a system of different sized market areas for varying city sizes is an insufficient explanation for manufacturing areas and bases his theory on manufacturing and auxiliary service levels in cities.

Critical assumptions in his theory are:

(1) A city has two industrial sectors, manufacturing and business services. The output from the service sector is used as inputs in manufacturing which then sells the final product to consumers.

(2) Manufacturing sales are not dependent on spatial location (transport cost is zero) while service outputs have infinite transport cost. Therefore, the whole range of needed services must exist for each manufacturing center.

(3) Economies of size are possible in the service and manufacturing sectors.

(4) Consumers maximize utility while industry attempts to maximize profit.

(5) Commuting costs are equal to marginal social costs and residential relocation costs are negligible.

Evans shows firm input prices for land, labor and services vary with city size while capital price differences are small. Land rent for a given size unit diminishes from the central district to the urban periphery at a diminishing rate, but also increases at a diminishing rate as city size increases. Wage rates increased with city size at a decreasing rate. The analysis is based on compensation required to keep workers in larger cities when faced with higher rent and travel costs.

The cost of business services decreases at a decreasing rate. This conclusion is an extension of cost theory applied to different productive functions of the manufacturing firms. If all functions would be provided at sufficient volume to minimize cost internally within the manufacturing firm there would be no business services. Since many special functions cannot maintain sufficient volume in a single manufacturing firm, firms performing these functions arise in the service sector. Services requiring higher volume levels must locate in larger cities where more manufacturing firms exist; the same is true for manufacturing firms requiring the most specialized services or which use considerable capital and little land or labor.

Because different manufacturing firms require different levels and proportions of inputs and will locate in the city size where total cost of the inputs is minimized, it follows that the relative input levels and prices with respect to city size "explains" the location of each manufacturing industry. The theory also helps to explain the distribution of city size groups in a large region.

One major implication of Evans' theory as well as other theories outlined herein is that the present city size distribution should be optimal, from a private industry standpoint, if firm profits do not systematically vary with city size. A second implication is that "optimal" city size depends on the industry in question and may be distributed over a very wide population range. However, Evans concedes the optimal city size distribution in his theory may not include the very largest cities in the U. S. if the assumption of commuting costs equaling marginal social costs were dropped.

Alonso used a different approach in developing a theory of city size.[17] He considered the entire city as a production unit where the objective is to maximize returns to the urban population (real income-principally from labor payments). Based on examination of previous empirical evidence, Alonso assumed average product (AP) for the production unit (the city) increased linearly throughout the range of city sizes. Urban costs were "harder to define and would include quantity and price effects in the costs of infrastructure and municipal operation, in the costs of exogenous inputs other than human ones into the city's economic activity, and in private consumption."[18] Labor input costs are excluded, which departs from traditional economic theory. The average costs (AC), under this definition, were considered U-shaped across city size, in the same manner as discussed before. The optimal city size would not coincide with minimum cost but where the rate of increase of AP and AC were equal, which would be a larger city size than the point of minimum costs.

Evans and Alonso subscribe to the hypothesis that wage rates and incomes vary positively and systematically with city size. This was established from numerous empirical studies of which a few are mentioned below.

Using 1949 U. S. income data, Edwin Mansfield found per capita income in the largest Standard Metropolitan Statistical Areas (SMSA's) exceeded per capita income in the smaller cities by 25 percent at the mean.[19] However, the variance was sufficiently large that in one-third of all cases small city per capita income would be expected to exceed that found in the largest SMSA's. He also found evidence that systematic regional income differences were partially explained by differing levels of urbanization, especially between the South and all other regions. The major weakness of his study is the failure to correct for differing levels of human resources and female participation rates in the labor force by city size.

Victor Fuchs studied the relationship of 1959 hourly earnings for region and city size differentials.[20] He standardized wage data, from the 1/1000 Census sample, for labor quality proxies--age, color, sex, and education. He then computed "expected earnings" for white and non-white males and females for each Census region and for seven city size groups. Comparing the ratio of actual earnings to expected earnings by region, he found the South to be under the national average by 17 percent. After standardizing for city size mix the difference decreased to 9 percent. Thus only a small portion of the regional wage differentials could be explained by differences in labor force composition; city size was an important effect.

Alternatively, standardizing for labor force composition and region left a 30 percent difference in hourly wage earnings between large SMSA's and rural areas, and 15 percent difference between large and small SMSA's. Multiple regression analysis rejected the hypothesis that difference in wage rates across city size was due to differing industry mix, unionization level, or sex of employees. Fuchs hypothesized the wage differential was related to higher cost of living after accounting for commuting costs and differing labor quality levels not captured by age, color, sex, and education variables.

Greenwood developed a labor supply and demand function relating 1960 average wage earnings in each SMSA to population size, physical capital per worker, education capital per worker, value of time spent commuting, property tax levels, local government expenditure, and percentage of employment in manufacturing.[21] Each variable significantly influenced wage rates with an R^2 of 0.82 over 211 observations (one for each SMSA). Value of time spent commuting was the statistically most important positive influence on wage rates but was estimated by a proxy index weighted by population and land area. Surprisingly, the population size variable had a negative sign implying that wage rates of production workers are lower in larger SMSA's than in smaller SMSA's. Greenwood explains that inclusion of the other variables related to city size, such as physical capital per worker and value of time spent commuting accounts for the observed direct relationship of city size to wage rate. Thus the negative coefficient on population size could be accounting for the previous heavy, selective in-migration to the larger cities and has resulted in the labor supply shift dominating the labor demand shift. If the demand shift had dominated, labor migration would have accentuated the wage differential among cities of different sizes.

Alonso contends that wage and income levels are positively associated with city size throughout the industrial world, displaying West German and Japanese data as evidence. He further contends that positive externalities of urban size is the major contributor. Census of Manufacturing data for 1963 for the 67 largest SMSA's in the U. S. shows that payroll per employee and value-added per employee increased with city size. Removing the wage effect from the value-added still left a strong positive relation to city size.[22]

It is evident from these studies that the case of a strong positive relationship of wages and income to city size has been established, but varied explanations remain for the causes. Greenwood's study is illuminating in trying to identify other variables associated with city size that in turn explained wage rates. Alonso's mainly stressed greater labor productivity and positive externalities in larger cities. What is not known is how the relationship of wages, labor productivity, agglomeration economies and other factors, associated with city size, in combination affects industrial profitability.

Because the separate influence of each of these elements on profitability cannot be estimated with reliability to determine overall optimal location with the data and techniques currently available, the approach in this study is to confine the analysis to the direct measure of profit rates by city size as a guage of industry performance. Issues of industry structure (monopoly elements, etc.) and incentives (divergence between private costs and social costs) are not analyzed in this study.

FOOTNOTES

[1]Remarks by former President Lyndon Johnson at 100th Anniversary of Dallastown, Pennsylvania, September 3, 1966, "Weekly Compilation of Presidential Documents," September 12, 1966, p. 1217. Reprinted in Urban and Rural America: Policies for Future Growth, Advisory Commission on Intergovernmental Relations (Washington, D. C., April 1968), p. XV.

[2]The only federal program directed toward industry relocation in rural areas is administered by the Economic Development Administration (EDA), Department of Commerce. The program consists of low interest loan grants to companies or development corporations that locate in areas designated as Redevelopment Areas and are unable to obtain full loans from commercial sources. Loans from 1965-70 totaled $216.4 million. For an evaluation of these programs see Luther G. Tweeten, Foundations of Farm Policy (Lincoln: University of Nebraska Press, 1971), pp. 400-402.

[3]Luther G. Tweeten and Y. C. Lu, "Attitudes by Place of Residence" (Paper presented at the 2nd meeting of the Mid-Continent Section of Regional Science Association, Stillwater, Oklahoma, April, 1973).

[4]Douglas Morris, "Cost of Public Services by City Size." (unpublished Ph.D. thesis, Oklahoma State University, 1972).

[5]A discussion of the major contributions of geographic toward plant location theory and the reasons for different emphasis from economists' contributions is contained in Robert B. McNee, "The Changing Relationship of Economics and Economic Geography," Economic Geography, XXXV (1959), 189-198.; John Thompson, "Some Theoretical Considerations for Manufacturing Geography," Economic Geography, XXXII (1966), 356-365.

[6]Melvin L. Greenhut, Plant Location in Theory and in Practice (Chapel Hill: University of North Carolina Press, 1956), pp. 283, 291.

[7]Von Thunen's original work is available only in German, but has been discussed by many American economists including Melvin L. Greenhut, Plant Location in Theory and Practice (Chapel Hill: University of North Carolina Press, 1956).

[8]Alfred Weber, Theory of the Location of Industries, trans. by Carl J. Friedrich, (Chicago: University of Chicago Press, 1929).

[9]Edgar Hoover works are critically reviewed in Melvin L. Greenhut, Plant Location in Theory and Practice (Chapel Hill: University of North Carolina Press, 1956), pp. 23-24.

[10] Market demand theory is extensively discussed in most recent location theory texts. Most discussion centers on Losch market demand concepts. Some good references are: Melvin L. Greenhut, Plant Location in Theory and Practice (Chapel Hill: University of North Carolina Press, 1956), pp. 23-100, 140-162; Walter Isard, Location and Space Economy, Regional Science Series, No. 1(Cambridge, MIT Press, 1956); J. Kanaske and L. Bramhall, ed. Locational Analysis for Manufacturing, Regional Science Series, No. 7 (Cambridge: MIT Press, 1969).

[11] Melvin L. Greenhut, Plant Location in Theory and Practice (Chapel Hill: University of North Carolina Press, 1956), pp. 183-191.

[12] Ibid, pp. 173-177.

[13] Alfred Weber, Theory of the Location of Industries, trans. by Carl J. Friedrich, (Chicago: University of Chicago Press, 1929), pp. 124-210.

[14] Two types of urbanization economies are separately discussed by Walter Isard, Location and Space Economy, Regional Science Series, No. 1 (Cambridge: MIT Press, 1956), pp. 172-188; Raymond Vernon, "Production and Distribution in the Large Metropolis," Location Analysis for Manufacturing, J. Kanaske and L. Bramhall, ed. Regional Science Studies, No. 7 (Cambridge: MIT Press, 1969), pp. 299-313.

[15] A multitude of cost studies on urban public services have been done. A review of early and recent works with further empirical analysis is contained in Walter Hirsch, "The Supply of Urban Public Services," Issues in Urban Economics, Harvey S. Perloff and Lowdon Wingo, Jr., ed. Resources for the Future (Baltimore: John Hopkins Press, 1968). A recent empirical study was completed by Douglas Morris, "Cost of Public Services by City Size," (unpublished Ph.D. Thesis, Oklahoma State University, 1972).

[16] Alan W. Evans, "The Pure Theory of City Size in an Industrial Economy," Urban Studies, IX (1972), pp. 49-78.

[17] William Alonso, The Economics of Urban Size, (Paper presented at the 10th European Congress of the Regional Science Association, London, England, 1970).

[18] Ibid, p. 70.

[19] Edwin Mansfield, "City Size and Income, 1949." Regional Income - Studies on Income and Wealth, Vol. 20 (Washington, D. C.: Bureau of Agricultural Research, 1950), pp. 271-320.

[20] Victor R. Fuchs, "Hourly Earnings Differentials by Region and Size of City," in Locational Analysis for Manufacturing, J. Kanaske and L. Bramhall, ed. Regional Science Studies, No. 7 (Cambridge: MIT Press, 1969), pp. 125-129.

[21] Michael J. Greenwood, "The Relationship between City Size and Industrial Wage Levels," Annals of Regional Science, IV (1970), pp. 48-60.

[22] William Alonso, The Economics of Urban Size, (Paper presented at the 10th European Congress of the Regional Science Association, London, England, 1970), pp. 74-75.

CHAPTER II

PRESENTATION OF THE ECONOMETRIC MODEL

The review of literature revealed that much of location and agglomeration theory explicitly extends the profit maximization assumptions and equilibrium results of neo-classical microeconomic theory to plant site location in different regions or cities. If perfect competition is accepted as the efficiency norm, the firms must locate where comparative profits are highest to maximize real output in the economy. (It is useful to abstract for now from the proposition that efficient performance in plant location will not maximize real output in the economy if market structure and incentives are such that private costs (benefits) digress from social costs (benefits). Continued competition among firms drives profit rates to the same level among all firms and locations.

This chapter begins with a presentation of the conceptual models that receive empirical application in a later chapter. Discussion of the data sources is deferred to the first section of Chapter III. Likewise, discussion of the variables is deferred to Chapter IV.

Development of Two Conceptual Models and Their Relationship to the Plant Location and Company Models

The purpose of the econometric model is to test the null hypothesis that private manufacturing firm profit rates do not systematically differ by city size by industry. The relationship of city size to firm profit rates is conceptualized as the following model:

2-1) Model I, $PR = f\{[CS], [V_n(CS)], [V_n]\}$

where:

PR = firm profit rate

$[CS]$ = variables defining city size, such as population size or density.

$[V_n(CS)]$ = variables affecting firm profit rates that are indirectly influenced by city size; examples may be wage rates, size of plant, firm growth rate.

$[V_n]$ = variables affecting firm profit rates but not associated with city size.

In Model I, company profit rate is a function of independent variables defining city size, indirectly influenced by city size, and variables not related to city size. To make Model I operational, the variables indirectly influenced by city size can be handled by two methods. The first is to interact each V_n variable with city size which allows the influence of (say) wage rates to vary with size of city.

The second method is to conceptualize the profit model as a two stage recursive form where each $V_n(CS)$ independent variable is specified as an explicit function of city size. By this method, the entire effect of city size on company profit rates is reflected provided the functional relationship of each variable to city size is properly specified. This requires a considerable background of prior research needed to make the model operational.

The actual models developed specify variable interaction with segmented city size groups. The models are divided into two categories based on the units of observation--the plant location or the company.

Introduction to the Plant Location and Company Models

The Plant Location and Company models are estimated using ordinary least squares (OLS) linear regression analysis. The advantages and limitations of the OLS model are well documented in the econometric literature and are not repeated here.

Both the Plant Location and Company models use the company profit rate as the dependent variable since the profit rate for each plant is not available. In the "Plant Location model" the company profit rate is entered as a dependent variable observation for each city where a plant is located. In the "Company model" the profit rate is entered as an observation only once for each company with the city size mix of the company's plant locations treated as a series of independent variables for the observation.

The Plant Location model may understate the effect of city size on company profit rates. In this model each independent variable not associated with city size, $[V_n]$, is entered once for each firm plant location in a different incorporated city. In contrast the city size related variables, $[V_n(CS)]$, vary with each firm plant location. The Company model properly weights the effect of city size on profit rates but it is more difficult to interpret individual coefficients.

Development of the Plant Location Model

The development of the Plant Location model is accomplished by adding classes of independent variables in a selected sequential order as illustrated by the four submodels in Table I. In submodel 1, four classes of independent variables are assumed X_f, X_m, NB_p, P_j with F, M,

TABLE I

DEVELOPMENT OF THE PLANT LOCATION MODEL THROUGH A SERIES OF FOUR SUB-MODELS

Submodel	Equation by Class of Independent Variables[a]
1	$PR = \beta_0 + \sum_{f=1}^{F} \beta_f X_f + \sum_{m=2}^{M} \beta_m X_m + \sum_{p=1}^{P} \beta_p NB_p + \sum_{j=1}^{J} \beta_j P_j + e_1$
2	$PR = \beta_0 + \sum_{f=1}^{F} \beta_f X_f + \sum_{m=1}^{M} \beta_m X_m + \sum_{p=1}^{P} \beta_p NB_p + \sum_{j=1}^{J} \beta_j P_j$ $+ \sum_{r=1}^{R} \beta_r R_r + e_2$
3	$PR = \beta_0 + \sum_{f=1}^{F} \beta_f X_f + \sum_{m=1}^{M} \beta_m X_m \quad \sum_{p=1}^{P} \beta_p NB_p \quad \sum_{j=1}^{J} \beta_j P_j$ $+ \sum_{r=1}^{R} \beta_r R_r + e_3$
4	$PR = \beta_0 + \sum_{f=1}^{F} \beta_f X_f + \sum_{m=1}^{M} \beta_m X_m + \sum_{p=1}^{P} \beta_p NB_p + \sum_{j=1}^{J} \beta_j P_j$ $+ \sum_{r=1}^{R} \beta_r R_r + \sum_{i=1}^{I} \beta_i CS_i + \sum_{i=1}^{I} \beta_i CS_i P_j + e_4$

[a]The class of independent variables are listed as:

X_f = company financial statement variables

X_m = company industry-enterprise binary variables

NB_p = binary variables for number of plant locations

P_j = plant location variables

R_i = census region binary variables

CS_i = city size binary variables

CS_iP_j = city size interaction dummy variables

P, and J degrees of freedom lost, respectively. Each additional submodel adds one class of independent variables respectively to the existing submodel. In submodel 2 the variable class R_r is entered followed by CS_i in submodel 3 and CS_iP_j in submodel 4. These last three submodels add location variables concerning region and city size to the other independent variables. Including the location variables after the other independent variables provides a method to analyze the contribution of sets of location variables in explaining profit rates. This is accomplished by F tests between a submodel with a particular set of location coefficients compared to a submodel without this set of coefficients. Before discussion of the statistical test conducted, each set of independent variables is introduced. Precise definition of independent variables is deferred to Chapter IV, but they were selected on the basis of economic theory presented in Chapter I, subject to data availability.

The X_f class of independent variables consists of financial and employment statistics for the entire company. Two variables represent the company's size (sales and assets) while two additional variables measure the value of capital and the amount of labor. Another variable measures the ratio of net worth to total assets. The final variable measures the firm's near-term growth rate.

The P_j class consists of two variables measuring the estimated value of output from an individual plant and the estimated weekly wage rate paid by the company at that plant location. These variables are not conceptually different from the X_f class except they were estimated for each plant used by the company in 1970. They are also used in the construction of the CS_iP_j set of variables in submodel 4.

The NB_p class consists of zero-one dummy variables for total number of production plants in the company structure. This is partly a measure of spatial dispersion of the company and also of its size. The multi-plant company is far more frequent than a single plant company among medium sized firms included in the sample. Some major reasons for a multi-plant system in a company include:

1. Economies of size in a production process are exhausted before product demand is exhausted, necessitating more than a single plant.

2. Companies produce many different products for final demand each with different input and technological requirements that are best suited to different site locations.

3. Companies use some plant sites for intermediate processing. The output of one plant is used as the input component in another company plant or partially sold to other final demand producers.

4. Market demand is the most powerful location force for the company but exists in separate area concentrations which can be served most efficiently by local plants.

These reasons are not exhaustive or even mutually exclusive but reinforce a hypothesis of profit patterns varying with number of plants but not necessarily in a linear specification. These effects should be separated from the specific city size and region variables. Single plant companies are treated as the intercept; thus each beta coefficient of an NB_p variable is interpreted as the expected difference in profit rate from a single-plant company for the industry analyzed.

Another common characteristic of medium and large sized manufacturing companies is industrial production diversification which extends across industry lines as defined by a single two-digit manufacturing SIC code. For example, many companies engaged in Non-electrical Machinery production (SIC 35) also conduct production activities in Electrical Machinery (SIC 36) or in Transportation Equipment (SIC 37). Empirical industrial organization studies do not show consistent profit rate differences between industrially diversified and concentrated manufacturing companies. However, it is impossible apriori to reject the hypothesis that profit rate differences indeed exist. Furthermore, each two digit SIC manufacturing industry exhibits different location patterns with respect to city size as discussed in Chapter V. Therefore it is important to separate multi-industry effects from city size effects on profit rates.

Another problem arises from use of two-digit SIC codes as the classification scheme. Many industries are quite heterogenous in their product makeup. For example, the Food industry includes activities as diverse as meat packing and beverage processing, while the Electrical Machinery industry (SIC 36) activities range from small electronic transistor circuits to large electrical machinery. There is no apriori reason to assume profit rates are the same for enterprises within an industry.

Accordingly, a class of zero-one dummy (binary) variables, X_m, was devised to account for differential profit rate effects due to multi-industry production or due to differences in enterprise specialization. All possible industry-enterprise effects were not considered since only intercept shifts in profit rates are hypothesized among companies with different industry-enterprise combinations. Secondly, enterprises were delineated only where identifiable among several companies within each major industry group analyzed. Companies included in the intercept produced goods in only one manufacturing industry in enterprises that were not included in the breakdown.

Region and City Size Variables

In submodel 2, regional zero-dummy variables (R_r) are entered as the first set of location variables. The Census Regions are the Northeast, Midwest, South, and West. Plants located in the Northeast serve as the intercept. Beta coefficients on the other regional binary variables are interpreted as the difference in expected profit rates from location in a region other than the Northeast.

The CS_i variables are included to test the effect on company profit rates of plant locations in different sized cities, without regard to plant size. The 1970 U.S. Census of population was used as the basis for classifying metropolitan areas (SMSA's) and non-metropolitan cities into seven city size groups.[2] Plants located in cities of less than 10,000 population serve as the intercept. Beta coefficients of other city size variables are interpreted as the expected profit rate difference between location in a larger city compared to location in a small city of less than 10,000 residents, other things equal.

This set of city size binary variables has a straightforward interpretation when all plants within a company are located in the same city size group. If plant locations for individual companies are distributed over a wide range of city size groups, the coefficients for each CS_i variable do not completely separate the effects on profit rates of each city size group. Thus it becomes important to know the plant distribution across city size groups to ascertain potential problems for this model. It is equally important to know how characteristics of multi-plant firms differ from single plant firms. If differences exist, the model is biased toward the profit and city size characteristics of multi-plant firms. These issues are discussed in Chapter III.

The development of submodel 3 with the CS_i class of variables is considered the most complete equation to test the direct effect of city size on profit rates and is presented as Equation A in all industry tables of Chapter IV.

The CS_iP_j class of interaction dummy variables represent estimated plant output or wage rate (the P_j variables) for each plant separately distributed across the seven city size classes. Two equations, B and C, are estimated using the structure of submodel 4 and are shown in all industry tables for the Plant Location model in Chapter IV. In Equation B, plant output is multiplied by the value of CS_i, the latter receiving its actual value for the city size group (where $CS_i = 1$)[3] in which the plant is located and zeros elsewhere. Wage rate remains a continuous variable in Equation B, but is included as a segmented variable by city size in Equation C taking the actual value in the city size group it is located, zero otherwise. In Equation C, plant output remains a continuous variable.

The coefficient of any CS_iP_j variable represents a change in the slope of the profit rate line due to the influence of either plant output or wage rates in the i^{th} city size class; it is not a change in the intercept of the profit rate line. The beta coefficient for wage rate or plant output in small cities of less than 10,000 residents establishes the initial slope. For larger cities, the coefficient represents the expected change in the slope of the profit rate line from the initial slope. Therefore, it does not provide a direct estimate of profit rates for cities exceeding 10,000 population, but does indicate the expected profit rate difference from location in cities of less than 10,000 residents.

In the complete plant location model with the CS_iP_j and CS_i variables included, the intercept beta is the expected profit rate for companies with the following characteristics:

a) One plant location.

b) Involved in only one manufacturing industry.

c) Involved in only one major enterprise, i.e. no subsidiary enterprise separately listed in industry reports.

d) Located in the Northeast region of the U.S.

e) Location in non-metropolitan cities of less than 10,000 population.

The estimated profit rate line originates from this intercept. Any firm with different plant number, industry-enterprise, or location characteristics than those listed above have different profit rate intercepts.

Covariance Analysis of the Plant Location Model

In several instances, it is useful to evaluate statistically subsets of related coefficients as well as each individual coefficient. This evaluation is accomplished by analysis of covariance for the R_r, CS_i, and CS_iP_j subsets as shown in Table II.

The sums of square sources are presented in incremental fashion and the first four correspond respectively with submodels 1, 2, 3, and 4 of Table I.

TABLE II

ANALYSIS OF COVARIANCE FRAMEWORK FOR PLANT LOCATION MODELS AND TESTS OF STATISTICAL SIGNIFICANCE FOR SUBSETS OF REGION AND CITY SIZE COEFFICIENTS

Source		Incremental Sums of Square*	Incremental Degrees of Freedom[a]
(1)	X_f, X_m, NB_p, P_j	$a'a$	$G = F + M + P + J$
(2)	R_r	$b'b$	R
(3)	CS_i	$c'c$	I
(4)	CS_iP_j	$d'd$	I
(5)	Residual	$e_4'e_4$	$N - 1 - (G + R + 2I)$
(6)	Total	$y'y$	$N - 1$

Test for Including Region (R_r) Intercept Variables

$$F_\alpha\ 2.1 = \frac{c'c/I}{y'y - (a'a + b'b)/N - G + R + 2I)}$$

Test for Including City Size (CS_i) Intercept Variables

$$F_\alpha\ 3.2 = \frac{c'c/I}{y'y - (a'a + b'b + c'c)/[N - (G + R + I)]}$$

Test for Including City Size (CS_iP_j) Slope Variables

$$F_\alpha\ 4.3 = \frac{d'd/I}{e_4'e_4/[N - 1 - (G + R + 2I)]}$$

*a = 1 x G vector of coefficients, explaining profit rates due to sources X_f, X_m, NB_p, P_j.

b = 1 x R vector of coefficients explaining profit rates due to addition of R_r given previous variables are left in equation.

c = 1 x I vector of coefficients explaining profit rates due to addition of CS_i given previous variables are left in equation.

d = 1 x I vector of coefficients explaining profit rates due to additions of CS_iP_j given previous variables are left in equation.

$e_4 = 1 \times [N - 1 - (G + R + 2I)]$ vector of residuals

$y = 1 \times (N - 1)$ vector of profit rate values corrected for mean profit rate.

Like the variables in Table I, the regression sums of squares are presented in incremental fashion in Table II. The total sums of square (y'y) is the same for each submodel of an industry, while the residual sums of square ($e_4'e_4$) shown is for the complete submodel 4. The degrees of freedom column is interpreted in the same manner. Since this presentation is in reverse order from the usual textbook order, it is helpful to establish a few identities based on total sums of squares (TSS) displayed below:

2-2) $a'a + e_1'e_1 = TSS$

2-3) $a'a + b'b + e_2'e_2 = TSS$

2-4) $a'a + b'b + c'c + e_3'e_3 = TSS$

2-5) $a'a + b'b + c'c + d'd + e_4'e_4 = TSS$

from 2-3), 2-4) and 2-5) respectively

2-6) $b'b = e_1'e_1 - e_2'e_2$

2-7) $c'c = e_2'e_2 - e_3'e_3$

2-8) $d'd = e_3'e_3 - e_4'e_4$

since the following relation exists

2-9) $e_1'e_1 > e_2'e_2 > e_3'e_3 > e_4'e_4$.

These series of identity equations (2-2) - (2-9) explicitly illustrate the meaning of incremental additions to regression sums of square. As a further example, incremental regression sums of square due to region (R_r) is the difference in error sums of squares between submodel 2 (Table I) which includes the region subset compared to submodel 1 which does not. The same interpretation follows for the addition of the CS_i and CS_iP_j variables to the model.

The three computed F-values are shown immediately below the analysis of covariance table. Each F-value is computed to test the significance of additional subsets of coefficients entered into each submodel, given the previously entered subsets remain. The numbers corresponding to a and b in the relation F_{α} a, b refer to a number of independent variables within the added subset of the unrestricted submodel compared to b independent variables in the entire restricted submodel. The specific computations for the three F-values are presented for each region and city size test. The general form of the numerator is incremental sums of square between the restricted and unrestricted submodel divided by the added number of variables. This result is divided by the denominator which is the error sums of squares of the unrestricted submodel divided by the respective degrees of freedom.[4]

The main F-tests of interest are for city size intercept dummy variables CS_i, and the city size slope dummy variables CS_iP_j. Slope variables for either plant output or wage rates are only tested after the city size binary variables are entered. F-values obtained for the slope variables may differ depending on whether the city size (CS_i) binary variables were previously entered or left out. Since the city size (CS_i) variables were always of interest, they were included before adding the slope dummy variables.

Company Model

The development of the Company model is in a similar format to the Plant Location models and is presented in Table III. The analysis of covariance with the respective F-tests is also similar and presented in Table IV. Discussion below centers on major differences from the Plant Location models.

TABLE III

DEVELOPMENT OF THE COMPANY MODEL THROUGH A SERIES OF SUB-MODELS

Submodel	
1	$PR = \beta_0 + \sum_{w=1}^{W} \beta_w X_w + \sum_{m=1}^{M} \beta_m X_m + \sum_{p=1}^{P} \beta_p NB_p + \varepsilon_1$
2	$PR = \beta_0 + \sum_{w=1}^{W} \beta_w X_w + \sum_{m=1}^{M} \beta_m X_m + \sum_{p=1}^{P} \beta_p NB_p + \sum_{r=1}^{R} \beta_r R_r + \varepsilon_2$
3	$PR = \beta_0 + \sum_{w=1}^{W} \beta_w X_w + \sum_{m=1}^{M} \beta_m X_m + \sum_{p=1}^{P} \beta_p NB_p + \sum_{r=1}^{R} \beta_r R_r$ $+ \sum_{i=1}^{I} \beta_i CS_i + \varepsilon_3$

[a]The classes of independent variables are listed as

X_w = company financial and wage variables

X_m = company industry-enterprise zero-one dummy variables

NB_p = zero-one dummy variables for number of plant locations

R_i = regional interaction variables

CS_i = city size interaction variables

The X_m and NB_p classes of independent variables are identical in the Company and Plant Location models. The company financial and wage variables (X_w) are identical to the company financial variables (X_f) in the Plant Location model, except for the addition of an estimated total wage variable.

The seven city size groups in the Plant Location models are retained in submodel 3, again with the smallest city size group serving as the intercept. The value inserted in the i^{th} city size group is the estimated plant output as a proportion of company sales originating from plants located in the same city size group. City size groups in which its plants are not located receive a zero value for that company.

The sum of observed plant index values across the seven city size groups must equal one. Plant index values in one city size group must be included in the intercept to prevent a singular matrix. The plant index weights assigned to a given city size group range from 0.00 to 1.00 depending on the existence and relative importance of the company plants in the given city size groups. Individual plant index weights were combined for two or more plants located in different cities but within the same city size group.

Individual coefficients for the i^{th} city size are interpreted as the expected profit rate difference linearly associated with a unit change in the proportions of firm output originating in the i^{th} city size group compared to profit rates associated with locations in excluded city size groups of less than 10,000 residents.

The regional interaction variables (R_r) were constructed in an identical procedure to the CS_i variables for the Company model with plant index weight in the Northeast region serving as the base. The individual coefficient in the R_r class is interpreted as the expected profit rate difference linearly associated with a unit change in the proportional index weight in the r^{th} region compared to profit rates in the Northeast region.

The analysis of covariance table and the associated F-tests are developed in Table IV using the same approach as in the Plant Location model. For the Company model, only two F-tests are performed. The first tests for statistical significance between two submodels due to the inclusion of regional interaction variables; the second tests the statistical significance of including city size interaction variables.

This completes the discussion of the Company model. Its usage is especially appropriate where individual plants of a firm are of different sizes with locations distributed across different city sizes or region. For best results the plant location mix of city size and region groups should vary among firms.

TABLE IV

ANALYSIS OF COVARIANCE FRAMEWORK FOR COMPANY MODELS AND TEST FOR STATISTICAL SIGNIFICANCE FOR SUBSETS OF REGION AND CITY SIZE COEFFICIENTS

Source	Incremental Sums of Square*	Incremental Degrees of Freedom
(1) X_w, X_m, NB_p	$q'q$	$H = W + M + P$
(2) R_r	$r'r$	R
(3) CS_i	$s's$	I
(4) Residual	$e_3'e_3$	$N - 1 - (H + R + I)$
(5) Total	$y'y$	$N - 1$

Test for Including Region (R_r) Variables

$$F_\alpha = \frac{r'r/R}{y'y - (q'q + r'r)/N - 1\ (H + R)}$$

Test for Including City Size (CS_i) Variables

$$F_\alpha = \frac{s's/I}{e_3'e_3/N - 1 - (H + R + I)}$$

*q = 1 x H vector of coefficients explaining profit rates due to sources X_w, X_m, NB_p.

r = 1 x R vector of coefficients explaining profit rates due to addition of source R_r given previous variables are left in equation.

s = 1 x I vector of coefficients explaining profit rates due to addition of CS_i given previous variables are left in equation.

e = 1 x [N - 1 - (H + R + I)] vector of residuals.

y = 1 x (N - 1) vector of profit rate values corrected for mean profit rates.

FOOTNOTES

[1]The discussion of the general linear model is based on J. Johnston, Econometric Methods (New York: McGraw Hill, 1972), pp. 121-207.

