FINAL REPORT

CHARACTERIZATION OF INNOVATIONS INTRODUCED ON THE U.S. MARKET IN 1982

Prepared by

Keith L. Edwards

Theodore J. Gordon
Principal Investigator

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THE FUTURES GROUP
76 Eastern Boulevard
Glastonbury, Connecticut 06033
(203) 633-3501

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PREFACE

Under contract to the U.S. Small Business Administration, The Futures Group (TFG) has conducted a study to determine systematic differences that may exist between innovating activity of large and small firms. This study expands on previous work performed for the SBA (Gellman Research Associates, "The Relationship Between Industrial Concentration, Firm Size, and Technological Innovation").

Meeting the objectives of the study required large-scale collection of innovation data from trade journals and construction of an automated data base of innovations. Additional data on the innovations were collected through telephone interviews with a subset of the firms selected at random from the data base.

Theodore J. Gordon was Principal Investigator; Keith Edwards performed a major portion of the data collection and analysis. Other staff contributors were Dana Rashti, Virginia Collins, Linda Tourtellotte, Tomoko Graham, and Thora Cahill. Tara Latawic, TFG staff statistician, was invaluable in those many instances where statistical analyses were conducted.

We wish to recognize the role played by the study's technical monitor, William Scheirer of the Small Business Administration. He followed our work closely and could be counted on throughout to provide meaningful suggestions when they were needed and, through appropriate questions, keep us on track.

1. INTRODUCTION AND EXECUTIVE SUMMARY

Under contract to the Small Business Administration, The Futures Group has completed a study designed to determine whether any systematic differences in innovating activity exist between large and small firms; in addition, the study was intended to broaden the industrial coverage used in prior research in this field.

The following definitions were used in this study:

- A small firm is defined as having fewer than 500 employees, including persons employed by subsidiaries.
- An innovation is a process that begins with an invention, proceeds with the development of the invention, and results in introduction of a new product, process or service to the marketplace.

Data Collection and Results

The objectives of the current research are as follows:

- Broaden the industrial coverage
- Determine whether any systematic differences exist in the innovations and the innovation processes of large and small firms.

These objectives were accomplished by constructing and analyzing a comprehensive data base of product, process, service, and management innovations introduced into the U.S. market in 1982. The data base consisted of 8,074 entries describing innovations and the companies that were responsible for them, and was formed by an intensive review of "new product" sections of trade journals and other sources. Further data on the innovations and the innovating firms were collected by telephone interviews conducted with a randomly selected sample of companies listed in the data base.

Of the 108 trade journals initially identified as potential sources, a total of 46 was eventually used to provide innovations for the data base. Of the 8,074 innovations recorded, 2,834 were categorized as large-firm innovations, 2,104 were categorized as small-firm innovations, and, because employment data could not be obtained, 3,136 were not allocable to either category.

A random sample of 600 companies (as opposed to innovations) was drawn from the data base for telephone interviews. Responses were sought to questions on:

- The year of invention of the innovation
- Source of funding of the innovation
- Origin of the technology embodied in the innovation
- Significance of the innovation
- Number of employees in the firm at the introduction of the innovation and at the time of the interview
- Ownership form of the company
- Typical user of the innovation.

Of the 459 persons who had initially agreed either to be interviewed or to look at the questionnaire, 375 were eventually interviewed. Of these, 155 were affiliated with large firms while the remaining 220 were employed by small firms.

Data Analysis

The data analysis was divided into two main segments: analysis based on the entire sample and analysis based on the telephone interview data. The principal analyses were designed to determine:

- Innovations/employee as a function of firm size (all firms)

- Percent distribution of innovations by state of innovating entity

- Differences in the significance of the innovations as a function of firm size

- Sales/employee as a function of firm size (innovating firms)

[illegible] analyses were conducted in an attempt to replicate the Gellman [illegible] while analysis of the telephone interview data focused on other [illegible] of the innovating process.

[illegible]ion and Findings

The current study has indeed broadened the industrial coverage of [illegible]tion studies. Prior research (Gellman) covered 635 innovations in [illegible]ustries* while TFG recorded 8,074 innovations in 362 industries. [illegible]lowing list presents our principal conclusions as regards large-[illegible]small-firm innovating activity:

- For the known records, small firms innovate at about 1.46 times the rate of large firms (in terms of innovations per employee) in increasing employment industries and 1.24 times the rate of large firms in decreasing employment industries; the rate for all firms is 1.43 times. When the makeup of the unknown records is estimated, small firms innovate at 2.38 times the rate of large firms.

- The top three innovating states (with respect to state of origin of innovation) are California, New York and New Jersey.

- The top three innovating states with respect to innovations per employee (using statewide employment as the denominator) are New Jersey, Massachusetts, and Connecticut.

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*Gellman Research Associates, "The Relationship Between Industrial [illegible]ration, Firm Size, and Technological Innovation," report prepared [illegible] Small Business Administration, May 11, 1982.

- Differences between large- and small-firm innovation frequency vary from economic sector to economic sector.

- The small-firm sales ratio (sales of innovating firms/employee of innovating firms) is 1.2 times higher than the large-firm ratio in industries that have increasing employment and 4.2 times higher in industries that have decreasing employment.

- We assigned a "significance" rating to innovations: the distribution of significance did not differ between large and small firms.

- Innovating activity in large and small firms varies with concentration ratio (CR). For both large and small firms, industries with lower concentration ratios produce the greatest numbers of innovations.

- Large and small firms in industries with expanding employment innovate at a much higher rate than that of large and small firms in industries with declining employment.

- Differences between large- and small-firm innovation frequency vary with CR.

- Differences between large- and small-firm innovation frequency vary with industry capital intensity.

- The frequency of innovation is affected by capital intensity. For large firms, the majority of innovations are produced in the less-capital-intensive industries. For small firms, innovations in increasing employment industries are more likely for $S \leq 10$ and for $S \geq 20$ in declining employment industries.

- Differences in time to introduction of innovation are not significant.

- Differences in source of funding are or are not significant, depending on the level of significance chosen for the chi-square test. A higher percentage of large-firm innovations is funded internally.

- Large and small firms show essentially the same distribution of origin of the technology embodied in their innovations.

- Company growth subsequent to the introduction of an innovation is or is not independent of firm size, depending on the level of significance chosen for the chi-square test, with small firms more likely to grow.

- Large firms are more likely to be corporations.

- A small firm is or is not as likely to use its innovations internally as is a large firm, depending on the level of significance chosen for the chi-square test.

- TFG found that a small firm is more likely than a large firm to sell its product to other businesses and is or is not as likely as a large firm (depending on the level of significance chosen for the chi-square test) to sell its product to civilian government. The small firm is just as likely as the large firm to sell its product to the military, to distributors, to retail establishments, or abroad.

- A large firm is just as likely to participate in telephone interviews as is a small firm.

While the TFG study reinforced many of the Gellman findings, some differences also appeared:

- TFG found that the frequency of innovation by both large and small firms is affected by capital intensity while Gellman found that this did not hold true for small firms.

- TFG found that small firms and large firms require essentially the same time for the innovation process. Gellman found that small firms bring their innovations to market sooner than large firms do.

- TFG findings show that large and small firms receive government support for innovative activity at the same frequency; Gellman found that large firms receive more frequent government support.

- TFG found that a large firm is just as likely to use its innovation internally as is a small firm. Gellman found that a greater percentage of large-firm innovations are for internal use.

- Gellman found that small firms introduce a greater percentage of their innovations into consumer and government markets than do large firms and that a greater percentage of small firms tend to sell their product abroad after introduction.

2. STUDY FLOW

This chapter describes the study design and procedures that were followed. During the course of the study, data on innovations and innovating companies were collected through literature searches and telephone interviews and stored in an automated data base. The contents of the data base were subsequently accessed and analyzed with the express purpose of identifying systematic differences between large-firm and small-firm innovating activity. The specific activities accomplished within each task are discussed in the following sections.

2.1. Task 1: Identification of Reporting Services

In this task we sought to identify potential sources of information about new innovations. We considered both hard-copy and on-line data. The potential sources were grouped into the following categories:

- Reporting services which focus on new technology regardless of sector. Predicast, for example, publishes data on significant technological innovations occurring in a narrow spectrum of industries and with no regard to country of origin. The present study required a broad spectrum of industries and innovations that were introduced on the U.S. market.
- Trade journals which report developments on a sectoral basis, including developments in new products and technology.
- Automated data bases which could be searched on-line by company name, industry, product or process, and so on.
- New-product advertising appearing in trade journals as well as catalogs and other general or less sectorally specific sources.

Searches through our own and other libraries uncovered a wealth of specific reporting services and other sources within these four categories; Tables 2.1-2.3 list the potential sources that were identified in this task.

2.2. Task 2: Selection of Reporting Services

Criteria used in selecting appropriate sources included:

- Did the source report complete information about the innovation and the company responsible? There are several possible definitions of completeness, including the degree of detail provided on the innovation itself, underlying technological sources, the use of public funds, and various measures of the innovation's possible impact. In addition, of course, the source should report information about the firm itself, most importantly its size, but also its ownership and location. The minimum criterion was the name of the innovating company and enough information on the innovation to establish its significance.

- Was the service affordable within the cost constraints of the study? Sources focusing on new technologies ranged in cost from $13 for the monthly Industrial Research/Development to $350 for the weekly Official Gazette of the U.S. Patent and Trademark Office. Trade journal costs range from $7 for the monthly Drug and Cosmetic Industry to $150 for the biweekly Energy Today. Costs for automated data base searches depend primarily on amount of time spent on-line.

- Does the source have a record of continuous publication? Obviously, the source will have to have been published during the time period to be chosen in Task 3. It is also important for future use by SBA that the source be likely to continue publishing regularly.

Table 2.I

SOURCES FOCUSING ON NEW TECHNOLOGY

AIDC Journal, the professional voice of American Industrial Development Council

International New Products News Letter, published by Trans-communications International, Inc.

Roundtree Report, devoted to new products, processes and technology developments

Technology Update (previously Technology Survey), published by Predicasts, Inc.

New Technology Index, published by Technology Clearinghouse

World Technology, published by Techni Research Associates

Innovation World, published by the Raymond Lee Organization

Official Gazette of the U.S. Patent and Trademark Office

Industrial Research/Development, published by Technical Publishing Corporation

Table 2.2

ON-LINE DATA BASES WITH INFORMATION ABOUT INNOVATIONS

CLAIMS/U.S. Patent Abstract

Economic Information Systems Industrial Plants

Economic Information Systems Nonmanufacturing Establishments

ABI/Inform

The Information Bank

Predicasts Overview of Markets and Technology (PROMPT)

Predicasts Frost and Sullivan Index

Trade and Industry Index

Table 2.3

SOURCES FOCUSING ON INDIVIDUAL SECTORS

ABA Banking Journal
Air Transport World
Administrative Management
American Druggist
American Machinist
Analytical Chemistry
ASHRAE Journal
Automotive Engineering
Automotive News
Aviation Week and Space Technology
Better Roads
Bioscience
Buildings
Building Supply News
Bus Ride
Byte
Ceramics Industry
Chemical Engineering
Chemical and Engineering News
Chemical Marketing Reporter
Chemical Week
Civil Engineering
Computer Decisions
Computer Design
Computerworld
Context - Dupont
Control Engineering
Datamation
Design Engineering
Diagnostic Medicine
Drug and Cosmetic Industry
Drug Therapy
Drugs and Cosmetics
Electronic News
Electronic Products
Electronics
Electronics Test
Engineering and Mining Journal
Feedstuffs
Food and Processing
Food Engineering
Food Product Development
Food Service Marketing
Foundry Management and Technology
The Glass Industry
Hardware Age
Heating/Piping/Air Conditioning
Home Center
Housing
Hydraulics and Pneumatics
Inc
Industrial Distribution
Industrial Engineering
Industrial Photography
Industry Week
Information and Records Management
Information Systems News
InformationWorld
Infosystems
Infoworld
Iron Age
Instruments and Control Systems
Intech
Iron and Steel Engineer
Journal of Metals
Journal of Micrographics
Laser Focus
Light Metal Age
Machine and Tool Blue Book
Manufacturing Engineering
Marine Engineering Log
Materials Engineering
Mechanical Engineering
Metal Finishing
Metal Progress
Mini-Micro Systems
MIS Week
Modern Material Handling
Modern Office Procedures
Modern Plastics
Modern Power Systems
New England Construction
The Office
Paper Trade Journal
Physics Today
Plastics Technology
Popular Science
The Practical Accountant

Table 2.3 (Cont.)

Progressive Grocer
Public Works
Purchasing
Quality Progress
Quick Frozen Foods
Rock Products
Rubber Developments
Sea Technology
Soaps, Cosmetics, Chemical Specialties
Spectrum
Sport Aviation
Surgical Business
Technological Breakthroughs, etc.
Technology Illustrated
Telocator
Textile World
Wards Auto World
Water Engineering and Management
Welding Journal
Word Processing and Information Systems

For the purposes of this study, innovation was defined as the introduction of a new product, process, or service to the market, or the implementation of a new management practice, and to that end we required sources that announced introductions of this sort. All of the sources listed in Tables 2.1 and 2.2 were explored initially but most were discarded for a variety of reasons. The sources listed in Table 2.1--sources focusing on new technology--tended to concentrate on highly significant innovations and, in most cases, were international in scope; that is, they covered significant products, regardless of the country of introduction. We sought a full range of innovations at all levels of significance from both large and small companies and, of course, with a focus on the United States. Data derived from the on-line data bases listed in Table 2.2 were prohibitively expensive in the quantities we hoped to accumulate. The patent abstracts were viewed as poor indicators of innovating activity because many patents are never commercialized, and commercialization is an extremely important step in the innovation process. Furthermore, many innovations are never patented.

Other sources that were considered and discarded include:

- New product newsletters. The general feeling was that these sources would not give as wide a coverage of the U.S. market as the researchers sought.

- Industry innovation awards. These sources only deal with significant innovations while we were interested in a more diverse sample.

- Catalog comparisons. While potentially a very fruitful source, the catalogs required comparison with previous issues to determine which products were new and which had been previously advertised; a very time consuming method with no guarantee of a high degree of success. Second, the catalogs would only provide product innovations.

- Summaries of new products from annual reports. This would limit us to innovations introduced by public corporations.

- Registration of new products with approval agencies. Material registered with approval agencies might not meet our criteria of introduction to the market in that the approval agency may eventually refuse to allow some of these products on the market.

The decision was made to use trade journals, each of which deals with a specific sector; in total, the journals describe a significant range of the industrial activity in the United States. Other advantages associated with the trade journals include cost effectiveness of data collection and continuous publication over time (thus the presence of time-series data if the need arises). All trade journals in TFG's library and the Hartford Public Library were canvassed to determine whether they contained news on new products in each issue. The ones that did were considered source candidates and are shown in Table 2.3.

In an attempt to determine the criteria by which editors decide to include a new product in their new-product sections (and thus to detect if any systematic biases exist), five journals were contacted for detailed discussion. The Surgical Business editor said that material is published on a first-come, first-served basis, regardless of firm size. However, they prefer to work with public relations departments of firms. When a company is too small to have its own public relations department, or cannot afford a public relations firm, Surgical Business works with the firm via personal contact to design the news item. The Electronics editor said that they choose material they consider significant from a pool of submitted material without regard to firm size. Intech receives 300-400 press releases each month and the technical editor and other staff members select 50 of these products that they deem to be of special interest. The

ASHRAE Journal also receives press releases, but their policy is to publish each one that they receive, generally within a month of receipt. Information obtained from Popular Science indicates that they utilize the same process as does Intech. If these positions are characteristic of the population of the new-product editors, then the material appearing in the new-product sections of the trade journals should only be weighted to the large firm to the extent that the small firm is not sophisticated enough, or does not have the necessary resources, to produce press releases. Furthermore, the material may be biased toward the unusual or what some editors consider to be of special interest.

2.3. Task 3: Selection of Time Period

The second issue confronted in formulating the data collection methodology was the time period for which data would be collected. The choices faced were:

- Collect data for a ten-year period, working back from 1982. Such an undertaking would allow the luxury of time-series analysis and detection of trends in the large-firm, small-firm innovation relationship. While highly desirable, data collection of this scope was made impossible by the time and budget constraints.

- Collect limited data for selected years within a ten-year framework. This would also allow some longitudinal analysis but would limit the breadth of industrial coverage.

- Collect data for new-product introductions in a single year. This would allow the widest possible coverage of industries in the time allocated and would allow meaningful cross-sectional analysis. Furthermore, because all products would be introduced during roughly equivalent economic conditions, accommodations would not have to be made for fluctuations in the general economy.

Because of its perceived advantages, data were collected for a one-year period, and the year chosen was 1982.

2.4. Task-4: Design of Classification Scheme and Data Base

Once the sources of innovation and the period were selected, we turned to the problem of describing the innovations. The innovation descriptors we set out to collect from the innovation sources are as follows:

a. Model name. This entry represents the name given to the innovation by the manufacturer (a trade name or trademark; for example, Polatrol Model 3258).

b. Name of the innovation. This tells what the product is, e.g., "a high-speed computer."

c. Description of the innovation. This entry describes what the innovation does and what kind of new capabilities it brings into the field in which it competes.

d. Year of introduction (more precisely, year of journal publication). In this case it would always be 1982 because we were only examining products introduced in 1982.

e. Year of invention (where available). This entry would permit us to determine whether time between invention and innovation varied with business size.

f. Innovation type.

   1. Product: That is, a manufactured item designed to be sold by the manufacturer to other manufacturers or consumers.

   2. Process: That is, a manufacturing procedure used internally by a manufacturer or sold or licensed to others.

   3. Service: That is, organized activity offered for sale, license, or franchise by one organization to other organizations or consumers.

   4. Management practices: That is, new management approaches used by organizations which are clearly identified by name and represent a process in organizing the organization's resources to accomplish its ends.

g. Innovation significance. This was a judgmental assessment about the innovation, based on the information contained in the source document. Four categories were used:

   1. Fundamental: That is, first in the market, establishing whole new categories of products, processes, or services.

   2. First of type: That is, first of type in existing categories.

   3. Significant improvement: That is, significant improvement over existing technology.

   4. Model change: That is, a modest improvement designed to update existing product, process or service.

h. Market characteristics: That is, market size and market aggregation

i. Source of funding

j. Origin of the technology which led to the innovation

The company descriptors included:

a. Name and location of the innovating entity

b. SIC code of innovating entity

c. Name and location of innovating enterprise, if different from innovating entity

d. SIC code of innovating enterprise if innovating enterprise differs from innovating entity

e. Number of employees in innovating enterprise at the time of introduction of the innovation

f. Number of employees in innovating enterprise at time data are recorded

g. Annual sales of innovating enterprise

h. Ownership form of innovating enterprise

i. Date of incorporation of innovating enterprise.

The load sheet used to record innovation data is reproduced in Figure 2.1. Table 2.4 presents sources used to collect company information.

ID #		SIC #	
MODEL NAME			
INNOVATION NAME			
DESCRIPTION			

YEAR OF INTRODUCTION		NAME OF INNOV. ENTERPRISE	
YEAR OF INVENTION		SIC	
TYPE OF INNOVATION			
INNOVATION SIGNIFICANCE		NUMBER OF EMPLOYEES AT INTRO OF INNOVATION	
MARKET SIZE		NUMBER OF EMPLOYEES AT: (GIVE DATE)	
MARKET AGGREGATION		ANNUAL SALES OF ENTERPRISE	
SOURCE OF FUNDING		OWNERSHIP FORM	
ORIGIN OF TECHNOLOGY		DATE OF INCORPORATION (FORMATION)	
NAME OF INNOVATING ESTABLISHMENT		REFERENCE	
SIC		INNOV.	
		CO.	

Figure 2.1. Load Sheet Used in Data Collection Effort

Table 2.4

REFERENCE SOURCES FOR COMPANY DATA

Electronic Sources

Dun & Bradstreet Data Base
SEC/Disclosure, Inc.
Economic Information Systems, Inc.
Compustat

Hard-Copy Sources

McRae's Industrial Directory
Commerce Register Directory for Manufacturers
Standard & Poor's Corporate Directory
Million Dollar Directory
Thomas's Register
Chicago, Cook County & Illinois Industrial Directory
Classified Directory of Wisconsin Manufacturers
State Industrial Directories
Illinois Manufacturers Directory
California Manufacturers Register
Directory of New England Manufacturers
Directory of Texas Manufacturers
Ohio Industrial Directory
Directory of Iowa Manufacturers
Directory of Oregon Manufacturers
Puerto Rico Official Industrial Directory
Directory of Colorado Manufacturers
Oklahoma Directory of Manufacturers and Products
Tennessee Directory of Manufacturers
Directory of Central Atlantic States Manufacturers

2.5. Task 5: Collection of Data and Entry into Computer

Methodology. The load sheet utilized in recording data was designed with an eye toward its use as a load sheet for data entry into a computer. The next question faced was whether that computer would be a mainframe--accessed remotely from The Futures Group--or one of The Futures Group's in-house microcomputers. After weighing the relative merits of the two possibilities, it was decided to construct the data base on an in-house microcomputer--the specific one chosen was a Commodore 2001 system--storing the data on multiple floppy disks. The data base management system used in constructing the data base was the JINSAM system. Figure 2.2 illustrates the number of fields in the data base and field names and relates the field names to the innovation and company descriptors.

The process of transferring data from identified sources to the data base is illustrated in Figure 2.3. Once an innovation was recorded on a load sheet, that sheet was checked against previously recorded sheets (the load sheets were filed in alphabetical order by model name) to determine whether or not it was a duplicate. If the particular innovation had been recorded previously, the load sheet was discarded. If the innovation had not been previously recorded, the company data sources were searched so that the record could be completed. The record was then entered into the computer regardless of whether or not company data had been obtained. For the most part, data entry was straightforward but in the cases where codes were used, the codes and their meanings are presented in Appendix 1.

Results. Of the 108 trade journals identified in Table 2.3 as potential sources, a total of 46 were eventually used to provide innovations for the data base. The magazines used, along with their reference numbers in the data

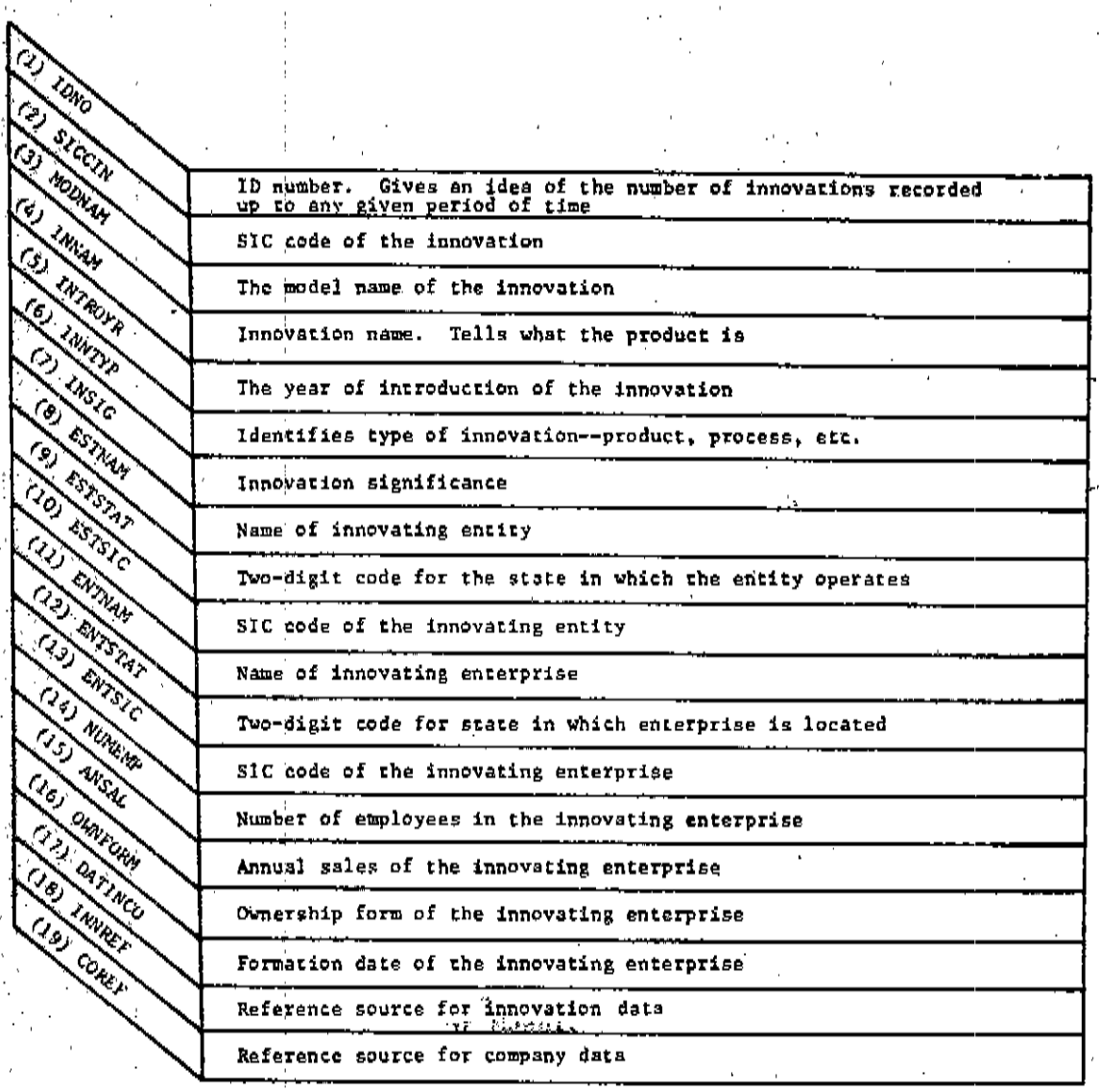

Figure 2.2. Construct of Data Base

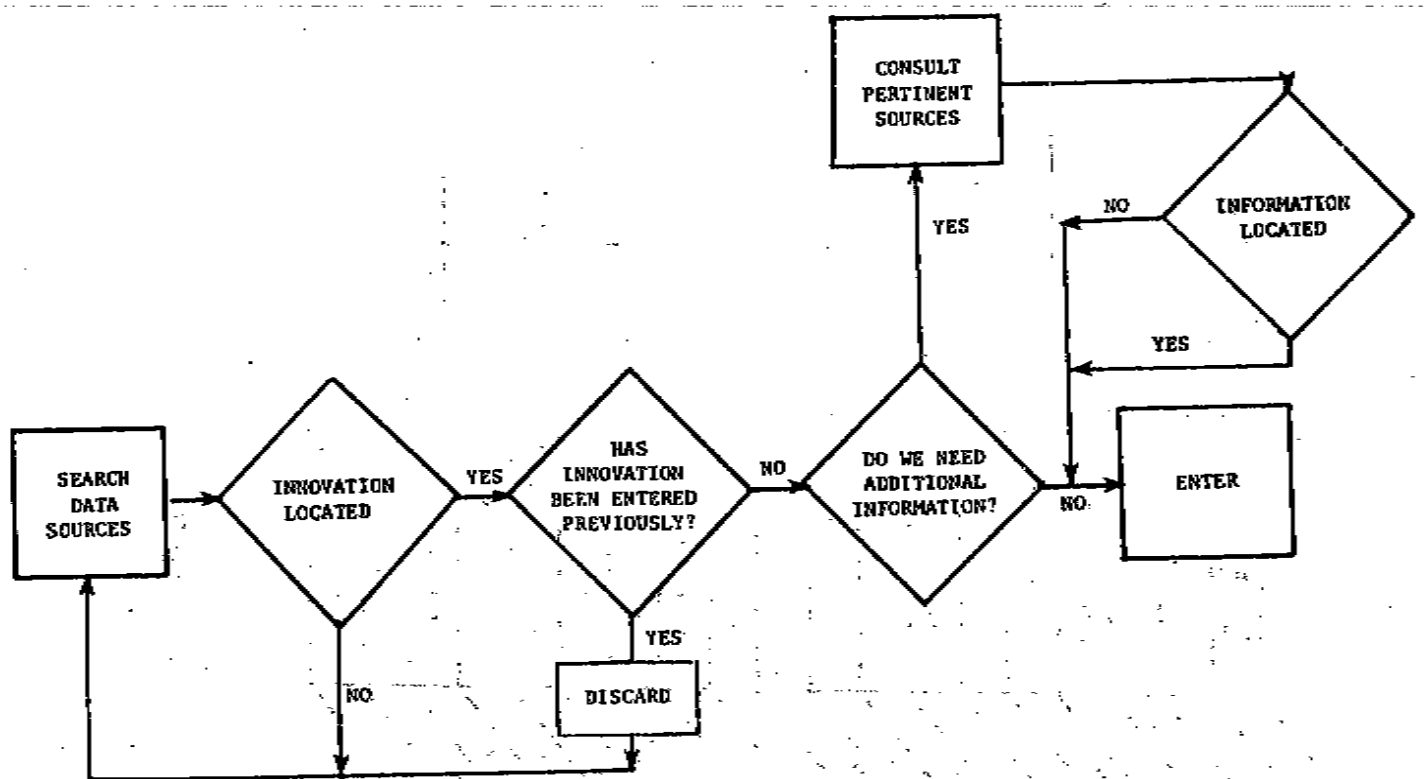

Figure 2.3. Data Entry Methodology

base, number of 1982 issues completed, and number of innovations, are shown in Table 2.5. A total of 8,800 innovations was recorded, but, as indicated in Table 2.5, 8,074 of those innovations were actually entered into the computer. The difference between these totals represents duplicates. Duplicates were of two types: (1) innovations appearing in more than one trade journal and (2) innovations appearing in separate issues of the same magazine.