[2]Originally cities were divided into nine population categories. Comparative analysis with a seven category breakdown revealed no information was gained by this finer breakdown.

[3]Note that the value of CS_i for small cities of less than 10,000 residents is included in intercept which always has a value equaling one. For this reason plant output or wage rate assumes actual values in the category represented by cities of less than 10,000 people regardless of which city size the plant is located in. For example, consider three plants whose city size category and wage rates are:

Plant

- I located in a city of less than 10,000 residents with weekly wages of $200.0.
- II located in a city of 30,000 residents with weekly wages of $220.00.
- III located in a city of 150,000 residents with weekly wages of $250.00.

Their respective CS_i values are:

Plant	CS_1 (<10,000 people)	CS_2 (10-50,000 people)	CS_3 (50-250,000 people)
I	1	0	0
II	1	1	0
III	1	0	1

and their respective CS_iP_j values (for wage rates) are:

Plant	CS_1	CS_2	CS_3
I	$200.00	0	0
II	$220.00	$220.00	0
III	$250.00	0	$250.00

[4]In a strict sense the F-values are testing for statistical differences between models differing only in one subset of coefficients as opposed to testing the statistical significance of the same subset of coefficients within a given equation. In a practical sense the estimates will not greatly differ provided the covariances, between any variables in the subset CS_i, CS_iP_j and R_r, in relation to other variables are small.

[5]Note that the best interpretive use of the plant location and company model is precisely opposite of one another. The plant location should theoretically obtain the best results when company plants are not distributed across a wide array of city size while the company model should be more efficient when plants are widely distributed with differing proportional weights. A knowledge of how dispersed company plants are located with respect to city size should indicate which model should obtain the most interpretative and reliable results.

CHAPTER III

SOURCES OF DATA, SELECTION OF THE SAMPLE, AND INVESTIGATION OF SAMPLE BIAS

A majority of this chapter details the procedure for selecting a sample of firms to be used in the empirical analysis. Data or model restrictions, of necessity, eliminated various industries as well as many firms within an acceptable industry from inclusion in the final sample. This process of elimination can introduce bias. Accordingly, it is necessary to investigate the impact of the selection process on the proportion of usable firms for each industry and difference in asset size and profitability between sampled firms and excluded firms. To give further insight into the characteristics of the sample, the final section shows the proportion of plants located within each of the various city size groups.

Alternative Data Sources

The minimum information needed in a comparative profit study is balance sheet and income statement data for manufacturing firms or industry groups in different sized U. S. cities. The most direct approach would be to obtain such primary data from each plant of each firm in each industry in each city. The obvious cost and time required preclude such an approach. In addition, corporations are reluctant to disclose cost and profit information by plant location.

This study uses secondary data. Unfortunately, the available secondary data have several shortcomings. A short discussion of alternative secondary data sources on U. S. manufacturing reveals some of the problems. The most detailed standardized information about manufacturing industry groups is found in the U. S. Census of Manufacturing published by the Census Bureau, Department of Commerce. The two latest editions respectively contain data for 1963 and 1967 with updated sample surveys published in the Annual Survey of Manufacturers. This census provides employment payroll costs, capital expenditures, value of shipment, cost of materials, and value added statistics for manufacturing industries for all Census divisions, states, Standard Metropolitan Statistical Areas (SMSA's), major cities, and counties. The industry is generally grouped at the two digit SIC level with further detail at the three and four digit level if disclosure rules permit.[1] The data are by establishment (plant location) and are insufficient to derive net income (profit).[2]

Two sources, Statistics of Income-Corporation Income Tax Returns and Statistics of Income-Business Income Tax Returns, published by the Internal Revenue Service reveal income statement data for manufacturing industries grouped by asset size and SIC code. Income statement information is available for all manufacturing by SMSA and for each two-digit SIC industry in most states.

Enterprise Statistics, published by the Census Bureau, specifically classifies Census of Manufacturing data for manufacturing enterprises, essentially three-digit SIC industries. Data at the enterprise level is considered the most useful for detailed industrial studies since production and marketing characteristics for most enterprises is reasonably homogenous. This source also links Census of Manufacturing data with

Internal Revenue Service Corporation income tax returns but does not provide a breakdown of net income statistics by region, city size group or individual cities.

Annual consolidated balance sheet and income statement information is available for medium sized and large corporations in private investment research sources such as Standard and Poor's Corporation Records and Moody's Industrials. Small firms are excluded from the study, because no information is available in published sources. The two major shortcomings of available individual corporation data is lack of information on cost of materials and labor to the company, and no breakdown of cost value of shipment on profit data from each plant location.

Standard and Poor's Corporation Records was selected as the major data source on company records for this study because coverage greatly exceeds that in Moody's Industrials. It lists data for over 10,000 publicly held corporations including 4,500 corporations primarily engaged in manufacturing activities. Additional data for cities concerning location and population are obtained from such sources as the 1970 U. S. Census of Population, Rand McNally Marketing Atlas, while wage data is obtained from the Bureau of Labor Statistics' Employment and Earnings for State and Standard Metropolitan Statistical Areas.

Sample Selection and Procedure

The initial sample of manufacturing companies used in this study was obtained from the "Classified Index of Industrial Companies" in Standard and Poor's Corporation Records. This six-volume data source consists of updated summary information of most U. S. corporations exceeding one million dollars in assets. It also contains reports on some large foreign corporations of interest to U. S. investors.[3] The amount and variety of information compiled increases with the size and importance of the corporation (company) but generally includes the following information:

(1) Consolidated balance sheet for two successive years;

(2) Consolidated income statements for several previous years;

(3) Amount and classification of stock and bond issuance;

(4) Number of employees for a given year;

(5) Location of plants by city and some indication of plant size;

(6) Description of production activities and review of recent history emphasizing any major product change, acquisition of other companies or sale of subsidiaries, and results of anti-trust, other civil and criminal suits.

The first step was to identify the index categories of industrial corporations that contained primarily manufacturing companies. This list is shown in alphabetical segments in Tables V and VI. Within each category, such as "Paper and Paperboard" (Table V), companies with production activities in this category were listed alphabetically. Companies with activities in two or more index categories were listed in each.

Standard and Poor's classification of companies into these index categories is based on information supplied by the companies. The "Classified Index on Industrial Companies" is not updated as frequently as the individual company reports, thus creating an information lag for companies rapidly changing their product mix. Another problem with using the classified index is that some categories contain both manufacturing and non-manufacturing sectors such as mining. This is evident for index categories in Table VI entitled:

TABLE V

ALPHABETICAL LISTING OF STANDARD AND POOR'S CLASSIFIED INDEX CATEGORIES OF INDUSTRIAL COMPANIES USED AS SAMPLE FRAME, SUBCLASSIFIED BY SEGMENT LEVEL OF INCLUSION WITH EXPECTED SIC CODE

	Expected* SIC Code
A. 100 Percent - Included	
Apparel--Clothing	23
Containers and Boxes	26, others
Furniture and Floor Covering	25
Paper and Paperboard	26
Printing and Publishing	27
Textiles--Cotton	22
Textiles--Synthetic, Wools, and Silks	22
B. 38 Percent - Included	
Ag Machinery and Equipment	35
Air Conditioning Equipment	35
Aircraft and Parts	37
Automobiles and Trucks	37
Automotive Parts and Accessories	37
Bakery Products	20
Beverages	20
Canned Fruit and Vegetables	20
Chemicals--Industrial	28
Chemical Products--Miscellaneous	28
Computer and Related Equipment	35
Confectionary and Related Products	20
Cosmetics	28
Dairy Products and Ice Cream	20
Drugs, Medicine, Dental and Hospital Supplies	28, 38
Electrical Appliances	36
Electrical Equipment	36
Electrical Machinery	36
Electronics	36

TABLE V (Continued)

	Expected SIC Code
Fertilizers	28
Fish and Seafood	20
Flour and Cereals	20
Frozen Foods	20
Food Products and Preparation--Miscellaneous	20
Hardware, Handtools and Accessories	34
Machinery Tools and Accessories	35
Meat Products	20
Office and Store Machines and Equipment	35
Paints and Varnishes	28
Plastics and Fabricated Plastic Products	28, 30
Plumbing Supplies, Heater and Miscellaneous Heating Equipment	34
Radio, TV, and Equipment, Phonographs and Musical Instruments	36, 39
Railroad Equipment	37
Shipbuilding and Repairing	37
Soaps and Cleanser	28
Sugar Producing and Refining	20

*The Expected SIC Code was determined by comparing a description of each category provided by Standard and Poors to description for each SIC Code listed in the Standard Industrial Classification Manual, Bureau of the Census, Washington, D. C., 1972.

TABLE VI

ALPHABETICAL LISTING OF STANDARD AND POOR'S CLASSIFIED INDEX CATEGORIES OF INDUSTRIAL COMPANIES WITH EXPECTED SIC CODE EXCLUDED FROM THE SAMPLE FRAME

Excluded Categories	Expected SIC Code
Aluminum and Alumin Products	33, M*
Asbestos	33
Cameras and Photographic Equipment	39
Cement and Concrete Products	32
Clay, Brick and Tile	32
Coal and Coke	33, M
Copper, Brass, and Bronze	33, M
Explosives, Ammunition and Firearms	19
Glass	32
Gold and Silver	33, M
Gypsum, Plasterboard, and Insulators	32, M
Lead and Zinc	33, M
Leather--Tanning and Finishing	31
Lumber	24
Nonferrous Metals	33, M
Oil Producing and Refining	29, M
Recreation and Sports Equipment	39
Steel and Iron	33
Tires, Rubber and Synthetic Rubber Products	30 (except 307 9)
Watches and Clocks and Wrist Watch Bands	39

*M is not a SIC Code, but represents all mining codes.

Aluminum and Aluminum Products
Coal and Coke
Copper, Brass and Bronze
Gold and Silver
Lead and Zinc
Nonferrous Metals
Oil Producing and Refining

Each index category was assigned a separate "activity code" representing the expected two or three digit SIC codes represented by the category. This code was punched on cards along with every company name in the enumerated categories and later stored on discs.

The second step was to obtain a list of unduplicated companies, that is, to eliminate any multiple listings of an individual company. This was accomplished by computer sorting of the initial list of company names into alphabetical order, regardless of activity code. A second computer program removed multiple listings of any company but retained the activity codes from the removed listings. This reduced the list from 7496 company names, including duplicates, to 4530 individual companies.

The third step was to establish and implement criteria for including manufacturing industries in the analysis.

An elimination process was used to finally determine the industries to retain. The minimum requirement for industry selection is a sufficient number of companies to analyze with either type of model. The Company model with the CS_i interaction variables contains at least fifteen to twenty independent variables; and it was judged that a minimum of forty to fifty usable companies is required to obtain statistically reliable results without resorting to small sample procedures and tests.

The manufacturing industries excluded from the analysis are represented by the categories listed in Table VI. The basis for exclusion is discussed in the following paragraphs.

Five manufacturing industries were eliminated from the analysis because of insufficient number of company observations. These are:[4]

SIC 19 - Ordnance and accessories
SIC 21 - Tobacco
SIC 31 - Leather products
SIC 38 - Instruments
SIC 39 - Miscellaneous

Another industry, SIC 30 - Rubber and Plastic Products was partitioned into two parts. Companies included within "Plastics and Fabricated Plastic Products" produced basic plastics (SIC 282) and plastic products (SIC 3079). They were analyzed as part of the Chemical Industry - SIC 28. The index category "Tires, Rubber and Synthetic Rubber Products" closely corresponded with the remaining companies in SIC 30 and was eliminated. Three other industries exhibiting particularly close ties to raw materials were eliminated; Lumber (SIC 24), Petroleum Refinery (SIC 29) and Stone, Clay and Glass Products (SIC 32).

The final industry eliminated was Primary Metals (SIC 33), because most of the index categories also included mining companies or integrated mining-manufacturing companies. The Primary Metal industry is one of the four largest manufacturing industries, based on employment or value added.[5] The demand for its output is comprised largely of other manufacturing industries which use the materials for making machinery and other equipment principally sold to the final demand sectors of the economy. Accordingly, the location pattern of this industry is assumed to be principally affected by the location of its industrial buyers and the differing geographic location of the numerous mineral used as raw materials. This complex set of industry demand and raw material location characteristics would be especially difficult to account for in the single equation models developed.

Eleven manufacturing industries remain in the analysis and are represented by the index categories in segment A and segment B of Table V. Segment A includes the industries:

SIC 22 - Textiles
SIC 23 - Apparel
SIC 25 - Furniture
SIC 26 - Paper and allied products
SIC 27 - Printing

Segment B includes the industries:

SIC 20 - Food
SIC 28 - Chemicals
SIC 34 - Fabricated Metals
SIC 35 - General Machinery
SIC 36 - Electrical Machinery
SIC 37 - Transportation Equipment

Each of the initial 4530 companies was then assigned to either segment A or B of Table V or to categories in Table V. Because 880 companies were assigned to excluded categories in Table VI, the sample frame was reduced from 4530 to 3550 companies. The included industries were divided into segments A and B on the basis of expected number of companies listed in the industry. Segment A included five industries, each with no more than 200 companies. This relatively low number of expected companies per industry allowed complete enumeration of the approximately 690 companies in segment A. In segment B, the number of expected companies per industry, based on activity codes, ranged from 400-1000. This relatively large number partially resulted from a high frequency of companies engaged in more than one industry represented in segment B. Limitations on research resources coupled with judgments of the sample size required for statistical reliability led to a sampling rate of 38 percent or 1110 companies, bringing the total number of selected companies to 1800.

Selecting Usable Firms and Analysis of Rejected Firms

Once the industry groups and sample of companies were selected, the fourth step was to determine the usability of the selected companies for inclusion in the industry profit rate analyses. Mere listing of the company name in the Classified Index of Industrial Companies did not assure that all of the needed financial, plant location, and employment information was obtainable.

Companies are included if data were available for the dependent and independent variables in both the Plant Location and Company models, provided the firm did not come under the six rejection reasons shown in Table VII. The table shows the number of rejected and "usable" firms per industry sampled.

Reason ONE eliminated conglomerate-type firms with major activities in more than two manufacturing industries but retained firms diversified in two industries. The usable multi-industry firms were included in the analysis of each industry, provided both industries were in the sample frame. For example, if a firm had production activities in industries SIC 22 and SIC 23, it was included in the analysis of both. If a firm had major (more than 60% of sales volume) production activities in SIC 23 (Apparel) and had lesser activity in SIC 31 (Leather, including shoes) it was included only in the analysis of SIC 23. The effect of the second industry on profit rates was adjusted for by independent variables to be discussed later. Necessity dictated the inclusion of multi-industry firms to gain sufficient observations and because these diversified firms are such a prominent part of the U. S. industry.

TABLE VII

NUMBER OF FIRMS SAMPLED FROM STANDARD AND POOR'S CLASSIFIED LISTING; CLASSIFIED BY USABLE AND UNUSABLE FOR ANALYSIS, BY REASON REJECTED

	SIC										
	20	22	23	25	26	27	28	34	35	36	37
1. Sampling Rate (%)	38	100	100	100	100	100	38	38	38	38	38
2. Sample Size (number of firms)	205	151	151	126	124	152	323	230	344	315	172
3. Number of Usable Firms	89	50	55	54	44	59	84	95	150	136	61
4. Number of Unusable Firms	116	101	96	72	80	93	239	135	194	179	111
Number of Unusable Firms by Reason Rejected[a]											
5. ONE	4	5	3	4	9	3	33	42	55	40	29
6. TWO	42	44	27	28	31	29	63	32	57	49	43
7. THREE	33	31	27	20	17	31	63	33	41	50	17
8. FOUR	18	14	6	8	18	12	43	14	23	21	9
9. FIVE	17	7	15	8	3	16	28	12	17	19	12
10. SIX	0	0	18	4	2	2	9	1	1	0	1

[a]Explanation of reasons rejected:

ONE = Firm engaged in more than two manufacturing industry two-digit SIC code.
TWO = Firm with more than eight plant locations; or plant location not listed.
THREE = Firm financial data not collected.
FOUR = Firm engaged in international manufacturing activities exceeding one plant location.
FIVE = Firm primarily engaged in non-manufacturing activities.
SIX = Firm entirely engaged in manufactruing SIC codes that were not included for the analysis.

Reason TWO arbitrarily set eight U. S. plant locations as the maximum limit for usable firms. It also excluded firms where no plant location by city was listed. Each plant location was considered a separate unit, for counting purposes, even if more than one plant was located in the same SMSA or city. This counting method had the practical effect of further reducing the number of cities and city sizes in which a company could be located.

Reason THREE excluded firms without sufficient financial data. The minimum acceptable financial data were two consecutive years of selected balance sheet and income statement statistics including the year 1970, and the sales information for 1967-1970. The purpose was to exclude firms at the extreme ends of its life cycle where profit patterns would be expected to sharply diverge from the profit patterns of ongoing firms. It also excluded small firms from $1 million to $10 million in assets that did not report annual financial statements except for earnings and total assets.

Reason FOUR excluded firms with significant foreign operations. A usable firm was arbitrarily permitted one foreign plant location with manufacturing activities not exceeding twenty percent of total revenues. This exception primarily affected U. S. companies with a small Canadian subsidiary. Very few U. S. companies with activities in Europe, or Asia or Latin America could meet this restriction.

Reasons FIVE and SIX excluded firms primarily engaged in non-manufacturing activities or entirely engaged in manufacturing industries not included in the analysis. This situation arose due to the pitfalls involved in using Standard and Poors classification system as an accurate listing of companies involved in the eleven included industries. The actual SIC codes for each company (firm) were obtained from Standard and Poor's 1971 Corporation Directory supplemented with description of the firm's activities found in S & P Corporation Records. If the two sources contained any conflicts, the latter source was considered the final authority, especially concerning the importance of each SIC code activity within the firm's industrial composition.

Firms allocated to reason THREE to SIX are mutually exclusive from each other and from the remaining reason categories. U. S. firms with significant foreign operations were allocated to reason FOUR even if the firms could have been rejected for other reasons. U. S. based firms that could be rejected for both reason ONE and TWO, were allocated to reason ONE. Multi-industry firms, whether accepted or rejected, were counted in all of their major respective industries.[6]

Five findings emerge from this table:

(1) The proportion of usable firms compared to sample size varied from a low of 26 percent in the Chemical Industry (SIC 28) to 44 percent in the Food, Non-electrical Machinery, and Electrical Machinery industries (SIC 20, SIC 35 and SIC 36). The median proportion of usable firms for the eleven industries was 36 percent.

(2) The number of usable companies was lowest in the industries where all listed companies were enumerated, varying from 44 firms in the Paper Industry (SIC 26) to 59 firms in the Printing Industry (SIC 27).

(3) Except for the Chemical Industry (SIC 28) and Paper Industry (SIC 26), the number of foreign companies or multinational U. S. companies did not exceed 10 percent of the companies listed in Standard and Poor's. The foreign Paper Industry companies were Canadian while the foreign Chemical Industry companies were European.

(4) The proportion of selected firms within the category of "unusable firms" that were rejected for inadequate data or wrong SIC codes (reason THREE, FIVE, and SIX) varied from 28 percent in the Transportation industry (SIC 37), to 62-63 percent in the Printing industry (SIC 27) and Apparel industry (SIC 23) with a median proportion of 37 percent. This proportion represents firms that should not be included in the original company list to obtain a sample.

(5) The proportion of "unusable firms" allocated to reasons ONE and TWO, because of diverse industrial structure, sharply varied across industry groups. The greatest proportion of rejections occurred in the Chemical, Fabricated Metals and the three Machinery and Equipment industries (SIC 28, 34, 35, 36 and 37), indicating the industrial diversity of firms engaged in these five industries, compared to the remaining six industries in the analysis. Reasons ONE and TWO sort against large diverse U. S. firms. This condition is also true of U. S. controlled multi-national firms. To judge bias, it is useful to compare the size distribution of the accepted usable firms with the size distribution of these particular rejected U. S. firms. Another important issue is profit rate differences, if any, between the accepted and rejected firms.

The asset size distribution of the accepted and rejected firms is shown in Table VIII with the number of firms reported in each asset size-industry cell. The total number of accepted (usable) and rejected firms is shown at the right hand side with the corresponding percentage component for the industry.

Less than 45 percent of firms in the Chemical and Transportation Equipment industry were accepted compared to 60-66 percent for four

TABLE VIII

FIRM DISTRIBUTION BY ACCEPT-REJECT CATEGORY BY ASSETS BY INDUSTRY

			Asset Size in Millions of Dollars								Total Firms and % by Category	
Industry	SIC	Category	1.0-4.9	5.0-9.9	10.0-24.9	25.0-49.9	50.0-99.9	100.0-249.9	250.0-499.9	500.0+	No.	%
Food	20	Accept	9	9	34	18	14	3	1	1	89	62.7
		Reject	0	0	5	4	7	7	6	24	53	37.3
Textiles	22	Accept	5	5	17	13	6	3	1	0	50	48.5
		Reject	2	1	2	3	11	18	9	7	53	51.5
Apparel	23	Accept	14	15	16	8	1	1	0	0	55	62.5
		Reject	1	1	1	3	11	10	1	5	33	37.5
Furniture	25	Accept	8	9	20	10	5	2	0	0	54	65.8
		Reject	0	1	7	5	5	7	0	3	28	34.2
Paper	26	Accept	3	8	16	4	8	4	1	0	44	51.7
		Reject	0	0	4	5	6	7	7	12	41	48.3
Printing	27	Accept	4	11	17	12	6	8	1	0	59	61.4
		Reject	0	1	4	7	8	9	6	2	37	38.6
Chemicals	28	Accept	16	22	27	8	6	4	1	0	84	43.0
		Reject	8	4	6	9	13	20	12	39	111	57.0
Fabricated Metals	34	Accept	7	20	33	16	14	4	1	0	95	54.9
		Reject	0	3	8	11	17	19	9	11	78	45.1
Non-Electrical Machinery	35	Accept	12	28	47	31	21	9	1	1	150	55.9
		Reject	1	4	4	11	22	36	16	24	118	44.1
Electrical Machinery	36	Accept	35	31	26	20	15	9	0	0	136	59.8
		Reject	8	0	22	14	24	12	17	2	99	42.2
Transportation Equipment	37	Accept	6	13	18	9	9	4	1	1	61	44.8
		Reject	2	0	11	16	18	12	12	4	75	55.2

industries: Food, Apparel, Furniture, and Printing. The remaining five industries have acceptance rates of 50-60 percent.

Inspection of the asset size categories reveals rejected firms are larger than accepted firms, as expected. No more than two accepted usable firms per industry have assets exceeding $250,000,000. The median and modal asset size range is 10.0-24.9 million dollars for accepted firms in all eleven industries.

The rejected firms do not follow the same asset size distribution pattern in each industry. The median rejected firm with respect to size in five industries is in the 50.0-99.9 million dollar asset category; while the median rejected firm in another five industries is in the 100.0-249.9 million dollar asset category. Finally, the median rejected firm in the Food industry is in the 250-499.9 million dollar asset category.

The rejection process eliminated most firms with more than 250 million dollars of assets from the analysis. The 760 usable sampled firms are most nearly representative of firms in the 1.0-249.9 million dollar asset range, essentially medium sized firms. A 1970 Federal Trade Commission Quarterly Financial Report showed 48 percent of manufacturing assets were property of 102 U. S. corporations exceeding one billion dollars in assets, while another 19 percent of assets were property of 218 manufacturing companies with 250.0-999.9 million dollars of assets. At the other extreme, over 250,000 manufacturing firms (corporations, proprietorships, and partnerships) with less than 1.0 million dollars in assets comprised 5 percent of total manufacturing assets. The remaining manufacturing companies, those with 1.0-250.0 million dollars in assets comprised 28 percent of total U. S. manufacturing assets.[7]

Profit rates for one-half of the rejected U. S. companies previously described in Table VIII were randomly selected to compare with profit rates of the accepted firms. Companies with extreme profit rates of 60 percent or more and -60 percent or less were removed. The profit rate means and standard deviations are shown in Table IX.

Among the eleven industries, profit rates of accepted firms exceeded those of rejected firms in five industries. Differences in profit rates between accepted and rejected firms do not exceed 3.1 percent for any industry. The profit rate standard deviation are quite large for both accepted and rejected firms. A chi-square contingency test gave no basis to reject the hypothesis that profit rates were not a function of the class (accepted or rejected) into which firms fell.

Analysis of Single Industry Vs. Multi-industry Firms

The analysis now turns to a brief comparison of single industry firms versus multi-industry firms used in the industry analyses. Multi-industry firms comprised 242 of the 722 usable firms. One hundred fifty-five of these 242 firms were analyzed within two industry categories. The second industry for the remaining 87 firms was outside the industry groups in the sample frame, which meant the firm was only analyzed for the included industry.

The multi-industry firms averaged 4.0 plant locations while the single industry firms averaged 3.5 plant locations. Thus, the multi-industry firms are weighted more frequently in the Plant Location models than in the Company model.

TABLE IX

PROFIT RATE MEAN AND STANDARD DEVIATION BY ACCEPT - REJECT CATEGORY BY INDUSTRY[a]

SIC Code	Accepted Firms		Rejected Firms	
	Profit Mean	Std. Deviation	Profit Mean	Std. Deviation
	Percent			
20	12.4	8.9	15.9	6.4
22	12.4	8.8	12.3	3.6
23	12.6	11.8	14.7	6.1
25	11.2	10.9	14.2	8.2
26	11.7	7.2	14.4	10.1
27	14.9	10.4	11.8	10.5
28	15.1	9.3	13.8	8.8
34	13.4	9.0	13.6	7.6
35	13.1	10.6	12.9	7.1
36	14.0	11.8	12.9	9.3
37	12.6	10.7	13.6	6.5

[a]Profit rate is defined as Operating Income/Total Assets.

In Table X the number of single industry and multi-industry firms are shown by asset size range for each included industry group. Multi-industry firms outnumber single industry firms in four industry groups--Furniture, Transportation Equipment, Fabricated Metals and Non-electrical Machinery--and exceeded two-thirds of usable firms in the last two industries. Only in the Food and Printing industries did the two-industry firms comprise less than one quarter of usable firms. The sample size would have been sharply reduced if these multi-industry firms would have been excluded from the analysis.

In all but three industry groups the median firm classified by size for both single industry and multi-industry firms is in the 10.0-24.9 million dollar asset range. The exceptions occur in the Food, Printing, and Transportation Equipment industries where the median sized multi-industry firm is in the 25.0-49.9 million asset range. From this analysis it appears the usable multi-industry firms greatly affected the sample size, but only marginally affected the average number of plant locations per firm.

Analysis of Plant Location by City Size Groups

Discussion now turns to plant location frequency by city size groups by industries of the sampled firms. This is accomplished in three parts, each summarized by a table.

Table XI depicts the percentage of plant locations by city size for companies by industry categories. City size is divided into nine population categories with three subtotals; 0-49,999 people, 50,000-999,999 people, and 1,000,000 or more people, hereafter referred to as small, medium, and large sized cities. The small cities are exclusively micro-

TABLE X

DISTRIBUTION OF FIRM NUMBERS BY SINGLE VS. MULTI-INDUSTRY BY SIC CODE BY ASSET SIZE RANGE

		Asset Size in Millions of Dollars							Total Number and Percent of Firms	
SIC	Type	0.0-4.9	5.0-9.9	10.0-24.9	25.0-49.9	50.0-99.9	100.0-249.9	250.0+		
20	Single	9	9	31	16	11	2	2	80	89.9
	Multi	0	0	3	2	3	1	0	9	10.1
22	Single	5	3	12	8	5	2	1	36	72.0
	Multi	0	2	5	5	1	1	0	14	28.0
23	Single	13	12	11	4	0	0	0	40	72.7
	Multi	1	3	5	4	1	1	0	15	27.3
25	Single	3	7	7	5	3	1	0	26	48.1
	Multi	5	2	13	5	2	1	0	28	51.9
26	Single	1	4	10	2	5	3	1	26	59.1
	Multi	2	4	6	2	3	1	0	18	40.9
27	Single	4	9	16	9	6	6	1	51	86.4
	Multi	0	2	1	3	0	2	0	8	13.6
28	Single	12	14	14	4	3	3	1	51	60.7
	Multi	4	8	13	4	3	1	0	33	39.3
34	Single	5	5	12	5	1	0	0	28	29.5
	Multi	2	15	21	11	13	4	1	67	70.5
35	Single	8	9	18	9	2	1	1	48	32.0
	Multi	4	19	29	22	19	8	1	102	68.0
36	Single	26	17	13	7	4	4	0	71	52.2
	Multi	9	14	13	13	11	5	0	65	47.8
37	Single	4	2	9	1	2	0	1	23	37.7
	Multi	2	7	9	8	7	4	1	38	62.3

TABLE XI

PERCENT OF PLANT LOCATIONS BY CITY SIZE FOR SAMPLED COMPANIES BY INDUSTRY; BASED ON TOTAL NUMBER OF PLANTS

CITY SIZE INTERVAL (1970population in thousands)	SIC 20	SIC 22	SIC 23	SIC 25	SIC 26	SIC 27	SIC 28	SIC 34	SIC 35	SIC 36	SIC 37
0 - 2.4	8.7	18.5	21.0	10.5	13.3	4.4	4.5	9.3	7.8	6.8	8.9
2.5 - 9.9	13.7	26.1	17.6	20.3	9.2	12.0	8.9	12.6	11.9	12.3	15.8
10.0 - 24.9	10.7	11.4	13.7	14.0	8.7	6.2	10.5	10.4	10.2	9.4	11.8
25.0 - 49.9	4.7	4.3	3.9	3.5	5.2	6.6	4.5	3.8	5.3	6.4	3.6
Subtotal 0 - 49.9	38.8	60.3	56.2	48.3	36.4	29.2	28.4	36.1	35.2	34.9	40.1
50.0 - 249.9	9.8	6.5	4.4	7.6	5.2	8.0	5.5	6.8	7.4	7.9	6.9
250.0 - 499.9	6.3	10.9	6.8	9.3	7.5	3.5	4.8	7.7	8.9	7.2	8.9
500.0 - 999.9	10.2	3.8	4.8	11.0	8.7	6.6	9.6	9.6	9.7	7.2	9.3
Subtotal 50.0 - 999.9	26.3	21.2	17.0	27.9	21.4	18.1	19.9	24.1	26.0	22.3	25.1
1000.0 - 2499.9	17.3	10.3	12.7	8.7	15.0	16.0	22.0	16.2	15.5	17.0	14.2
2500.0 - 15000.0	17.6	8.2	14.1	15.1	27.2	36.7	29.7	23.6	23.3	25.8	20.6
Subtotal 1000.0+	34.9	18.5	26.8	23.8	42.2	52.7	51.7	39.8	38.8	42.8	34.8
TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
TOTAL PLANTS NUMBER	337	183	202	161	170	226	364	353	590	434	235

politan and do not include any suburban or satellite cities as defined by the U. S. Census Bureau. Percentage of 1970 U. S. manufacturing employment for small, medium and large cities is shown for comparison purposes.

Three principal findings emerge. First, the share of plants exceeds the overall share of employment (30.7 percent) in small cities for nine of eleven industries. On the average, plants in the small cities have fewer employees than plants in medium sized and large sized cities. Based on total employment in the eleven industries the large metropolitan areas had 44.3 percent of total employment, while medium sized metropolitan locations had 25 percent employment share.

A second finding was that six industries (Food, Textiles, Apparel, Furniture, Paper and Transportation Equipment - SIC 20, 22, 23, 25, 26 and 37 respectively)- had a majority or plurality of plant locations in small micropolitan cities of under 50,000 population. In the remaining five industries, larger cities of over 1,000,000 population had a majority or plurality portion of plant numbers. In no case did the medium sized cities have a plurality of plants.

Among small cities, the population categories of 2,500-9,999 and 10,000-24,999 residents had the largest share of plants except for the Apparel (SIC 23) and Paper (SIC 26) industries. Among the large cities, the popualtion size group of 2,500,000 or more had the most plants, except for the Textile (SIC 22) industry. Although this largest city size group consists of only seven metropolitan areas (New York, Los Angeles, Chicago, Detroit, Philadelphia, Baltimore, and Washington, D.C.) these cities comprised over 20 percent of plant locations in most industries.

Finally, wide variation was evident in the share of plants by city size groups among industries. Textile (SIC 22), Apparel (SIC 23), and Furniture (SIC 25) industries were most evident in smaller cities while the Printing and Chemical industries were most evident in large cities. The medium sized cities were proportionately favored by the Food, Fabricated Metals, Non-electrical Machinery and Transportation Equipment industries - SIC 20,34, 35, and 37 respectively.