Table 2.5 indicates that of the 8,074 innovations recorded, 2,834 were categorized as large-firm innovations, 2,104 were categorized as small-firm innovations, and 3,136 were not allocable to either category. The principal sources for large-firm innovations were Electronics (367), Popular Science (218), and Food Processing (178). The principal sources for small-firm innovations were Intech (205), Electronics (171), and Food Processing (168).

Table 2.6 shows the sources used in collecting company data and the number of records supplied by each source. The prime source of company data was Standard and Poor's Corporate Register which provided 92 percent of the large-firm data, 36 percent of the small-firm data, and 68 percent of the total company data.

Table 2.7 indicates the percentage of innovations that fall into the three identified categories: large-firm innovations; small-firm innovations; and not allocable. Over 38 percent of the innovations in the data base could not be categorized by company size but, of the remaining 4,938 innovations, 57 percent were of the large-firm variety, while 43 percent were small-firm innovations.

Table 2.5

DISTRIBUTION OF INNOVATIONS BY JOURNAL SOURCE

Publication	Reference No. in Data Base	No. of 1982 Issues Completed	Large-Firm Innovations	Small-Firm Innovations	Not Allocable	Total
ABA Banking Journal	102	12/12	48	26	69	143
Air Transport World	1	5/12	16	21	63	100
Administrative Management	2	12/12	148	38	113	299
American Druggist	3	11/12	61	16	39	116
ASHRAE Journal	6	7/12	64	43	72	179
Automotive Engineering	7	10/12	54	21	25	100
Bus Ride	14	7/12	5	8	22	35
Byte	15	10/12	37	45	141	223
Ceramics Industry	16	12/12	47	88	93	228
Chemical Engineering	19	8/26	40	65	114	219
Computer Design	23	1/12	32	8	8	48
Datamation	27	12/12	88	29	90	207
Diagnostic Medicine	104	1/12	4	2	3	9
Drug & Cosmetic Industry	30	5/12	48	21	35	104
Drug Therapy	103	12/12	17	7	22	46
Electronics	101	26/26	367	171	348	886
Food Engineering	37	2/12	43	43	55	141
Food Processing	36	11/12	178	168	194	540
Hardware Age	42	11/12	98	97	86	281
Industrial Photography	50	2/12	4	2	14	20
Industry Week	51	2/52	2	0	6	8
Information Systems News	53	2/12	3	2	0	5
Infosystems	55	3/12	47	16	48	111
Infoworld	56	4/26	2	0	8	10
Intech	59	12/12	149	205	175	529
Laser Focus	63	1/12	4	6	11	21
Materials Engineering	68	2/12	9	8	5	22
Mechanical Engineering	69	12/12	78	50	65	193
Metal Progress	71	4/12	29	34	36	99
Mini-Micro Systems	72	4/12	27	33	51	111
Modern Material Handling	74	9/12	90	115	107	312
Modern Office Procedures	75	10/12	80	51	101	232
Modern Plastics	76	5/12	134	70	54	258
The Office	79	1/12	7	4	9	20
Physics Today	81	12/12	19	40	25	84
Popular Science	106	12/12	218	104	281	603
Progressive Grocer	84	11/12	17	9	6	32
Quick Frozen Foods	88	12/12	75	55	23	153
Sea Technology	107	12/12	26	46	95	167
Soaps, Cosmetics, Chemical Specialties	91	12/12	94	53	66	213
Surgical Business	105	12/12	94	131	144	369
Telocator	95	4/12	1	3	26	30
Textile World	96	8/12	43	45	37	125
Water Engineering & Management	98	12/12	115	76	62	253
Welding Journal	99	9/12	1	0	0	1
Word Processing and Information Systems	100	9/12	70	29	89	188
TOTALS			2834	2104	3136	8074

Table 2.6

DISTRIBUTION OF INNOVATIONS*
BY SOURCE OF COMPANY DATA

Source	Reference No. In Data Base	Company Data Supplied (No. of records) Large Firm	Small Firm	Total
California Manufacturer's Register	14	23.5	172.5	196
Chicago, Cook County and Illinois Industrial Directory	10	0	2	2
Classified Directory of Wisconsin Manufacturers	11	4.5	26	30.5
Commerce Register Directory of Manufacturers	2	55.5	267.5	323
Directory of Central Atlantic State Manufacturers	24	1	10.5	11.5
Directory of Colorado Manufacturers	21	0	7	7
Directory of Iowa Manufacturers	18	2	2	4
Directory of New England Manufacturers	15	10	62	72
Directory of Oregon Manufacturers	19	1.5	9	10.5
Directory of Texas Manufacturers	16	2	0	2
Illinois Manufacturers Directory	13	7	74	81
McRae's Industrial Directory	1	22.5	247.5	270
Million Dollar Directory	4	103	328.5	431.5
Ohio Industrial Directory	17	1	60	61
Oklahoma Directory of Manufacturers and Products	22	.5	3.5	4
Puerto Rico Official Industrial Directory	20	2	0	2
Standard & Poor's Corporate Register	3	2596.5	762.5	3359
State Industrial Directories	12	1.5	62.5	64
Tennessee Directory of Manufacturers	23	0	7	7
		2834	2104	4938

*An innovation was divided up between two sources (.5 each) if both had to be consulted in order to complete the information on a company.

Table 2.7

CATEGORIZATION OF INNOVATIONS

Category	Number	Percent
Large-Firm Innovations	2834	35.1
Small-Firm Innovations	2104	26.1
Not Allocable	3136	38.8
Total	8074	100.0

2.6. Task 6: Collection of Additional Data Through Telephone Interviews

Once the data base of innovations was in place, a subset of 600 companies (rather than innovations) was randomly selected for additional data collection and analysis.

Interview design. The questions asked of interviewees were designed to gain more information about the innovation and the company itself--information that could not be gained from our published sources.

The first interview question (Appendix 2) sought information on the year of invention of the innovation. The response to this question was designed to provide information about time-to-innovation characteristics of large and small firms. Questions 2 and 3 sought to discover the source of funding for the innovation and, if there was more than one source, the source which contributed the majority of funds. The origin of the technology embodied in the innovation was explored in Question 4.

Question 5 was inserted as a check against the work we had done in completing the data base. The interviewee was asked to rate the significance of the innovation using the same rating system utilized by The Futures Group. The information supplied could thus be compared with the judgments recorded by The Futures Group.

Question 6 requested information about growth in employment between the introduction of the innovation and the present, while Question 7 inquired as to the ownership form of the innovating company. The final question explored the issue of where the innovation was used: external sales to other business; used internally; etc.

Interview protocol. The interview protocol called for a Futures Group researcher to contact the product engineer or marketing department

of each of the 600 firms in the sample, and request that the company participate in the telephone interviews. Once someone at the target firm who was familiar with the innovation was identified, the researcher identified herself, identified the company for which she was working, and gave a brief description of the study. The potential interviewee was then invited to participate in a later telephone interview where certain characteristics relating to both the innovation and company would be explored.

Certain incentives were advanced to encourage participation: the candidate was informed that his participation was voluntary; any information supplied to us would be treated as confidential and neither his name nor the name of his firm would be published; the interview questions would be mailed to him ahead of time; and he would receive a brief synopsis of the study upon its completion. If the candidate agreed to an interview, a date and time was set for the actual interview and a copy of the questions was mailed to him/her.

Derivation of sample for interviews. The entire SBA data base was housed on 15 floppy disks. Forty records were selected at random by the computer from each disk to complete the random sample of the 600 companies which were to be contacted for telephone interviews.

Results. The enlistment and interview sequences proceeded as follows and the results are graphically illustrated in Figure 2.4.

Companies sampled	600
No telephone listing	41
Companies reached	559
Duplicates	15
	544
Targeted individuals not contacted	15
Persons reached	529

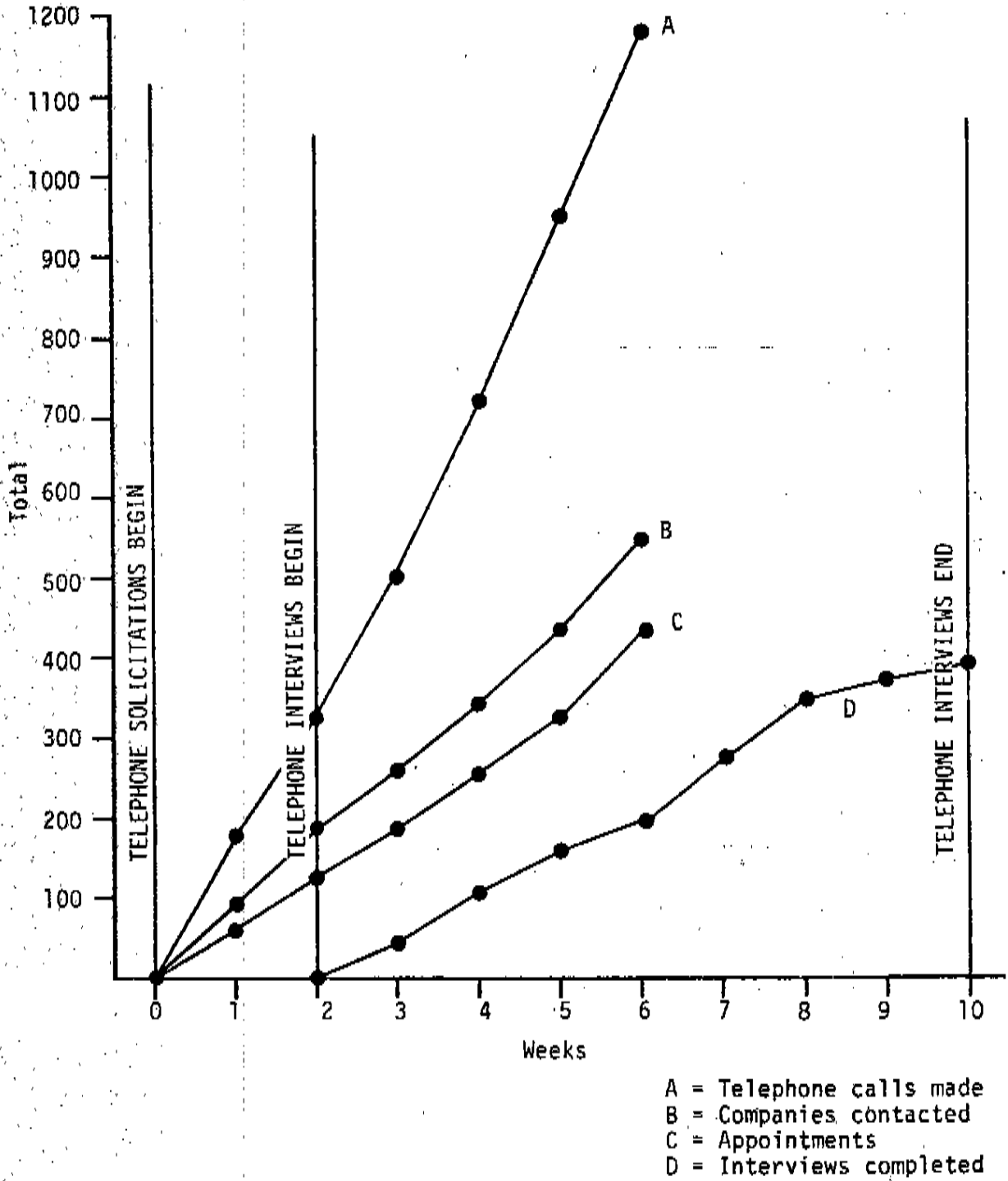

Figure 2.4. Telephone Interview Schedule and Results

Persons reached	529
Immediate refusals	70
Agreed to an interview or to look at questionnaire	459
Declined participation	52
	407
Undecided to the end	13
	394
No response	14
Respondents	380
Response mailed: not received	5
Responses collected	375

Duplication occurred when companies for which we had no data prior to the enlistment effort turned out to be subsidiaries or divisions of companies which we had already interviewed or were scheduled to interview. (The subsidiary and major company were represented in the data base through the introduction of separate products.)

2.7. Task 7: Analysis

The data analysis was divided into two main segments: analysis based on use of the entire sample and analysis of the telephone interview data. We conducted analyses designed to replicate the Gellman findings and, in addition, conducted several other key studies:

- Percent distribution of innovations by state of innovating entity
- Large-firm and small-firm distribution of innovation significance
- Sales/employee as a function of firm size.

The analysis of the telephone interview data encompassed all the questions included in the questionnaire (Appendix 2).

The detailed analyses are presented in the following chapter.

2.8. Task 8: Final Report

Data collection methodologies, data analyses, and findings are described in detail in this final report.

3. DATA ANALYSIS

Among the analyses of the data base were:

- Innovation significance: that is, do large firms and small firms differ in the significance of the innovations which they produce?

- Sales rate: that is, do large and small firms differ with respect to the sales realized per employee of innovating firms?

- Innovation rate: that is, do large and small firms differ with respect to the number of innovations produced per employee of innovating industry?

- Geographic distribution: that is, is the frequency of innovation different for large and small firms which are located in various states?

Most of these analyses were conducted for groups of industries (4-digit level) based on the following classification scheme:

A_i - all industries represented in the data base.

I_e - Industries experiencing an increase in total employment between 1972 and 1977.

D_e - Industries experiencing a decline in employment between 1972 and 1977.

N_c - Industries experiencing no employment change between 1972 and 1977.

U_i - Industry employment data unavailable for comparison of 1972 and 1977 totals. (The 1972 or 1977 census did not contain the required information).

The employment data used to assign industries to one or another of these groups is presented in Appendix 3.