The data in Table XII depicts the number of firms with plants in N city size classes by industry. The cities were divided into seven population classes, the same as used in the Plant Location and Company model analyses. In the Food industry, 19 firms had all of their plants in only one city size category, 24 firms had their plants in two different city size groups, while 4 firms had plants in at least five different city size groups. This table portends the potential problems encountered in using the Plant Location model. Profit measures are only available for companies, but most companies have their plants in more than one city size group. In six industries (Food, Chemicals, Fabricated Metals, Non-electrical Machinery, Electrical Machinery and Transportation Equipment) over 24 percent of the firms have plants located in four or more city size groups. In most industries firms with plants in one or two city size groups occurred more frequently than firms in a wider array of city size category.

Table XIII lists the number of firms in each industry that have plant location distributions within seven mutually exclusive combinations of city size classes. For this table, cities were again classified into small, medium, and large population sizes. If a firm had plants in each size class, then it was categorized into the A-B-C combination; if

TABLE XII

NUMBER OF COMPANIES WHICH HAVE PLANTS IN
N CITY SIZE CLASSES BY INDUSTRY[a,b]

SIC	Industry	N 1	2	3	4	5+	Total Companies
20	Food	19	24	20	21	4	89
22	Textile	16	17	12	4	1	50
23	Apparel	14	19	14	6	2	55
25	Furniture	17	17	10	8	2	54
26	Paper	14	7	11	6	6	44
27	Printing	17	16	16	6	4	59
28	Chemicals	22	27	17	16	4	84
34	Fabricated Metals	24	25	22	20	4	95
35	Non-electrical Machinery	30	47	22	35	16	150
36	Electrical Machinery	51	27	30	20	8	136
37	Transportation Equipment	9	15	13	16	7	61

[a]Seven city size classes were used for this analysis. They are listed below in thousands of people:

0.0 - 9.9
10.0 - 49.9
50.0 - 249.9
250.0 - 499.9
500.0 - 999.9
1000.0 - 2499.9
>2500.0

[b]The value of N was determined by the number of different city size groups a company had plants in. For example, if a company had two plants, one in a city of 0.0 - 9.9 thousand residents and one plant in a city of 500 - 999.9 thousand residents the value of N equals 2.

TABLE XIII

NUMBER OF COMPANIES IN MUTUALLY EXCLUSIVE COMBINATIONS OF CITY SIZE CLASSES BY INDUSTRY[a]

SIC	Industry	City Size Combination							Total Companies
		ABC	AB	AC	BC	A	B	C	
20	Food	27	16	4	12	22	4	4	89
22	Textile	7	13	4	4	21	4	2	50
23	Apparel	11	10	11	4	11	0	8	55
25	Furniture	9	10	11	4	12	4	4	54
26	Paper	15	5	8	5	6	1	4	44
27	Printing	11	4	15	6	0	3	20	59
28	Chemicals	28	3	22	16	6	3	5	84
34	Fabricated Metals	7	29	19	9	2	10	15	95
35	Non-electrical Machinery	50	18	34	20	8	12	8	150
36	Electrical Machinery	34	7	29	12	11	16	27	136
37	Transportation Equipment	27	8	8	7	1	5	5	61

[a]City size classes A, B, and C are of the following size range:

A = 0 - 49,999 population
B = 50,000 - 999,999 population
C = 1,000,000+ population

Companies in city size combinations A.B, A.C, B.C, and A.B.C have a minimum of one plant in each city size range included in the combinations. Thus companies in A.B.C have a minimum of one plant each in cities of 0.0 - 49.9 thousand, 50.0-999.9 thousand and 1000.0 thousand or more people.

it had plants only in the small and medium sized cities then it was categorized into the A-B combination. When a firm had plant locations solely in the large or medium or small sized cities it was A or B or C accordingly.

An important general finding is the relatively large proportion of firms which simultaneously operate plants in all three city size classes. The Paper, Chemical, Non-electrical Machinery and Transportation Equipment industries each have one-third or more of their firms in all three (A-B-C combination) size groups. In the latter three industries, firms in the A-B-C combination exceeded the entire number of firms with plants only in the A, B, or C sizes. Plants within these three industries appear not to be restricted to one city size class. This suggests that there may be economies in specialization, performing operations in the city size class which is most efficient.

In the Textile, Furniture and Fabricated Metals industry the A-B-C combination occurred infrequently and characterized less than one-sixth of all firms. Only in the Textile industry did the proportion of firms exclusively in A, B, or C exceed one-half. Absence of substantial economies for large cities and presence of low wage labor apparently made small cities attractive for the Textile industry. The Food industries also had a high proportion (one-fourth) of firms with plants exclusively in small cities. Alternatively the Printing and Electrical Machinery industries have one-third and one-fifth of the firms located exclusively in large cities.

The proportion of firms with plants in two of the three city size groups (A-B, B-C, A-C) varied from 36 percent in the Food industry to 60 percent in the Fabricated Metals industry, with 40-48 percent a typical figure. The combination of small and large cities (A-C) was most frequent of the three combinations in all industries except the Food, Textile, and Fabricated Metals industries.

Table XIII has several shortcomings. It is based on cross sectional data, hence does not show the changing distribution of plants among city size groups. The table does not disaggregate by city size the different subfunctions or enterprises within a firm, neither does it indicate which industry in a multi-industry firm was located in a particular city size group. However, since the multi-industry frequency is of prominence in five industries (Chemicals, Fabricated Metals, Non-electrical Machinery, Electrical Machinery and Transportation Equipment) the distortion therefrom across city size groups would affect only these industries and is not likely to be serious.

Summary

This chapter depicts the secondary data used in subsequent empirical analysis. The major weakness of using secondary instead of primary data was the lack of balance sheet and income statement data for individual plant locations. However, the Plant Location and Company models were developed to adjust for this weakness in estimating differences in industry profitability by city size groups selected for subsequent empirical analysis were primarily engaged in manufacturing. The included and eliminated industries can be compared to the industry employment trends discussed in Chapter V as one measure of their suitability for growth and development in smaller cities.

Possible sample bias arose from the necessity to limit usable firms to activities in only two manufacturing industries and to a maximum of eight plant locations. The result was a tendency to select medium sized companies between $1 million to $250 million asset size. While the rejected U. S. manufacturing firms were bigger, their profit rates did not significantly differ as was shown in Table IX. Because individual plant profit rates are not available it is impossible to indicate the full extent of bias in the dependent variable resulting from this selection process. But a likely assumption is that the distribution of individual plant profit rates from the company average does not greatly differ between accepted and rejected firms. Furthermore, medium sized firms appear to be of primary interest for location in micropolitan communities.

A likely effect of excluding larger, more diversified firms is to increase the significance of the individual plant numbers N_p, and financial statement, X_f, or X_w, variables. If economies of production size are largely exhausted by firms of $250 million asset size and eight plants, the inclusion of larger sized firms with more plant locations would weaken the relationship of size or plant numbers to profitability.

A likely, but untested, possibility is that the sampled medium sized firms are more profitable in micropolitan areas than are the larger industrial firms. This case would arise if larger firms have a higher frequency of labor union contracts with uniform money wages paid regardless of plant locations. The second condition is that profitability would be enhanced in smaller cities provided lower wages could be paid.

Some evidence was shown in Table XI that medium sized firms have located plants in small cities with greater frequency compared to larger firms. Another important finding is the widespread tendency of multi-plant firms in most industries to have plants in small, medium, and large cities.

In the author's opinion what bias may exist by excluding larger firms is toward greater profitability of plant locations in smaller cities. If no differences of industrial profitability exists between city sizes in the empirical results, then it is very unlikely this result would be changed to confirm increased profitability in smaller cities by including the larger firms in the sample.

FOOTNOTES

[1]Disclosure rules used by the Census of Manufacturing state the census data for all manufacturing will be published for any city exceeding 450 manufacturing employees. Industry data is published for any two, three or four digit SIC codes where employment exceeds 450 for any SIC level and more than one establishment (plant location) is involved.

[2]An approximation of operating income can be obtained from the computation:

Value of shipments - (Employment payroll costs including social security, cost of materials)

This computation does not include the cost of rent, fuel, etc. in the cost of materials category and thus is not a true operating income defined as sales minus costs of goods sold including all administrative and overhead expenses.

A net income before or after tax computation can't be obtained from the Census of Manufacturing data, leaving operating income as the chief alternative. Furthermore, the base for profits, however defined, would have to be sales instead of assets or equity. From a theoretical standpoint, profit rates defined in terms of asset or equity is preferable.

[3]Standard and Poors obtains records from all publicly held corporations exceeding one million dollars in assets that pay a fee to be listed in the S & P publications. S & P sources do not include data for proprietorships, partnerships, and cooperatives regardless of size. However, these legal business organizational forms are not usually prominent above the million dollar asset class. While the S & P list is incomplete it nevertheless provides more information about the company than most other corporation record volume by other investor sources.

[4]The index groupings from which the eliminated industries came are not completely synonymous with SIC codes and sometimes extend across two-digit SIC industry lines. For example, the group Leather Tanning and Finishing represents firms in SIC 31, Leather Products, but SIC 31 firms are also included in the category Apparel because they manufacture shoes. Another example is the Recreation and Sports Equipment group which includes Miscellaneous manufacturing (SIC 39) with movie and entertainment companies. These examples are not the majority case, however.

[5]Based on statistics in the U. S. Bureau of the Census, 1970 Annual Survey of Manufacturers (Washington, D. C.: Government Printing Office, 1972).

[6]Unusable multi-industry firms with diversification in three or more industries were only counted for the three industries with their largest sales activities. Since the summation of firms for reason ONE across the eleven industries equaled 227, this implies a minimum of 72 firms were rejected for industrial diversification reasons. The actual number is probably much larger as many of the firms had activities in excluded industries, and are not triple counted across industry lines.

[7]Specific source from which the data was obtained is the Federal Trade Commission, Quarterly Financial Report (Washington, D. C. Government Printing Office, 1st Quarter, 1970), p. 61.

[8]An attempt was made to determine if plant size was smaller in the smaller cities compared to plant size in larger cities. Many of the companies sampled reported square footage data for each plant location. This was converted to a percentage of company square footage and allocated to each city size group (small, medium or large) the companies were located in. The company's importance within an industry was weighted by its 1970 sales. Results from this weighting procedure indicated plant size was smaller in the small cities, implying employment may also be less. But it could not account for the entire difference. Although this cursory analysis gave some indication that plant size is smaller in small cities it is not reported in a table nor is it discussed in detail. It does suggest that medium sized companies must locate in small cities with greater frequency.

CHAPTER IV

PRESENTATION OF THE DEPENDENT AND INDEPENDENT VARIABLES AND ANALYSIS OF EMPIRICAL RESULTS

In this chapter the empirical results of the Plant Location and Company models are presented to determine if industry profits vary systematically by city size. To constrain the reporting to manageable proportions and to avoid repetition of similar results among industries, in this chapter the profit analysis centers on the Fabricated Metals, Electrical Machinery, Furniture, Printing, Food, and Apparel industries. The tables for the remaining five industries are presented in Appendices A and B.

Before discussing the profit patterns of the six industries, the dependent variable - company profit rate is defined, followed by a section defining the independent variables.

Definition of Company Profit Rate--The Dependent Variable

The company profit rate (PR) can be defined in several ways, three of which are shown below:

(1) PR = Net Income After Federal Income Taxes/Stockholders Equity

(2) PR = Net Income Before Federal Income Taxes/Total Assets

(3) PR = Operating Income/Total Assets

The first definition is the most commonly used and represents the after-tax returns to the stockholder investor which may be used for distribution of dividends or as retained earnings. In the second and third definitions, profit rate is considered a return to all owned resources of the firm, including current and fixed assets. Operating income is defined as total sales revenues less material costs, wages and salaries, and general administrative and selling expenses. Subtraction of interest, depreciation and depletion charges from Operating Income results in Net Income Before Federal Income Taxes.

The numerator for definition (3), Operating Income, is a more stable component than Net Income Before or After Federal Income Taxes. This is due to differing levels of actual interest payments between firms depending upon the level and proportion of creditor capitalization of the firm. Differing depreciation, depletion and tax accounting practices used by firms give rise to different reported net income levels among firms with similar Operating Incomes. Furthermore, the denominator in (3), Total Assets, is less variable than Stockholders Equity since firms of similar size or within the same industries have widely varying equity capital ratios.

The statistical models also were analyzed for the other two profit rates measures. Results concerning the effect of city size on profit rates did not differ appreciably from the results obtained using Operating Income/Total Assets as the profit rate measure.

The Independent Variables

All independent variables are listed in Table XIV, accompanied with a short definition. Independent variables are grouped into classes in both the Plant Location and Company models. This table is supplemented with discussion of key variables in the following paragraphs.

TABLE XIV

LIST AND DESCRIPTION OF INDIVIDUAL INDEPENDENT VARIABLES WITHIN EACH CLASS OF VARIABLES FOR THE PLANT LOCATION AND COMPANY MODELS

X_f =	COMPANY FINANCIAL STATEMENT VARIABLES USED IN PLANT LOCATION MODELS
Symbol	Description
SALES	1970 company sales in billions of dollars.
CAPITAL	1970 company book value of net plant and equipment in billions of dollars.
LABOR	1970 average labor force for the company in thousands of workers.
C/L RATIO	Ratio expressed in thousands of dollars of capital per worker.
ASSETS	1970 company total long and short term assets in billions of dollars.
NETWORTH RATIO	Stockholders equity/total assets. Stockholders equity is the total value of common stock, preferred stock, capital or paid-in surplus, and retained earnings.
GROWTH RATE	Arithmetic average sales growth from 1967-1970 expressed in percentage terms. Average sales for this period was the base for computation.
P_j =	PLANT LOCATION VARIABLES USED IN THE PLANT LOCATION MODELS.
WAGERATE	1970 estimated weekly wage rate for employment in the company's industry for each company plant location, expressed in hundreds of dollars.
PLANT OUTPUT	Company sales (in billions of dollars) allocated to individual plants according to estimated importance (based on size) of the plant to the company.

TABLE XIV (Continued)

X_w	=	COMPANY FINANCIAL AND WAGE VARIABLES USED IN COMPANY MODEL
		All but one of these variables are identical in symbol and description to the X_f Variables in the plant location model. The additional variable is shown below.
Symbol		Description
TOTAL WAGES		Estimate of total company wages for production employees in thousands of dollars. Annual wages per employee per plant is computed as (WAGERATE 52) where WAGERATE is expressed in dollars. Company employees (LABOR) are allocated to plants based on the plant size index to obtain the total company wages.
NB_p	=	NUMBER OF COMPANY PLANTS ZERO-ONE DUMMY VARIABLES USED IN THE PLANT LOCATION AND COMPANY MODEL
		Plant numbers per company were divided into four groups as shown below. NB1 served as the intercept.
Symbol		Description
NB 1		Company had one plant location
NB 2-3		Company had two or three plant locations.
NB 4-5		Company had four or five plant locations.
NB 6-7-8		Company had six, seven or eight plant locations.
CS_i	=	CITY SIZE ZERO-ONE DUMMY VARIABLE USED IN THE PLANT LOCATION MODEL
		The intercept term is CS1 representing cities less than 10,000 people.

TABLE XIV (Continued)

Symbol	Description
	The following description is expressed in actual population categories; the variable equals "1" if plant is located in the category; "0" otherwise.
CS_1	Less than 10,000 population, serves as the intercept.
CS_2	10,000-49,999 population
CS_3	50,000-249,999 population
CS_4	250,000-499,999 population
CS_5	500,000-999,999 population
CS_6	1,000,000-2,499,999 population
CS_7	2,500,000 or more population
CS_i	CITY SIZE INTERACTION VARIABLES USED IN COMPANY MODEL These variables represent the importance of company plant locations in each city size class based on the proportion of plant output in the i^{th} city size class to company sales. For each firm, this computation across all seven city size groups sums to "one". The computation for each CS_i class containing a plant is (Σ PLANT OUTPUT)/ SALES. If no plant location exists in the i^{th} city size class the CS_i value in the i^{th} city size class is "zero"; and can equal "one" if all plants are in the i^{th} city size class. The population categories remain the same as in the Plant Location Model and are not shown below.

TABLE XIV (Continued)

CS_iP_j = CITY SIZE INTERACTION DUMMY VARIABLES USED IN PLANT LOCATION MODEL

The following variables are the PLANT LOCATION VARIABLES (previously described) allocated across CITY SIZE classifications. The value of the SC_iP_j term is "0" if the variables $CS_i = 0$. The value of the CS_iP_j term is the same as the P_j value, if $CS_{ij} = 1$.

The following lists these variables according to CITY SIZE classification and computation of interaction term. The computation of the PLANT $OUTPUT_1$ and WAGE $RATE_1$ variables are identical to computation of the P_j variable WAGE RATE and PLANT OUTPUT because CS_1 as the intercept always equals "1".

Symbol	POPULATION	COMPUTATION
PLANT $OUTPUT_1$	Less than 10,000	PLANT OUTPUT
PLANT $OUTPUT_2$	10,000-49,999	PLANT OUTPUT X CS_2
PLANT $OUTPUT_3$	50,000-249,999	PLANT OUTPUT X CS_3
PLANT $OUTPUT_4$	260,000-499,999	PLANT OUTPUT X CS_4
PLANT $OUTPUT_5$	500,000-999,999	PLANT OUTPUT X CS_5
PLANT $OUTPUT_6$	1,000,000-2,499,999	PLANT OUTPUT X CS_6
PLANT $OUTPUT_7$	2,500,000 or more	PLANT OUTPUT X CS_7
WAGE $RATE_1$	Less than 10,000	WAGE RATE
WAGE $RATE_2$	10,000-49,999	WAGE RATE X CS_2
WAGE $RATE_3$	50,000-249,999	WAGE RATE X CS_3
WAGE $RATE_4$	250,000-499,999	WAGE RATE X CS_4
WAGE $RATE_5$	500,000-999,999	WAGE RATE X CS_5
WAGE $RATE_6$	1,000,000-2,499,999	WAGE RATE X CS_6
WAGE $RATE_7$	2,500,000 or more	WAGE RATE X CS_7

TABLE XIV (Continued)

R_r	=	REGIONAL ZERO-ONE DUMMY VARIABLE USED IN PLANT LOCATION VARIABLE
		The regions used coincide with the four Bureau of Census Regions with the NORTH-EAST serving as the intercept. The following description lists the states in each category. The variable equals "1" if plant is located in the category; "0" otherwise.
Symbol		Description
NORTHEAST		Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont.
MIDWEST		Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin.
SOUTH		Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, Washington, D. C., Virginia.
WEST		Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming.
R_r	=	REGIONAL INTERACTION VARIABLES USED IN COMPANY MODELS
		These variables represent the importance of company plant locations in each region. Relative importances based on the proportion of plant output in the r^{th} region as compared to total company sales. It is computed in the same manner as the CITY SIZE INTERACTION VARIABLE, previously described. The regions are defined in the same manner and with the same symbols as for the REGIONAL ZERO-ONE DUMMY VARIABLE and are not repeated here.

TABLE XIV (Continued)

X_m	=	INDUSTRY-ENTERPRISE ZERO-ONE DUMMY VARIABLES USED IN THE PLANT LOCATION AND COMPANY MODELS
		These variables are used to discern effects on profit rates due to the second industry in the multi-industry company. They are also used to discern effects on profit rates due to subdividing an industry into "enterprises". The industry variables are listed below by SIC code and a description of their name. The "enterprise" codes are listed by symbol, name, and SIC codes. In addition, the description for a non-manufacturing code is given.

Symbol		Description
	INDUSTRY	
SIC 20		Food
SIC 21		Tobacco
SIC 22		Textile
SIC 23		Apparel
SIC 24		Lumber and Wood Products
SIC 25		Furniture
SIC 26		Paper and Allied Products
SIC 27		Printing
SIC 28		Chemical
SIC 29		Petroleum Refinery Products
SIC 30		Rubber Products
SIC 31		Leather
SIC 32		Stone, Clay, and Glass Products
SIC 33		Primary Metals

TABLE XIV (Continued)

SIC 34	Fabricated Metals
SIC 35	General or Nonelectrical Machinery
SIC 36	Electrical Machinery
SIC 37	Transportation Equipment
SIC 38	Instruments
SIC 39	Miscellaneous Products
ENTERPRISE	
Meat	Meat Packing and Slaughtering - SIC 201
DRINK	Alcohol and Nonalcohol Beverages - SIC 208
CANFD	Canned food products - SIC 203
DRUGS	Chemical drugs - SIC 284
PLASTIC	Chemical Plastics and Plastic Products - SIC 282, 3079
CHEMIND	Industrial Chemicals - SIC 281
HARDWARE	Hardware and Small Tool - SIC 342, 345
PLUMBING	Plumbing and Heating Equipment - SIC 343
Elec 1	Electronics - SIC 367
Elec 2	Electrical Appliance - SIC 363
Elec 3	Electrical Machinery - SIC 362, 361, except 3611
Elec 4	Electrical Equipment - SIC 364, 369, 3611
Elec 13	Electronics and Electrical Machinery
Elec 14	Electronics and Electrical Equipment
Elec 34	Electrical Machinery and Electrical Equipment
AUTO	Automobiles and Truck - SIC 371, 379

TABLE XIV (Continued)

AIR	Aircraft and Parts - SIC 272
RAIL	Railroad Equipment - SIC 374
NOMANF	Company had some non-manufacturing activities such as a radio or TV station, retailing or wholesaling but not a major portion of the company activities.
MULTI-INDUSTRY	Company involved in a second industry. This was used separately including the second industry did not give any significant coefficients.

The SALES and ASSET variables represent the firm's absolute size. The ASSET variable was not included in an industry analysis if its simple correlations with SALES exceeded 0.70, resulting in its usage only in the Food industry while the SALES variable was included in all industries examined. If strong economies of size are present the expected sign would be positive, otherwise no significant relationship should exist.

CAPITAL and LABOR are frequently cited in economic literature as influencing firm profits. LABOR is measured as the number of company employees on a given date of the year and is not an average for the entire year. The statistics do not distinguish between production employees and nonproduction employees; or among different skill levels. The measure of CAPITAL is "net value of physical plant and equipment" as defined by the company. The most frequent valuation method subtracts depreciation from the original value of plant or equipment when purchased or constructed, without considering replacement cost. Without a knowledge of the specific firm's accounting practices, it is impossible to standardize this statistic. It is assumed the measure is sufficiently reliable for an industry analysis. CAPITAL and LABOR were not separately entered in an equation if their simple correlations exceeded 0.70. If the correlation exceeded this level, the two variables are entered as one relationship--the capital-labor ratio (C/L RATIO).

GROWTH RATE was computed from sales growth (decline) from 1967-1970. An alternative measure would be asset change which in part reflects the contribution of past profit changes to growth. Sales data were used instead of asset data because it was reported for a longer time period. Sales growth is frequently stated as a major company goal, and may conflict with attaining high profit rates. Nevertheless, the net impact of growth on profit rates is expected to be positive.

NETWORTH RATIO measures the importance of varying equity ratios on firm profit rates. A higher networth ratio reflects a lesser portion of short-term and capital debt to pay off, thus profit rates should tend to be higher if the firm can achieve similar growth and have the same costs (excepting debt repayment) without using borrowed money or having large accounts payable. The NETWORTH RATIO in a given year is a reflection of the firms' growth decisions in previous years and how they achieved it, whether by borrowed or internal capital. In this sense, it serves as a proxy for several complex dynamic variables.

The WAGE RATE variable reflects the demand-supply relationship for LABOR at given locations. It also serves as a proxy for different skill levels which were not obtainable for the LABOR variable. The Fuchs and Greenwood articles, reviewed in Chapter I, indicate wage rates are extremely interrelated with labor skills and productivity, precluding separation of a pure wage effect from the productivity effect on profit rates.

The variable, WAGE RATE, was unavailable from company data sources. It was estimated from average weekly wage rates obtained for states and SMSA's by industry for 1970 from the Bureau of Labor Statistics (BLS) source _Employment and Earnings for States and SMSA for 1939-1970_.

A wage rate was estimated for each plant based on the city location. If no wage rate was available for the city, as was the case for all nonmetropolitan cities, the state average wage rate was used for employment in the respective industry. The state-wide average included estimates from smaller cities and SMSA's but was not revalued to exclude the SMSA effect.

Use of average wage rate data assumes a competitive labor market for the company. It ignores the possibility of union contracts with the same wage level covering company employees regardless of plant location. It further assumes the company used the average distribution of labor skill levels prevailing in the labor area. While these assumptions may be in serious conflict for a given location, the estimate provides a reasonable index of varying wage levels among cities. The fact that many of the sampled companies supplied wage rate data to the BLS provides some basis for assuming a close relationship between the estimated wage rate and the actual wage rate paid.

In Equation C, WAGE RATE is segmented by plant location in each city size group to determine if the interaction of wage rates and city size systematically affects company profit rates.

It is imperative to emphasize that the construction of WAGE $RATE_1$ in the segmented CS_iP_j variables is the same as for WAGE RATE in the P_j class. Both have weekly values for every plant observation regardless of city size class. The construction of the WAGE RATE variables for the remaining city size classes (CS_2 through CS_7) depends on whether a plant is located in that city size group. For example, if a plant is located in the New York City SMSA (population 14.5 million) represented by CS_7 and the weekly wage rate is \$220.00 (\$4.50 per hour) the value of WAGE $RATE_7$ for the plant is \$220.00. In addition, the value of WAGE $RATE_1$ for this plant is also \$220.00. The remaining WAGE $RATE_1$ variables for the other city size classes are zero because the value for $CS_{2,\ 3,\ 4,\ 5,}$ and $_6$ are zero since the plant is not located in these city size groups.

Construction of the WAGE RATE variables in this manner makes it possible to depict nonlinear interactions between wages and city size as they influence profit rates.[1] This relationship to profit rates is expected to be negative in larger city size groups unless increased labor productivity offsets the increased wages in large cities.

The city size groups used for the CS_i and CS_iP_j variables were derived from 1970 Census population data. If a plant was located in a city or suburb within an SMSA, the entire SMSA population was used as the classification basis. For cities located in non-metropolitan counties, the actual city population was used.[2] The use of the SMSA population will add an upward bias to the categorization of plants to a city size class.

Three classes of variables and two individual variables are formulated from an index of individual plant size as a proportion of company size. The index assumes a value between 0.01 and 1.00 for an individual plant. It is based on data reported in Standard and Poor's for each plant--annual output in physical units, or square footage of plant space. Annual output is used to form the index for the Food and Paper industries. Square footage data are used to form the index for the other industries because it was the only information available. These measures converted to index form for each plant removed the assumption of equal plant size and importance in the company and were used in constructing the variables discussed in the next three paragraphs.

The index value for plant size multiplied by company sales (SALES) became the estimate for the variable, PLANT OUTPUT. In Equation B, PLANT OUTPUT is segmented by plant location in each city size group, while in Equations A and B it remains a continuous linear variable. It was included to test if plant size varies systematically upward as city size becomes large and whether resulting economies of plant size are sufficient to influence profit rates.[3]

The plant size index was directly used in the construction of the company model variable classes R_r and CS_i, where the estimated company output was distributed proportionally across region and city size classes, respectively.

Furthermore, the index value was used indirectly in the computation of TOTAL WAGES as company labor was allocated proportionally to each plant based on its index value. The computation for TOTAL WAGES became:

$$\text{4-1)}\quad \text{TOTAL WAGES} = \sum_{i=1}^{p} (\text{WAGE RATE} \times 52) \times (\text{LABOR} \times \text{PLANT SIZE INDEX})$$

where

52 = Number of weeks in a year

p = Number of company plants.

The enterprise variables closely conform to the definition of enterprises or combinations of enterprises as used in the 1967 Enterprise Statistics published by the Bureau of the Census, Department of Commerce. Many enterprise groups besides the ones listed in Table XIV were originally examined, but those listed in the table were selected because sufficient observations were available in each enterprise group. The use of enterprises for five industries: Food, Chemicals, Fabricated Metals, Electrical Machinery, and Transportation Equipment provides some indication of their influence on profit rates.