Table 3.1 shows the distribution of innovations by TFG classification as well as by industrial sector. (The distribution of innovations by four-digit SIC code is presented in Appendix 4.) The innovations included in

Table 3.1

COMPARISON OF THE DISTRIBUTION OF INNOVATIONS WITH RESPECT TO ECONOMIC SECTOR AND FIRM SIZE

Sector	Total Innovations			Number of Innovations in Increasing Employment Industries*			Number of Innovations in Decreasing Employment Industries**			Number of Innovations in No Change Industries***			Number of Innovations in Undefined Industries****		
	Large Firm	Small Firm	Not Allocable	Large Firm	Small Firm	Not Allocable	Large Firm	Small Firm	Not Allocable	Large Firm	Small Firm	Not Allocable	Large Firm	Small Firm	Not Allocable
Agriculture, Forestry and Fishing	4	-	-	-	-	-	-	-	-	-	-	-	4	-	-
Mining	102	2	-	77	2	-	25	-	-	-	-	-	-	-	-
Construction	24	3	-	24	2	-	-	-	-	-	-	-	-	1	-
Manufacturing	2455	1954	67	1967	1585	57	487	309	10	1	1	-	-	59	-
Transportation and Public Utilities	21	9	-	-	-	-	-	-	-	-	-	-	21	9	-
Wholesale Trade	77	75	3	12	19	1	64	52	2	-	3	-	1	1	-
Retail Trade	9	-	-	4	-	-	-	-	-	-	-	-	5	-	-
Finance, Insurance and Real Estate	68	14	8	-	-	-	-	-	-	-	-	-	68	14	8
Services	70	32	1	5	4	-	10	10	1	-	-	-	55	18	-
Not Allocable	4	15	3057	-	-	-	-	-	-	-	-	-	4	15	3057
Totals	2834	2104	3136	2089	1612	58	586	371	13	1	4	-	158	117	3065

H_o: Differences between large- and small-firm innovation frequency, with respect to economic sector, are not significant.

$x^2 = 138.99$

DF = 7[a]

Result: Calculated $x^2 > x_a^2$ ($x_a^2 = 18.47$ at 1% with 7 degrees of freedom). Reject null hypothesis.

[a]Degrees of freedom equals 7 because the agriculture and mining sectors and the retail and finance sectors were combined for the x^2 test. Test only conducted on total innovations column.

*Industries with increasing employment between 1972 and 1977.

**Industries with decreasing employment between 1972 and 1977.

***Industries with no change between 1972 and 1977.

****Industry employment data was unavailable for comparison.

the data base were allocated to a particular industry based on the SIC code of the innovating enterprise. A chi-square test was applied to the total innovations column in Table 3.1 to determine whether or not the difference between large- and small-firm innovation frequency, with respect to economic sector, was significant. (It should be noted that even though test results may indicate that differences are significant, the results may be due to chance.) Results of the test indicate that the difference between large- and small-firm innovation frequency varies with economic sector. A higher percentage of large-firm innovations is introduced in the agriculture, forestry and fishing, mining, construction, transportation and public utilities, retail, finance, insurance and real estate, and service sectors while a higher percentage of small-firm innovations occur in the manufacturing and wholesale sectors. Table 3.2 shows the distribution of industries appearing in the data base. As might have been expected, the manufacturing sector is dominant in that it includes 78 percent of the industries which appear in the data base. The manufacturing sector also had a lion's share of recorded innovations: 90 percent of the sectorally allocated innovations.

As these tables show, most of the industries in the data base can be characterized as industries with increasing employment; furthermore, an overwhelming majority of innovations came from these increasing-employment industries.

Table 3.2

DISTRIBUTION OF INDUSTRIES IN DATA BASE

Sector	Number of Industries Included in Data Base	Industries			
		Increasing Employment (I_e)*	Decreasing Employment(D_e)*	No Change(N_c)*	Undefined(U_i)**
Agriculture, Forestry and Fishing	3	-	-	-	3
Mining	8	4	4	-	-
Construction	2	1	-	-	1
Manufacturing	282	166	113	2	1
Transportation and Public Utilities	12	-	-	-	12
Wholesale Trade	27	7	18	1	1
Retail Trade	4	1	-	-	3
Finance, Insurance and Real Estate	7	-	-	-	7
Services	17	6	2	-	9
Totals	362	185	137	3	37

*Change in employment was determined by comparing 1972 and 1977 industry census data at the four-digit level.

**Industry employment data was unavailable for comparison.

3.1. Geographic Analysis

Table 3.3 shows the distribution of innovations, by state of the innovating entity, for those innovations for which geographic data exist. As Table 3.3 illustrates, almost 20 percent of the innovations in our data base were introduced in California. Table 3.3 also shows that over 25 percent of the innovations that could not be allocated to the large- or small-firm categories also originated in California. Only two other states--New York and New Jersey--had over 10 percent of the innovations in any of the four categories. When the total number of innovations originating in each state is divided by the number of employees in that state,* however, New Jersey, Massachusetts, and Connecticut have the best innovation/employee ratios.

3.2. Analysis of Innovation Significance

Table 3.4 and Figures 3.1-3.3 illustrate the percent distribution of innovations by innovation significance. Innovation significance is characterized as follows:

1. The innovation establishes whole new categories.
2. The innovation is the first of its type on the market in existing categories.
3. The innovation represents a significant improvement of existing technology.
4. The innovation is a modest improvement designed to update an existing product.

Results of the chi-square tests indicate that differences in the frequency of innovation, with respect to innovation significance and firm size, are not significant.

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*U.S. Department of Commerce, Bureau of the Census, 1981 Statistical Abstract of the United States, 102nd edition (Washington DC: USGPO, 1981).

Table 3.3

INNOVATIONS* BY STATE OF INNOVATING ENTITY

State	Innovations			
	Large Firm	Small Firm	Not Allocable	Total
Alabama	6	1	6	13
Arkansas	0	2	0	2
Arizona	27	10	19	56
California	416	347	688	1451
Colorado	22	19	31	72
Connecticut	127	54	34	215
Delaware	24	1	6	31
District of Columbia	2	0	1	3
Florida	30	32	68	130
Georgia	33	7	45	85
Hawaii	0	0	1	1
Idaho	3	0	4	7
Illinois	183	193	128	504
Indiana	30	39	37	106
Iowa	16	6	8	30
Kansas	8	16	12	36
Kentucky	16	6	8	30
Louisiana	1	1	5	7
Maine	3	3	3	9
Maryland	24	21	23	68
Massachusetts	222	151	162	535
Michigan	98	59	59	216
Minnesota	101	58	40	199
Mississippi	3	1	3	7
Missouri	29	21	31	81
Montana	0	2	0	2
Nebraska	4	7	6	17
Nevada	0	1	0	1
New Hampshire	16	21	19	56
New Jersey	252	292	190	734
New Mexico	0	0	6	6
New York	274	201	312	787
North Carolina	28	11	35	74
North Dakota	0	0	2	2
Ohio	158	107	112	377
Oklahoma	16	7	6	29
Oregon	24	9	24	57
Pennsylvania	183	177	114	474
Rhode Island	12	26	9	47
South Carolina	10	9	16	35
South Dakota	0	1	1	2
Tennessee	21	9	17	47
Texas	122	39	117	278
Utah	3	2	10	15
Vermont	1	8	3	12
Virginia	28	13	38	79
Washington	17	29	36	82
West Virginia	3	2	1	6
Wisconsin	80	52	59	191
Wyoming	0	1	0	1
Totals	2676	2074	2555	7305

*Excluding innovations whose state of origin could not be determined.

Table 3.4

COMPARISON OF THE DISTRIBUTION OF INNOVATIONS WITH RESPECT TO LEVEL OF SIGNIFICANCE

A_i Industries

Innovation Significance	Innovations	
	Large Firms	Small Firms
2	50	30
3	360	216
4	2424	1858
	2834	2104

H_o: Differences in the frequency of innovation, with respect to innovation significance and firm size, are not significant.

$\chi^2 = 9.05$

DF = 2

Result: Calculated $\chi^2 < \chi_e^2$ at 1% ($\chi_e^2 = 9.21$ at 1% with 2 degrees of freedom). Do not reject null hypothesis.

I_e Industries

Innovation Significance	Innovations	
	Large Firms	Small Firms
2	38	25
3	286	176
4	1799	1411
	2123	1612

H_o: Differences in the frequency of innovation, with respect to innovation significance and firm size, are not significant.

$\chi^2 = 5.79$

DF = 2

Result: Calculated $\chi^2 < \chi_e^2$ at 1% ($\chi_e^2 = 9.21$ at 1% with 2 degrees of freedom). Do not reject null hypothesis.

D_e Industries

Innovation Significance	Innovations	
	Large Firms	Small Firms
2	9	5
3	63	37
4	506	329
	578	371

H_o: Differences in the frequency of innovation, with respect to innovation significance and firm size, are not significant.

$\chi^2 = .215$

DF = 2

Result: Calculated $\chi^2 < \chi_e^2$ ($\chi_e^2 = 4.60$ at 10% with 2 degrees of freedom). Do not reject null hypothesis.