Analysis of the Electrical Machinery Industry and Fabricated Metals Industry

The analysis of plant location models and company models for the sampled industries begins with the series of six tables (XV-XX) for two

TABLE XV

REGRESSION ANALYSIS OF ELECTRICAL MACHINERY INDUSTRY - PLANT LOCATION MODEL

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
Constant	-0.1548***	0.0511	-0.1587***	0.0524	-0.2948***	0.0883
X_f						
SALES	-0.0637	0.1282	-0.0414	0.1346	-0.0317	0.1288
C/L RATIO	1.5706	1.6864	1.5349	0.0017	2.5223	1.7133
NETWORTH RATIO	0.2737***	0.0233	0.2724***	0.0235	0.2746***	0.0233
GROWTH RATE	0.0007*	0.0004	0.0007*	0.0004	0.0007*	0.0004
X_m						
SIC 34	-0.0256	0.0218	-0.0270	0.0220	-0.0240	0.0217
SIC 35	-0.0003	0.0139	-0.0011	0.0140	-0.0040	0.0139
SIC 37	0.0167	0.0208	0.0148	0.0212	0.0140	0.0208
SIC 38	0.0045	0.0202	0.0026	0.0204	-0.0014	0.0202
SIC 28	-0.0068	0.0245	-0.0071	0.0247	-0.0069	0.0244
Elec 1	0.0480***	0.0143	0.0476***	0.0144	0.0456**	0.0142
Elec 2	0.0562***	0.0216	0.0553**	0.0220	0.0514***	0.0216
Elec 3	0.0608***	0.0199	0.0608***	0.0203	0.0650***	0.0198
Elec 4	0.0657***	0.0187	0.0657***	0.0189	0.0609***	0.0188
Elec 13	-0.0136	0.0226	-0.0157	0.0231	-0.0191	0.0225
Elec 14	-0.0408	0.0323	-0.0402	0.0325	-0.0289	0.0322
Elec 34	-0.0559*	0.0328	-0.0485	0.0338	-0.0528*	0.0327
NB_p						
NB 2-3	0.0308	0.0209	0.0296	0.0210	0.0263	0.0209
NB 4-5	0.0091	0.0212	0.0089	0.0214	0.0075	0.0213
NB 6-7-8	0.0468**	0.0218	0.0453**	0.0220	0.0429**	0.0218
R_r						
MIDWEST	-0.0085	0.0132	-0.0100	0.0134	-0.0097	0.0132
SOUTH	-0.0112	0.0161	-0.0139	0.0164	0.0022	0.0169
WEST	0.0388***	0.0146	0.0357**	0.0149	0.0422***	0.0153
CS_i						
CS 2	0.0057	0.0164	0.0014	0.0198	-0.0325	0.1159
CS 3	-0.0065	0.0207	-0.0018	0.0270	0.1146	0.1214

TABLE XV (Continued)

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
CS 4	0.0173	0.0215	0.0254	0.0255	0.1802	0.1294
CS 5	0.0388*	0.0212	0.0552**	0.0262	0.3609**	0.1352
CS 6	-0.0053	0.0165	-0.0021	0.0193	0.0419	0.1294
CS 7	-0.0146	0.0152	-0.0074	0.0190	0.3173***	0.1232
P_j						
WAGE RATE	0.0212	0.0328	0.0242	0.0313		
PLANT OUTPUT	0.8990**	0.3080			0.8817**	0.4320
CS_iP_j						
PLANT OUTPUT 1			1.1403	0.7556		
PLANT OUTPUT 2			0.3354	0.9675		
PLANT OUTPUT 3			-0.4131	1.2422		
PLANT OUTPUT 4			-0.5320	0.9737		
PLANT OUTPUT 5			-1.8351	1.6974		
PLANT OUTPUT 6			-0.2959	0.9638		
PLANT OUTPUT 7			-0.7547	1.1187		
WAGE RATE 1					0.1218**	0.0611
WAGE RATE 2					0.0286	0.0849
WAGE RATE 3					-0.0882	0.0912
WAGE RATE 4					-0.1212	0.0970
WAGE RATE 5					-0.2462**	0.1021
WAGE RATE 6					-0.0389	0.0923
WAGE RATE 7					-0.2394***	0.0886
Summary						
N		460		460		460
R^2		0.322		0.326		0.345
F-Value		6.79***		5.68***		6.20***
Coefficient of Variation		90.20%		90.58%		89.25%
Profit Mean		11.21%		11.21%		11.21%

* - Coefficient is significant at the 0.10 probability level
** - Coefficient is significant at the 0.05 probability level
*** - Coefficient is significant at the 0.01 probability level

TABLE XVI

ANALYSIS OF COVARIANCE - PLANT LOCATION MODEL
ELECTRICAL MACHINERY--SIC 36

Source	Equation B--Output SS	d.f.	MS	Equation C--Wage Rate SS	d.f.	MS
(1) X_f, X_m, P_j, NB_p	1.8737	21	0.0892	1.8727	21	0.0892
(2) R_r	0.1238	3	0.0413	0.1238	3	0.0413
(3) CS_i	0.0853	6	0.0143	0.0853	6	0.0143
(4) $CS_i \cdot P_j$	0.0252	6	0.0042	0.1517	6	0.0258
(5) Residual	4.3605	423	0.0103	4.2340	423	0.0100
(6) Total	6.4675	459		6.4675	459	

Test for Including Intercept Variables	(Region)	(City Size)
Source:	R_r	CS_i
Equations:	A, B, C	A, B, C
Computed F	4.015	1.415
Tabulated $F_{.05}$	2.68	2.18
Conclusion	Reject H_0 at .01 level	Fail to reject H_0

Test for Including Slope Variables	(Plant Output X City Size)	(Wage Rate X City Size)
Source:	CS_iP_j	CS_iP_j
Equations:	B	C
Computed F	0.407	2.528
Tabulated $F_{.05}$	2.18	2.18
Conclusion	Fail to reject H_0	Reject H_0 at .05 level

TABLE XVII

REGRESSION ANALYSIS OF FABRICATED METALS INDUSTRY - PLANT LOCATION MODEL

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
Constant	-0.1634***	0.0451	-0.1628***	0.0458	-0.1002***	0.0291
X_f						
SALES	0.1746***	0.0912	0.1737**	0.0923	0.1138**	0.0769
C/L RATIO	-0.0097	0.7565	-0.0070	0.7665	-0.0769	0.7743
NETWORTH RATIO	0.2851***	0.0227	0.2849***	0.0230	0.2874***	0.0228
GROWTH RATE	0.0022***	0.0003	0.0022**	0.0003	0.0022***	0.0003
X_m						
NOMANF	-0.0614***	0.0130	-0.0606***	0.0131	-0.0611***	0.0129
SIC 28	0.0871***	0.0157	0.0888***	0.0163	0.0880***	0.0159
SIC 35	0.0279***	0.0097	0.0305***	0.0100	0.0304***	0.0097
SIC 36	-0.0306**	0.0151	-0.0295**	0.0155	-0.0329**	0.0150
SIC 37	-0.0049	0.0179	-0.0039	0.0182	-0.0047	0.0179
HARDWARE	0.0424***	0.0085	0.0427***	0.0086	0.0423***	0.0085
PLUMBING	-0.0173	0.0117	-0.0148	0.0121	-0.0173	0.0117
HRDWR & PLMBG	0.0734***	0.0209	0.0703***	0.0215	0.0649***	0.0210
NB_p						
NB 2-3	0.0385*	0.0219	0.0364*	0.0223	0.0379*	0.0219
NB 4-5	0.0027	0.0211	-0.0007	0.0215	0.0058	0.0209
NB 6-7-8	0.0243	0.0218	0.0205	0.0222	0.0275	0.0214
R_r						
MIDWEST	0.0127	0.0092	0.0124	0.0093	0.0112	0.0089
SOUTH	0.0207	0.0134	0.0204	0.0135	0.0107	0.0134
WEST	0.0041	0.0125	0.0045	0.0126	0.0059	0.0125
CS_i						
CS 2	-0.0052	0.0120	-0.0065	0.0158	0.0450	0.0866
CS 3	0.0248	0.0161	0.0155	0.0193	-0.0480	0.1012

TABLE XVII (Continued)

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
CS 4	0.0039	0.0151	-0.0026	0.0176	0.0196	0.0913
CS 5	-0.0108	0.0140	-0.0156	0.0196	-0.2472**	0.1257
CS 6	0.0010	0.0121	0.0048	0.0145	-0.0234	0.0788
CS 7	0.0007	0.0110	0.0008	0.0139	-0.1532***	0.0588
P_j						
WAGE RATE	0.0440*	0.0246	0.0463*	0.0249		
PLANT OUTPUT	-0.3790	0.3014			-0.3810	0.3100
CS_iP_j						
PLANT OUTPUT 1			-0.0673	0.6434		
PLANT OUTPUT 2			0.1536	1.1642		
PLANT OUTPUT 3			0.6429	0.8140		
PLANT OUTPUT 4			0.4984	0.7451		
PLANT OUTPUT 5			0.4327	1.1870		
PLANT OUTPUT 6			-0.4356	0.9491		
PLANT OUTPUT 7			-0.0317	0.9973		
WAGE RATE 1					0.0100	0.0450
WAGE RATE 2					-0.0333	0.0580
WAGE RATE 3					0.0480	0.0736
WAGE RATE 4					-0.0150	0.0621
WAGE RATE 5					0.1578*	0.0836
WAGE RATE 6					0.0165	0.0515
WAGE RATE 7					0.0990***	0.0366
Summary						
N		364		364		364
R^2		0.494		0.497		0.504
F-Value		12.64***		10.22***		11.28***
Coefficient of Variation		46.34%		46.61%		46.14%
Profit mean		14.11%		14.11%		14.11%

* - Value significant at 0.10 probability level
** - Value significant at 0.05 probability level
*** - Value significant at 0.01 probability level

TABLE XVIII

ANALYSIS OF COVARIANCE - PLANT LOCATION MODEL
FABRICATED METALS—SIC 34

Source	Equation B--Output SS	d.f.	MS	Equation C--Wage Rate SS	d.f.	MS
(1) X_f, X_m, P_j, NB_p	1.3723	17	0.0807	1.3723	17	0.0807
(2) R_i	0.0139	3	0.0046	0.0139	3	0.0046
(3) CS_i	0.0190	6	0.0032	0.0190	6	0.0032
(4) $CS_i \cdot P_j$	0.0088	6	0.0015	0.0388	6	0.0065
(5) Residual	1.4316	331	0.0043	1.4016	331	0.0042
(6) Total	2.8456	363		2.8456	363	

Test for Including Intercept Variables	(Region)	(City Size)
Source:	R_i	CS_i
Equation:	A, B, C	A, B, C
Computed F	1.088	0.741
Tabulated $F_{.05}$	2.68	2.18
Conclusion	Fail to reject H_0	Fail to reject H_0
Test for Including Slope Variables	(Plant Output X City Size)	(Wage Rate X City Size)
Source:	CS_iP_j	CS_iP_j
Equation:	B	C
Computed F	0.340	1.528
Tabulated $F_{.05}$	2.18	2.18
Conclusion	Fail to reject H_0	Fail to reject H_0

TABLE XIX

REGRESSION ANALYSIS - COMPANY MODEL

Electrical Machinery Industry			Fabricated Metals Industry		
	Equation D			Equation D	
Variables	Beta Coefficient	Std. error of beta	Variables	Beta Coefficient	Std. error of beta
Constant	-0.0801	0.0644	Constant	-0.1237*	0.0651
X_{fw}			X_{fw}		
SALES	0.6043	0.3836	SALES	-0.2946	0.7284
C/L RATIO	-3.3064	3.0692	C/L RATIO	0.6255	1.3931
NETWORTH RATIO	0.3026***	0.0639	NETWORTH RATIO	0.2432***	0.0575
GROWTH RATE	0.0028***	0.0009	GROWTH RATE	0.0030***	0.0011
TOTAL WAGES	-0.0010	0.0013	TOTAL WAGES	0.0013	0.0029
X_m			X_m		
NOMANF	-0.0494	0.0522	NOMANF	-0.0633*	0.0356
SIC 28	0.0180	0.0542	SIC 28	0.0828**	0.0402
SIC 34	0.0281	0.0439	SIC 35	0.0140	0.0239
SIC 35	0.0488*	0.0299	SIC 36	-0.0261	0.0330
SIC 37	0.0879	0.0635	SIC 37	-0.0351*	0.0214
SIC 38	0.0732*	0.0415	HARDWARE	0.0351*	0.0214
ELEC 1	0.0446*	0.0277	PLUMBING	-0.0376	0.0282
ELEC 2	0.0076	0.0504	HRDWR & PLMBG	0.0426	0.0607
ELEC 3	0.0218	0.0389			
ELEC 13	-0.1104**	0.0493			
ELEC 14	-0.0508	0.0615			
ELEC 34	-0.0173	0.0647			
NB_p			NB_p		
NB 2-3	-0.0473	0.0303	NB 2-3	0.0572	0.0326
NB 4-5	-0.0487	0.0331	NB 4-5	0.0156	0.0316
NB 6-7-8	-0.0204	0.0373	NB 6-7-8	0.0372	0.0370
R_r			R_r		
MIDWEST	0.0040	0.0033	MIDWEST	0.0362	0.0279
SOUTH	-0.0418	0.0456	SOUTH	0.0598	0.0495
WEST	0.0159	0.0321	WEST	0.0379	0.0429

TABLE XIX (Continued)

Electrical Machinery Industry			Fabricated Metals Industry		
	Equation D			Equation D	
Variables	Beta Coefficient	Std. error of beta	Variables	Beta Coefficient	Std. error of beta
CS_i			CS_i		
CS 2	-0.0625	0.0582	CS 2	-0.0116	0.0527
CS 3	-0.0147	0.0534	CS 3	0.0731	0.0493
CS 4	0.0166	0.0714	CS 4	0.0137	0.0535
CS 5	0.0678	0.0675	CS 5	0.0664	0.0529
CS 6	0.0122	0.0459	CS 6	0.0191	0.0469
CS 7	0.0014	0.2450	CS 7	0.0263	0.0400
Summary			Summary		
N		123	N		90
R^2		0.419	R^2		0.458
$\bar{R}^2$		0.232	$\bar{R}^2$		0.250
F-Value		2.22***	F-Value		2.16***
Coefficient of Variation		90.68%	Coefficient of variation		58.58%
Profit mean		11.40%	Profit mean		13.40 %

* - Value significant at 0.10 probability level
** - Value significant at 0.05 probability level
*** - Value significant at 0.01 probability level

TABLE XX

ANALYSIS OF COVARIANCE FOR COMPANY MODEL OF THE FABRICATED METALS AND ELECTRICAL MACHINERY INDUSTRIES

Source	FAB. METALS-SIC 34			ELEC. MAC.-SIC 36		
	SS	d.f.	MS	SS	d.f.	MS
X_w, X_m, NB_p	0.2906	16	0.0182	0.6421	21	0.0306
R_r	0.0139	3	0.0046	0.0234	3	0.0078
CS_i	0.0289	6	0.0048	0.0450	6	0.0075
Residual	0.3943	64	0.0062	0.9835	92	0.0107
Total	0.7277	89		1.6941	122	

Test for Including Regional Variables

Source	R_r	R_r
Computed F	0.657	0.744
Tabulated $F_{.05}$	2.74	2.70
Conclusion	Fail to reject H_0	Fail to reject H_0

Test for Including City Size Variables

Source	CS_i	CS_i
Computed F	0.783	0.702
Tabulated $F_{.05}$	2.25	2.22
Conclusion	Fail to reject H_0	Fail to reject H_0

industries. Tables XV and XVI contain three equations for the Plant Location model and analyses of covariance tables for the Electrical Machinery industry. Tables XVII and XVIII contain the same information for the Fabricated Metals industry. In Table XIX the equation for the Company model is shown for both industries while Table XX contains the analyses of covariance for the Company model of both industries. This same format is followed in Tables XXI-XXVI for the Furniture and Printing industries and in Tables XXVII-XXXII for the Food and Apparel industries. The tables for the remaining industries are in Appendix A and B.

A detailed interpretation for each table is given for the Electrical Machinery industry. For any subsequent industry only empirical highlights are discussed.

The beta coefficients are proportional values which can be multiplied by 100 to form percentages. As an example, in Table XV, the constant term in Equation A of -0.1548 represents a -15.48 percent profit rate. If the firm had industrial activities in SIC 34, its expected profit rate would be -18.04 percent, a decline of 2.56 percentage points from the profit rate in the constant term. In this chapter the term "percentage points" refers to the absolute change in company profit rate, while relative changes in profit rates are referred to as percentage increases or decreases. In the above example, a change in profit rates by 2.56 percentage points from -15.48 percent to -18.04 percent is a 16.5 percentage decrease in the profit rate.

Within the X_f variables, the NETWORTH RATIO and GROWTH RATE coefficients appear significant in all three equations. (The term "significance" refers to statistical significance of a coefficient at a 0.05 probability level or better.) The coefficient for NETWORTH RATIO

TABLE XXI

REGRESSION ANALYSIS OF FURNITURE INDUSTRY - PLANT LOCATION MODEL

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
Constant	-0.1486**	0.0732	-0.1779**	0.0725	-0.2343***	0.0906
X_f						
SALES	0.6065***	0.2060	0.5782***	0.2044	0.7134***	0.2117
C/L RATIO	-2.5980	2.1936	-2.2713	2.1733	-3.2197	2.2185
NETWORTH RATIO	0.3629***	0.0319	0.3823***	0.0319	0.3534***	0.0319
GROWTH RATE	0.0047***	0.0007	0.0043***	0.0007	0.0046***	0.0007
X_m						
NOMANF	0.0601***	0.0232	0.0540**	0.0233	0.0649***	0.0233
MULTI-INDUSTRY	0.0387***	0.0114	0.0328***	0.0116	0.0437***	0.0120
NB_p						
NB 2-3	0.0589**	0.0240	0.0715***	0.0245	0.0542**	0.0247
NB 4-5	0.0654***	0.0257	0.0742***	0.0260	0.0633**	0.0265
NB 6-7-8	0.0853***	0.0272	0.0936***	0.0275	0.0754***	0.0281
R_r						
MIDWEST	0.0216	0.0184	0.0235	0.0186	0.0329*	0.0189
SOUTH	-0.0383*	0.0220	-0.0385*	0.0216	-0.0179	0.0236
WEST	-0.0169	0.0197	-0.0310*	0.0201	-0.0147	0.0200
CS_i						
CS 2	0.0133	0.0156	0.0066	0.0219	0.0554	0.0760
CS 3	0.0036	0.0213	0.0173	0.0340	0.3274***	0.1229
CS 4	0.0037	0.0205	-0.0152	0.0296	-0.0521	0.1276
CS 5	0.0321*	0.0182	0.0489**	0.0221	0.1025	0.0897
CS 6	0.0046	0.0219	0.0119	0.0248	0.0828	0.1388
CS 7	0.0302	0.0209	0.0894***	0.0286	0.2862*	0.1518

TABLE XXI (Continued)

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
P_j						
WAGE RATE	-0.0610	0.0495	0.0531	0.0490		
PLANT OUTPUT	0.1063	0.5375			-0.0775	0.5430
CS_iP_j						
PLANT OUTPUT 1			0.7229	0.8266		
PLANT OUTPUT 2			0.7188	1.4603		
PLANT OUTPUT 3			-2.2102	4.1750		
PLANT OUTPUT 4			1.6502	1.8160		
PLANT OUTPUT 5			-1.6617	1.2813		
PLANT OUTPUT 6			-0.6689	1.1791		
PLANT OUTPUT 7			-0.8900	2.8863		
WAGE RATE 1					0.0167	0.0669
WAGE RATE 2					-0.0415	0.0703
WAGE RATE 3					-0.2717***	0.1025
WAGE RATE 4					0.0480	0.1135
WAGE RATE 5					-0.0677	0.0784
WAGE RATE 6					-0.0702	0.1115
WAGE RATE 7					-0.2028*	0.1187
Summary						
N		162		162		162
R^2		0.631		0.663		0.655
F-value		12.07***		10.23***		9.86***
Profit mean		11.93%		11.93%		11.93%

* - Value significant at 0.10 probability level
** - Value significant at 0.05 probability level
*** - Value significant at 0.01 probability level

TABLE XXII

ANALYSIS OF COVARIANCE - PLANT LOCATION MODEL FURNITURE--SIC 25

	Source	Equation B--Output SS	d.f.	MS	Equation C--Wage SS	d.f.	MS
(1)	X_f, X_m, P_j, NB_p	0.8589	11	0.0781	0.8589	11	0.0781
(2)	R_r	0.0312	3	0.0104	0.0312	3	0.0104
(3)	CS_i	0.0185	6	0.0185	0.0185	6	0.0031
(4)	$CS_i \cdot P_j$	0.0459	6	0.0340	0.0340	6	0.0057
(5)	Residual	0.4846	135	0.0036	0.4966	135	0.0037
(6)	Total	1.4392	161		1.4392	161	

Test for Including Intercept Variables	(Region)	(City Size)
Source	R_r	CS_i
Equation	A, B, C	A, B, C
Computed F	2.784	0.792
Tabulated $F_{.05}$	2.68	2.18
Conclusion	Reject H_0 at .05 level	Fail to reject H_0

Test for Including Variables	(Plant Output X City Size)	(Wage Rate X City Size)
Source	CS_iP_j	CS_iP_j
Equation	B	C
Computed F	2.131	1.542
Tabulated $F_{.05}$	2.18	2.18
Conclusion	Reject H_0 at .10 level	Fail to reject H_0

TABLE XXIII

REGRESSION ANALYSIS OF PRINTING INDUSTRY - PLANT LOCATION MODEL

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
Constant	0.0236	0.0643	0.0389	0.0662	-0.0196	0.1439
X_f						
SALES	-0.1368	0.0962	-0.1497	0.1005	-0.1559	0.1004
C/L RATIO	1.3935	1.6013	1.5778	1.6133	1.3335	1.6654
NETWORTH RATIO	0.1882***	0.0433	0.1857***	0.0435	0.1886***	0.0442
GROWTH RATE	0.0019***	0.0007	0.0019**	0.0008	0.0018**	0.7420
X_m						
NOMANF	-0.0031	0.0145	-0.0005	0.0147	-0.0015	0.0148
SIC 26	-0.0236	0.0201	-0.0263	0.0203	-0.0253	0.0204
SIC 35-36-37	0.0275	0.0255	-0.0291	0.0257	0.0261	0.0268
SIC 38-39	-0.0229	0.0300	-0.0190	0.0309	-0.0218	0.0302
NB_p						
NB 2-3	-0.0050	0.0262	-0.0025	0.0265	-0.0020	0.0265
NB 4-5	0.0157	0.0265	0.0136	0.0257	0.0151	0.0258
NB 6-7-8	0.0201	0.0252	0.0217	0.0256	0.0208	0.0255
R_r						
MIDWEST	0.0339***	0.0134	0.0322**	0.0136	0.0345**	0.0139
SOUTH	0.0271	0.0184	0.0300*	0.0186	0.0322*	0.0191
WEST	0.0435***	0.0157	0.0444***	0.0186	0.0444***	0.0162
CS_i						
CS 2	-0.0104	0.0188	-0.0281	0.0240	-0.1134	0.1824
CS 3	-0.0019	0.0226	-0.0056	0.0277	0.0613	0.2130
CS 4	-0.0142	0.0292	-0.0152	0.0382	-0.0321	0.2738
CS 5	-0.0271	0.0234	-0.0579*	0.0375	-0.0760	0.1860
CS 6	-0.0681***	0.0178	-0.0599***	0.0238	0.1149	0.1733
CS 7	-0.0106	0.0164	-0.0138	0.0199	0.0689	0.1593

TABLE XXIII (Continued)

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
P_i						
WAGE RATE	-0.0062	0.0331	-0.0134	0.0334		
PLANT OUTPUT	0.1757	0.2681			0.1799	0.2725
CS_iP_i						
PLANT OUTPUT 1			0.1200	0.2561		
PLANT OUTPUT 2			1.3665	1.3497		
PLANT OUTPUT 3			0.3038	1.4000		
PLANT OUTPUT 4			0.1761	1.6763		
PLANT OUTPUT 5			3.1890	2.3476		
PLANT OUTPUT 6			0.5487	1.4343		
PLANT OUTPUT 7			0.4405	1.2063		
WAGE RATE 1					0.0227	0.0885
WAGE RATE 2					0.0705	0.1214
WAGE RATE 3					-0.0420	0.1417
WAGE RATE 4					0.0131	0.1859
WAGE RATE 5					0.0330	0.1224
WAGE RATE 6					-0.1207	0.1134
WAGE RATE 7					-0.0499	0.1012
Summary						
N		225		225		225
R^2		0.276		0.295		0.290
F-value		3.50		2.93		2.86
Coefficient of Variation		46.15%		46.22%		46.40%
Profit mean		15.89%		15.89%		15.89%

* - Value significant at 0.10 probability level
** - Value significant at 0.05 probability level
*** - Value significant at 0.01 probability level

TABLE XXIV

ANALYSIS OF COVARIANCE - PLANT LOCATION MODEL
PRINTING--SIC 27

Source	Equation B--Output SS	d.f.	MS	Equation C--Wage SS	d.f.	MS
(1) X_f, X_m, P_j, NB_p	0.2717	13	0.0209	0.2717	13	0.0209
(2) R_r	0.0386	3	0.0129	0.0386	3	0.0129
(3) CS_i	0.1040	6	0.0173	0.1040	6	0.0173
(4) $CS_i \cdot P_j$	0.0289	6	0.0048	0.0289	6	0.0048
(5) Residual	1.0574	196	0.0054	1.0658	196	0.0054
(6) Total	1.5006	225		1.5006	225	

Test for Including Intercept Variables	(Region)	(City Size)
Source	R_r	CS_i
Equation	A, B, C	A, B, C
Computed F	2.249	3.222
Tabulated $F_{.05}$	2.68	2.18
Conclusion	Reject H_0 at .10 level	Reject H_0 at .01 level
Test for Including Slope Variables	**(Plant Output X City Size)**	**(Wage Rate X City Size)**
Source	CS_iP_j	CS_iP_j
Equation	B	C
Computed F	0.893	0.628
Tabulated $F_{.05}$	2.18	2.18
Conclusion	Fail to reject H_0	Fail to reject H_0

TABLE XXV

REGRESSION ANALYSIS - COMPANY MODEL

FURNITURE INDUSTRY			PRINTING INDUSTRY		
	Equation D			Equation D	
Variables	Beta Coefficient	Std. error of beta	Variables	Beta Coefficient	Std. error of beta
Constant	-0.1026	0.0959	Constant	0.0187	0.0793
X_w			X_w		
SALES	1.6821*	0.8837	SALES	0.0435	0.4556
C/L RATIO	-6.2925	4.4485	C/L RATIO	-2.1225	3.8138
NETWORTH RATIO	0.3621***	0.0725	NETWORTH RATIO	0.2575***	0.0910
GROWTH RATE	0.0027**	0.0012	GROWTH RATE	0.0038**	0.0017
TOTAL WAGES	-0.0055	0.0040	TOTAL WAGES	0.0001	0.0015
X_m			X_m		
NOMANF	0.0207	0.0517	NOMANF	-0.0190	0.0372
MULTI-IND	0.0182	0.0288	SIC 26	-0.0217	0.0518
			SIC 35-36-37	0.0553	0.0660
			SIC 38-39	-0.1103	0.0968
NB_p			NB_p		
NB 2-3	0.0293	0.0373	NB 2-3	0.0056	0.0359
NB 4-5	0.0183	0.0462	NB 4-5	0.0509	0.0354
NB 6-7-8	0.0546	0.0470	NB 6-7-8	0.0418	0.0359
R_r			R_r		
MIDWEST	0.0580	0.0600	MIDWEST	0.1246***	0.0407
SOUTH	-0.0381	0.0504	SOUTH	-0.0496	0.0846
WEST	0.0264	0.0596	WEST	0.0946*	0.0527
CS_i			CS_i		
CS 2	0.0061	0.0528	CS 10-49	-0.1130	0.0806
CS 3	-0.0828	0.0870	CS 50-249	-0.0764	0.0861
CS 4	-0.0563	0.0834	CS 250-499	-0.2040*	0.1141
CS 5	0.0181	0.0843	CS 500-999	-0.1245*	0.0779

TABLE XXV (Continued)

FURNITURE INDUSTRY			PRINTING INDUSTRY		
	Equation D			Equation D	
Variables	Beta Coefficient	Std. error of beta	Variables	Beta Coefficient	Std. error of beta
CS 6	-0.0404	0.0798	CS 1000-2499	-0.2472***	0.0627
CS 7	0.0025	0.0736	CS 2500+	-0.0974*	0.0556
Summary					
N		49	N		59
R^2		0.699	R^2		0.604
$\bar{R}^2$		0.518	$\bar{R}^2$		0.385
F-Value		3.55***	F-Value		2.69***
Profit mean		11.21%	Profit mean		14.94%

* - Value significant at 0.10 probability level
** - Value significant at 0.05 probability level
*** - Value significant at 0.01 probability level

TABLE XXVI

ANALYSIS OF COVARIANCE FOR COMPANY MODEL OF THE FURNITURE AND PRINTING INDUSTRIES

Source	FURNITURE-SIC 25			PRINTING-SIC 27		
	SS	d.f.	MS	SS	d.f.	MS
X_w, X_m, NB_p	0.3535	10	0.0354	0.1374	12	0.0115
R_r	0.0294	3	0.0098	0.1202	3	0.0401
CS_i	0.0141	6	0.0024	0.1218	6	0.0203
Residual	0.1708	29	0.0059	0.2486	37	0.0067
Total	0.5678	48		0.6280	58	

Test for Including Regional Variables

Source	R_r	R_r
Computed F	0.445	4.655
Tabulated $F_{.05}$	2.88	2.83
Conclusion	Fail to reject H_0	Reject H_0 at .01 level

Test for Including City Size Variables

Source	CS_i	CS_i
Computed F	0.399	3.020
Tabulated $F_{.05}$	2.43	2.37
Conclusion	Fail to reject H_0	Reject H_0 at .05 level

TABLE XXVII

REGRESSION ANALYSIS OF FOOD INDUSTRY - PLANT LOCATION MODEL

Variable	Equation A		Equation B		Equation C	
	Beta Coefficient	Std. error of beta	Beta Coefficient	Std. error of beta	Beta Coefficient	Std. error of beta
Constant	0.1446***	0.0397	0.1582***	0.0395	0.1368***	0.0401
X_f						
SALES	0.1739***	0.0455	0.1791***	0.0451	0.1771***	0.0467
CAPITAL	0.3247***	0.1033	0.2995***	0.1075	0.3192***	0.1045
LABOR	0.0060**	0.0029	0.0060**	0.0029	0.0061**	0.0029
NETWORTH RATIO	0.1183***	0.0193	0.1172***	0.0190	0.1192***	0.0193
ASSETS	-0.4403***	0.0693	-0.4225***	0.0709	-0.4393***	0.0706
X_m						
NOMANF	0.0176	0.0149	0.0215	0.0146	0.0171	0.0149
SIC 21	0.0038	0.0236	0.0092	0.0232	0.0045	0.0236
SIC 35-36-37	0.0136	0.0128	0.0140	0.0126	0.0144	0.0129
MEAT	-0.0130	0.0126	-0.0126	0.0123	-0.0120	0.0125
DRINK	0.0522***	0.0138	0.0515***	0.0137	0.0520***	0.0139
CANFD	0.0066	0.0163	0.0102	0.0160	0.0057	0.0164
NB_p						
NB 2-3	0.0083	0.0193	0.0008	0.0193	0.0084	0.0196
NB 4-5	0.0174	0.0191	0.0119	0.0190	0.0188	0.0195
NB 6-7-8	0.0363	0.0204	0.0240	0.0205	0.0363*	0.0207
R_r						
MIDWEST	-0.0037	0.0113	-0.0062	0.0111	-0.0042	0.0114
SOUTH	-0.0283**	0.0134	-0.0272**	0.0132	-0.0284**	0.0135
WEST	-0.0407***	0.0126	-0.0408***	0.0125	-0.0419***	0.0127
CS_i						
CS 2	-0.0036	0.0128	-0.0007	0.0161	0.0979	0.0676
CS 3	-0.0217	0.0150	-0.0479**	0.0178	-0.1020	0.0761
CS 4	-0.0097	0.0179	-0.0192	0.0212	0.2183	0.1368

TABLE XXVII (Continued)

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
CS 5	0.0017	0.0148	-0.0137	0.0175	0.0177	0.0778
CS 6	-0.0246*	0.1130	-0.0524***	0.0150	-0.0155	0.0604
CS 7	-0.0213	0.0135	-0.0359**	0.0163	-0.0328	0.0733
P_j						
WAGE RATE	-0.0766***	0.0238	-0.0744***	0.0235		
PLANT OUTPUT	-0.0001	0.0001			-0.0001	0.0001
CS_iP_j						
PLANT OUTPUT 1			-0.0002*	0.0001		
PLANT OUTPUT 2			-0.0001	0.0003		
PLANT OUTPUT 3			0.0007**	0.0003		
PLANT OUTPUT 4			0.0002	0.0003		
PLANT OUTPUT 5			0.0003*	0.0002		
PLANT OUTPUT 6			0.0010***	0.0003		
PLANT OUTPUT 7			0.0004	0.0004		
WAGE RATE 1					-0.0719***	0.0239
WAGE RATE 2					-0.0706	0.0461
WAGE RATE 3					0.0560	0.0521
WAGE RATE 4					-0.1632*	0.0971
WAGE RATE 5					-0.0108	0.0515
WAGE RATE 6					-0.0063	0.0398
WAGE RATE 7					0.0075	0.0489
Summary						
N		338		338		338
R^2		0.380		0.415		0.394
F-value		7.64***		7.01***		6.41***
Coefficient of Variation		52.43%		51.41%		53.35%
Profit mean		13.26%		13.26%		13.26%

* - Value significant at 0.10 probability level
** - Value significant at 0.05 probability level
*** - Value significant at 0.01 probability level

TABLE XXVIII

ANALYSIS OF COVARIANCE - PLANT LOCATION MODEL FOOD--SIC 20

Source	Equation B--Output SS	d.f.	MS	Equation C--Wage SS	d.f.	MS
(1) X_f, X_m, P_j, NB_p	0.8190	16	0.0512	0.8190	16	0.0512
(2) R_r	0.0714	3	0.0238	0.0714	3	0.0238
(3) CS_i	0.0379	6	0.0063	0.0379	6	0.0063
(4) $CS_i \cdot P_j$	0.0860	6	0.0143	0.0334	6	0.0056
(5) Residual	1.4212	306	0.0046	1.4737	306	0.0048
(6) Total	2.4305	337		2.4305	337	

Test for Including Intercept Variables	(Region)	(City Size)
Source	R_r	CS_i
Equation	A, B, C	A, B, C
Computed F	4.914	1.308
Tabulated $F_{.05}$	2.68	2.18
Conclusion	Reject H_0 at .01 level	Fail to reject H_0
Test for Including Slope Variables	(Plant Output X City Size)	(Wage Rate X City Size)
Source	CS_iP_j	CS_iP_j
Equation	B	C
Computed F	3.088	1.155
Tabulated $F_{.05}$	2.18	2.18
Conclusion	Reject H_0 at .01 level	Fail to reject H_0

TABLE XXIX

REGRESSION ANALYSIS OF APPAREL INDUSTRY - PLANT LOCATION MODEL

Variable	Equation A		Equation B		Equation C	
	Beta Coefficient	Std. error of beta	Beta Coefficient	Std. error of beta	Beta Coefficient	Std. error of beta
Constant	-0.2193***	0.0611	-0.2224*	0.0635	-0.2119	0.0806
X_f						
SALES	0.1581	0.3084	0.0730	0.3455	0.1722	0.3218
C/L RATIO	-7.7574***	2.1792	-8.0106***	2.2606	-7.8646***	2.2926
NETWORTH RATIO	0.1589***	0.0400	0.1635***	0.0416	0.1614***	0.0410
GROWTH RATE	0.0022***	0.0004	0.0022***	0.4280	0.0022***	0.0004
X_m						
NOMANF	0.0362	0.0269	0.0370	0.0278	0.0379	0.0274
SIC 22	0.0399**	0.0178	0.0433**	0.0183	0.0406**	0.0183
SIC 25-26	0.1173***	0.0342	0.1209**	0.0349	0.1098***	0.0361
SIC 35-36-37	0.1104**	0.0500	0.1161**	0.0513	0.1126**	0.0542
SIC 38-39	0.0306	0.0336	0.0313	0.0350	0.0285	0.0344
NB_p						
NB 2-3	0.1029***	0.0326	0.1073***	0.0342	0.1005***	0.0332
NB 4-5	0.1133***	0.0340	0.1124***	0.0357	0.1096***	0.0348
NB 6-7-8	0.0077	0.0352	0.0100	0.0373	0.0053	0.0360
R_r						
MIDWEST	-0.0511*	0.0281	-0.0528*	-0.0287	-0.0559*	0.0295
SOUTH	0.0517***	0.0165	0.0495***	0.0168	0.0501***	0.0169
WEST	0.0221	0.0220	0.0231	0.0224	0.0215	0.0231
CS_i						
CS 2	-0.0079	0.0161	0.0059	0.0231	-0.0517	0.0871
CS 3	0.0128	0.0283	0.0497	0.0400	0.0654	0.1985
CS 4	0.0053	0.0233	-0.0009	0.0331	0.0861	0.2285
CS 5	-0.0722***	0.0259	-0.0775**	0.0333	-0.0455	0.1305