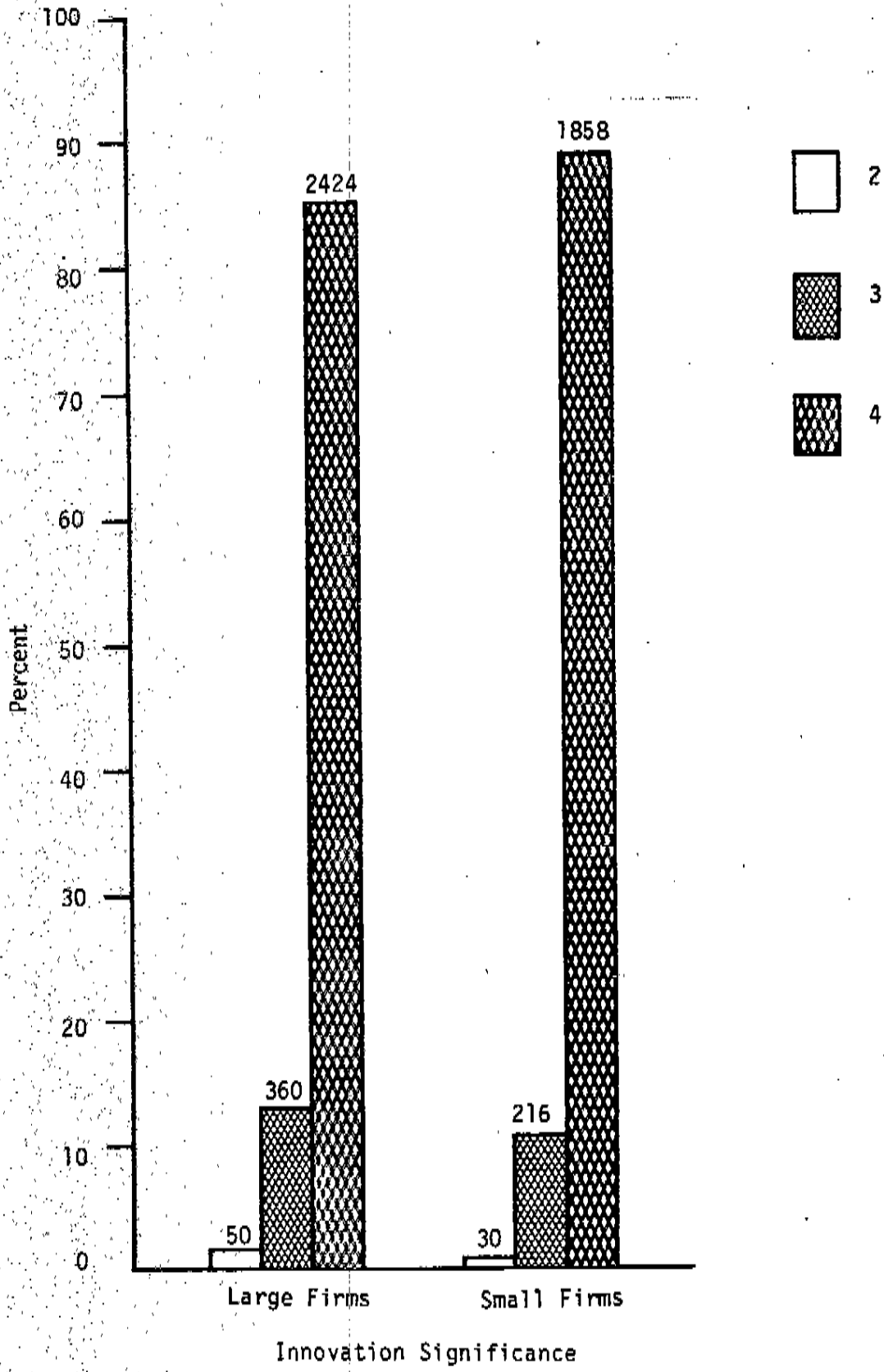

Figure 3.1. Percent Distribution of Innovation Significance--A_1 Industries

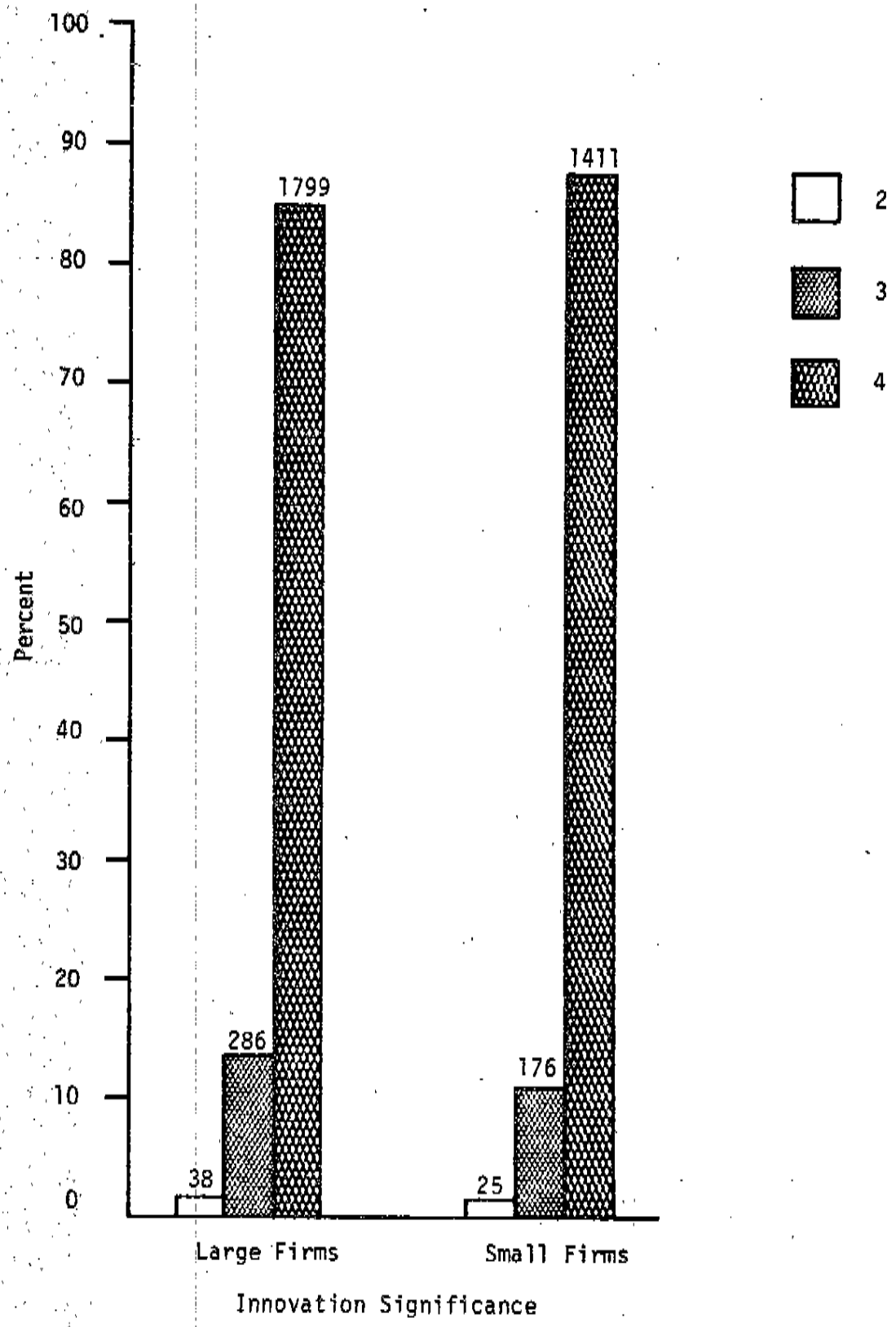

Figure 3.2. Percent Distribution of Innovation Significance--I_e Industries

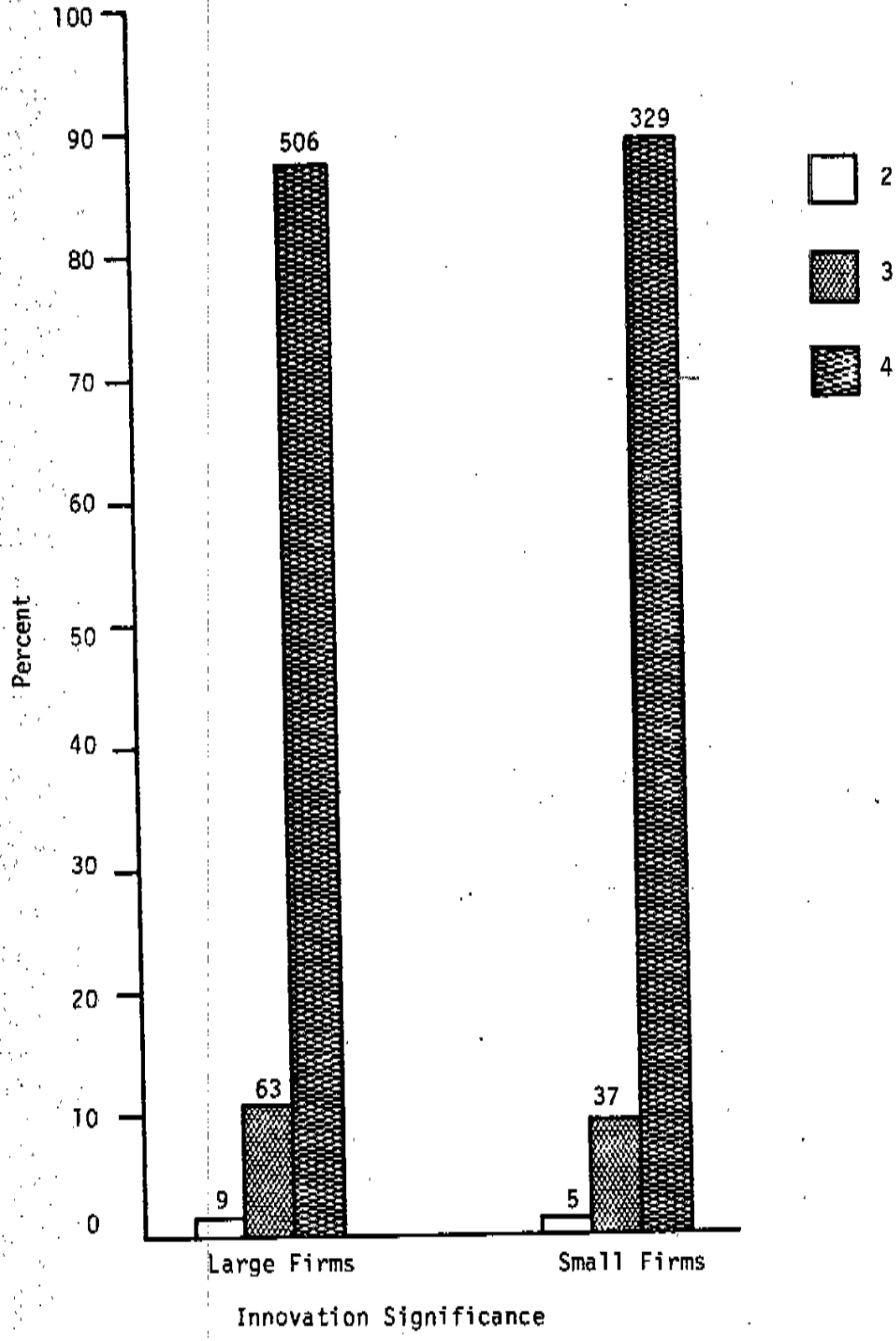

Figure 3.3. Percent Distribution of Innovation Significance--D_e Industries

3.3. Analyses of Sales/Employee

Annual sales of innovating firms were collected along with other company data, and the large- and small-firm sales/employee ratios were computed and compared. The number of employees used in this computation is the total of employees represented by firms in the data base. The data base was searched manually to eliminate duplicates so that even though a firm might have produced 10 innovations, its employees would only be counted once; thus these measures depict annual sales of innovating firms per employee of innovating firms.

Figure 3.4 shows the large- and small-firm sales/employee distribution for innovating firms in A_i, I_e, and D_e industries. In every case, small firms have a higher sales productivity than larger firms, but the difference for industries with declining employment is very dramatic: small firms have better than a 4 to 1 edge in this group.

3.4. Rate of Innovation

Figures 3.5-3.7 present estimates of innovation rates for innovations of various levels of significance. In all cases the innovation rate is higher for small firms. For innovations having a significance of 2 (Figure 3.5), small firms exhibit a higher ratio in all three categories: A_i, I_e, and D_e industries. The same is true for significances of 3 and 4.

It should be noted that the large- and small-firm employment data used here differs from the employment data used in the sales/employee analysis. In this instance we used published data of the total employment in the pertinent industries; that is, employment of both innovating

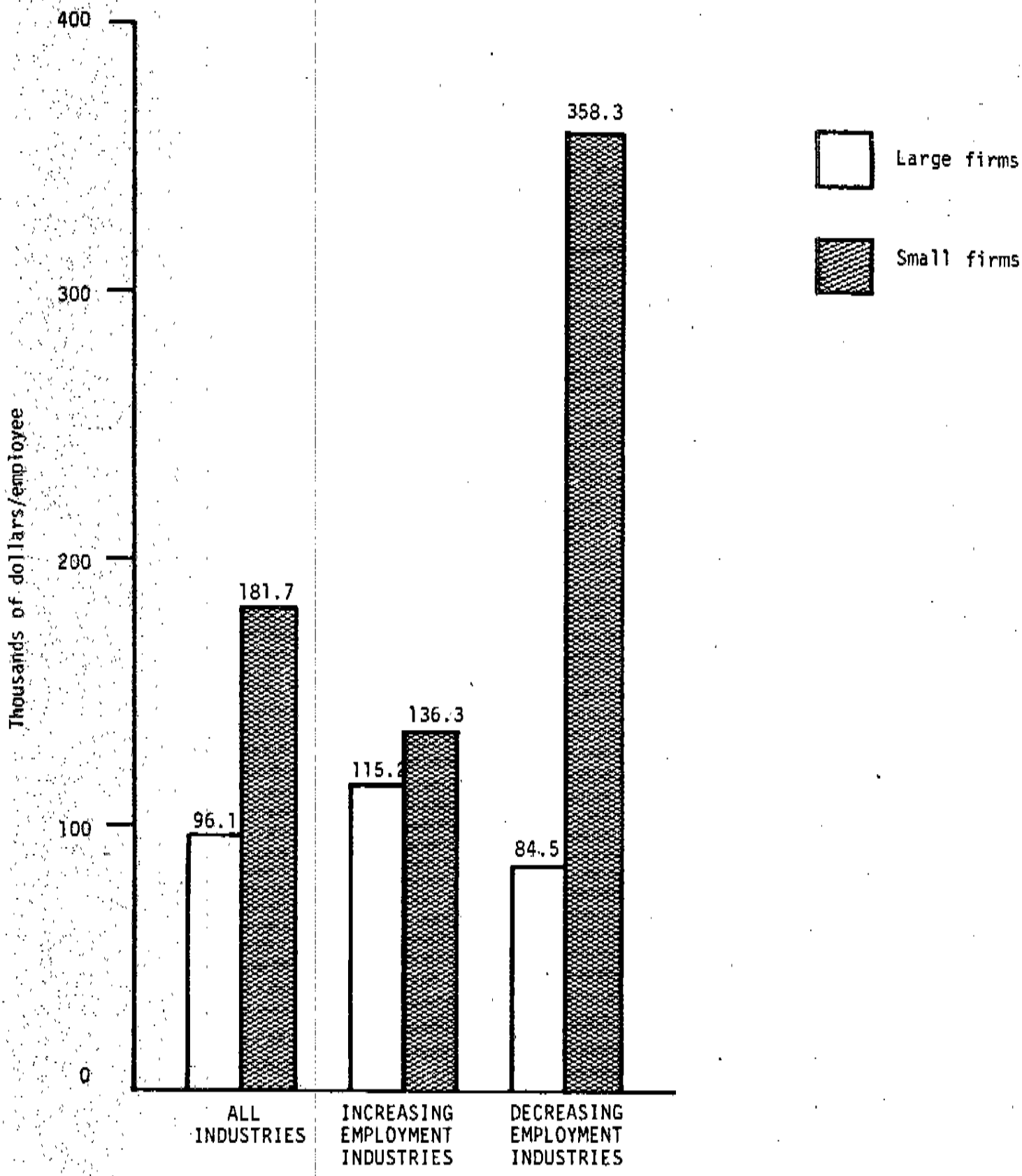

Figure 3.4. Comparison of Sales/Employee for Large and Small Firms in Data Base

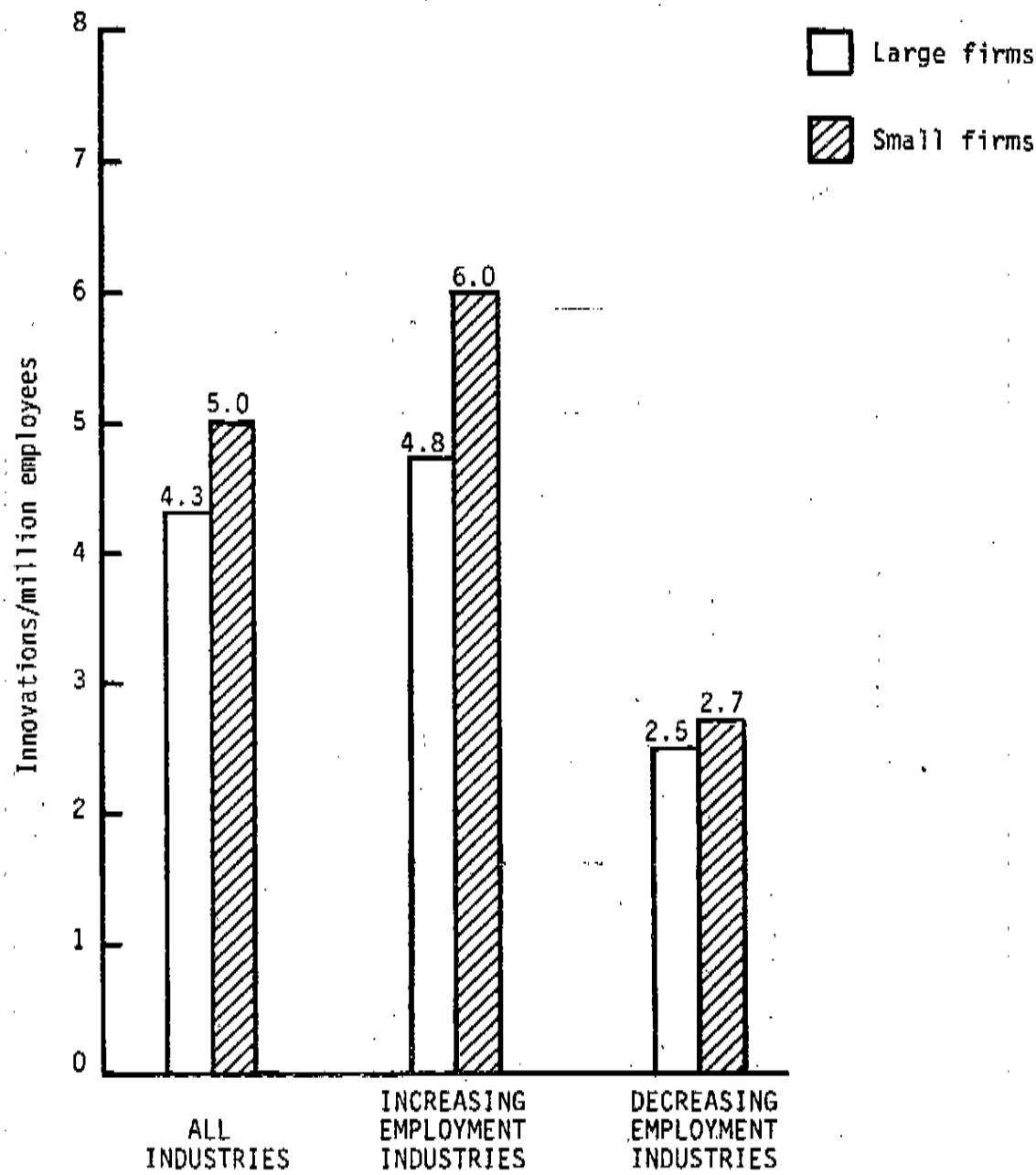

Figure 3.5. Innovations/Million Employees for Innovations Having a Significance of 2