TABLE XXIX (Continued)

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
CS 6	0.0139	0.0188	0.0199	0.0268	0.0687	0.1191
CS 7	-0.0177	0.0233	-0.0133	0.0289	-0.0764	0.1236
P_j						
WAGE RATE	0.1941***	0.0481	0.1899***	0.0500		
PLANT OUTPUT	-1.7339*	1.0785			-0.0018*	0.0011
CS_iP_j						
PLANT OUTPUT 1			-0.6782	0.0022		
PLANT OUTPUT 2			-2.5496	2.9372		
PLANT OUTPUT 3			-6.9641	5.1151		
PLANT OUTPUT 4			0.8064	3.4143		
PLANT OUTPUT 5			0.7800	3.3386		
PLANT OUTPUT 6			-1.1580	3.2588		
PLANT OUTPUT 7			-1.0238	2.7619		
WAGE RATE 1					0.1877**	0.0840
WAGE RATE 2					0.0518	0.1036
WAGE RATE 3					-0.0621	0.2367
WAGE RATE 4					-0.0980	0.2756
WAGE RATE 5					-0.0283	0.1435
WAGE RATE 6					-0.0608	0.1370
WAGE RATE 7					0.0567	0.1246
Summary						
N		203		203		203
R^2		0.487		0.496		0.491
F-Value		7.38***		5.87***		5.76***
Profit mean		12.59%		12.59%		12.59%

* - Value significant at 0.10 probability level
** - Value significant at 0.05 probability level
*** - Value significant at 0.01 probability level

TABLE XXX

ANALYSIS OF COVARIANCE - PLANT LOCATION MODEL
APPAREL--SIC 23

Source	Equation B --Output SS	d.f.	MS	Equation C --Wage SS	d.f.	MS
(1) X_f, X_m, P_j, NB_p	0.7809	14	0.0558	0.7809	14	0.0558
(2) R_r	0.1147	3	0.0382	0.1147	3	0.0382
(3) CS_i	0.0632	6	0.0105	0.0632	6	0.0105
(4) $CS_i \cdot P_j$	0.0178	6	0.0030	0.0178	6	0.0030
(5) Residual	0.9927	123	0.0057	1.0022	173	
(6) Total	1.9693	202		1.9693	202	

Test for Including Intercept Variables	(Region)	(City Size)
Source	R_r	CS_i
Equation	A, B, C	A, B, C
Computed F	6.587	1.865
Tabulated $F_{.05}$	2.68	2.18
Conclusion	Reject H_0 at .01 level	Reject H_0 at .10 level
Test for Including Slope Variables	(Plant Output X City Size)	(Wage Rate X City Size)
Source	CS_iP_j	CS_iP_j
Equation	B	C
Computed F	0.517	0.242
Tabulated $F_{.05}$	2.18	2.18
Conclusion	Fail to reject H_0	Fail to reject H_0

TABLE XXXI

REGRESSION ANALYSIS-COMPANY MODEL

FOOD INDUSTRY			APPAREL INDUSTRY		
	Equation D			Equation D	
Variables	Beta Coefficient	Std. error of beta	Variables	Beta Coefficient	Std. error of beta
Constant	0.0395	0.0492	Constant	-0.1227	0.1134
X_f			X_f		
SALES	0.0626	0.1373	SALES	-1.9376	2.2534
CAPITAL	0.3109	0.4920	C/L RATIO	-9.3869	5.8428
LABOR	0.0353	0.0482	NETWORTH RATIO	0.2631***	0.0961
NETWORTH RATIO	0.2084***	0.0575	GROWTH RATE	0.0077***	0.0023
ASSETS	-0.4381*	0.2300	TOTAL WAGES	0.0069	0.0082
TOTAL WAGES	-0.0030	0.0059			
X_m			X_m		
NOMANF	0.0153	0.0391	NOMANF	0.0870	0.0905
SIC 21	-0.0538	0.0670	SIC 22	0.0566	0.0506
SIC 35-36-37	0.0212	0.0364	SIC 25-26	0.0245	0.1512
MEAT	-0.0101	0.0252	SIC 35-36-37	0.4653	0.3018
DRINK	0.0314	0.0308	SIC 38-39	-0.1095	0.0965
CANFD	-0.0171	0.0343			
NB_p			NB_p		
NB 2-3	0.0307	0.0266	NB 2-3	0.1147*	0.0670
NB 4-5	0.0238	0.0298	NB 4-5	0.1369*	0.0818
NB 6-7-8	0.0289	0.0387	NB 6-7-8	0.0397	0.0830
R_r			R_r		
MIDWEST	-0.0142	0.0324	MIDWEST	-0.0920	0.1000
SOUTH	-0.0524	0.0394	SOUTH	-0.0377	0.0663
WEST	-0.0721**	0.0315	WEST	-0.0658	0.0551
CS_i			CS_i		
CS 2	-0.0258	0.0455	CS 2	0.0694	0.0946

TABLE XXXI (Continued)

FOOD INDUSTRY			APPAREL INDUSTRY		
	Equation D			Equation D	
Variables	Beta Coefficient	Std. error of beta	Variables	Beta Coefficient	Std. error of beta
CS 3	0.0096	0.0599	CS 3	-0.2893	0.2878
CS 4	-0.0678	0.0637	CS 4	0.0321	0.1192
CS 5	0.0618	0.0597	CS 5	-0.1673	0.1396
CS 6	-0.0690*	0.0407	CS 6	0.0706	0.0704
CS 7	-0.0976**	0.0390	CS 7	0.0268	0.0933
Summary			Summary		
N		80	N		51
R^2		0.483	R^2		0.611
$\bar{R}^2$		0.269	$\bar{R}^2$		0.316
F-value		2.15**	F-value		2.00**
Profit mean		12.40%	Profit mean		12.62%

* - Value significant at 0.10 probability level.
** - Value significant at 0.05 probability level.
*** - Value significant at 0.01 probability level.

TABLE XXXII

ANALYSIS OF COVARIANCE FOR COMPANY MODEL OF THE FOOD AND APPAREL INDUSTRY

Source	FOOD-SIC 20 SS	d.f.	MS	APPAREL-SIC 23 SS	d.f.	MS
X_w, X_m, NB_p	0.1972	15	0.0131	0.3728	13	0.0287
R_r	0.0290	3	0.0097	0.0100	3	0.0033
CS_i	0.0756	6	0.0126	0.0415	6	0.0069
Residual	0.3227	55	0.0059	0.2696	28	0.0096
Total	0.6246	79		0.6939	50	

Test for Including Regional Variables

	FOOD-SIC 20	APPAREL-SIC 23
Source	R_r	R_r
Computed F	1.481	0.364
Tabulated $F_{.05}$	2.75	2.89
Conclusion	Fail to reject H_0	Fail to reject H_0

Test for Including City Size Variables

	FOOD-SIC 20	APPAREL-SIC 23
Source	CS_i	CS_i
Computed F	2.147	0.719
Tabulated $F_{.05}$	2.27	2.45
Conclusion	Reject H_0 at .10 level	Fail to reject H_0

indicates that a 10 percentage point increase is associated with an expected profit rate increase of 2.74 percentage points, other things equal. GROWTH RATE is expressed in percentage terms, thus an increase in the company GROWTH RATE by 1 percentage point is expected to increase the profit rate by 0.07 percentage points.

In the industry-enterprise (X_m) class of variables, the multi-industry variables SIC 34, 35, 37, 38, and 28 do not significantly affect profit rates in any of the three equations. In direct contrast, four electrical enterprises coefficients are significant at the 0.01 level in all three equations. To help interpret the coefficients, assume a firm is engaged only in the Electrical Machinery industry in some enterprise not listed in the X_m variables. This firm has a constant coefficient of -0.1548. Alternatively, a firm engaged in the Electronics enterprise (Elec 1) of the Electrical Machinery industry and also with activities in the Transportation Equipment industry (SIC 37) would have a constant term of -0.0891. This new constant value is the sum of the coefficients for the industry constant, Electronic enterprise (Elec 1) and SIC 37 (-0.1548 + -.0480 + 0.0167 = 0.0891). The expected profit rates of these two firms would on the average differ by 6.47 percentage points, due entirely to differing industry-enterprise mix, even if all other characteristics were the same.

The X_m binary variables were included to control for differing profit rate effects of multi-industry firms from single-industry firms and to separate any enterprise effects. The multi-industry variables are mutually exclusive from each other but not from the enterprise variables. This means that any enterprise and multi-industry combination is possible. Enterprise variables are mutually exclusive from each other but can be found in single industry or multi-industry firms. While the multi-industry and enterprise variables were important in the analysis of profit rate variation for each industry, it is hazardous to make inter-industry comparisons.

Increased plant numbers within a company displayed a direct association with profit rates, but only firms with six to eight plants (NB 6-7-8) had significantly higher profit rates for all three equations. Apparently, plant and enterprise diversification increased profit rates in the Electrical Machinery industry.

Analysis of the regional coefficients indicates only firms in the West had significantly higher profit rates than firms located in the Northeast (the intercept). The coefficients for the South were negative in Equations A and B, but positive in Equation C. This is an example of a recurring pattern for the region and city size coefficients, with sign changes most frequently associated with Equation C.

Only plant locations in medium sized cities of 500,000 - 999,999 residents (CS_5) exhibited a significant positive relationship to profit rates in all three equations. In addition, the largest cities (2,500,000 or more residents) exhibit a strong positive coefficient in Equation C, but not in Equations A and B. Standard error of betas for the CS_i coefficients in Equation C are large compared to those in the other two equations. This occurrence may arise because of multicollinearity among the CS_i and CS_iP_j variables.

In Equations A and B, the WAGE RATE coefficient is positive but not significant. However, in Equation C several of the coefficients for the segmented WAGE RATE variables are significant, indicating the interaction of wages and city size does affect profit rates. The coefficient for weekly wage rates in small cities of less than 10,000 residents (WAGE $RATE_1$) implies that a weekly wage rate increase of $10.00 (25¢ per hour) raises the profit rate by 1.218 percentage points in the sampled firms. This anomalous positive association can occur because the impact of wages on profit rates cannot be separated from the impact of labor quality, which is expected to have a positive relation to profit rates.

The wage rate coefficients for the remaining city size classes are evaluated as differences from the coefficient of WAGE $RATE_1$. As stated in Table XIV, the construction of WAGE $RATE_1$ in Equation C is identical to the WAGE RATE variable of Equations A and B. Both have positive continuous weekly wage rate values regardless of city size class. The other segmented WAGE $RATE_i$ variables assume their actual value if plants are located in the i^{th} city size group, "zero" otherwise.

The coefficients of WAGE $RATE_i$ are negative in five city size groups and are significantly different from the WAGE $RATE_1$ coefficient for plants in cities of 500,000 - 999,999 residents (WAGE $RATE_5$) and in cities of 2,500,000 or more residents (WAGE $RATE_7$). Addition of the segmented WAGE RATE variables, which allow for interaction of wages with city size, also increased the magnitude of most CS_i coefficients compared to their values in Equations A and C. These results suggest that higher wage rates are not associated with a sufficient gain in labor skill and productivity in the larger cities to avoid falling profits. However, the implication remains that profits are higher in larger cities given an adjustment to the same wage and productivity level of workers among all city size groups.

The coefficients for PLANT OUTPUT in Equations A and C had a significant positive effect on profit rates. Greater plant size or output affected profit rates in Equation A such that a $10 million increase in average plant output would be expected to increase company profit rates by 0.899 percentage points. In contrast, for Equation B the coefficients for segmented PLANT OUTPUT variables in all city size groups exceeding 50,000 population were negative but did not significantly differ from the coefficient of PLANT $OUTPUT_1$. While plant output positively affects profit rates in the Electrical Machinery industry, it does not have significantly differing effects by city size groups.

The three equations each have a fairly low R^2 (0.32-0.33) indicating the equations failed to explain 67-68 percent of the profit rate variation. These findings are consistent with the hypothesis that historical accident or luck, differences in management among plants and firms, and errors in measurement of other variables not presented in Table XV account for a major proportion of the variation in profit rates among firms. The profit mean for the sampled firms was 11.21 percent. The coefficient of variation computed as the size of the standard error of the estimate in relation to the profit mean was 90 percent.

The analysis of covariance in Table XVI shows the extra regression sums of squares due to inclusion of the region (R_r), city size (CS_i) and the CS_iP_j variables for Equation B (PLANT OUTPUT) and Equation C (WAGE RATE). The regression sums of square due to the inclusion of the X_f, X_m, NB_p, R_r, CS_i, and P_j class of variables is the same for all three equations. The only differences in explained sums of squares arises from adding the CS_iP_j variable class to Equations B and C.[4]

The residual sums of squares are listed only for Equations B and C. The residual sums of square for Equation A is formed by subtracting from the Total Sums of Square the explained sums of squares due to the X_f,

X_m, P_j, NB_p, R_r, and CS_i variables. The difference between the residual sums of square for Equation A compared to the residual sums of square shown for Equations B and C is the extra sums of squares explained by the segmented PLANT OUTPUT or WAGE RATE variables.

The primary purpose of Table XVI is to report whether the addition of the R_r and CS_i variables to all three equations and the addition of CS_iP_j variables to Equation B and C were each significant additional explanation of profit rate patterns in this industry.

The F-test for regional intercept differences leads to rejecting the null hypothesis, H_0 of similar profit rates among regions given control for other independent variables. The F-test for the addition of the city size (CS_i) binary variables provides no basis to reject the null hypothesis that profit rates are the same among cities of various sizes.

The F-test for including segmented Plant Output variables, which interacts plant size with city size, revealed no significant added explanation to profit rates. However, the F-test for including the segmented WAGE RATE variables, which interacts wages with city size, was significant at the 0.05 level. For this industry, the analysis of covariance confirmed that regional and wage rate variables had significant effects on profit rates. However, many of the individual coefficients reported in Table XV were not significant.

By comparing the analysis of covariance tables with the individual equations it is possible to discern the relative importance of individual and grouped variables in explaining profit rates. Based on Equation C, firms with plants located in medium and large size cities in excess of 50,000 population would be expected to have higher profit rates if they could obtain comparable quality labor as other city size classes at a given wage rate. Increased wage rates had a strong negative impact on profit rates in the medium sized and larger cities. According to the individual coefficients in Equation C, firms with the highest profit potential, other factors equal, would have activity in the Transportation Equipment as well as the Electrical Machinery industry, with Electrical Equipment as the major electrical enterprise. This firm would have six to eight plants with locations in the West in cities of 2,500,000 or more people.

The results of applying the Company model to the Electrical Machinery industry are presented in the left half of Table XIX with the corresponding analysis of covariance in Table XX. Considerable contrast from the Plant Location model is evident in the absence of significant coefficients in the NB_p, R_r, and CS_i categories.

Coefficients for plant numbers (NB_p) are interpreted as before, but the coefficients for the region (R_r) and city size (CS_i) variables are interpreted quite differently than in the Plant Location model. In the Company model the coefficient for the WEST is not significantly different at the 0.05 level from that for the NORTHEAST. Interpreted as the true population parameter, as the proportion of a firm's national output produced in the WEST increased by 10 percentage points the expected profit rate would only increase by 0.159 percentage points. The coefficients for the CS_i variables were positive in the medium and large cities, but unlike the results in the Plant Location model, they were not significant. The differences in results from the Plant Location model is due to measuring plant size or output proportions by region or city size instead of equal weighting of plants regardless of location as was the case in Equation B of Table XV.

In the summary portion of Table XIX, two coefficients of determination are shown. The first ($R^2 = 0.419$) is the conventional coefficient of multiple determination, the same type as shown in Table XV. The second, $\bar{R}^2$, is adjusted for degrees of freedom. When the sample size is fairly small in relation to the number of explanatory variables, the adjusted $\bar{R}^2$ is substantially less than R^2. $\bar{R}^2$ is not included in the Plant Location model because the number of observations is large compared to the number of explanatory variables which minimizes the difference between the R^2 and $\bar{R}^2$ values.

The F-value for the Company model equation indicates overall equation significance at the 0.01 level. In subsequent industries, the F-values for the entire equation of the Company model are not always significant at that level. In contrast, the F-value for all equations of each industry in the Plant Location model are significant at the 0.01 level. Because the F-value depends on the relative ratio of explanatory variables to sample size (k/n-1), the Plant Location model may overestimate the magnitude of the F-ratio. This is because the replication of firm observations overestimates the true sample size (n) in the Plant Location model due to lack of independence between observations of multiple plant firms.

The covariance analysis in Table XX indicated that regional or city size coefficients did not significantly affect profit rates in the Company model. In the covariance analysis of the Plant Location model in Table XVI, city size coefficients were significant, but coefficients of the regional variables were not significant.

The overall conclusion from analyzing both models is that city size is not an important factor in explaining profit rates. However, differences in wage rates (or labor productivity) in different city sizes appear to influence profit rates.

Analysis of the Plant Location models for the Fabricated Metals industry in Table XVII again shows the importance of the NETWORTH RATIO and GROWTH RATE in explaining variations in profit rates. The signs of their coefficients are positive as in the previous industry. Coefficients for company SALES variables are also significant as are most coefficients of the multi-industry and enterprise variables. It appears the sample selection of multi-industry firms substantially influenced the profit rates within the industry.

The positive WAGE RATE coefficients are significant in Equations A and B. This implies higher wage firms were compensated sufficiently by increased productivity to reflect a higher profit rate. It is possible that higher productivity is due to greater physical capital usage, but the coefficient of the C/L RATIO is near zero and not significant, supporting the hypothesis that higher labor productivity was not due to added physical capital.

The city size variables were not individually important except in Equation C where CS_5 and CS_7 exhibited strong negative effects. At the same time the WAGE RATE coefficients for cities over 500,000 population are positive with WAGE RATE_5 and WAGE RATE_7 significant. One interpretation is that, other factors equal, Fabricated Metal plants are less profitable in large cities, but overall diseconomies are offset by higher labor productivity.

Analysis of covariance reported in Table XVIII for the Fabricated Metals industry clearly indicates the inclusion of the region and city size binary variables did not raise the explained variation in profit rates. Neither was the interaction of PLANT OUTPUT and WAGE RATE with city size groups a significant explanation of profit rates. In this model, the R^2 indicates that approximately 50 percent of the profit rate variation was explained by the independent variables. This R^2 is substantially higher than for the Electrical Machinery industry, implying greater reliance can be placed on the results for this industry.

Tables XIX and XX contain the Company model analysis for the Fabricated Metals industry, findings corroborating those in the Plant Location model. The coefficient for the NETWORTH RATIO and GROWTH RATE were again very significant while the coefficients for the region and city size variables were insignificant.

The importance of the NOMANF and various multi-industry variables suggests the particular structural mix of company activities was considerably more important than a firm's regional or city size location. The concurrence of both the Company and Plant Location models strengthens argument that industrial structure, financial size and strength, and growth rate are the primary factors influencing profit rate differences within the Fabricated Metals industry. Regional and city size effects on profit rates were negligible, implying that the Fabricated Metals industry plants are distributed in a manner consistent with private economic efficiency.

Major points in the comparative analysis of the Electrical Machinery and Fabricated Metals industries are summarized:

1) NETWORTH RATIO and GROWTH RATE were two of the most significant explanatory variables in all models of both industries.

2) The inclusion of multi-industry and enterprise variables significantly affected profit rates in both industries. This implies that diversity in structure of these two large industries has substantial impact on their profit patterns.

3) Individual city size variables had opposing effects on profit rates in the two industries within the Plant Location model.

4) WAGE RATE variation by city size groups significantly affected profit rates in the Electrical Machinery industry. While several of the WAGE RATE coefficients were significant in the Fabricated Metals industry, the overall relationship to profit rates was insignificant.

Analysis of the Furniture Industry and Printing Industry

Tables XXI through XXVI compare the Plant Location and Company models for the Furniture (SIC 25) and Printing (SIC 27) industries beginning with the Plant Location model for the Furniture industry in Table XXI. All usable firms in both industries were sampled and the industry analysis is based on plant locations of 49 and 59 firms respectively. As can be seen from Tables XXIII and XXV, the multi-industry variables were not important predictors of Printing industry profit rates. For the Furniture industry, the X_m variables NOMANF and MULTI-INDUSTRY were important in the Plant Location model (Table XXI) but not in the Company model (Table XXV).

Review of the Furniture industry models again emphasized the importance of the NETWORTH RATIO, GROWTH RATE and SALES in explaining profit rate differences. The coefficient for each of these variables in all equations of both models have a positive sign, with the NETWORTH RATIO clearly being the most important based on size of coefficient in relation to its standard error. It is interesting to note that the positive and significant signs for both the NETWORTH RATIO and GROWTH RATE were also found in the Fabricated Metals and Electrical Machinery industries.

The existence of other industrial activities, non-manufacturing activities, and additional plant numbers contributed significantly to higher profit rates for all three equations in the Plant Location model. The coefficients for the same variables were not significant in the Company model, although their signs were the same.

The individual region (R_r) and city size (CS_i) variables were not significant additions in the Plant Location model. The negative sign for the SOUTH coefficient, significant at the 0.10 level in Equations A and B, is somewhat surprising since the Furniture industry is heavily concentrated in the South. No city size coefficient emerged as significant in all equations though CS_5 and CS_7 were important in two equations while CS_3 was important in Equation C.

In contrast to the city size coefficients, the coefficients for the segmented PLANT OUTPUT and WAGE RATE variables were generally negative. Although no individual PLANT OUTPUT coefficient is significant, covariance analysis in Table XXII reveals the interaction of plant output (size) with city size significantly explains profit rate variation in the Furniture industry. On the other hand, WAGE RATE coefficients as a group did not significantly affect profit rates although the individual coefficients for $WAGE\ RATE_3$ and $WAGE\ RATE_7$ were negative and significant.

It is notable that results of the Furniture industry varied modestly from the previous industries despite sharp differences in location patterns by city size. The Furniture industry firms were oriented to small cities following the Textile and Apparel industries in extent of micropolitan concentration. On the other hand, much higher metropolitan concentration of plant locations characterizes the Fabricated Metals and Electrical Machinery industries. The Printing industry had the highest metropolitan concentration of any industry included and analysis of its

Plant Location and Company models indicates substantial differences in results from any other industry.

In comparing Table XXIII containing the Plant Location model of the Printing industry to Table XXV which contains the Company models, the most noticeable finding is the very low R^2's of the three equations of the Plant Location model (0.276 to 0.295) compared to the fairly high R^2 of the Company model. Even the corrected $\bar{R}^2$ of 0.385 in the Company model is higher than the unadjusted R^2 of the Plant Location model, a situation unique to the Printing industry. It confirms the effectiveness of the Company model in analyzing an industry where companies are distributed over a wide array of city size groups.

Except for the usual significance of the NETWORTH RATIO and GROWTH RATE, none of the other financial, multi-industry, non-manufacturing, and number of plant variables were significant in any of the equations in either model.

Location in the West or Midwest regions boosted profit rates compared to locations in the Northeastern United States. From Equation B the expected profit rate increase from a Western location was 4.44 percentage points compared to a 3.22 percentage point increase from a Midwest location. The same pattern occurred with the regional coefficients of the Company models (Table XXV). It represents the strongest agreement between the Plant Location and Company models of any industry on the relative importance of individual and grouped location variables.

The city size coefficients also influenced profit rates, but generally in a negative direction. In Equation B (Table XXIII) Printing plants located in cities of 500,000 to 2,500,000 had expected profit rates of 5.0 to 5.8 percentage points less than expected profit rates of plant locations in towns of under 10,000. The downward pressure is even more pronounced in the Company model where location in all city size groups over 250,000 population has significantly lower profit rates than for locations in the smallest cities.

This finding from both models is in dissonance with the strong urban orientation of the Printing industry. However, in recent years numerous newspapers, magazines, and book operations have closed in the nation's larger cities. This suggests that Printing firms may no longer have their greatest profit potential in the larger cities. While more routine printing operations may profitably decentralize to smaller cities, it remains very doubtful that major daily newsgathering and news publishing functions can profitably relocate from the nation's major industrial, financial and governmental centers. Table XIII in Chapter III shows that no printing firms were wholly located in cities of less than 50,000. However, many multi-plant firms with plants in large cities also had plants in medium size and smaller cities. It appears that Printing firms with a mixture of city size plant locations are more profitable than firms located only in large metropolitan areas.

Analysis of covariance for the Plant Location model in Table XXIV indicates the region and city size coefficients were important as a class in explaining profit rate variation with the CS_i class significant at the 0.01 level. Covariance analysis in Table XXVI indicates the city size and region coefficients were highly significant additions to the Company model. Based on the Company model results, plant locations are expected to be most profitable in the West or Midwest and in cities under 250,000 population. Least profitable locations are expected to be in the South and in cities between 250,000 - 2,499,999 residents.

The many contrasts between the Furniture and Printing industries analysis can be expected due to the substantial differences in location and market orientation. A major similarity emerging is the overall agreement of results between the Plant Location and Company models with respect to financial, region, and city size related variables.

In both industries the Company model was well specified. For the Plant Location models, Equation B of the Furniture industry in Table XXI and Equation A of the Printing industry in Table XXIII were the best specified. This judgment is based on the importance of PLANT OUTPUT to explanation of profit rates in the Furniture industry and the importance of city size (CS_i) in explaining profit rates of the Printing industry.

The major findings for the Furniture and Printing industries are summarized as follows:

1) City size exhibited a systematically negative and significant effect on profit rates of the Printing industry for both the Plant Location and Company models. This profit pattern dramatically conflicts with the strong urban orientation of the Printing industry.

2) Coefficients for segmented PLANT OUTPUT variables, represented the interaction of plant size and city size, were important in explaining profit patterns of the Furniture industry.

3) The Furniture industry Plant Location model equation explained over 63 percent of profit rate variation compared to less than 30 percent explanation of profit rates in the Printing industry.

4) The Company models for both industries were well specified with two of the highest R^2's within the eleven industries analyzed.

Analysis of the Food Industry and Apparel Industry

Tables XXVII through XXXII contain the information for analyzing the final two industries--Food and Apparel---of this chapter. The Food industry is the only case where all of the financial (X_f) variables were significant at the 0.05 level. CAPITAL and LABOR are entered as separate variables instead of using the C/L RATIO because they were separately more significant than when combined into a ratio. Another departure from the usual pattern was the addition of the variable, ASSET. This was the only industry in which SALES and ASSET were not highly inter-correlated; so they were both used. A third change was deleting GROWTH RATE because no specified linear relation could be found that satisfactorily incorporated it into the Food industry model.

The above results for the Food industry are affected by the contrast of Food firms in the Meat enterprise compared to firms in other Food enterprises. First, firms with a Meat enterprise are represented in excess of expected proportions containing 40 percent of the usable firms and only 25 percent of all Food firms originally sampled. The sales volume per dollar of assets is considerably larger for Meat enterprise firms than for the rest of the Food industry, and also the amount of capital per worker is much higher for Meat enterprise firms.

Plant locations were most profitable in the Northeast and Midwest with significant profit rate declines in the South or West. City size coefficients were generally negative, but only in Equation B were any individual coefficients significant. According to results of Equation B, plants were least profitable in cities between 50,000 - 249,999 residents and especially in cities in excess of 1,000,000 population. This finding is in line with Food industry employment trends away from larger cities during the 1960's, especially evident in the Meat enterprise.

Several of the individual PLANT OUTPUT coefficients were significantly positive and the analysis of covariance in Table XXVIII indicates PLANT OUTPUT coefficients as a group also significantly explained profit rate variation. Covariance analysis also indicated that coefficients of region and city size variables substantially influenced profit rates.

The coefficient for WAGE RATE was significant and strongly negative in Equations A and B implying that higher wage rates detracted from profit rates in the Food industry. There does not appear to be any systematic wage effect on profit rates in different city sizes as shown by inspection of the individual WAGE RATE coefficients in Equation C and the covariance analysis in Table XXXIII. This finding indicates the effect of wage increases on company profits were uniform in most city sizes.

The Company model follows the same pattern as the Plant Location model except fewer variables are significant in all categories. Covariance analysis in Table XXXII indicates city size significantly explained profit rates while the region variables did not. The R^2's of both the Company and Plant Location models explained from 0.38 to 0.48 of the total profit variation--about average for the eleven industries.

Plant locations in the Apparel industry are oriented to the smaller cities as are plants in the Food and Furniture industries. Unlike the results for these two industries, the Apparel industry had no city size coefficients, except for CS_5, that were significant individually or as a group in all equations of the Plant Location models.

PLANT OUTPUT in Equations A and C exhibited a significant negative effect on profit rates. But the interactions of plant size and city size in the segmented PLANT OUTPUT variables of Equation B did not result in any significant coefficients, though most remained negative. Covariance analysis in Table XXX confirmed that PLANT OUTPUT coefficients did not systematically affect profit rates by city size.

In direct contrast to the Food industry, WAGE RATE coefficients in Equations A and B of the Apparel industry were strongly positive and significantly influenced profit rates. Interpreting the WAGE RATE coefficient in Equation A, a $10.00 increase in the weekly wage rate would be expected to increase the firm profit rate by 1.94 percentage points. Comparing this variable to the coefficient for C/L RATIO reveals the latter to be surprisingly negative and very significant. This is the only example in the eleven industries where the capital-labor ratio is an important effect on profit rates. One interpretation of the C/L RATIO coefficient sign is that the Apparel industry has too much physical capital per worker for maximum economic efficiency. At the same time higher wages are associated with greater profitability. Because the Apparel industry is not capital intensive and is also noted for low wage payments, it is unlikely the industry actually has excess physical capital resources, but may have many workers who do not have the skill levels to efficiently use the sophisticated equipment.

In addition to the usual significance of the NETWORTH RATIO and GROWTH RATE, other significant variables were found in the X_m, NB_p, and R_r sections. Multi-plant and multi-industry firms were more profitable than single-plant or single-industry firms. Plant locations in the South were most profitable. This coefficient confirms the wisdom of regional location trends apparent for the last forty years in the Apparel industry. According to the Plant Location model, profit rates are expected to increase by 5 percentage points due to plant locations in the South.

The major points from the analysis of the Food and Apparel industries are:

1) Despite common characteristics of small city orientation and below average industrial growth, the Food and Apparel industries displayed dissimilar empirical results.

2) Region was a significant factor explaining profit variation in both industries, according to their respective Plant Location models. Northeast and Midwest plant locations were most profitable for the Food industry while the South was the most profitable location for the Apparel industry. The results are consistent with long-term trends in both industries.

3) The interaction of plant size and city size represented by segmented PLANT OUTPUT variables was a significant positive factor in explaining profit rate variation in the Food industry, while location in large city sizes was negatively associated with profitability.

4) City size coefficients as a group influenced profitability in the Apparel industry, but the individual coefficients, except for CS_5, did not significantly vary from each other.

This concludes the analysis of the Plant Location and Company models for six of the eleven sampled industries. The remaining industry tables are in Appendix A covering the Plant Location models and Appendix B containing tables for the Company models. Results in the tables do not reveal significant effects of city size on profit rates. A more complete discussion accompanies each appendix.