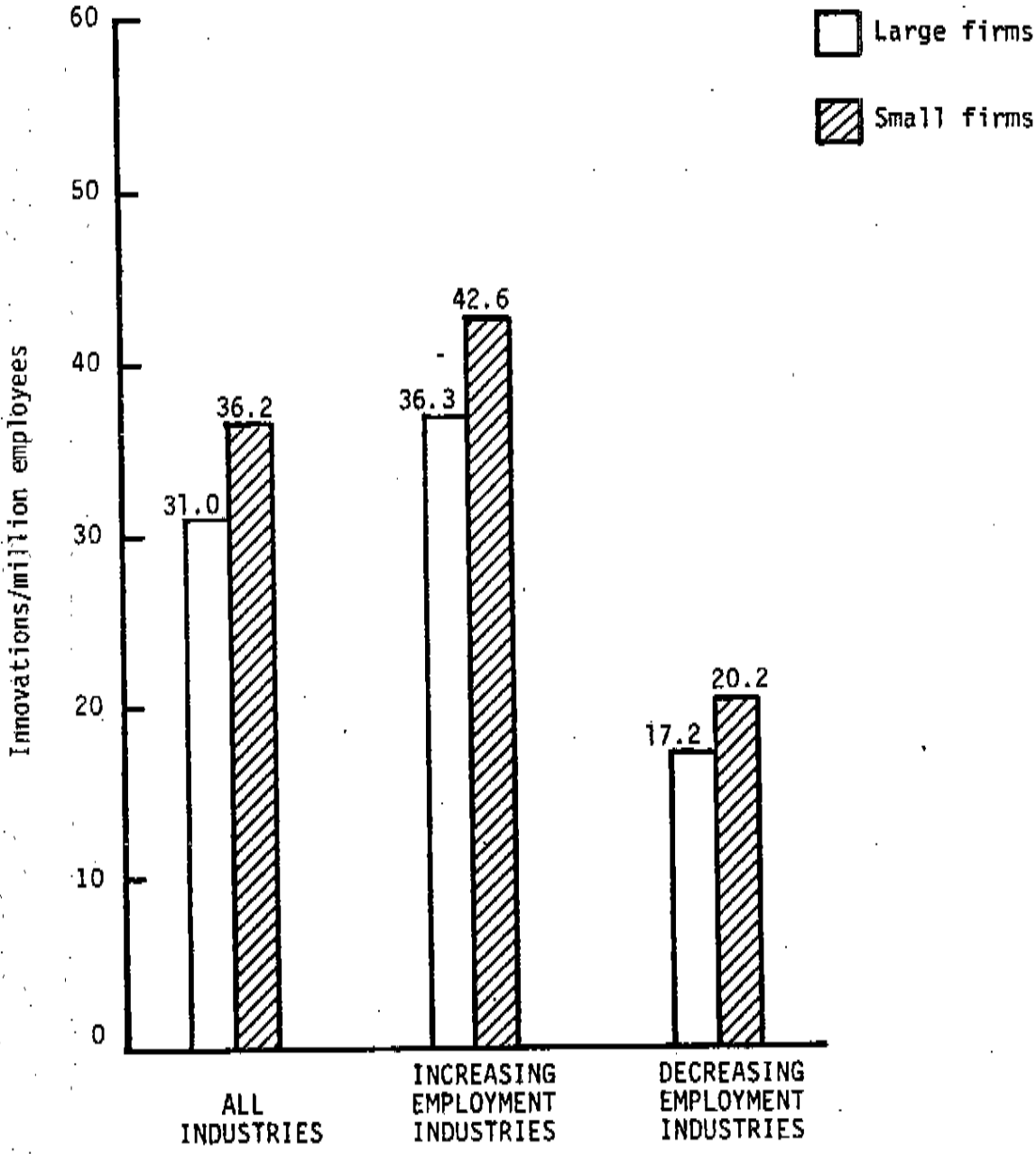

Figure 3.6. Innovations/Million Employees for Innovations Having a Significance of 3

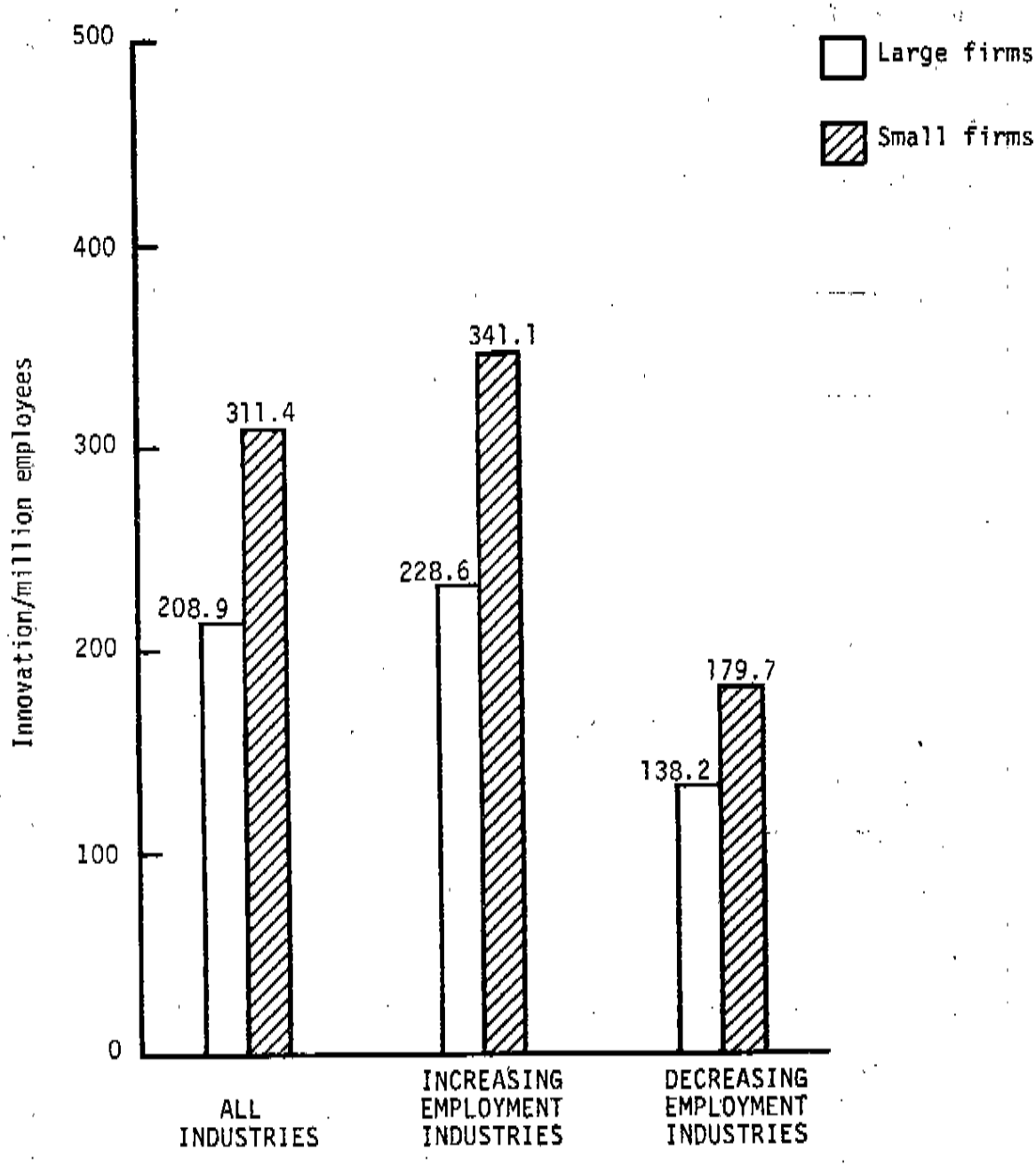

Figure 3.7. Innovations/Million Employees for Innovations with a Significance of 4

and noninnovating firms, therefore, these results should be interpreted only on a relative basis. We used this approach to obtain a relative measure of innovation per total employee (rather than innovation per employee of innovating firms--as would have been the case if we had simply summed employment from our data base).

3.5. Statistical Analysis of Data

The industry-specific data collected by The Futures Group are shown in Appendix 3. The definitions used in this section are as follows*:

- Concentration ratio--Four-firm concentration ratio by value of shipments as reported in the 1977 Census of Manufactures

- Capital-intensity ratio--Gross stocks per employee, where gross stocks represent capital assets on hand adjusted for discards of worn-out assets.

- Annual growth rate = $\frac{\text{1977 Employment-1972 Employment}}{\text{5 x 1972 Employment}}$

Table 3.5 shows the comparison of the frequency of large- and small-firm innovations for A_i, I_e, and D_e innovations. The innovations used for the comparison were drawn from the industries for which large- and small-firm employment was obtained. The statistical test chosen to check for a relationship between firm size, frequency of innovation, and level of employment is the chi-square test. The null hypothesis is that the frequency of innovation is proportional to the level of employment and, as such, is independent of firm size. The results of the test cause a rejection of

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*Gellman, op. cit.

Table 3.5

COMPARISON OF THE FREQUENCY OF LARGE- AND SMALL-FIRM INNOVATIONS

A_i Industries

	Innovations	Employment (1000)
Large Firms	2,608	11,601.2
Small Firms	1,923	5,966.7
	4,531	17,567.9

H_o: Differences in the frequency of innovation, with respect to firm size, are not significant.

$\chi^2 = 143.13$

DF = 1

Result: Calculated $\chi^2 > \chi_\alpha^2$ ($\chi_\alpha^2 = 6.63$ at 1% with 1 degree of freedom). Reject null hypothesis.

I_e Industries

	Innovations	Employment (1000)
Large Firms	2,052	7,868.8
Small Firms	1,571	4,136.3
	3,623	12,005.1

H_o: Differences in the frequency of innovation, with respect to firm size, are not significant.

$\chi^2 = 125.46$

DF = 1

Result: Calculated $\chi^2 > \chi_\alpha^2$ ($\chi_\alpha^2 = 6.63$ at 1% with 1 degree of freedom). Reject null hypothesis.

D_e Industries

	Innovations	Employment (1000)
Large Firms	551	3,660.2
Small Firms	342	1,830.4
	893	5,490.6

H_o: Differences in the frequency of innovation, with respect to firm size, are not significant.

$\chi^2 = 9.99$

DF = 1

Result: Calculated $\chi^2 > \chi_\alpha^2$ ($\chi_\alpha^2 = 6.63$ at 1% with 1 degree of freedom). Reject null hypothesis.

the null hypothesis: that is, differences in the frequency of innovation are significant. Table 3.6 indicates that small firms introduce about 43 percent more innovations per employee than large firms in A_i industries; about 46 percent more innovations per employee in I_e industries; and about 24 percent more innovations per employee in D_e industries. Large firms in I_e industries introduce 73 percent more innovations per employee than large firms in D_e industries, while small firms in I_e industries innovate at a little more than twice the rate of their counterparts in D_e industries.

Table 3.7 shows the distribution of innovations and employment by concentration ratio for large and small firms in A_i, I_e, and D_e industries. We sought to determine whether the distribution of small- or large-firm innovations is related to industry concentration, and the statistical test chosen to check for a possible relationship between concentration ratio (CR), frequency of innovation, and level of employment was the chi-square test. The null hypothesis is that, as the concentration ratio (CR) varies, innovations vary according to employment. The innovation distribution was compared to the employment distribution to determine whether or not a CR effect existed (the employment distribution was used as the theoretical distribution and the innovation distribution as the observed values for the chi-square test*).

The test results for large and small firms in A_i, I_e, and D_e industries are shown in Tables 3.8 and 3.9. The results of the chi-square test indicate that innovating activity in large and small firms in A_i, I_e, and D_e

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*The same assumptions were used in the Gellman study.

Table 3.6

INNOVATIONS/MILLION EMPLOYEES

	A_i Industries	I_e Industries	D_e Industries
Large Firms	225	261	151
Small Firms	322	380	187

Table 3.7

DISTRIBUTION OF INNOVATIONS AND EMPLOYMENT WITH RESPECT TO CONCENTRATION RATIO FOR LARGE AND SMALL FIRMS

Concentration Ratio	Innovations					
	A_i Industries		I_e Industries		D_e Industries	
	Large Firms	Small Firms	Large Firms	Small Firms	Large Firms	Small Firms
$0 \leqq CR \leqq 0.2$	356	403	252	304	103	96
$0.2 < CR \leqq 0.4$	913	827	792	706	121	115
$0.4 < CR \leqq 0.6$	826	598	613	514	210	84
$0.6 < CR \leqq 0.8$	283	43	240	35	42	8
$0.8 < CR \leqq 1.0$	60	12	49	4	11	7
	2438	1883	1946	1563	487	310

Concentration Ratio	1977 Employment (1000)					
	A_i Industries		I_e Industries		D_e Industries	
	Large Firms	Small Firms	Large Firms	Small Firms	Large Firms	Small Firms
$0 \leqq CR \leqq 0.2$	1892.0	2306.6	1349.4	1670.6	542.3	636.0
$0.2 < CR \leqq 0.4$	3100.0	1369.6	2016.5	842.4	1079.5	527.3
$0.4 < CR \leqq 0.6$	3289.8	611.3	1884.5	437.7	1405.3	173.6
$0.6 < CR \leqq 0.8$	1301.3	149.7	967.5	124.5	265.9	25.1
$0.8 < CR \leqq 1.0$	539.0	22.5	432.2	16.9	106.8	5.6
	10122.1	4459.7	6650.1	3092.1	3399.8	1367.6

Table 3.8

COMPARISON OF THE DISTRIBUTION OF INNOVATIONS WITH THE DISTRIBUTION OF EMPLOYEES WITH RESPECT TO CONCENTRATION RATIO FOR LARGE FIRMS

A_i Industries

Concentration Ratio	Innovations		Employment (1000)	
	f	%	f	%
$0 \leq CR \leq 0.2$	356	15	1892.0	19
$0.2 < CR \leq 0.4$	913	37	3100.0	31
$0.4 < CR \leq 0.6$	826	34	3289.8	33
$0.6 < CR \leq 0.8$	283	12	1301.3	13
$0.8 < CR \leq 1.0$	60	2	539.0	5
	2438		10122.1	

H_o: Frequency of innovation is unaffected by CR

$x^2 = 97.5$

DF = 4

Result: Calculated $x^2 > x_\alpha^2$ ($x_\alpha^2 = 13.27$ at 1% with 4 degrees of freedom). Reject null hypothesis.

I_e Industries

Concentration Ratio	Innovations		Employment (1000)	
	f	%	f	%
$0 \leq CR \leq 0.2$	252	13	1349.4	20
$0.2 < CR \leq 0.4$	792	41	2016.5	30
$0.4 < CR \leq 0.6$	613	32	1884.5	28
$0.6 < CR \leq 0.8$	240	12	967.5	15
$0.8 < CR \leq 1.0$	49	3	432.2	6
	1946		6650.1	

H_o: Frequency of innovation is unaffected by CR

$x^2 = 195.6$

DF = 4

Result: Calculated $x^2 > x_\alpha^2$ ($x_\alpha^2 = 13.27$ at 1% with 4 degrees of freedom). Reject null hypothesis.

D_e Industries

Concentration Ratio	Innovations		Employment (1000)	
	f	%	f	%
$0 \leq CR \leq 0.2$	103	21	542.3	16
$0.2 < CR \leq 0.4$	121	25	1079.5	32
$0.4 < CR \leq 0.6$	210	43	1405.3	41
$0.6 < CR \leq 0.8$	42	9	265.9	8
$0.8 < CR \leq 1.0$	11	2	106.8	3
	487		3399.8	

H_o: Frequency of innovation is unaffected by CR

$x^2 = 17.6$

DF = 4

Result: Calculated $x^2 > x_\alpha^2$ ($x_\alpha^2 = 13.27$ at 1% with 4 degrees of freedom). Reject null hypothesis.

Table 3.9

COMPARISON OF THE DISTRIBUTION OF INNOVATIONS WITH THE DISTRIBUTION OF EMPLOYEES WITH RESPECT TO CONCENTRATION RATIO FOR SMALL FIRMS

A_i Industries

Concentration Ratio	Innovations f	Innovations %	Employment (1000)* f	Employment (1000)* %
$0 \leq CR \leq 0.2$	403	21	2306.6	52
$0.2 < CR \leq 0.4$	827	44	1369.6	31
$0.4 < CR \leq 0.6$	598	32	611.3	14
$0.6 < CR \leq 0.8$	43	2	149.7	3
$0.8 < CR \leq 1.0$	12	1	22.5	1
	1883		4459.7	

H_o: Frequency of innovation is unaffected by CR

$\chi^2 = 863.6$

DF = 4

Result: Calculated $\chi^2 > \chi_a^2$ ($\chi_a^2 = 13.27$ at 1% with 4 degrees of freedom). Reject null hypothesis.

I_e Industries

Concentration Ratio	Innovations f	Innovations %	Employment (1000)* f	Employment (1000)* %
$0 \leq CR \leq 0.2$	304	19	1670.6	54
$0.2 < CR \leq 0.4$	706	45	842.4	27
$0.4 < CR \leq 0.6$	514	33	437.7	14
$0.6 < CR \leq 0.8$	35	2	124.5	4
$0.8 < CR \leq 1.0$	4	0	16.9	1
	1563		3092.1	

H_o: Frequency of innovation is unaffected by CR

$\chi^2 = 953.1$

DF = 3**

Result: Calculated $\chi^2 > \chi_a^2$ ($\chi_a^2 = 11.34$ at 1% with 3 degrees of freedom). Reject null hypothesis.

D_e Industries

Concentration Ratio	Innovations f	Innovations %	Employment (1000)* f	Employment (1000)* %
$0 \leq CR \leq 0.2$	96	31	636.0	47
$0.2 < CR \leq 0.4$	115	37	527.3	39
$0.4 < CR \leq 0.6$	84	27	173.6	13
$0.6 < CR \leq 0.8$	8	3	25.1	2
$0.8 < CR \leq 1.0$	7	2	5.6	0
	310		1367.6	

H_o: Frequency of innovation is unaffected by CR

$\chi^2 = 66.5$

DF = 4

Result: Calculated $\chi^2 > \chi_a^2$ ($\chi_a^2 = 13.27$ at 1% with 4 degrees of freedom). Reject null hypothesis.

*Percent may not sum to 100 due to rounding

**Degrees of freedom equals three as a result of combining the intervals $0.6 < CR \leq 0.8$ and $0.8 < CR \leq 1.0$ for the χ^2 test.

industries varies with CR. For both large and small firms, the interval $0.2 < CR \leq 0.6$ is the producer of the greatest number of innovations, while the interval $0.6 < CR \leq 1.0$ produces the fewest innovations. Thus, lower levels of industry concentration seem to be related to higher rates of innovation for both large and small firms, and where concentration is highest, innovation is lowest.

Table 3.10 shows the average rate of innovation per employee for large and small firms in each industry grouping compared to the average rate of innovation per employee for each CR interval.

We also analyzed the data to determine whether the differences between large- and small-firm innovation frequency in the three industry groupings, with respect to concentration ratio, were significant. Table 3.11 shows the comparison of distributions of large- and small-firm innovations in A_i, I_e, and D_e industries, with respect to concentration ratio and the chi-square test results. The results indicate that differences between large- and small-firm innovation frequency, with respect to CR, are significant.

The large- and small-firm distribution of innovations by industry capital intensity (capital stock/employee), S, is presented in Table 3.12 for A_i, I_e, and D_e industries, while the employment distribution is shown in Table 3.13. The chi-square test conducted in Table 3.12 indicates that the differences between large- and small-firm innovation frequency vary with capital intensity. The results of the chi-square tests for a capital-intensity effect in large- and small-firm innovation activities are shown in Tables 3.14 and 3.15. These results show that there is a capital-intensity effect: For large firms, innovations are more likely to be produced in the less-capital-intensive industries ($S \leq 10$ and $10 < S \leq 15$).

Table 3.10

COMPARISON OF LARGE- AND SMALL-FIRM AVERAGE INNOVATION/EMPLOYEE WITH RESPECT TO CONCENTRATION RATIO

A_i Industries

Average Innovation/ Million Employees		Concentration	Large Firms		Small Firms	
Large Firms	Small Firms	Ratio	Above Average	Below Average	Above Average	Below Average
241	422	$0 \leq CR \leq 0.2$		X		X
		$0.2 < CR \leq 0.4$	X		X	
		$0.4 < CR \leq 0.6$	X		X	
		$0.6 < CR \leq 0.8$		X		X
		$0.8 < CR \leq 1.0$		X	X	

I_e Industries

Average Innovation/ Million Employees		Concentration	Large Firms		Small Firms	
Large Firms	Small Firms	Ratio	Above Average	Below Average	Above Average	Below Average
293	505	$0 \leq CR \leq 0.2$		X		X
		$0.2 < CR \leq 0.4$	X		X	
		$0.4 < CR \leq 0.6$	X		X	
		$0.6 < CR \leq 0.8$		X		X
		$0.8 < CR \leq 1.0$		X		X

D_e Industries

Average Innovation/ Million Employees		Concentration	Large Firms		Small Firms	
Large Firms	Small Firms	Ratio	Above Average	Below Average	Above Average	Below Average
143	227	$0 \leq CR \leq 0.2$	X			X
		$0.2 < CR \leq 0.4$		X		X
		$0.4 < CR \leq 0.6$	X		X	
		$0.6 < CR \leq 0.8$	X		X	
		$0.8 < CR \leq 1.0$		X	X	

Table 3.11

COMPARISON OF THE DISTRIBUTION OF INNOVATIONS
WITH RESPECT TO CONCENTRATION RATIO AND FIRM SIZE

Concentration Ratio	Innovations					
	A_i Industries		I_e Industries		D_e Industries	
	Large Firms	Small Firms	Large Firms	Small Firms	Large Firms	Small Firms
$0 \leq CR \leq 0.2$	356	403	252	304	103	96
$0.2 < CR \leq 0.4$	913	827	792	706	121	115
$0.4 < CR \leq 0.6$	826	598	613	514	210	84
$0.6 < CR \leq 0.8$	283	43	240	35	42	8
$0.8 < CR \leq 1.0$	60	12	49	4	11	7
	2438	1883	1946	1563	487	310

H_o: Differences between large- and small-firm innovation frequency, with respect to concentration ratio, are not significant.

$\chi^2 = 183.7$ $\chi^2 = 124.2$ $\chi^2 = 41.7$

DF = 4 DF = 3* DF = 4

Results: Calculated $\chi^2 > \chi_\alpha^2$ ($\chi_\alpha^2 = 13.27$ at 1% with 4 degrees of freedom and 11.34 at 1% with 3 degrees of freedom). Reject null hypothesis.

*The intervals $0.6 < CR \leq 0.8$ and $0.8 < CR \leq 1.0$ were combined for the χ^2 test, resulting in degrees of freedom equaling 3.

Table 3.12

COMPARISION OF THE FREQUENCY OF INNOVATIONS WITH RESPECT TO CAPITAL STOCK PER EMPLOYEE

A_i Industries

Capital Stock/Employee ($1000)	Innovations	
	Large Firms	Small Firms
$S \leq 10$	943	899
$10 < S \leq 15$	671	685
$15 < S \leq 20$	355	180
$20 < S$	487	149
	2456	1913

H_o: Differences between large- and small-firm innovation frequency, with respect to capital stock per employee, are not significant.

$x^2 = 168.75$

DF = 3

Result: Calculated $x^2 > x_a^2$ ($x_a^2 = 11.34$ at 1% with 3 degrees of freedom). Reject null hypothesis.

I_e Industries

Capital Stock/Employee ($1000)	Innovations	
	Large Firms	Small Firms
$S \leq 10$	672	743
$10 < S \leq 15$	594	593
$15 < S \leq 20$	332	173
$20 < S$	357	92
	1955	1601

H_o: Differences between large- and small-firm innovation frequency, with respect to capital stock per employee, are not significant.

$x^2 = 176.16$

DF = 3

Results: Calculated $x^2 > x_a^2$ ($x_a^2 = 11.34$ at 1% with 3 degrees of freedom). Reject null hypothesis.

D_e Industries

Capital Stock/Employee ($1000)	Innovations	
	Large Firms	Small Firms
$S \leq 10$	271	156
$10 < S \leq 15$	68	92
$15 < S \leq 20$	23	7
$20 < S$	129	56
	491	311

H_o: Differences between large- and small-firm innovation frequency, with respect to capital stock per employee, are not significant.

$x^2 = 33.98$

DF = 3

Result: Calculated $x^2 > x_a^2$ ($x_a^2 = 11.34$ at 1% with 3 degrees of freedom). Reject null hypothesis.

Table 3.13

DISTRIBUTION OF EMPLOYEES FOR INNOVATING INDUSTRIES WITH RESPECT TO CAPITAL STOCK PER EMPLOYEE

A_i Industries

Capital Stock/Employee ($1000)	Employees (1000) Large Firms	Small Firms
$S \leq 10$	3005.7	1356.1
$10 < S \leq 15$	2095.0	1454.2
$15 < S \leq 20$	1478.4	394.6
$20 < S$	2564.8	311.1
	9143.9	3516.0

I_e Industries

Capital Stock/Employee ($1000)	Employees (1000) Large Firms	Small Firms
$S \leq 10$	1795.3	767.6
$10 < S \leq 15$	1639.7	1121.4
$15 < S \leq 20$	1222.0	352.0
$20 < S$	1347.3	187.0
	6004.3	2428.0

D_e Industries

Capital Stock/Employee ($1000)	Employees (1000) Large Firms	Small Firms
$S \leq 10$	1123.0	538.4
$10 < S \leq 15$	455.3	327.8
$15 < S \leq 20$	256.4	42.6
$20 < S$	1175.1	115.0
	3009.8	1023.8

Table 3.14

COMPARISON OF THE FREQUENCY OF INNOVATIONS BY LARGE FIRMS WITH THE DISTRIBUTION OF EMPLOYEES WITH RESPECT TO CAPITAL STOCK PER EMPLOYEE

A_i Industries

Capital Stock/Employee	Innovations	%	Employment (1000)	%
$S \leq 10$	943	38	3005.7	33
$10 < S \leq 15$	671	27	2094.7	23
$15 < S \leq 20$	355	14	1478.4	16
$20 < S$	487	20	2564.8	28
	2456		9143.6	

H_o: Frequency of innovation is unaffected by capital intensity

$\chi^2 = .107$

DF = 3

Result: Calculated $\chi^2 > \chi_a^2$ ($\chi_a^2 = 11.34$ at 1% with 3 degrees of freedom). Reject null hypothesis.

I_e Industries

Capital Stock/Employee	Innovations	%	Employment (1000)	%
$S \leq 10$	672	34	1795.3	30
$10 < S \leq 15$	594	30	1639.7	27
$15 < S \leq 20$	332	17	1222.0	20
$20 < S$	357	18	1347.3	22
	1955		6004.3	

H_o: Frequency of innovation is unaffected by capital intensity

$\chi^2 = 46$

DF = 3

Result: Calculated $\chi^2 > \chi_a^2$ ($\chi_a^2 = 11.34$ at 1% with 3 degrees of freedom). Reject null hypothesis.

D_e Industries

Capital Stock/Employee	Innovations	%	Employment (1000)	%
$S \leq 10$	271	55	1123.0	37
$10 < S \leq 15$	68	14	455.3	15
$15 < S \leq 20$	23	5	256.4	9
$20 < S$	129	26	1175.1	39
	491		3009.8	

H_o: Frequency of innovation is unaffected by capital intensity

$\chi^2 = 75.38$

DF = 3

Result: Calculated $\chi^2 > \chi_a^2$ ($\chi_a^2 = 11.34$ at 1% with 3 degrees of freedom). Reject null hypothesis.

Table 3.15

COMPARISON OF THE FREQUENCY OF INNOVATIONS
BY SMALL FIRMS WITH THE DISTRIBUTION OF EMPLOYEES
WITH RESPECT TO CAPITAL STOCK PER EMPLOYEE

A_i Industries

Capital Stock/Employee	Innovations	%	Employment (1000)	%
$S \leq 10$	899	47	1356.1	39
$10 < S \leq 15$	685	36	1454.2	41
$15 < S \leq 20$	180	9	394.6	11
$20 < S$	149	8	311.1	9
	1913		3516.0	

H_o: Frequency of innovation is unaffected by capital intensity
$x^2 = 57$
DF = 3
Result: Calculated $x^2 > x_a^2$ ($x_a^2 = 11.34$ at 1% with 3 degrees of freedom). Reject null hypothesis.

I_e Industries

Capital Stock/Employee	Innovations	%	Employment (1000)	%
$S \leq 10$	743	46	767.6	32
$10 < S \leq 15$	593	37	1121.4	46
$15 < S \leq 20$	173	11	352.0	14
$20 < S$	92	6	187.0	8
	1601		2428.0	

H_o: Frequency of innovation is unaffected by capital intensity
$x^2 = 161$
DF = 3
Result: Calculated $x^2 > x_a^2$ ($x_a^2 = 11.34$ at 1% with 3 degrees of freedom). Reject null hypothesis.

D_e Industries

Capital Stock/Employee	Innovations	%	Employment (1000)	%
$S \leq 10$	156	50	538.4	53
$10 < S \leq 15$	92	30	327.8	32
$15 < S \leq 20$	7	2	42.6	4
$20 < S$	56	18	115.0	11
	311		1023.8	

H_o: Frequency of innovation is unaffected by capital intensity
$x^2 = 16$
DF = 3
Result: Calculated $x^2 > x_a^2$ ($x_a^2 = 11.34$ at 1% with 3 degrees of freedom). Reject null hypothesis.

For small firms, innovations are more likely for $S \leq 10$ in industries with growing employment and for $S \geq 20$ in industries with declining employment.

3.6. Analysis of Telephone Survey Data

Three hundred and seventy five of the 600 firms selected randomly from the data base (155 from large firms and 220 from small firms) supplied additional data by telephone about their innovating activity. As indicated in Chapter 2, our questions focused on

- year of invention of the innovation
- source of funding
- origin of the technology
- number of employees at the introduction of the innovation.