Analysis of Profit Rate Distribution by City Size by Number of Plant Locations

That profit rates in any given industry tend to be statistically irrelated to city size is also apparent in the raw data. Table XXXIII shows the distribution of profit rates by industry by city size for a more comprehensive list of industries. Profit rates are expressed in seven percentage brackets in rows while city size is expressed in the familiar seven population size brackets across columns. Each cell is

TABLE XXXIII

TWO WAY FREQUENCY TABLE OF PROFIT RATES BY CITY SIZE BY NUMBER OF PLANT LOCATIONS

	City Size (in thousands)						
Profit Rate	0.0–9.9	10.0–49.9	50.0–249.9	250.0–499.9	500.0–999.9	1000.0–2499.9	>2500.0
(Percent)							
			FURNITURE--SIC 25				
< - (0.1)	11	2	1	3	1	5	2
0.0 - 4.9	5	1	0	0	0	3	0
5.0 - 9.9	5	4	5	1	3	2	1
10.0 - 14.9	10	8	3	3	7	6	9
15.0 - 19.9	16	7	2	7	3	3	4
>20.0	7	5	2	0	4	1	2
X^{2*} = 38.86	d.f** = 30		p*** = .11				
			FABRICATED METALS--SIC 34				
< - (0.1)	2	1	0	1	1	1	0
0.0 - 4.9	7	6	3	2	3	10	6
5.0 - 9.9	20	12	5	0	7	13	16
10.0 - 14.9	15	10	2	10	9	13	23
15.0 - 19.9	11	8	5	6	10	15	21
>20.0	24	14	8	8	4	10	13
X^2 = 33.68	d.f. = 30		p = .30				
			GENERAL MACHINERY--SIC 35				
< - (0.1)	7	6	5	2	4	9	6
0.0 - 4.9	6	8	2	3	4	4	6
5.0 - 9.9	21	7	5	6	7	16	18
10.0 - 14.9	25	23	5	14	16	19	45
15.0 - 19.9	28	23	10	10	15	21	28
20.0 - 29.9	29	19	18	19	8	19	17
>30.0	2	3	0	1	2	4	1
X^2 = 45.64	d.f. = 36		p = .25				
			ELECTRICAL MACHINERY--SIC 36				
< - (0.1)	13	6	5	1	6	6	10
0.0 - 4.9	10	12	5	4	2	10	12
5.0 - 9.9	21	18	6	6	7	30	29
10.0 - 14.9	14	8	4	6	4	10	24
15.0 - 19.9	28	23	10	10	15	21	28
20.0 - 29.9	29	19	18	19	8	19	17
>30.0	2	3	0	1	2	4	1
X^2 = 49.43	d.f. = 36		p = .15				

TABLE XXXIII (Continued)

	City Size (in thousands)						
Profit Rate	0.0- 9.9	10.0- 49.9	50.0 249.9	250.0 499.9	500.0 999.9	1000.0 2499.9	>2500.0
(Percent)							
			TRANSPORTATION--SIC 37				
< - (0.1)	1	1	2	2	1	3	0
0.0 - 4.9	8	7	1	4	2	6	8
5.0 - 9.9	13	7	4	8	7	8	13
10.0 - 14.9	2	8	7	2	3	5	10
15.0 - 19.9	9	5	2	1	3	5	8
20.0 - 29.9	15	6	3	2	2	9	4
>30.0	9	3	1	0	1	1	3
X^2 = 43.62	d.f. = 36		p = .30				
			FOOD--SIC 20				
< - (0.1)	3	4	2	1	1	6	3
0.0 - 4.9	6	4	1	1	1	5	4
5.0 - 9.9	12	10	4	4	3	15	10
10.0 - 14.9	29	12	11	8	11	25	16
15.0 - 19.9	5	10	6	1	3	8	3
>20.0	20	15	7	6	17	13	8
X^2 = 27.80	d.f. = 30		p = .60				
			CHEMICAL--SIC 28				
0.0 - 4.9	3	5	1	2	1	9	4
5.0 - 9.9	7	8	0	3	7	19	10
10.0 - 14.9	14	11	9	8	13	28	30
15.0 - 19.9	9	15	2	7	10	22	27
20.0 - 29.9	13	11	7	5	3	16	10
>30.0	2	1	3	1	1	7	5
X^2 = 31.67	d.f. = 30		p = .35				
			TEXTILES--SIC 22				
< - (0.1)	4	4	3	0	1	2	0
0.0 - 4.9	6	3	1	2	0	1	5
5.0 - 9.9	25	8	3	6	3	7	2
10.0 - 14.9	22	1	2	4	1	8	1
15.0 - 19.9	16	6	1	3	1	2	0
>20.0	9	4	2	5	1	5	1
X^2 = 45.89	d.f. = 30		p = .05				

TABLE XXXIII (Continued)

Profit Rate	City Size (in thousands) 0.0-9.9	10.0-49.9	50.0-249.9	250.0-499.9	500.0-999.9	1000.0-2499.9	>2500.0
(Percent)							
			APPAREL--SIC 23				
< - (0.1)	9	6	0	0	5	4	1
0.0 - 4.9	0	0	1	5	0	6	6
5.0 - 9.9	21	4	2	3	2	4	1
10.0 - 14.9	23	8	0	0	2	5	3
15.0 - 19.9	15	4	0	3	0	6	1
>20.0	13	14	6	4	2	13	4
X^2 = 85.19	d.f. = 24		$p < .01$				
			PAPER--SIC 26				
< - 4.9	6	3	0	2	0	1	2
5.0 - 9.9	7	8	2	2	4	16	11
10.0 - 14.9	17	7	3	4	3	6	5
15.0 - 19.9	4	5	2	1	3	2	14
>20.0	4	1	3	3	4	9	7
X^2 = 41.87	d.f. = 24		$p = .02$				
			PRINTING--SIC 27				
< - 4.9	9	1	1	0	3	4	4
5.0 - 9.9	5	3	0	0	1	13	5
10.0 - 14.9	8	8	3	1	5	16	15
15.0 - 19.9	12	7	3	3	3	13	25
>20.0	11	10	11	2	3	4	16
X^2 = 43.50	d.f. = 24		$p = .01$				

*X^2 = Chi-square

**d.f. = degress of freedom

***p = probability

the number of plants for the respective industry within the requisite city size and profit rate category. For example, companies in the Furniture industry had seven plants located in cities of less than 10,000 residents with profit rates < -0.1 percent, while sixteen plants within the same small city group were in Furniture industry firms with a 15.0 percent to 19.9 percent profit rate.

Plants are found in most city size categories and profit rate categories. In eight of the eleven industries, the median plant profit rate did not vary more than one profit rate category moving across city size groups. For the other three industries (Apparel, Transportation Equipment and Printing) the median firm profit rate varied by two profit categories by city size groups. Taking as an example the Printing industry, the median plant in a city of 50,000-250,000 population was in the profit rate category of 20.0-29.9 percent, while the median profit plant in a city of 1,000,000-2,500,000 population was in the 10.0-14.9 percent profit rate category. In contrast, in the Electrical Machinery industry the median profit plant for all city groups below 1,000,000 population was in the 15.0-19.9 percent profit category while the median profit plant was in the 10.0-14.9 percent profit category in large cities.

Chi-square tests for the data in Table XXXIII reveal that city size and profit rate are significantly associated at the 0.05 level in four industries--Textile, Apparel, Paper and Printing. In two of the four industries, Textile and Printing, profit rates tend to be higher in smaller cities while no systematic relation is apparent in the other two industries by inspection of the raw data. The regression models confirmed that the relationship of city size and profit rates remained significant in the Printing industry and also the Apparel industry after accounting for other explanatory variables.

When either wage rates or plant size was interacted with city size the results were inconclusive. In the lower wage industries analyzed--Furniture and Apparel--the interaction of wages and city size did not significantly influence profit rates in their Plant Location models. In one of the higher wage industries--Electrical Machinery--the interaction of wages and city size was an important influence in explaining profit rate variation.

The concurrence of the raw data, Plant Location model, and Company model for the six industries suggests a tentative conclusion of satisfactory industrial plant location performance across different city sizes. Within the Plant Location models of the six industries discussed, city size (CS_i) was significant only in the Printing and Apparel industries. City size coefficients were sometimes significant individually but not as a group in the other four industries. The segmented variables, WAGE RATE and PLANT OUTPUT were often as important as the city size binary variables.

No difference in profit rates across city size groups suggests industry performance is good and trends in plant and employment distribution by city size point to industries best suited for particular city sizes. The analysis of recent employment changes by city size is the topic of the next chapter.

FOOTNOTES

[1]The construction and interpretation of the segmented WAGE RATE variables is based on the summary of covariance analysis discussed in J. Johnston, Econometric Methods (2nd ed. New York: McGraw Hill, 1972), pp. 204-207.

[2]A three-fold process was used to determine if a city was within an SMSA. First before the companies were selected the plant locations from the census list of cities exceeding 2,500 people were cross checked with Rand McNally maps to find if they were located in an SMSA county. An SMSA code was assigned to the city, if it was within these counties. Secondly, after the plant locations were obtained, a simple comparison was made to this list of cities to obtain the needed population information. Third, if the plant was located in a town of less than 2,500 population, the town was checked on the map before deciding the proper category (SMSA or non-SMSA).

[3]PLANT OUTPUT was not included in the industry analysis until it was discovered that number of plants in the sampled firms were distributed in favor of smaller cities, as reported in Chapter III. One possibility was that plant size may increase in larger cities. Because increased plant size may have some economies, the variable PLANT OUTPUT was constructed to account for different sized plants and also differing company sales levels.

[4]For analysis purposed, the explained sums of squares contributed by PLANT $OUTPUT_1$ variable of Equations B is totaled within the P_j source in conformity with the inclusion of PLANT OUTPUT in the P_j variable class for Equations A and C. The sums of squares for the remaining interaction of segmented PLANT OUTPUT variables with city size groups over 10,000 population are in the CS_iP_j source and total 0.0252. The computation of sums of squares contributed for the segmented WAGE RATE variables of Equation C was identical to the segmented PLANT OUTPUT variables computation.

CHAPTER V

DIMENSIONS OF U. S. MANUFACTURING BY CITY SIZE

This chapter briefly reviews the dimensions of U. S. manufacturing concentration and dispersion by city size and regions since 1929. The findings are based on previous empirical studies with some updating where possible. The purpose is to reconcile seemingly contradictory findings, to present the current magnitude of rural industrialization and where it is principally located, and to identify manufacturing industries dispersing to small metropolitan and rural areas. This review presents additional information to evaluate the empirical findings on relative industrial probability on city size. Because the foregoing analysis supported the hypothesis that industry performance is satisfactory in moving to locations so as to eliminate profit differences, the analysis of trends in location of industry should reveal what types of industry are best suited for the various city sizes.

Review of U. S. Manufacturing Growth Patterns

Metropolitan (SMSA) growth has outstripped, in relative and absolute terms, small city and rural growth in every decade since 1900. Census-defined rural areas, comprising towns of less than 2,500 people and open countryside, ceased to gain population after 1950, stabilizing at 54 million.[1] Nearly 16 million rural residents reside within metropolitan counties.

A study by Rand McNally reclassified "urban" as cities and other built-up areas exceeding 20,000 people. This eliminated census-defined rural metropolitan residents and small city non-metropolitan residents from consideration in urban growth statistics.[2] They found that urban areas exceeding 250,000 population matched or exceeded the national urban growth rate of 9.8 percent during the 1960-65 period, while smaller urban areas grew at a lesser rate. Urban areas exceeding 1 million people added 52.9 percent of the total urban population increase; small urban areas of less than 250,000 added 22.3 percent. These urban areas had relatively faster increases throughout the Southern and Western regions. Clawson, using state economic areas as the analytical unit, confirmed the same trends for the entire 1960-70 period.[3]

Another descriptive study classified cities and SMSA's according to employment shares in manufacturing, retailing, and other services.[4] Manufacturing employment shares exceeding 50 percent were most frequent in cities from 50,000-250,000 people. Nearly half the cities exceeding 250,000 have manufacturing employment shares of 30-50 percent. Cities with concentrated retailing or specialized economic functions, and smaller shares of manufacturing, were generally less than 250,000 and most frequently less than 50,000 population. The implication is that cities did not generally become large without building a significant manufacturing base. Later, more rapid growth was needed in the retailing, government, and other service sectors which reduced the employment share in manufacturing.

A USDA economic base study developed a location coefficient for employment earnings by economic sector for Rand McNally trade areas classified into five urban orientation groups.[5] Partial results for

1967 are shown in Table XXXIV. The location coefficient measures the relative dependence of the local region on employment in sector _i_ in urban category _j_ compared to national totals. For the manufacturing sector, these coefficients are least in the "isolated urban" (0.73) and "sparse rural" (0.68) group. The manufacturing location coefficient for "densely rural" is substantially higher (1.01) and near the national norm. In fact, manufacturing comprised a larger relative earning share for the "densely rural" group than for any other nonfarm sector except for federal, state and local governments.

The "densely rural" group is largely concentrated in the Southeast division and part of the North Central division outside the major metropolitan areas. The "isolated urban" and "sparse rural" groups comprise the Northern Plains, Southern Plains, Mountain, South Central and most of the Pacific division. Their distance from national market and employment centers historically precluded manufacturing development from approaching the national norm. However, the "isolated urban" regions approach the national norm in their nonfarm economic base, except for manufacturing.

The nonfarm economic base for "sparse rural" regions is concentrated in the State and local government, contract construction, wholesale and retail trade, and Federal Government sectors. The location coefficients for these four sectors are similar to the equivalent coefficients in the "isolated urban" category. It is deficiencies in the transportation and public utilities, services, and FIRE (finance, insurance, and real estate) sectors that create the major differences in the nonfarm economic base between the "sparse rural" and "isolated urban" regions. The same deficiencies are also reflected in the "densely rural" region. The

TABLE XXXIV

LOCATION COEFFICIENTS OF EARNINGS BY SOURCE, BY URBAN-ORIENTATION GROUPING OF MULTI-COUNTY TRADING AREAS, 1967

Source of Earnings (% of national earnings)	Urban Orientation Group[a] 1	2	3	4	5
	Location Coefficients				
Total nonfarm earnings (96.6%)	1.03	1.01	0.97	0.97	0.89
Federal government earnings (7.0%)	0.67	1.26	1.33	1.17	0.97
State and local government earnings (9.5%)	0.89	0.88	1.16	1.18	1.35
Manufacturing (29.6%)	1.09	1.18	0.73	1.01	0.68
Contract construction (6.0%)	0.95	1.00	1.08	0.92	1.00
Wholesale and retail trade (16.7%)	1.05	0.93	1.03	0.87	0.99
Finance, insurance, and real estate (5.1%)	1.25	0.84	0.92	0.61	0.65
Services (14.2%)	1.13	0.89	0.96	0.81	0.86
Transportation and other public utilities (7.0%)	1.10	0.90	1.03	0.89	0.87
Agriculture (3.6%)	0.12	0.68	1.85	1.94	4.09

Source: Table condensed from Table 11, Agr. Econ. Report No. 205, 1971, USDA, ERS. Urban group definitions are from text.

[a]Trade area urban orientation groups are listed and defined as follows:

Code	Name	Population Density	&	Census Urban	% Total Population
1	Major metropolitan	>100 or		85-100	34.1
		>500		0-100	
2	Minor metropolitan	100-400		0-84.9	23.1
3	Isolated urban	0-100		>50	25.0
4	Densely rural	50-100		0-49.9	8.8
5	Sparse rural	0-49.9		<50	9.0

major difference in economic structure between the "sparse rural" and "densely rural" region is the much greater reliance on agriculture and less reliance on manufacturing in the "sparse rural" regions. It is also illuminating that both the "densely rural" and "isolated urban" regions have nearly the same reliance on agriculture in their economic structure.

This descriptive summary of the importance of manufacturing and other economic sectors by degree of "rurality" updated and condensed similar results described in other works by Perloff and Creamer.[6] Their report differs by using earnings instead of employment change as the analytical base. Aggregate earnings reflects employment levels, labor productivity, and demand for labor at various locations, but can be defended as a better measure than employment in defining the regions' economic base.

Another key dimension to understanding the role of manufacturing in today's society is provided by studies measuring manufacturing concentration and dispersion by region and city size through time. Manufacturing employment has increased throughout the twentieth century. A net addition of 2.9 million workers was gained by the manufacturing sector in the 1960's, bringing 1970 manufacturing employment to 19,811,000 workers. The share of the nation's labor force in manufacturing reached a peak of 28 percent in 1954 and declined to 24 percent in 1970.[7,8] Hence, manufacturing is a "declining industry" despite gains in the number of workers.

Since 1929 manufacturing has steadily decentralized from the Old Manufacturing Belt, which included the New England, Middle Atlantic, and North Central Census divisions plus the states of Minnesota, Iowa, Missouri, and West Virginia. The share of U. S. manufacturing employment in this Belt steadily declined from 75 percent in 1929 to 64 percent in 1966. The relative manufacturing increases went to the South Atlantic, South Central and southern portion of the Mountain and Pacific divisions of the U. S.[9, 10]

In the Southwest, from Texas to California, manufacturing increased fastest from 1939-1954 with the ascendency of the Transportation and Electrical Machinery industries. Defense oriented production played a major role in the location and growth of these industries. Since 1954 manufacturing growth concentrated in the Textile, Apparel, Lumber, and Furniture industries and more recently with increases in the Electrical and Non-electrical Machinery industries.

The second major location change has been from the industrial areas of the central city to new industrial centers in the suburbs and metropolitan fringe areas. There has also been some dispersion to non-metropolitan regions. Studies by Daniel Creamer best capsulize manufacturing employment changes by type of city location from 1929-1966. He categorized city locations into:[11]

A. Principal industrial centers exceeding 100,000 and their suburbs.

B. Other cities exceeding 100,000 and their suburbs.

C. Industrial counties with a minimum of 10,000 manufacturing employees but no city of 100,000 people.

D. Rest of the country.

Precise definitions of categories A and B were not given, but the distinction is based on employment level and share in manufacturing. The major findings are:

(1) Primary industrial diffusion from the principal industrial centers of the city to its suburbs was the major location change after World War II. Total manufacturing employment share held by principal industrial centers declined from 35.8 percent in 1947 to 27.9 percent in 1963. Conversely, their suburbs employed 18.3 percent of the manufacturing labor force in 1947 and 26.3 percent in 1963. Total employment share of the principal industrial areas fractionally increased 0.1 percent.

(2) Secondary manufacturing diffusion to 'other large cities' was evident in the increased employment share from 6.6 percent in 1947 to 8.5 percent in 1963. But the major trend within these cities was also the industrial movement to suburban locations.

(3) 'Industrial counties' have maintained their employment share of 10 percent since World War II. This share is not adjusted to exclude counties reclassified as "industrial" between the 1929 and 1966 base periods.

(4) From 1929-1966 only 128 out of 2,885 counties industrialized sufficiently to be reclassified as "industrial counties" or "other cities exceeding 100,000". These counties comprised all of the relative employment share increase in previously minor industrial areas.

(5) About one-third of the counties reclassified were located in the Old Manufacturing Belt, with another third in the South Atlantic and South Central divisions. No less than 70 percent of these counties were adjacent to previous industrial cities and counties. These can be interpreted as extensions of the metropolitan region into its surrounding countryside, not as separate industrial growth centers.

The remaining third of the 128 counties were concentrated in the Pacific division and the States of Texas, Louisiana, and Arizona. All but seven of these counties were non-contiguous with a previously industrialized county and could be reasonably considered new industrial growth centers.[12]

More recent research by Haren disclosed that non-metropolitan county manufacturing employment increased 1.36 million jobs between 1959-1969 or 4.0 percent annually compared to metropolitan county increase of 2.64 million jobs during the same period--a slower 2.1 percent annual growth rate.[13] Counties with urban population of 2,500-25,000 added 780,000 manufacturing jobs at a 4.6 percent annual rate. This compares to counties with urban population from 25,000-50,000 which added 476,000 manufacturing jobs at a 3.3 percent annual rate. Entirely rural counties increased their manufacturing employment base from 184,000 to 290,000 jobs at a 5.8 percent annual rate, but this was still an insignificant 1.4 percent of national manufacturing employment. A total of 985 of 2,613 non-metropolitan counties had a manufacturing base of 1,000-10,000 workers while 85 additional non-metropolitan counties had over 10,000 manufacturing workers.

Geographically, the South accounted for over 50 percent of non-metropolitan manufacturing employment increase, while the North Central division accounted for 25 percent of the increase.

Since the economic slowdown in 1970, manufacturing employment remained stable in non-metropolitan counties and decreased by over 1 million in metropolitan areas because of their greater dependence on Transportation, Electrical, Ordnance, and Primary Metal industries subject to cyclical downturns and cutbacks in space and defense activities.

Case studies on manufacturing employment trends in Pennsylvania, Oklahoma, and the TVA region all cited faster manufacturing growth in non-metropolitan areas. Growth has centered in cities between 5,000-30,000 population. The Pennsylvania study emphasized that rural and small urban areas in an industrial state could sustain manufacturing growth even if located up to 150 miles from a large urban center. These studies also display the increased diversity of manufacturing industries locating in micropolitan areas. In addition to the long-term micropolitan orientation of Food Processing, Lumber, Paper products, and Textiles industries, these studies show increasing micropolitan orientation of Electrical, Transportation, and Non-electrical Machinery industries and of the Apparel, Furniture, and Chemical industries. The segments relocating or expanding in micropolitan areas are an outgrowth of increased product specialization and diversity within each of these industries.

Employment Shifts Between Large SMSA's and Smaller Cities by Industry from 1947-1967

Table XXXV shows the employment breakdown for each manufacturing two-digit SIC code for 1947, 1963 and 1967 based on Census of Manufacturing Data. Data for 1947 and 1963 were previously published in Edwin S. Mills' Urban Economics while the author updated coverage to include the 1967 Census of Manufacturing. The SMSA employment totals are computed for metropolitan areas in 1963 that employed 40,000 or more manufacturing workers. These large SMSA's consisted of over 85 percent of all metropolitan manufacturing employment and 59.3 percent of total manufacturing employment in 1967, leaving 40.7 percent of manufacturing employment in

TABLE XXXV

MANUFACTURING EMPLOYMENT IN THE UNITED STATES AND IN LARGE SMSA'S BY SIX INDUSTRY GROUPS, 1947, 1963 and 1967 (EMPLOYMENT DATA IN THOUSANDS)

		1947 Employment			1963 Employment			1967 Employment			U. S. Employment Change 1947-67 (%)
SIC Code	Industry	U. S.	SMSA	Percent-age in SMSA's	U. S.	SMSA	Percent-age in SMSA's	U. S.	SMSA	Percent-age in SMSA's	
20	Food	1,442	717	49.7%	1,643	858	52.2%	1,650	837	50.7%	14.4
21	Tobacco	112	33	29.5	77	25	32.5	75	27	35.3	-33.1
22	Textiles	1,233	384	31.1	863	233	27.0	929	264	28.4	-24.7
23	Apparel	1,082	759	70.1	1,280	745	58.2	1,357	739	54.4	25.4
24	Lumber Products	636	87	13.7	563	98	17.4	554	101	18.2	-12.9
25	Furniture	322	158	49.1	377	181	48.0	425	199	46.8	32.0
26	Paper	450	207	46.0	588	286	48.6	639	331	51.7	42.0
27	Printing	715	511	71.5	913	658	72.1	1,031	750	72.8	44.2
28	Chemicals	632	370	58.5	737	411	55.8	841	481	57.1	33.1
29	Petroleum Refining	212	133	62.7	153	75	49.0	142	82	57.6	-33.0
30	Rubber Products	259	176	68.0	415	260	62.7	517	310	59.9	99.6
31	Leather	383	159	41.5	327	143	43.7	329	137	41.5	-14.1
32	Stone, Clay, Glass Products	462	203	43.9	574	258	44.9	590	275	46.6	27.7
33	Primary Metals	1,157	839	72.5	1,127	687	61.0	1,281	847	66.2	10.7
34	Fabricated Metals	971	698	71.9	1,082	751	69.4	1,342	945	70.4	38.2
35	Nonelectrical Machinery	1,545	1,015	65.9	1,459	958	65.7	1,865	1,250	67.1	20.7
36	Electrical Machinery	801	614	76.7	1,512	1,029	68.1	1,875	1,213	64.6	134.1
37	Transportation Equip.	1,182	901	76.2	1,601	1,170	73.1	1,834	1,371	74.8	55.2
38	Instruments	232	184	79.3	305	225	73.8	394	272	69.2	69.8
39	Miscellaneous	464	339	73.1	391	278	71.1	423	295	69.8	- 8.8
	Totals	14,294	8,490	59.4	15,987	9,329	58.4	18,092	10,733	59.3	26.6

Source: Compiled from data in the U. S. censuses of manufactures, 1947, 1963 and 1967. Data for 1947 and 1963 are adapted from Table 2-5 with the same heading in Edwin S. Mills, Urban Economics, Scott Foresman and Company, Glenview, Illinois, 1972. The same procedure was used by the author for computing the employment changes for 1967.

in smaller metropolitan and micropolitan areas. From these data it is possible to obtain an overview of manufacturing employment by industry in (a) industrial SMSA's as contrasted to (b) employment in rural, small city, and small SMSA's, hereafter referred to as small city.

Substantial differences in SMSA orientation is evident for the 21 industries. In each time period measured, Lumber products exhibited the weakest SMSA employment orientation, 18.2 percent in 1967. Other industries below the national SMSA average for the twenty year period were Textiles, Tobacco, Leather, Paper, Furniture Products, Food Processing and Stone, Clay, and Glass Products. In 1967 the Apparel industry joined this grouping. These industries have substantial raw material inputs from rural areas. Industries with over 70 percent employment concentration in SMSA's in 1967 are Printing (72.8 percent) Fabricated Metals (70.4 percent) and Transportation Equipment (74.8 percent). In 1947, four other industries--Primary Metals, Electrical Machinery, Instruments, and Miscellaneous--had over 70 percent of their total employment in SMSA's.

Between 1947 and 1967, nine industries decreased their SMSA orientation (as measured by the share of industry employment) by greater than two percentage points. Three of these industries--Petroleum Refining, Miscellaneous, and Textiles--declined in absolute employment for the entire U. S. in SMSA's and also in the small city category. While these industries dispersed to smaller cities, they were not growth prospects. However, between 1963 and 1967, the Textiles industry registered modest employment increases of 35,000 in SMSA's and 31,000 in smaller cities. It remained the largest single industry in smaller cities with 665,000 employment. While Petroleum Refining had continually declined since

1947 as an employment source, its future growth prospects are uncertain. At the present time, it is unlikely that the Textile, Miscellaneous, and Petroleum Refining industries will be major growth prospects for micropolitan areas.

The most significant dispersing industries from 1947 to 1967 were Electrical Machinery, Rubber Products, Instruments, and Apparel. The Electrical Machinery and Rubber Products industries doubled their employment between 1947 and 1967 while the Instruments industry employment increased 69.8 percent. Only the Apparel industry, with employment growth of 25.4 percent, fell short of the national manufacturing employment growth of 26.6 percent. Despite large employment increases, these four industries also reduced their relative SMSA orientation a minimum of 10 percent measured by absolute employment increases in smaller cities. Electrical Machinery led all industries with employment gains of 475,000 from 187,000 to 662,000. The Apparel industry followed with a 295,000 gain in smaller cities and an actual decline of 20,000 employment in large SMSA's during the 1947-1967 period.

The Primary Metal industry experienced a decline of 30,000 employment between 1947 and 1963 with an absolute increase of 122,000 employment in smaller cities. From 1963 to 1967 the industry experienced a 154,000 (13.7 percent) employment increase which entirely occurred in the large SMSA's. Since 1967 the industry had another cyclical downturn followed by an upswing. No attempt here is made to determine the net employment shift to smaller cities since then.

The Transportation Equipment and Fabricated Metals industries exhibited above average employment growth throughout the 20-year period with slight shifts to smaller cities. But they remained principally located in the large SMSA's with 74.8 and 70.4 percent of 1967 total manufacturing employment respectively. Because of their rapid overall growth within smaller cities of 182,000 and 124,000, respectively, these two industries closely followed the Electrical Machinery and Apparel industries in absolute employment increases. The Chemical industry also maintained above average employment growth rate during this period with a slight shift to smaller cities. As with the Transportation Equipment and Fabricated Metals industries the Chemical industry shifted considerably (over two percent) to small cities between 1947 and 1963, but reversed somewhat to larger cities between 1963 and 1967. However, Chemical industry employment in smaller cities increased 98,000 in the twenty year period.

Non-electrical Machinery remained one of three major industries from 1947-1967 with nearly 1.9 million employees in 1967. The industry declined in employment over the first sixteen years but resurged with a 406,000 employment increase from 1963 to 1967 with a 114,000 gain in the smaller cities. The result was a relative shift to the large SMSA's, but substantial absolute increases in small cities.

The Furniture and Paper industries exhibited similar growth rates from 1947-1967 but had reverse SMSA orientation patterns. The Furniture industry declined from 49.1 percent of employment in large SMSA's in 1947 to 46.8 percent in 1967, while the Paper industry increased from 46.0 percent to 51.7 percent of total employment in the large SMSA's. Employment increase in smaller cities from 1947-1967 was 62,000 and 65,000 respectively for the Furniture and Paper industries. The underlying trends for the Furniture industry was location near raw material sources and cheap labor. Alternatively, the Paper industry was becoming more market oriented.

Food industry employment expanded near the national average from 1947-1963, but showed almost zero growth from 1963-1967. Decentralization of the meat packing enterprise primarily accounted for the percentage reduction of large SMSA employment from 1963-1967.

Finally, Printing and Stone, Clay and Glass Products represent an urban oriented and raw material oriented industry respectively; each industry shifted toward large SMSA's.

Summary of Major Findings

The most important finding is the lack of relative manufacturing employment shift from either the large SMSA's or the smaller cities throughout the 1947-1967 period, despite a rapid population shift to the metropolitan areas. The somewhat stable employment shares indicate that in the aggregate large SMSA's and smaller cities experience similar manufacturing employment growth rates. The industries with the greatest relative or absolute employment increases in smaller cities were the Electrical Machinery, Apparel, Transportation Equipment, Fabricated Metals, Chemicals, Rubber Products, Instruments, Furniture, and Primary Metals. In addition, Lumber products and Textiles remained very micropolitan oriented, but were declining employment industries. Meanwhile, the Food industry stabilized employment during the mid-1960's with a slight shift to smaller cities.

A finer employment breakdown (into three-digit SIC codes) than that in the foregoing tables is not available by SMSA in the Census of Manufacturing. If it were, an even better picture of employment dispersion could be obtained.

In summary, rural industrialization growth became a major force in the 1960's especially for the North Central and Southern regions. Before 1960, manufacturing dispersion outside of metropolitan areas was mostly to contiguous counties. Since 1960, employment gains have spread further from large urban centers, reducing net outmigration from rural areas. Whether these micropolitan areas should be viewed as new self-sustained growth centers or merely extensions of influence from the metropolitan centers has not been settled in public policy discussions. Lindley and Berry, in separate analyses for the Economic Development Administration, conclude that most rural and small urban centers cannot be considered self-sustained employment growth centers. Their analyses suggest a growth center should contain a minimum of 25,000 people.[15] In any event, more rural residents throughout much of the U. S. east of the Northern Plains and south of the Upper New England area are coming within commuting distance of manufacturing jobs. In the Northern Plains and Western regions, manufacturing activity not heavily influenced by raw materials and transport cost are tied to metropolitan areas.

The individual manufacturing industries exhibit sharply varying large city orientation. As expected, employment in industries processing raw material originating from rural areas are less oriented to larger cities. Many industries which earlier were associated with large cities shifted their employment mix toward smaller cities. These included the Electrical Machinery, Apparel, Primary Metals, Transportation Equipment, Chemicals, Furniture, Instruments, and Rubber Products. All of these industries, except Primary Metals, are moderate to rapid employment growth industries.

FOOTNOTES

[1]D. Hathaway, et al., People of Rural America: 1960 Census Monograph (Washington, D. C.: Government Printing Office, 1965); and U. S. Bureau of the Census, 1970 Census of Population - General Population Characteristics, U. S. Summary (Washington, D. C.: Government Printing Office, 1971).

[2]Advisory Commission on Intergovernmental Relations, "The Pattern of Urbanization," Urban and Rural America: Policies for Future Growth (Washington, D. C.: Government Printing Office, April, 1968), pp. 1-29.

[3]Marion Clawson, "Population, Settlement and Growth Patterns," American Journal of Agricultural Economics, Vol. 52 (December, 1970), pp. 766-774.

[4]Advisory Commission on Intergovernmental Relations, "The Pattern of Urbanization," Urban and Rural America: Policies for Future Growth (Washington, D. C.: Government Printing Office, April, 1968), pp. 1-29.

[5]U. S. Department of Agriculture, "Regional Variations in Economic Growth and Development with Emphasis on Rural Areas," Agricultural Economics Report No. 205 (Washington, D. C.: Government Printing Office, May, 1971).

[6]For review and summary of considerable empirical work on manufacturing sectors changing importance by region or city size, see Daniel Creamer, "Manufacturing Employment by Type of Location--An Examination of Recent Trends," National Industrial Conference Board, No. 106 (New York: National Industrial Conference Board, 1969); Harvey S. Perloff, et al., Regions, Resources and Economic Growth (Lincoln: University of Nebraska Press, 1960), pp. 380-486.

[7]Ibid.

[8]Claude C. Haren, "Current Spatial Organization of Industrial Production and Distribution Activity," (enlargement of oral presentation to the Conference on Problems and Potentials of Rural Industrialization, West Lafayette, Indiana, July 11-13, 1972).

[9]Harvey S. Perloff, et al., Regions, Resources and Economic Growth (Lincoln: University of Nebraska Press, 1960), pp. 380-486.

[10]Daniel Creamer, "Manufacturing Employment by Type of Location--An Examination of Recent Trends," National Industrial Conference Board, No. 106 (New York: National Industrial Conference Board, 1969).

[11] Ibid.

[12] Counties contiguous with the Los Angeles, San Diego, San Francisco, and Seattle metropolitan areas were defined as extensions of the metropolitan areas instead of "new growth center". In addition to the states and divisions listed, three other states had one county reclassified from "rest of county" to "industrial county" during the 1929-1963 period. The major city and its state included Lincoln, Nebraska; Albequerque, New Mexico; and Little Rock, Arkansas.

[13] Summary works by Haren include: Claude C. Haren, "Current Spatial Organization of Industrial Production and Distribution Activity," (enlargement of oral presentation to Conference on Problems and Potentials of Rural Industrialization, West Lafayette, Indiana, July 11-13, 1972); Claude C. Haren, "Rural Industrial Growth in the 1960's," American Journal of Agricultural Economics, Vol. 52 (August, 1970), pp. 431-437.

[14] Case studies indicated in text were: Dan Childs, "Economic Evaluation of Industry Location by City Size in Oklahoma," (unpublished M. S. Thesis, Oklahoma State University, 1973); Theodore E. Fuller, "Trends in Manufacturing Among Small Centers of Pennsylvania," (University Park: Pennsylvania State University, Bulletin 788, December, 1971); M. E. Foster, "Programs for Dealing with Problems and Advantages of Rural Areas," Rural Development Problems and Advantages of Rural Locations for Industrial Plants (Raleigh: Agricultural Policy Institute, North Carolina State University, July, 1970), pp. 77-95.

[15] Brian Berry, "Region Growth Centers--A Status Report," Proceedings of 3rd Annual Meeting, Regional Economic Development Research Conference (Washington, D. C.: Government Printing Office, 1972), p. 9; Lindley is summarized in Urban and Rural America: Policies for Future Growth, ACIR (Washington, D. C.: Government Printing Office, April, 1968), pp. 57-58.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Objectives and Purpose of the Study

The major objective in this thesis was to determine if profit rates in selected U. S. manufacturing industries varied systematically by city size. A second objective was to determine which manufacturing industries were dispersing and increasing in micropolitan and small metropolitan areas.

The impetus for this study arose because a policy encouraging rural industrialization has often been advocated as a means to increase employment and diversify the economic base of micropolitan areas, which primarily depend on agricultural, mining or forestry employment. During this century, employment in the manufacturing sector has increased every decade and provides the major economic base for most of our nation's 211 metropolitan areas. Findings discussed in Chapter V showed that manufacturing employment until the mid-1960's had not generally decentralized from the larger metropolitan areas; regional manufacturing employment shifts and employment shifts to suburban areas had been far more prominent. Since the mid-1960's there has been some relative manufacturing employment shifts to micropolitan areas, according to studies by Haren, and others, especially in the Southern region, Appalachia and the North Central Census division.

At the same time, some national leaders have suggested future population growth should be redirected to small metropolitan areas and medium sized cities of micropolitan areas to relieve further population congestion in our largest metropolitan areas. These leaders generally advocated positive national and regional policies that would redirect population growth, including policies that would encourage manufacturing decentralization from large metropolitan areas at much faster rates than observed in the past. To make any realistic appraisal of whether a given policy to decentralize manufacturing industries can succeed, it is important to know how well manufacturing industries have performed in selecting profitable locations, and which manufacturing industries are adaptable to expansion and relocation in micropolitan areas.

In estimating manufacturing company profit rates by place of residence (city size), this study supplies information to assess the performance of manufacturing industries in responding to comparative profit incentives by location in different city sizes. If industry profit rates do not differ systematically by city size, industrial performance would appear to be adequate and review of past employment provides an indication of which manufacturing industries are already responding to profit incentives offered by micropolitan and small metropolitan areas.

To meet this first objective, ascertaining industry performance, multiple linear regression models were developed while the second objective, determining which industries are adaptable to growth in micropolitan areas, was met by reviewing industry employment trends for large metropolitan, micropolitan and small metropolitan areas.

Review of Models and Procedure

In the econometric models developed, company profit rates were assumed to be a function of

1) Independent variables not associated with city size. These included financial, enterprise, multi-industry, plant number and region variables

2) City size binary variables

3) Interaction of independent variables with city size - the variables used were Wagerate and Plant Output

Two models were developed based on the unit of observation - the individual plant location or the company. A covariance analysis procedure was established to indicate whether the addition of subsets of variables resulted in a significant explanation of profit rates. In the Company model, the variable subsets for region and city size were tested while in the Plant Location model the subsets of region binary variables, city size binary variables, the interaction of plant output and city size, and the interaction of wage rates and city size were each tested for their contribution toward explaining profit rate variation.

The results from the covariance analysis from each industry were considered more important than the significance (or lack of significance) of individual coefficients for the city size binary and interaction variables.

The final sample consisted of 760 usable firms from eleven manufacturing industries: Food, Textile, Apparel, Furniture, Paper, Printing, Chemicals, Fabricated Metals, Non-electrical Machinery, Electrical Machinery and Transportation Equipment. Other manufacturing industries were excluded because there were too few companies within the industry to analyze to obtain statistically reliable results or because the industry was primarily oriented to raw material in its location pattern. An example is the Lumber industry.

Within the eleven industries, usable firms were selected which had sufficient data for each independent variable, did not have significant foreign operations, did not have manufacturing activities in more than two industries (conglomerates) and did not have more than eight plant locations. The sample selection process resulted in using medium-sized firms, those which have from $1,000,000 to $250,000,000 assets, for the analysis. Smaller firms were excluded because they were not reported in Standard and Poor's Corporation Records. The larger firms were excluded most frequently because of too many plant locations or because of international activities. In five industries, (SIC 28, 34, 35, 36, and 37) many firms were also excluded because of industrial activities in three or more industries. An analysis of comparative profit rates between the usable medium-sized firm and the excluded medium-sized and larger firms did not reveal any significant differences.

Findings of the Plant Location Model, Company Model, and Employment Trends by Industry

The plant location patterns by city size of the usable firms (Tables XI, XII and XIII of Chapter III) revealed micropolitan cities have a higher proportion of plant locations than manufacturing employment numbers in these cities would indicate. Part of this may be explained by smaller plants prevailing in micropolitan areas, but it is also likely that medium size companies select plant locations outside of the larger metropolitan areas with greater frequency than larger companies. One finding was that multi-plant firms in most industries tend to have plant locations in both small and large cities instead of plant locations exclusively in large cities or exclusively in small cities. This plant location diversity by city size provides some initial indication that firms choose locations consistent with profit incentives.

The major empirical results for each industry analyzed are summarized in Table XXXVI. In the first three columns the relationship of city size variables, segmented plant output variables and segmented wage rate variables to company profit rates is described for the Plant Location model. In the fourth column the relationship of city size variables to company profit rates for the Company model is explained. The fifth column contains summary comments on employment trends from 1947-1967 for the industry and whether relative employment shifts to small cities or large cities occurred based on information reported in Chapter V.

No relationship between company profit rates and the city size binary and interaction variables of the Plant Location model and Company model is found for the Chemical and Transportation Equipment industries, meaning that no city size, plant output or wage rate coefficients were significant individually or as a group. In most industries there are some significant individual coefficients for each subset of variables but the addition of the entire subset or class does not significantly explain profit rate variation. In a few industries the city size binary or interaction variables are related to profit rates and are discussed in the next four paragraphs.

The city size (CS_i) variables in both the Plant Location and Company models significantly explained profit rate variation in only the Printing industry. The coefficients for city size groups exceeding

TABLE XXXVI

SUMMARY OF EMPIRICAL FINDINGS BY INDUSTRY ANALYZED

Industry	Relationship of City Size (CS_i) Variables to Company Profit Rates - Plant Location Model	Relationship of Segmented Plant Output Variables to Company Profit Rates - Plant Location Model	Relationship of Segmented Wage Rate Variables to Company Profit Rates - Plant Location Model	Relationship of City Size (CS_i) Variables to Company Profit Rates - Company Model	Employment Trends 1947-67 between Small and Large Cities*
Food	Many city size coefficients are significantly negative in Equation B, but city size coefficients do not significantly explain profit rate variations.	Several individual coefficients are significantly positive and coefficients of plant output variables as a group significantly explains profit rate variation	No relationship	Coefficients for CS_6 and CS_7 (cities of over 1,000,000 residents) are significant and negative Covariance analysis indicates city size significantly explains profit rate variation.	Below average employment growth of 14.4% between 1947-67. Moderate employment shift to small cities after 1963.
Textile	Coefficient for CS_6 and CS_7 (cities of over 1,000,000 residents) are significantly negative. Covariance analysis indicates city size does not significantly explain profit rate variation.	No relationship	Only the $WAGERATE_6$ coefficient was significantly positive. Covariance analysis indicated coefficients of wage rate variables failed to explain profit rate variation.	Entire equation was insignificant, so no relationship expected.	Employment declined by 24.7% from 1947-67 with same increase after 1963. Moderate employment shift to small cities continues in this most rurally orientated industry. Only 28.4% of industry employment in 1967 was in large SMSA's.
Apparel	Covariance analysis indicates city size significantly explains profit rate variation.	No relationship	No relationship	No relationship	All of employment increase from 1963-67 occurred in small cities. The increase of 295,000 employment in small cities from 1947-67 is second fastest absolute growth occurring in smaller cities.

TABLE XXXVI (Continued)

Industry	Relationship of City Size (CS_i) Variables to Company Profit Rates - Plant Location Model	Relationship of Segmented Plant Output Variables to Company Profit Rates - Plant Location Model	Relationship of Segmented Wage Rate Variables to Company Profit Rates - Plant Location Model	Relationship of City Size (CS_i) Variables to Company Profit Rates - Company Model	Employment Trends 1947-67 between Small and Large Cities*
Furniture	Different coefficients are significantly positive in each equation, while covariance analysis indicates city size coefficients as a group do not significantly explain profit rate variation.	Covariance analysis indicated coefficents of Plant Output variables segmented by city size significantly explained profit rate variation.	Coefficients for $WAGERATE_3$ and $_7$ are significantly negative. Covariance analysis indicates segmented wage rate variables do not significantly explain profit rate variation.	No relationship	Employment growth of 32.3% from 1947-67. Moderate employment shift to smaller cities.
Paper	Coefficients for CS_4 and CS_5 (cities of 250,000-999,999 residents) are significantly positive, but covariance analysis indicates city size coefficients as a group do not significantly explain profit rate variation.	No relationship	No relationship	Entire equation was insignificant, so no relationship expected.	Continuous employment shift to large SMSA's with only 3,000 absolute employment increase in small cities from 1963-67 compared to 45,000 employment increase in larger SMSA's.
Printing	All city size coefficients in Equation A and B are negative with CS_6 significant. City size significantly explains profit rate variations according to covariance analysis.	No relationship	No relationship	City size coefficients are all negative and significant for cities larger than 250,000 residents. City size coefficients significantly explain profit rate variation.	Employment growth of 44.2% from 1947-67. Remains one of the most large city oriented of all manufacturing industries.
Chemicals	No relationship	No relationship	No relationship	No relationship	Employment increase of 33.1% from 1947-67 with no relative employment shift between small and large cities.

TABLE XXXVI (Continued)

Industry	Relationship of City Size (CS_i) Variables to Company Profit Rates - Plant Location Model	Relationship of Segmented Plant Output Variables to Company Profit Rates - Plant Location Model	Relationship of Segmented Wage Rate Variables to Company Profit Rates - Plant Location Model	Relationship of City Size (CS_i) Variables to Company Profit Rates - Company Model	Employment Trends 1947-67 between Small and Large Cities*
Fabricated Metals	CS_5 and CS_7 coefficients are significantly negative in Equation C. Covariance analysis indicated city size did not significantly explain profit rate variation.	No relationship	Coefficients for $WAGERATE_5$ and $_6$ were significantly positive, but covariance analysis indicated wage rate segmented by city size did not significantly explain profit rate variation.	No relationship	Increase of 371,000 employees (38.2% growth rate) from 1947-67 with no shift to small cities. Over 70% of employment is in the large cities.
Non-electrical Machinery	No relationship	Three Plant Output coefficients are significantly negative from coefficients for small cities. Covariance analysis indicates plant output segmented by city size does not significantly explain profit rate variation.	Coefficient for $WAGERATE_3$ (cities of 50,000-250,000) is significantly negative. Covariance analysis indicated wage rate variables segmented by city size significantly explain profit rate variation.	No relationship	One of the nation's three largest industries with 1,865,000 employees in 1967. Moderate growth of 20.7% from 1947-67 with slight employment shift to larger cities.
Electrical Machinery	Coefficient for CS_5 is significantly positive but city size coefficients as a group do not significantly explain profit rate variation.	No relationship	Coefficients for $WAGERATE_5$ and $_7$ were significantly negative. Covariance analysis indicated wage rate segmented by city size significantly explained profit rate variation.	No relationship	Fastest growth industry from 1947-67 with an employment increase from 801,000 to 1,875,000. Employment shift to smaller cities is even more pronounced. Best single employment growth prospect in micropolitan America.

TABLE XXXVI (Continued)

Industry	Relationship of City Size (CS_i) Variables to Company Profit Rates - Plant Location Model	Relationship of Segmented Plant Output Variables to Company Profit Rates - Plant Location Model	Relationship of Segmented Wage Rate Variables to Company Profit Rates - Plant Location Model	Relationship of City Size (CS_i) Variables to Company Profit Rates - Company Model	Employment Trends 1947-67 between Small and Large Cities*
Transportation Equipment	No relationship	No relationship	No relationship	No relationship	Employment growth of 55.2% from 1947-67. It remained the most large city oriented manufacturing industry during the 20 year period.

*Large cities are defined as Standard Metropolitan Statistical Areas (SMSA's) with 40,000 or more manufacturing employees in 1963. Small cities include small SMSA's with less than 40,000 manufacturing employees and non-metropolitan cities and towns.

250,000 residents were significantly negative, suggesting lower profit rates in the larger cities. A look at past employment trends from 1947-1967 revealed no discernible employment shifts to smaller cities. It is unlikely that the metropolitan oriented Printing industry is rapidly decentralizing to smaller SMSA's and micropolitan areas, except for possibly some routine functions. Based on the plant location pattern of the firms analyzed, it is more likely that Printing industry firms with plant locations in large and small cities are more profitable than firms with plant location exclusively in large cities exceeding 1,000,000 residents.

The interaction of wage rates and city size in the Plant Location model was significantly related to company profit rates in the Electrical Machinery and Non-electrical Machinery industries. This implies that wage levels differ by city size and systematically influence profit rates in these two industries, while city size, by itself, does not influence profit rates. The Electrical Machinery industry has been the nation's fastest growth industry from 1947-1967 with an addition of 1,064,000 employees by 1967 from the 801,000 employment level in 1947. At the same time the industry rapidly decentralized to micropolitan and small metropolitan areas and was the leading source of new industrial employment in the smaller cities with an increase from 187,000 employees in 1947 to 662,000 in 1967. During this same period employment in the Non-electrical Machinery industry increased by 20.7% which is below the employment increase of 26.6% for all manufacturing industries. There was no relative employment shift to either small or large cities.

The interaction of plant output and city size in the Plant Location model was significantly related to profit rates in only the Food and Furniture industries. In both industries about one-half of the total employment is in micropolitan and small metropolitan areas. Since 1963 there has been a moderate employment shift toward smaller cities in both industries, and today they represent moderate employment growth prospects for micropolitan areas.

Further indication is provided in the Company model that city size influenced profit rates in the Food industry, but this is not revealed by the city size variable in the Plant Location models. Conversely, in the Apparel industry city size influenced profit rates in the Plant Location model, but not in the Company model. Employment in both the Food and Apparel industry has been decentralizing to micropolitan areas in recent years.

The Principal Findings from the Analysis of the Eleven Industries

The principal finding from the summary Table XXXVI was that profit rates are not influenced directly by city size except for the Printing industry and possibly the Food and Apparel industries. More often, the influence of city size was apparent in the interaction of wage rates or plant output with city size. However, in five industries - Textiles, Paper, Chemicals, Fabricated Metals, and Transportation Equipment - city size did not influence profit rates directly or through interaction with other variables in either the Plant Location or Company model. A possible interpretation is that industry can locate plants anywhere and is equally efficient in making a profit but the more reasonable interpretation is that industry responds to profit incentives and locates where it can increase profit. According to manufacturing employment data from 1947-1967 (Table XXXV of Chapter V) industry has maintained from 58.4% to 59.4% of total employment in the nation's larger cities and suburbs, indicating overall stability by city size even though rapid changes were occurring in individual industries. The findings of this study that profit rates do not, in general, vary systematically by city size tend to refute claims that manufacturing industry firms are not adequately responding to profit incentives offered by varied locations.

The second principal finding from the empirical results reported in Chapter IV and Appendices A and B is the importance of financial, multi-industry, enterprise, plant number and region independent variables in explaining profit rates as contrasted to the lack of importance of the city size binary and interaction variables.

Coefficients of regional variables were significant as a group in eight of the eleven industries analyzed and at least one region coefficient was individually significant in almost every industry. There was no trend across industries of expected profit rates in one region being significantly different from profit rates in all other regions.

Individual coefficients for plant numbers (NB_p) also influenced profit rates in most industries. For example, firms with four to eight plants had significantly higher expected profit rates than single plant firms in six industries analyzed.

Multi-industry variables were an important influence on profit rates in nine industries. The assumption that multi-industry firms have systematically different profit rates from single industry firms was not substantiated. Profit rates varied in multi-industry firms according to the industry combinations in which the firm was engaged; some multi-industry combinations were more profitable than single industry firms, other combinations less profitable. While an enterprise breakdown was attempted in only five industries, several coefficients of enterprise variables were significant in three industries - Electrical Machinery, Fabricated Metals and Food. Results from the analysis of multi-industry and enterprise variables suggest that industrial structure and diversification has a more prominent effect on profit rates than does location by different city sizes.

The most important explanatory variables were found in the financial (X_f and X_w) class. In the Plant Location model, coefficients for the variables, NETWORTH RATIO and GROWTH RATE, were significantly positive in ten of eleven industries. The coefficients for SALES and C/L RATIO were significant in four and three industries, respectively. In the Food industry the coefficients for CAPITAL, LABOR, and ASSET were also significant.

Because these variables were so prominent it is important to investigate if the financial (X_f) variables are directly influenced by city size which in turn would influence profit rates. This could be accomplished by a two stage least squares model as described in the conceptual model section of Chapter II. The author examined this issue on an ad hoc basis by postulating the linear relation of:

6-1) $X_f = a + b$ (City size)

where X_f = A financial variable which could be NETWORTH RATIO, GROWTH RATE, SALES, C/L RATIO, CAPITAL, LABOR, ASSET

City size = Population of the city in which the plant is located, expressed in millions of people.

Each financial variable was specified as a function of city size in each industry. No city size coefficient was significant at the 0.10 level in the Food, Chemical, Fabricated Metals, Non-electrical Machinery and Electrical Machinery industries. City size for the Transportation Equipment and Apparel industries significantly explained variation in GROWTH RATE and NETWORTH RATIO respectively. City size significantly explained variation in SALES in the Apparel, Furniture and Paper industries. The variables C/L RATIO, CAPITAL and LABOR each had significant coefficients in three industries. The two most significant equations based on the t-value for the city size coefficient are shown below along with the R^2 and F-value for the equation. The numbers in parenthesis are standard errors of beta.

Apparel industry

6-2) LABOR = 2.347 - 0.273 (City size)

(0.151) (0.083)

$R^2 = 0.05$ F-value = 10.68

Textile industry

6-3) C/L RATIO = 5.340 + 0.488 (City size)

(0.299) (0.228)

$R^2 = 0.025$ F-value = 4.57

This examination showed the influence of city size on the financial variables was very weak, and in most cases, no relationship was evident. This finding further supports the general conclusion of this study that profit rates do not systematically differ by city size--there is very little indirect influence of city size on profit rates through the other independent variables. However, future research is needed to explore fully the relationship of all independent variables to city size which in turn significantly affect profit rates, and to incorporate the results into two stage least square models. Other specifications of city size could change the findings of the ad hoc examination.

Further Shortcomings of This Study and Directions for Further Research

One of the principal shortcomings of this study resulted from using secondary data for the company instead of primary data for each plant location. The entire effect of city size on profit rates could not be estimated in the plant location model because of replicated observations for the dependent variable - company profit rates - for each firm plant location. Obtaining an estimate of a profit rate for each plant would be one method to resolve the issue. However, using primary data for a broad extensive study would be costly to obtain and would still be subject to considerable measurement error. A suggested alternative would be to concentrate a study, using primary data, on a few industries with employment growth potential in micropolitan areas.

The other principal shortcoming of this study arose from using cross-sectional data. Ideally, information on profit rate trends of industry plant locations should be related to changing employment patterns, plant and equipment investment and other explanatory variables that may change their city size orientation in different time periods. This can only be done through construction of dynamic models for which the basic research had not yet begun. The importance in explaining profit rates of the variables GROWTH RATE and NETWORTH RATIO which indirectly incorporate information on past financial trends within the company gives some indication that extended research into the use of a dynamic model would be fruitful.

Conclusions

Findings in this study lead to the general conclusion that industry performance is satisfactorily responding to comparative profit incentives by location. However, excellent industry performance as measured by equating private costs and returns at the margin does not imply overall economic efficiency for society if private costs (returns) differ from social costs (returns). If further research identifies a discrepancy between private and social costs (benefits), then national policy might be directed at changing industrial structure to alleviate this discrepancy or change prevailing location incentives. Policies to improve industrial performance in responding to location incentives would appear to need low priority, as industry performance appears adequate as judged by this study.

Based on recent employment trends from 1947-1967, the manufacturing industries which provide moderate to rapid employment growth prospects for micropolitan areas include Electrical Machinery, Apparel, Transportation Equipment, Chemicals and Furniture of the eleven industries analyzed and also the Instrument and Rubber Products industries. More extensive research on the latest industry employment trends for a wider breakdown of city size groups is needed for a better determination of potential growth industries for selected micropolitan areas. The scope of this study was too broad to suggest industry growth prospects for individual micropolitan regions.

Some consistency in results is apparent from examining industry employment patterns and findings from the Plant Location and Company models. Electrical Machinery, Apparel and Furniture industries are decentralizing to micropolitan areas and offer growth prospects. In these industries some relationship of city size, either directly or through interaction with wage rates and plant output, to profit rates was found. In the Printing industry city size was an important influence on profit rates and reflected the financial losses and business failures observed in many Printing firms in large cities, but there is no employment shift to small cities, perhaps in part because of trade union pressures. City size also influenced profits in the Food industry which is decentralizing to micropolitan areas, but was not a major growth industry.

City size was not related to profit rates in the Transportation Equipment and Chemicals industries which offer growth prospects for micropolitan areas. However, this growth is not due to relative employment shifts to micropolitan cities, but is due to the moderate to rapid overall growth of these industries.

Finally, the general conclusion from this study that manufacturing industries respond to comparative profit incentive offered by different city sizes, should be viewed in the context of research findings on where other private and public services can be provided most efficiently.

A SELECTED BIBLIOGRAPHY

Advisory Commission on Intergovernmental Relations. Urban and Rural America: Policies for Future Growth. Washington, D. C.: Advisory Commission on Intergovernmental Relations, April, 1968.

Alonso, William. "The Economics of Urban Size." Paper presented at the 10th European Congress of the Regional Science Association, London, England, 1970.

Berry, Brian. "Region Growth Centers--A Status Report." Proceedings. 3rd Annual Meeting of Regional Economic Development Research Conference. Washington, D. C., April, 1972.

Childs, Dan. "Economic Evaluation of Industry Location by City Size in Oklahoma." (Unpublished M.S. thesis, Oklahoma State University, 1973.)

Clawson, Marion. "Population, Settlement and Growth Patterns." American Journal of Agricultural Economics, LII (December, 1970), 766-744.

Creamer, Daniel. "Manufacturing Employment by Type of Location--An Examination of Recent Trends." National Industrial Conference Board, No. 106. New York: National Industrial Conference Board, 1969.

Evans, Alan W. "The Pure Theory of City Size in an Industrial Economy." Urban Studies, IX (1972) 49-78.

Federal Trade Commission. Quarterly Financial Report. Washington, D. C.: U. S. Government Printing Office, 1st Quarter, 1970.

Foster, M. S. "Programs for Dealing with Problems and Advantages of Rural Locations for Industrial Plants." Raleigh: North Carolina State University, Agriculture Policy Institute, July, 1970.

Fuchs, Victor R. Hourly Earnings Differentials by Region and Size of City. Edited by J. Kanaske and L. Bramhall. Cambridge: MIT Press, 1969.

Fuller, Theodore E. "Trends in Manufacturing Among Small Centers of Pennsylvania." University Park: Pennsylvania State University, Bulletin 788, December, 1971.

Greenhut, Melvin L. Plant Location in Theory and in Practice. Chapel Hill: University of North Carolina Press, 1956.

Greenwood, Michael J. "The Relationship between City Size and Industrial Wage Levels." Annals of Regional Science, IV (1970), 48-50.

Haren, Claude C. "Current Spatial Organization of Industrial Production and Distribution Activity." Enlargement of oral presentation at conference on problems and potential of rural industrialization, West Lafayette, Indiana, July 11-13, 1972.

______________. "Rural Industrial Growth in the 1960's." American Journal of Agricultural Economics, LII (1970), 431-437.

Hirsch, Walter. "The Supply of Urban Public Services." Issues in Urban Economics. Edited by H. Perloff and L. Wingo. Baltimore: John Hopkins Press, 1968.

Isard, Walter. Location and Space Economy. Regional Science Series, No. 1. Cambridge: MIT Press, 1956.

Johnston, J. Econometric Methods. New York: McGraw Hill, 1972.

Mansfield, Edwin. "City Size and Income, 1949." Regional Income Studies on Income and Wealth, XX. Washington, D. C.: National Bureau of Economic Research, 1950.

McNee, Robert B. "The Changing Relationship of Economics and Economic Geography." Economic Geography, XXXV (July, 1959), 189-198.

Morris, Douglas. "Cost of Public Services by City Size." (Unpublished Ph.D. dissertation, Oklahoma State University, 1972.)

Perloff, Harvey, et al. Regions, Resources and Economic Growth. Lincoln: University of Nebraska Press, 1960.

Standard and Poors. Standard and Poors Corporation Records. I-VI. New York: Standard and Poors, 1972.

______________. Standard and Poors Directory of Corporations. New York: Standard and Poors, 1972.

Thompson, John. "Some Theoretical Considerations for Manufacturing Geography." Economic Geography, XXXII (1966), 356-365.

Tweeten, Luther G. Foundations of Farm Policy. Lincoln: University of Nebraska Press, 1971.

Tweeten, Luther G. and Y. C. Lu. "Attitudes by Place of Residence." Paper presented at 2nd meeting of the Mid-Continent Section of Regional Science Association, Stillwater, Oklahoma, April, 1973.

U. S. Department of Agriculture. Regional Variations in Economic Growth and Development with Emphasis on Rural Areas. Agriculture Report No. 205, Economic Research Service, Washington, D. C.: Government Printing Office, May, 1971.

U. S. Bureau of the Census. Annual Survey of Manufacturers - 1970. Washington, D. C.: Government Printing Office, 1972.

________________. Census of Manufacturing - 1967. Washington, D. C.: Government Printing Office, 1969.

Weber, Alfred. Theory of the Location of Industries. Translated by Carl J. Friedrich. Chicago: University of Chicago Press, 1929.

APPENDIX A

REGRESSION ANALYSIS OF FIVE MANUFACTURING INDUSTRIES - PLANT LOCATION MODEL

Appendix A contains ten tables, XXXVII - XLVI, that are used to analyze profitability in five manufacturing industries. The odd numbered tables (XXXVII, XXXIX, XLI, XLIII, XLV) contain the listing of variables, coefficients, and standard error of beta for the three equations of the Plant Location model for the Transportation Equipment, Non-electrical Machinery, Chemicals, Textiles and Paper industries respectively. The even numbered tables XXXVIII, XL, XLII, XLIV, XLVI) contain the co-variance analysis for the contribution of region, city size, segmented plant output and segmented wage rate variables in explaining profit rate variation for each of the above five industries. Major points are summarized in the following paragraphs.

The coefficients of the financial variables are significant in most of the five industries except for SALES which is significant only in the Transportation Equipment industry.

Coefficients for multi-industry variables were significant in all but the Textile industry. Enterprise variables were only listed for the Transportation Equipment and Chemicals industries. No enterprise co-efficient in either industry was significantly different from the inter-cept. However, in the Chemical industry, two enterprises had coeffic-ients significantly different from each other.

TABLE XXXVII

REGRESSION ANALYSIS OF TRANSPORTATION EQUIPMENT INDUSTRY - PLANT LOCATION MODEL

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
Constant	-0.2268***	0.0715	0.2363***	0.0738	-0.1526	0.1192
X_f						
SALES	-0.1576***	0.0449	0.1606***	0.0462	-0.1578***	0.0456
C/L RATIO	-0.5946	1.6177	-0.1334	1.6494	-0.8166	1.6471
NETWORTH RATIO	0.2735***	0.0291	0.2764***	0.0294	0.2737***	0.0294
GROWTH RATE	0.0014**	0.0006	0.0015**	0.0006	0.0014**	0.0006
X_m						
SIC 34-35	0.0121	0.0149	0.0078	0.0152	0.0141	0.0150
SIC 36	-0.0360*	0.0210	-0.0425*	0.0233	-0.0304*	0.0232
SIC 28	0.0496	0.0324	0.0472	0.0326	0.0536	0.0326
AUTO	-0.0175	0.0255	-0.0092	0.0235	-0.0175	0.0232
RAIL	-0.0223	0.0380	-0.0200	0.0486	-0.0274	0.0474
NB_p						
NB 2-3	0.1828***	0.0408	0.1870***	0.0412	0.1755***	0.0418
NB 4-5	0.2412***	0.0406	0.2449***	0.0410	0.2390***	0.0414
NB 6-7-8	0.2818***	0.0403	0.2844***	0.0407	0.2820***	0.0409
R_r						
MIDWEST	0.0102	0.0191	0.0049	0.0194	0.0098	0.0193
SOUTH	0.0198	0.0214	0.0128	0.0219	0.0160	0.0219
WEST	0.0132	0.0215	0.0137	0.0217	0.0137	0.0220
CS_i						
CS 2	-0.0077	0.0207	-0.0202	0.0268	0.0583	0.1450
CS 3	-0.0045	0.0280	0.0093	0.0322	-0.0131	0.1848
CS 4	-0.0163	0.0271	-0.0151	0.0327	-0.0710	0.1449
CS 5	0.0001	0.0252	0.0143	0.0284	-0.3424	0.1940
CS 6	0.0059	0.0226	-0.0025	0.0267	-0.0775	0.2012
CS 7	-0.0061	0.0210	-0.0033	0.0249	-0.2363	0.1566

TABLE XXXVII (Continued)

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
P_i						
WAGE RATE	-0.0022	0.0380	-0.0066	0.0387		
PLANT OUTPUT	0.0569	0.2095			-0.0030	0.2113
CS_iP_i						
PLANT OUTPUT$_1$			0.9083	1.2100		
PLANT OUTPUT$_2$			0.7993	1.6202		
PLANT OUTPUT$_3$			-0.0154	1.2352		
PLANT OUTPUT$_4$			-0.5793	1.3016		
PLANT OUTPUT$_5$			-1.0134	1.2255		
PLANT OUTPUT$_6$			-0.7152	1.2255		
PLANT OUTPUT$_7$			-0.4524	1.4074		
WAGE RATE$_1$					-0.0467	0.0710
WAGE RATE$_2$					-0.0472	0.0941
WAGE RATE$_3$					0.0050	0.1201
WAGE RATE$_4$					0.0342	0.1001
WAGE RATE$_5$					0.2245	0.1250
WAGE RATE$_6$					0.0468	0.1235
WAGE RATE$_7$					0.1466	0.0990
Summary						
N		247		247		247
R^2		0.504		0.513		0.521
F-Value		9.39		7.57		7.82
Coefficient of Variation		70.81%		71.15%		70.55%
Profit mean		13.52%		13.52%		13.52%

* - Coefficient significant at 0.10 probability level
** - Coefficient significant at 0.05 probability level
*** - Coefficient significant at 0.01 probability level

TABLE XXXVIII

ANALYSIS OF COVARIANCE - PLANT LOCATION MODEL
TRANSPORTATION EQUIPMENT--SIC 37

Source	Equation B--Output SS	d.f.	MS	Equation C--Wage Rate SS	d.f.	MS
(1) X_f, X_m, P_j, NB_p	2.0518	15	0.1368	2.0518	15	0.1368
(2) R_r	0.0095	3	0.0032	0.0095	3	0.0032
(3) CS_i	0.0043	6	0.0007	0.0043	6	0.0007
(4) $CS_i \cdot P_j$	0.0359	6	0.0060	0.0719	6	0.0120
(5) Residual	1.9989	216	0.0092	1.9655	216	0.0091
(6) Total	4.1004	246		4.1004	246	

Test for Including Intercept Variables	(Region)	(City Size)
Source	R_r	CS_i
Equation	A, B, C	A, B, C
Computed F	0.352	0.783
Tabulated $F_{.05}$	2.68	2.18
Conclusion	Fail to reject H_0	Fail to reject H_0

Test for Including Slope Variables	(Plant Output X City Size)	(Wage Rate X City Size)
Source	CS_iP_j	CS_iP_j
Equation	B	C
Computed F	0.648	1.315
Tabulated $F_{.05}$	2.18	2.18
Conclusion	Fail to reject H_0	Fail to reject H_0

TABLE XXXIX

REGRESSION ANALYSIS OF NON-ELECTRICAL MACHINERY INDUSTRY - PLANT LOCATION MODEL

Variable	Equation A		Equation B		Equation C	
	Beta Coefficient	Std. error of beta	Beta Coefficient	Std. error of beta	Beta Coefficient	Std. error of beta
Constant	0.0683	0.0413	-0.0688	0.0415	-0.1062	0.0693
X_f						
SALES	0.0013	0.0525	-0.0077	0.0532	-0.0091	0.0526
C/L RATIO	1.7659	0.9646	1.7747	0.9656	2.1164	0.9726
NETWORTH RATIO	0.1466***	0.0208	1.1391***	0.0210	0.1525***	0.0209
GROWTH RATE	0.5710	0.2956	0.0005	0.0003	0.0005	0.0003
X_m						
NOMANF	-0.0092	0.0125	-0.0093	0.0125	-0.0066	0.0126
SIC 25	-0.0532**	0.0223	-0.0543**	0.0223	-0.0496**	0.0227
SIC 28	0.0180	0.0184	0.0188	0.0184	0.0178	0.0184
SIC 34	0.0215**	0.0097	0.0216**	0.0097	0.0204**	0.0097
SIC 36	-0.0034	0.0107	-0.0051	0.0810	-0.0033	0.0108
SIC 37	0.0212*	0.0125	0.0202*	0.0126	0.0222*	0.0126
SIC 38-39	0.0027	0.0168	0.0012	0.0168	0.0028	0.0170
NB_p						
NB 2-3	0.0429**	0.0197	0.0401**	0.0197	0.0400**	0.0196
NB 4-5	0.0682***	0.0197	0.0661***	0.0197	0.0680***	0.0198
NB 6-7-8	0.0717***	0.0196	0.0704***	0.0196	0.0712***	0.0196
R_r						
MIDWEST	0.0034	0.0089	0.0035	0.0089	0.0046	0.0090
SOUTH	0.0016	0.0119	0.0013	0.0119	-0.0045	0.0125
WEST	0.0003	0.0115	0.0002	0.0115	-0.0029	0.0116
CS_i						
CS_2	0.0052	0.0120	0.0034	0.0155	0.1279	0.0889
CS_3	0.0038	0.0150	0.0040	0.0193	0.2879***	0.1120
CS_4	-0.0084	0.0142	0.0098	0.0178	0.0748	0.0993

TABLE XXXIX (Continued)

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
CS_5	-0.0176	0.0140	-0.0025	0.0163	0.0358	0.1007
CS_6	-0.0177	0.0124	-0.0060	0.0148	-0.0685	0.0955
CS_7	-0.0101	0.0113	-0.0004	0.0145	-0.0410	0.0884
P_j						
WAGE RATE	0.0278	0.0216	0.0264	0.0216		
PLANT OUTPUT	0.2814	0.2149			0.2865	0.2146
CS_iP_j						
PLANT $OUTPUT_1$			1.2700**	0.6552		
PLANT $OUTPUT_2$			0.0743	0.9206		
PLANT $OUTPUT_3$			-0.4773	0.8319		
PLANT $OUTPUT_4$			-1.7600*	1.0383		
PLANT $OUTPUT_5$			-1.2900*	0.7271		
PLANT $OUTPUT_6$			-1.0510	0.6868		
PLANT $OUTPUT_7$			-1.5791*	0.9316		
WAGE $RATE_1$					0.0513	0.0443
WAGE $RATE_2$					-0.0835	0.0603
WAGE $RATE_3$					-0.1988**	0.0773
WAGE $RATE_4$					-0.0571	0.0682
WAGE $RATE_5$					-0.0369	0.0693
WAGE $RATE_6$					0.0325	0.0629
WAGE $RATE_7$					0.0150	0.0577
Summary						
N		598		598		598
R^2		0.167		0.179		0.184
F-value		4.60		3.99		4.12
Coefficient of Variation		61.83%		61.71%		61.52%
Profit mean		13.60%		13.60%		13.60%

* - Coefficient significant at 0.10 probability level
** - Coefficient significant at 0.05 probability level
*** - Coefficient significant at 0.01 probability level

TABLE XL

ANALYSIS OF COVARIANCE - PLANT LOCATION MODEL NONELECTRICAL MACHINERY--SIC 35

Source	Equation B--Output			Equation C--Wage Rate		
	SS	d.f.	MS	SS	d.f.	MS
(1) X_f, X_m, P_j, NB_p	0.7597	16	0.0475	0.7597	16	0.0474
(2) R_r	0.0069	3	0.0023	0.0069	3	0.0023
(3) CS_i	0.0461	6	0.0077	0.0461	6	0.0077
(4) $CS_i \cdot P_j$	0.0577	6	0.0096	0.0821	6	0.0137
(5) Residual	3.9863	566	0.0070	3.9619	566	0.0069
(6) Total	4.8566	597		4.8566	597	

Test for Including Intercept Variables	(Region)	(City Size)
Source	R_r	CS_i
Equation	A, B, C	A, B, C
Computed F	0.324	1.089
Tabulated $F_{.05}$	2.68	2.18
Conclusion	Fail to reject H_0	Fail to reject H_0
Test for Including Slope Variables	**(Plant Output X City Size)**	**(Wage Rate X City Size)**
Source	CS_iP_j	CS_iP_j
Equation	B	C
Computed F	1.374	1.958
Tabulated $F_{.05}$	2.18	2.18
Conclusion	Fail to reject H_0	Reject H_0 at .10 level

TABLE XLI

REGRESSION ANALYSIS OF CHEMICAL INDUSTRY - PLANT LOCATION MODEL

	Equation A		Equation B		Equation C	
	Beta Coefficient	Std. error of beta	Beta Coefficient	Std. error of beta	Beta Coefficient	Std. error of beta
Constant	-0.0620	0.0464	-0.0613	0.0467	-0.0726	0.0924
X_f						
SALES	0.0228	0.0982	0.0236	0.1015	0.0081	0.0998
C/L RATIO	-2.0258**	0.8937	-2.0452**	0.9023	-2.1562**	0.8969
NETWORTH RATIO	0.2706***	0.0260	0.2776***	0.0263	0.2704***	0.0263
GROWTH RATE	0.0041***	0.0005	0.0042***	0.0005	0.0042***	0.5156
X_m						
NOMANF	-0.0217	0.0220	-0.0226	0.0221	-0.0266	0.0223
SIC 34	0.0365**	0.0158	0.0330**	0.0161	0.0391**	0.0159
SIC 35-37	0.0143	0.0141	0.0136	0.0142	0.0173	0.0144
SIC 36	-0.0477**	0.0155	-0.0498***	0.0158	-0.0471***	0.0156
SIC 38	-0.0288*	0.0154	-0.0308**	0.0156	-0.0296**	0.0155
DRUGS	0.0118	0.0142	0.0125	0.0145	0.0123	0.0143
CHEMIND	0.0200	0.0135	0.0177	0.0135	0.0204	0.0134
PLASTIC	0.0017	0.0109	0.0025	0.0110	0.5441	0.0110
CHEM & DRUG	-0.0114	0.0224	-0.0131	0.0225	-0.0087	0.0224
PLSTC & DRUG	0.0252	0.0322	0.0254	0.0323	0.0212	0.0328
NB_p						
NB 2-3	0.0318	0.0206	0.0321	0.0208	0.0314	0.0208
NB 4-5	0.0473**	0.0207	0.0484**	0.0209	0.0489**	0.0208
NB 6-7-8	0.0474**	0.0210	0.0502**	0.0209	0.0487**	0.0210
R_r						
MIDWEST	0.0218**	0.0102	0.0236**	0.0103	0.0235**	0.0103
SOUTH	0.0251**	0.0125	0.0280**	0.0126	0.0282**	0.0128
WEST	0.0088	0.0116	0.0125	0.0118	0.0054	0.0120
CS_i						
CS_2	0.0050	0.0152	-0.0068	0.0181	0.0452	0.1297

TABLE XLI (Continued)

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
CS_3	0.0282	0.0199	0.0263	0.0213	0.0921	0.1202
CS_4	0.0046	0.0201	-0.0232	0.0263	-0.1185	0.1337
CS_5	-0.0225	0.0171	-0.0333*	0.0210	-0.1458	0.1149
CS_6	-0.0009	0.0138	-0.0120	0.0165	0.0793	0.1149
CS_7	-0.0043	0.0138	-0.0185	0.0165	0.1129	0.1332
P_j						
WAGE RATE	-0.0157	0.0244	-0.0162	0.0245		
PLANT OUTPUT	0.0583	0.2528			0.0845	0.2552
CS_iP_j						
PLANT $OUTPUT_1$			-0.7247	0.9691		
PLANT $OUTPUT_2$			1.7502	1.5193		
PLANT $OUTPUT_3$			0.6476	0.9895		
PLANT $OUTPUT_4$			3.1745*	1.9016		
PLANT $OUTPUT_5$			1.4700	1.6245		
PLANT $OUTPUT_6$			1.5797	1.2719		
PLANT $OUTPUT_7$			2.0701	1.4102		
WAGE $RATE_1$					-0.0103	0.0596
WAGE $RATE_2$					-0.0270	0.0988
WAGE $RATE_3$					-0.0437	0.0821
WAGE $RATE_4$					0.0833	0.0895
WAGE $RATE_5$					0.0862	0.0791
WAGE $RATE_6$					-0.0522	0.0766
WAGE $RATE_7$					-0.0756	0.0976
Summary						
N		365		365		365
R^2		0.393		0.404		0.406
F-Value		7.77		6.59		6.64
Coefficient of Variation		46.17%		46.16%		46.08%
Profit mean		15.79%		15.79%		15.79%

* - Coefficient significant at 0.10 probability level
** - Coefficient significant at 0.05 probability level
*** - Coefficient significant at 0.01 probability level

TABLE XLII

ANALYSIS OF COVARIANCE - PLANT LOCATION MODEL CHEMICALS--SIC 28

	Source	Equation B--Output SS	d.f.	MS	Equation C--Wage Rate SS	d.f.	MS
(1)	X_f, X_m, P_j, NB_p	1.0835	19	0.0570	1.0835	19	0.0570
(2)	R_r	0.0364	3	0.0121	0.0364	3	0.0121
(3)	CS_i	0.0367	6	0.0061	0.0367	6	0.0061
(4)	$CS_i \cdot P_j$	0.0311	6	0.0052	0.0311	6	0.0052
(5)	Residual	1.7531	330	0.0053	1.7531	330	
(6)	Total	2.9428	364		2.9428	364	

Test for Including Intercept Variables	(Region)	(City Size)
Source	R_r	CS_i
Equation	A, B, C	A, B, C
Computed F	2.278	1.152
Tabulated $F_{.05}$	2.68	2.18
Conclusion	Reject H_0 at .10 level	Fail to reject H_0

Test for Including Slope Variables	(Plant Output X City Size)	(Wage Rate X City Size)
Source	CS_iP_j	CS_iP_j
Equation	B	C
Computed F	0.976	1.211
Tabulated $F_{.05}$	2.18	2.18
Conclusion	Fail to reject H_0	Fail to reject H_0

TABLE XLIII

REGRESSION ANALYSIS OF TEXTILE INDUSTRY - PLANT LOCATION MODEL

Variable	Equation A		Equation B		Equation C	
	Beta Coefficient	Std. error of beta	Beta Coefficient	Std. error of beta	Beta Coefficient	Std. error of beta
Constant	0.0484	0.0564	0.0436	0.0568	0.0966	0.0819
X_f						
SALES	-0.0654	0.1599	0.0467	0.1690	-0.0350	0.1639
C/L RATIO	-5.3594***	1.7692	-5.5218***	1.7837	-5.5139***	1.8340
NETWORTH RATIO	0.1094***	0.0329	0.1153***	0.0333	0.1267***	0.0346
GROWTH RATE	0.0028***	0.0005	0.0029***	0.0005	0.0029	0.0005
X_m						
NOMANF	-0.0009	0.0257	0.0033	0.0263	0.0051	0.0267
MULTI-IND	-0.0118	0.0130	-0.0119	0.0131	-0.0137	0.0138
NB_p						
NB 2-3	-0.0235	0.0282	-0.0336	0.0285	-0.0229	0.0300
NB 4-5	-0.0084	0.0291	-0.0243	0.0300	-0.0113	0.0305
NB 6-7-8	-0.0448	0.0315	-0.0597*	0.0324	-0.0480	0.0332
R_r						
MIDWEST	-0.0289	0.0438	-0.0249	0.0439	-0.0168	0.0474
SOUTH	0.0210	0.0153	0.0213	0.0157	0.0168	0.0165
WEST	0.1024**	0.0392	0.1026**	0.0403	0.1235***	0.0414
CS_i						
CS_2	-0.0055	0.0156	0.0160	0.0223	-0.0366	0.1164
CS_3	-0.0287	0.0227	-0.0008	0.0433	-0.0966	0.1587
CS_4	0.0131	0.0178	0.0318	0.0261	0.0899	0.1220
CS_5	-0.0040	0.0287	0.0079	0.0687	-0.2506	0.3865
CS_6	-0.0429**	0.0205	-0.0625**	0.0260	-0.2511**	0.1300
CS_7	-0.0557**	0.0266	-0.0673**	0.0329	-0.1211	0.1193

TABLE XLIII (Continued)

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
P_i						
WAGE RATE	0.0674	0.0459	0.0761*	0.0472		
PLANT OUTPUT	-0.7764	0.0604			-0.7447	0.6081
CS_iP_i						
PLANT OUTPUT$_1$			-0.8546	0.8979		
PLANT OUTPUT$_2$			-1.4835	1.1550		
PLANT OUTPUT$_3$			-1.3543	1.7835		
PLANT OUTPUT$_4$			-1.4025	1.5312		
PLANT OUTPUT$_5$			-1.0252	9.2624		
PLANT OUTPUT$_6$			1.8835	1.4349		
WAGE RATE$_1$					0.0100	0.0758
WAGE RATE$_2$					0.0313	0.1249
WAGE RATE$_3$					0.0719	0.1660
WAGE RATE$_4$					-0.0780	0.1265
WAGE RATE$_5$					0.2544	0.3937
WAGE RATE$_6$					0.1992*	0.1240
WAGE RATE$_7$					0.0594	0.1020
Summary						
N		184		184		184
R^2		0.332		0.393		0.385
F-Value		6.00		3.91		3.78
Coefficient of Variation		58.04%		57.41%		57.79%
Profit mean		12.01%		12.01%		12.01%

* - Coefficient significant at 0.10 probability level
** - Coefficient significant at 0.05 probability level
*** - Coefficient significant at 0.01 probability level

TABLE XLIV

ANALYSIS OF COVARIANCE - PLANT LOCAION MODEL
TEXTILES--SIC 22

Source	Equation B--Output SS	d.f.	MS	Equation C- Wage Rate SS	d.f.	MS
(1) X_f, X_m, P_j, NB_p	0.3709	11	0.0337	0.3708	11	0.0337
(2) R_r	0.0373	3	0.0124	0.0373	3	0.0124
(3) CS_i	0.0438	6	0.0073	0.0438	6	0.0073
(4) $CS_i \cdot P_j$	0.0311	6	0.0052	0.0212	6	0.0035
(5) Residual	0.7460	157		0.7559	157	0.0048
(6) Total	1.2291	183		1.2291	183	

Test for Including Intercept Variables	(Region)	(City Size)
Source	R_r	CS_i
Equation	A, B, C	A, B, C
Computed F	2.546	1.531
Tabulated $F_{.05}$	2.68	2.18
Conclusion	Reject H_0 at .10 level	Fail to reject H_0

Test for Including Slope Variables	(Plant Output X City Size)	(Wage Rate X City Size)
Source	CS_iP_j	CS_iP_j
Equation	B	C
Computed F	1.084	0.734
Tabulated $F_{.05}$	2.18	2.18
Conclusion	Fail to reject H_0	Fail to reject H_0

TABLE XLV

REGRESSION ANALYSIS OF PAPER INDUSTRY - PLANT LOCATION MODEL

Variable	Equation A		Equation B		Equation C	
	Beta Coefficient	Std. error of beta	Beta Coefficient	Std. error of beta	Beta Coefficient	Std. error of beta
Constant	0.0432	0.0388	0.0513	0.0411	0.0898	0.0713
X_f						
SALES	0.1144	0.0963	0.0865	0.1035	0.1061	0.0995
CAPITAL	-0.2166**	0.1063	-0.1897	0.1148	-0.1958	0.1096
LABOR	-0.0016	0.0046	-0.0011	0.0050	-0.0023	0.0049
NETWORTH RATIO	0.2133	0.0232	0.2140	0.0238	0.2084	0.0244
GROWTH RATE	0.0033***	0.0004	0.0033***	0.0005	0.0033***	0.0005
X_m						
NOMANF	0.0154	0.0216	0.0179	0.0228	0.0142	0.0221
SIC 22-23	0.0503***	0.0159	0.0502***	0.0165	0.0542***	0.0164
SIC 24	-0.0110	0.0145	-0.0116	0.0147	-0.0092	0.0151
SIC 28	0.0044	0.0164	0.0015	0.0179	0.0107	0.0174
SIC 35	-0.0940***	0.0148	-0.0942***	0.0151	-0.0930***	0.0153
NB_p						
NB 2-3	-0.0625***	0.0158	-0.0587***	0.0164	-0.0617	0.0090
NB 4-5	-0.0698***	0.0155	-0.0654***	0.0162	-0.0705	0.0158
NB 6-7-8	0.0109	0.0150	0.0135	0.0158	0.0112	0.0154
R_r						
MIDWEST	0.0121	0.0086	0.0130	0.0088	0.0120	0.0090
SOUTH	0.0145	0.0106	0.0127	0.0109	0.0149	0.0109
WEST	0.0215	0.0107	0.0219**	0.0111	0.0272**	0.0113
CS_i						
CS_2	0.0112	0.0111	0.0039	0.0136	0.0359	0.1399
CS_3	0.0104	0.0156	0.0155	0.0204	0.0920	0.1433
CS_4	0.0219*	0.0129	0.0147	0.0172	-0.0238	0.0968

TABLE XLV (Continued)

Variable	Equation A Beta Coefficient	Equation A Std. error of beta	Equation B Beta Coefficient	Equation B Std. error of beta	Equation C Beta Coefficient	Equation C Std. error of beta
CS_5	0.0225*	0.0134	0.0238	0.0173	0.1528	0.1536
CS_6	0.0088	0.0120	0.0205	0.0182	0.0939	0.0881
CS_7	0.0136	0.0100	0.0092	0.0120	0.0120	0.0904
P_j						
WAGE RATE	0.0091	0.0248	0.0141	0.0264		
PLANT OUTPUT	0.0975	0.2448			0.1217	0.2487
CS_iP_j						
PLANT $OUTPUT_1$			-0.0432	0.2487		
PLANT $OUTPUT_2$			0.3819	0.4261		
PLANT $OUTPUT_3$			-0.2653	0.6963		
PLANT $OUTPUT_4$			0.5135	0.7685		
PLANT $OUTPUT_5$			0.0827	0.9824		
PLANT $OUTPUT_6$			-1.7076	1.6020		
PLANT $OUTPUT_7$			0.3218	0.6913		
WAGE $RATE_1$					-0.0016	0.0369
WAGE $RATE_2$					-0.0183	0.0938
WAGE $RATE_3$					-0.0554	0.0986
WAGE $RATE_4$					0.0336	0.0672
WAGE $RATE_5$					-0.0930	0.1127
WAGE $RATE_6$					-0.0611	0.0620
WAGE $RATE_7$					-0.0750	0.0624
Summary						
N		171		171		171
R^2		0.692		0.699		0.702
F-value		13.05		10.41		10.52
Coefficient of Variation		31.76%		32.09%		31.97%
Profit mean		12.39%		12.39%		12.39%

* - Coefficient significant at 0.10 probability level
** - Coefficient significant at 0.05 probability level
*** - Coefficient significant at 0.01 probability level

TABLE XLVI

ANALYSIS OF COVARIANCE - PLANT LOCATION MODEL
PAPER--SIC 26

	Source	Equation B--Output SS	d.f.	MS	Equation C--Wage Rate SS	d.f.	MS
(1)	X_f, X_m, P_j, NB_p	0.4867	16	0.0304	0.4867	16	0.0304
(2)	R_r	0.0100	3	0.0033	0.0100	3	0.0033
(3)	CS_i	0.0083	6	0.0014	0.0083	6	0.0014
(4)	$CS_i \cdot P_j$	0.0047	6	0.0008	0.0064	6	0.0011
(5)	Residual	0.2197	139	0.0016	0.2180	139	0.0016
(6)	Total	0.7294	170		0.7294	170	

Test for Including Intercept Variables	(Region)	(City Size)
Source	R_r	CS_i
Equation	A, B, C	A, B, C
Computed F	2.205	0.892
Tabulated $F_{.05}$	2.68	2.18
Conclusion	Reject at .10 level	Fail to reject H_0

Test for Including Slope Variables	(Plant Output X City Size)	(Wage Rate X City Size)
Source	CS_iP_j	CS_iP_j
Equation	B	C
Computed F	0.496	0.682
Tabulated $F_{.05}$	2.18	2.18
Conclusion	Fail to reject H_0	Fail to reject H_0

At least one of the coefficients for plant number variables (NB_p) is significant in every equation of each industry. In the Transportation Equipment and Non-electrical Machinery industry, multi-plant companies which have from two to eight plants, were significantly more profitable than single plant companies.

Regional locations significantly explained profit rate variation in the Chemical, Textiles and Paper industry, according to their co-variance analysis. The Paper industry is most profitable in the Western region while the Chemical industry is most profitable in the Midwest and South.

Covariance analysis indicates city size does not significantly add to explaining company profit rate variation in any of the five industries. However, except for the Transportation Equipment, some individual city size coefficients are significant within each industry. For example, coefficients for CS_6 and CS_7 representing cities of over 1,000,000 residents are significantly negative in the micropolitan oriented Textile Industry. In general, city size did not affect profitability as much in these five manufacturing industries as in the six industries analyzed in the text.

Coefficients of segmented Plant Output and Wage Rate variables are not very important except in the Non-electrical Machinery industry. In this industry, covariance analysis indicates Wage rate segmented by city size significantly explains profit rate variation. Plant Output is not important in the covariance analysis (Table XL) but three Plant Output coefficients are significantly negative from the expected profit rate in small cities of less than 10,000 residents. However, the low R^2 values of 0.167 to 0.184 in the three equations of the Non-electrical Machinery industry indicates little reliance can be placed on results of the Plant Location model for this industry. This is by far the lowest R^2 for any of the eleven industries analyzed.

The overall conclusion is that for each of the five industries the financial, multi-industry, plant number and region variables were more important in explaining company profit rates than city size, or segmented Plant Output or Wage Rate variables.

APPENDIX B

REGRESSION ANALYSIS OF THREE MANUFACTURING INDUSTRIES - COMPANY MODEL

Appendix B contains four tables (XLVII - L) that are used to report profitability in three manufacturing industries. In Table XLVII the Company model results of the Transportation Equipment and Non-electrical Machinery industries are shown, while their covariance analysis is contained in Table XLVIII. In Table XLIX and L the Company model results and covariance analysis respectively are shown for the Chemicals industry.

The tables for the Company model of the Textile and Paper industries are not shown because the F-values for the entire equation was not significant at the 0.10 level. The only significant individual coefficients in each industry were for the variable, NETWORTH RATIO.

City size coefficients individually or as a group for the Transportation Equipment, Non-electrical Machinery and Chemicals industry were not significant. The same result applies to the coefficient of the region variables, multi-industry variables and enterprise variables.

Only coefficients for multi-plant variables and for the NETWORTH RATIO were significant in each industry. Coefficients for GROWTH RATE were significantly positive in the Chemical and Non-electrical Machinery industries. The other financial variables were not important in the three industries.

TABLE XLVII

REGRESSION ANALYSIS - COMPANY MODEL

TRANSPORTATION EQUIPMENT INDUSTRY - NONELECTRIC MACHINERY INDUSTRY

	Equation D			Equation D	
Variables	Beta Coefficient	Std. error of beta	Variables	Beta Coefficient	Std. error of beta
Constant	0.1998*	0.1184	Constant	-0.1086*	0.0572
X_f			X_f		
SALES	-0.4920	0.5904	SALES	0.3869	0.2690
C/L RATIO	1.7335	3.0681	C/L RATIO	-0.3186	2.3061
NETWORTH RATIO	0.3540***	0.0965	NETWORTH RATIO	0.2528***	0.0561
GROWTH RATE	0.0012	0.0022	GROWTH RATE	0.0026***	0.0008
TOTAL WAGES	0.0017	0.0029	TOTAL WAGES	-0.0015	0.0011
X_m			X_m		
NOMANF	-0.1451**	0.0638	NOMANF	-0.0069	0.0320
SIC 28	-0.0191	0.0777	SIC 25	-0.0401	0.0558
SIC 34-35	-0.0060	0.0382	SIC 28	0.0236	0.0424
SIC 36	0.0119	0.0631	SIC 34	0.0188	0.0238
AUTO	0.0389	0.0648	SIC 36	0.0104	0.0245
AIR	-0.0186	0.0583	SIC 37	0.0227	0.0320
RAIL	0.0263	0.1407	SIC 38-39	0.0390	0.0443
NB_p			NB_p		
NB 2-3	0.1177*	0.0655	NB 2-3	0.0367	0.0281
NB 4-5	0.1514**	0.0690	NB 4-5	0.0561*	0.0314
NB 6-7-8	0.1299*	0.0761	NB 6-7-8	0.0645*	0.0338
R_r			R_r		
MIDWEST	-0.0089	0.0618	MIDWEST	0.0338	0.0265
SOUTH	0.0688	0.0744	SOUTH	0.0499	0.0352
WEST	-0.0235	0.0769	WEST	0.0357	0.0403

TABLE XLVII (Continued)

Variables	Equation D Beta Coefficient	Equation D Std. error of beta	Variables	Equation D Beta Coefficient	Equation D Std. error of beta
CS_i			CS_i		
CS_2	-0.0955	0.1098	CS_2	0.0510	0.0498
CS_3	-0.0949	0.1678	CS_3	0.0173	0.0518
CS_4	-0.1202	0.1170	CS_4	-0.0696	0.0576
CS_5	-0.048	0.0920	CS_5	0.0045	0.0512
CS_6	0.0010	0.0944	CS_6	-0.0191	0.0434
CS_7	-0.0487	0.0817	CS_7	0.0049	0.0405
Summary					
N		54			144
R^2		0.573			0.263
$\bar{R}^2$		0.231			0.122
F-value		1.62*			1.77*
Coefficient of Variation		74.72%			76.77%
Profit mean		12.62%			13.05%

* - Coefficient significant at 0.10 probability level
** - Coefficient significant at 0.05 probability level
*** - Coefficient significant at 0.01 probability level

TABLE XLVIII

ANALYSIS OF COVARIANCE FOR COMPANY MODEL OF THE NONELECTRICAL MACHINERY AND TRANSPORTATION EQUIPMENT INDUSTRIES

Source	MACHINERY-SIC 35			TRANS. EQUIP.-SIC 37		
	SS	d.f.	MS	SS	d.f.	MS
X_w, X_m, NB_p	0.3463	15	0.0231	0.3193	15	0.2129
R_r	0.0230	3	0.0077	0.0031	3	0.0010
CS_i	0.0520	6	0.0087	0.0233	6	1.0039
Residual	1.1792	119	0.0099	0.2580	29	0.0089
Total	1.6005	143		0.6037	53	

Test for Including Variables

Source	R_r	R_r
Computed F	0.782	0.128
Tabulated $F_{.05}$	2.68	2.88
Conclusion	Fail to reject H_0	Fail to reject H_0

Test for Including Variables

Source	CS_i	CS_i
Computed F	0.875	0.432
Tabulated $F_{.05}$	2.18	2.44
Conclusion	Fail to reject H_0	Fail to reject H_0

TABLE XLIX

REGRESSION ANALYSIS - COMPANY MODEL
CHEMICAL INDUSTRY

Variables	Equation D Beta Coefficient	Equation D Std. error of beta
Constant	-0.1371	0.0726
$\underline{X_f}$		
SALES	0.3507	0.6709
C/L RATIO	-1.3406	1.7881
NETWORTH RATIO	0.2176***	0.0574
GROWTH RATE	0.0035***	0.0010
TOTAL WAGES	-0.0016	0.0026
$\underline{X_m}$		
NOMANF	-0.0103	0.0473
SIC 34	0.0461	0.0407
SIC 35-37	0.0172	0.0326
SIC 36	-0.0541	0.0406
SIC 38	-0.0142	0.0512
DRUGS	0.0005	0.0302
CHEM	0.0070	0.0314
PLASTIC	-0.0080	0.0276
$\underline{NB_p}$		
NB 2-3	0.0783**	0.0306
NB 4-5	0.0834**	0.0330
NB 6-7-8	0.0915**	0.0352
$\underline{R_r}$		
MIDWEST	0.0486	0.0358
SOUTH	0.0450	0.0374
WEST	0.0013	0.0442
$\underline{CS_i}$		
CS_2	-0.0023	0.0612
CS_3	0.0424	0.0730
CS_4	0.0533	0.0709

TABLE XLIX (Continued)

Variables	Equation D Beta Coefficient	Std. error of beta
CS_5	-0.0243	0.0648
CS_6	0.0369	0.0481
CS_7	-0.0070	0.0509
Summary		
N		84
R^2		0.484
$\bar{R}^2$		0.265
F-value		2.18***
Coefficient of Variation		52.82%
Profit mean		5.20%

* - Coefficient significant at 0.10 probability level
** - Coefficient significant at 0.05 probability level
*** - Coefficient significant at 0.01 probability level

TABLE L

ANALYSIS OF COVARIANCE FOR COMPANY MODEL OF THE CHEMICAL INDUSTRY

Source	CHEMICALS-SIC 28		
	SS	d.f.	MS
X_w, X_m, NB_p	0.3089	16	0.0193
R_r	0.0172	3	0.0057
CS_i	0.0209	6	0.0035
Residual	0.3692	58	0.0064
Total	0.7164	83	

Test for Including Regional Variables

Source	R_r
Computed F	0.940
Tabulated $F_{.05}$	2.76
Conclusion	Fail to reject H_0

Test for Including Variables

Source	CS_i
Computed F	0.546
Tabulated $F_{.05}$	2.26
Conclusion	Fail to reject H_0

The R^2 for the Non-electrical Machinery industry of 0.263 was the lowest for any Company model of the eleven industries analyzed. In the other two industries the R^2 of 0.484 in the Chemicals industry and 0.573 in the Transportation Equipment industry were near the average for the eleven industries for the Company model.

VITA

Larry Leonard Janssen

Candidate for the Degree of

Master of Science

Thesis: COMPARATIVE PROFIT RATES OF U. S. MANUFACTURING FIRMS BY CITY SIZE

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Nebraska City, Nebraska, February 21, 1949, the son of Mr. and Mrs. Harry Janssen.

Education: Graduated from Syracuse-Dunbar Public High School, Syracuse, Nebraska, in May, 1967; received the Bachelor of Science degree from the University of Nebraska with a major in Agricultural Economics in May, 1971; completed the requirements for the Master of Science degree from Oklahoma State University with a major in Agricultural Economics May, 1974.

Professional Experience: Student assistant NEBFARM, Department of Agricultural Economics University of Nebraska, June 1968 to February 1969; Student Trainee--Statistical Reporting Service, Lincoln, Nebraska, June 1969 to August 1971; Student assistant, Department of Agricultural Economics, University of Nebraska, February 1971 to August 1971; Research Assistant, Department of Agricultural Economics, Oklahoma State University, September, 1971 to May 1973.

Professional Organizations: Member of American Agricultural Economics Association, Southern Agricultural Economics Association, Gamma Sigma Delta.