Table 3.16 and Figure 3.8 show the distribution of years to introduction for large- and small-firm innovations. The number of years was determined by subtracting the respondent-supplied year of invention from the year of introduction (1982). In order to test whether differences in the large and small firm time to introduction were significant, the data in Table 3.16 were subjected to a chi-square test. The results of the test indicate that time of introduction is independent of firm size. If the average years to innovation (4.3 years for large and small firms) is subtracted from the year for which data were collected (1982), and a few months allowed for journal publication, this takes us back almost to 1977 and adds justification for using that year's employment with 1982 innovation data in the analyses.

Table 3.17 shows the distribution of responses regarding sources of funding and the results of the chi-square test. Depending on the level of

Table 3.16

DISTRIBUTION OF INNOVATIONS WITH RESPECT TO TIME TO INTRODUCTION

Years	Large Firms	Small Firms
1	89	113
2	27	29
3	6	17
4	8	11
5	4	2
≥ 5	21	46
	155	218
Average Years**:	4.3	4.3

H_o: Differences in time to introduction, with respect to firm size are not significant.

$\chi^2 = 5.94$

DF* = 4

Result: Calculated $\chi^2 < \chi_\alpha^2$ at 10% ($\chi_\alpha^2 = 7.77$ @ 10% with 4 degrees of freedom). Do not reject null hypothesis.

*Degrees of freedom equals 4 as a result of combining the ≥ 5 rows for the chi-square test.

**If > 5 category is omitted, the average years to introduction equals 1.59 for large firms and 1.60 for small firms.

Table 3.17

SOURCE OF FUNDING FOR INNOVATIONS

	Innovations	
Funding Source	Large Firms	Small Firms
Company generated	145	190
Government funded*	5	6
Other private funds**	4	23
	154	219

H_o: Differences in source of funding, with respect to firm size, are not significant.

$\chi^2 = 8.12$

DF = 2

Result: Calculated $\chi^2 < \chi_\alpha^2$ at 1% and $> \chi_\alpha^2$ at 5% (χ_α^2 = 9.21 @ 1% with 2 degrees of freedom and 5.99 @ 5% with 2 degrees of freedom). Do not reject null hypothesis at 1%; reject null hypothesis at 5%.

*Government-funded category is an aggregation of innovations funded by government grants (large firms = 1; small firms = 4) and client-funded, government contract (large firms = 4; small firms = 2).

Other funds is an aggregation of private grant (large firms = 0; small firms = 1), client funded, commercial client (large firms = 3; small firms = 7), venture capital (large firms = 1; small firms = 12), and bank loans* (large firms = 0; small firms = 3).

***Bank loans was not one of the categories of choice supplied to the respondents on the questionnaire. The companies that supplied this information did so of their own volition.

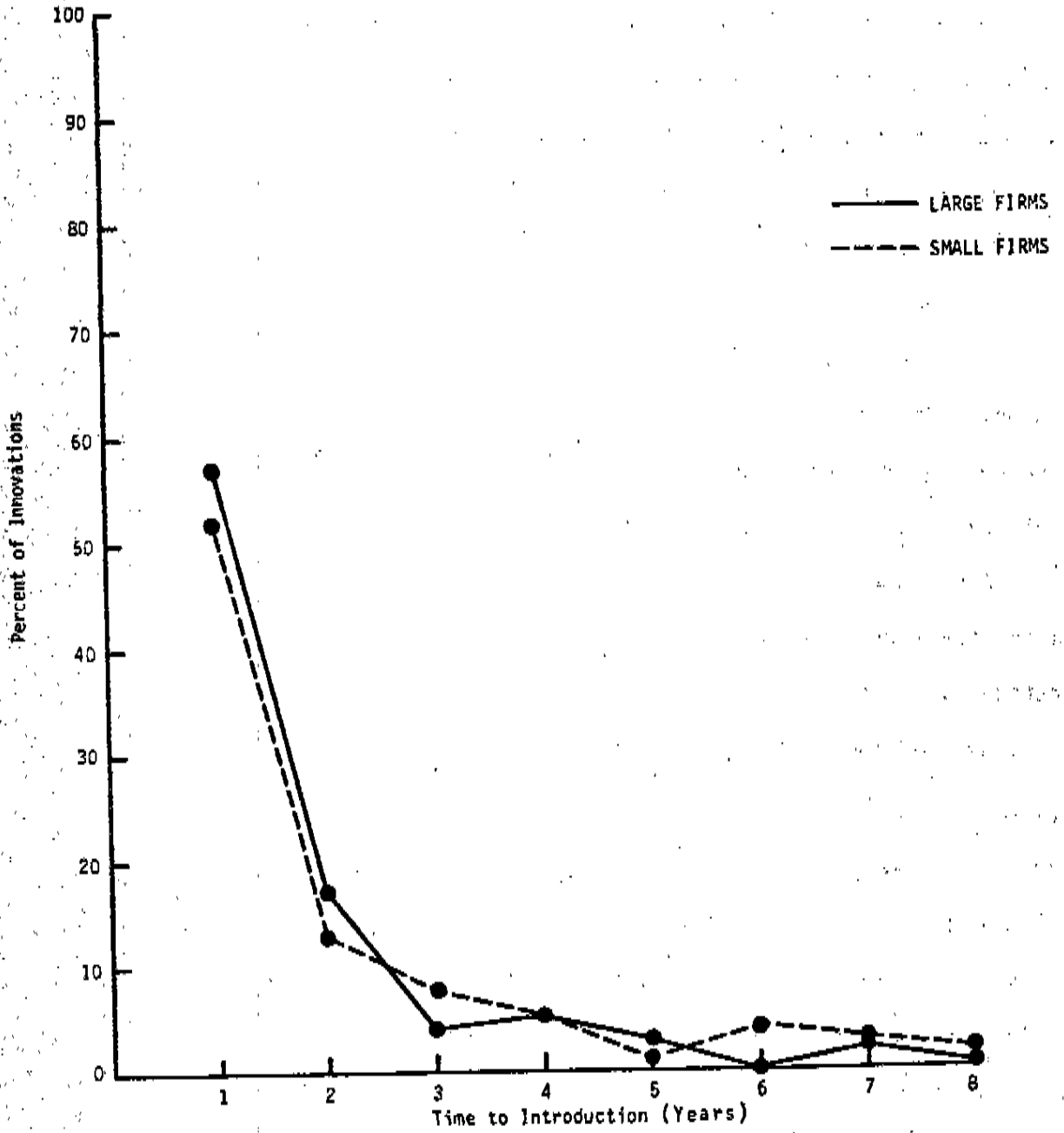

Figure 3.8 Percent Distribution of Large- and Small-Firm Time to Introduction for Selected Years

significance chosen, source of funding with respect to firm size, is or is not significant: at the 1 percent level, source of funding is not significant but at the 5 percent level, the reverse is true. Table 3.17 indicates that 94 percent of the large-firm innovations were funded internally while 86 percent of the small-firm innovations were funded internally. Approximately the same percent of large- and small-firm innovations were funded by the government. While only 2.6 percent of large-firm innovations were funded by other private sources, fully 10 percent of small-firm innovations tapped that source.

The distribution of responses regarding the origin of the technology embodied in the innovation is presented in Table 3.18, with the results of the chi-square test. These data show that differences in the origin of the technology of large and small firms are not significant.

Respondents were asked to rate the significance of the innovation using the same criteria employed by The Futures Group. The telephone ratings are compared to The Futures Group ratings in Figure 3.9. The ratings assigned by the respondents are more liberal than The Futures Group's as evidenced by the fact that The Futures Group did not assign any 1's but 25 respondents gave their products 1's; only thirteen 2's were assigned by The Futures Group but 87 were assigned by respondents; forty-seven 3's were assigned by The Futures Group but 165 by respondents. The liberalism on the part of the respondents, especially in the assignation of 1's, may be attributed to product loyalty on the part of some respondents and, perhaps, unfamiliarity with other products on the market on the part of some of the nontechnical respondents. Alternately, TFG may really have underrated the innovations.

Table 3.18

ORIGIN OF TECHNOLOGY EMBODIED IN THE INNOVATION

	Innovations	
Origin	Large Firms	Small Firms
Internally developed	138	188
Licensed/purchased	3	9
Acquisition of Organization	14	22
	155	219

H_o: Differences in origin of technology, with respect to firm size, are not significant.

$\chi^2 = 1.60$

DF = 2

Result: Calculated $\chi^2 < \chi_\alpha^2$ at 10% ($\chi_\alpha^2 = 4.60$ at 10% with 2 degrees of freedom). Do not reject null hypothesis.

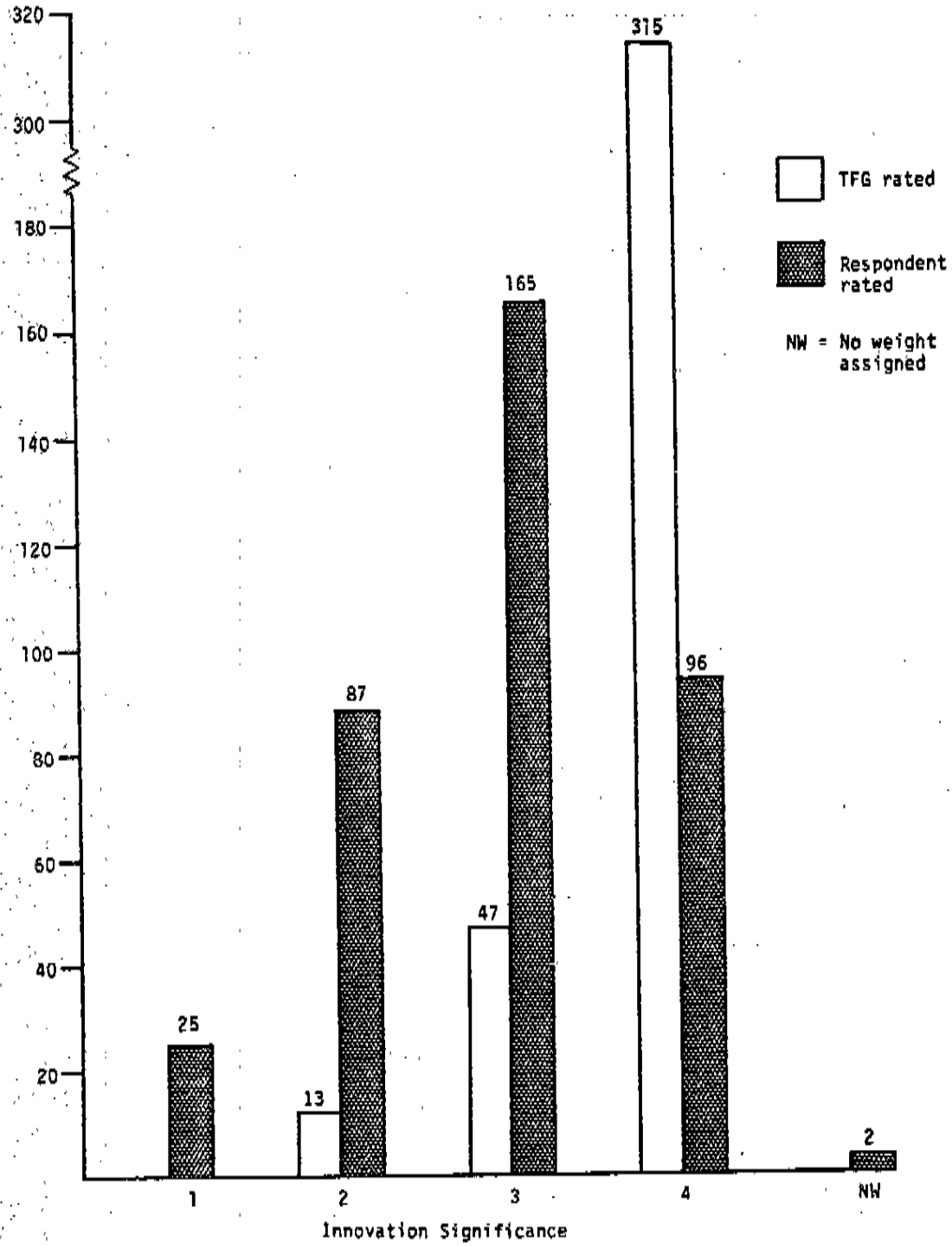

Figure 3.9. Comparison of Innovation Significance--TFG and Respondent-Rated

Based on responses from participants, the number of employees in the company at the date of introduction of the innovation was compared with the number of employees at the time of the interview to determine what changes, if any, had occurred. Table 3.19 shows the distribution of responses and the results of the chi-square test. These data show that differences in company growth subsequent to the introduction of the innovation are not significant at the 1 percent level of significance but show a statistical relationship at the 5 percent level, with small firms more likely to grow.

Table 3.20 shows the distribution of company ownership form by size of innovating company and the results of the test to determine whether differences in ownership form were significant. The null hypothesis is rejected: A higher percentage of large firms than small firms are corporations, while a higher percentage of small firms than large firms are partnerships and sole proprietorships.

Table 3.21 shows the distribution of responses concerning internal usage of the innovation. The chi-square test indicates that at the 5 percent level of significance, a small firm is just as likely as a large firm to use its innovation internally. At the 10 percent level of significance, however, the null hypothesis is rejected; that is, large firms are more likely to use their innovations internally than are small firms.

Tables 3.22-3.27 present the results of tests designed to determine whether or not small and large firms differed as to where and to whom they sold their innovations. The tests indicate that they are just as likely to sell their innovations to the military, distributors, retail establishments, or abroad; they are or are not just as likely (depending on the level of significance chosen) to sell their innovations to civilian

Table 3.19

COMPANY GROWTH SUBSEQUENT TO INTRODUCTION OF INNOVATION

Employment	Large Firms	Small Firms
Increased	33	123
Decreased	14	20
No change	19	59
	66	202

H_o: Differences in company growth subsequent to the introduction of an innovation are not significant.

$x^2 = 6.75$

DF = 2

Result: Calculated $x^2 < \chi_\alpha^2$ at 1% and $> \chi_\alpha^2$ at 5% ($\chi_\alpha^2 = 9.21$ at 1% with 2 degrees of freedom and 5.99 at 5% with 2 degrees of freedom). Do not reject null hypothesis at 1%; reject null hypothesis at 5%.

Table 3.20

COMPARISON OF DISTRIBUTION OF COMPANY OWNERSHIP FORM

Ownership Form	Large Firms	Small Firms
Corporation	152	193
Partnership	0	10
Joint Venture	1	0
Sole Proprietorship	1	17
Cooperative*	1	0
	155	220

H_o: Differences in company ownership form, with respect to firm size, are not significant.

$\chi^2 = 14.6$

DF = 2*

Result: Calculated $\chi^2 > \chi_\alpha^2$ ($\chi_\alpha^2 = 9.21$ at 1% with 2 degrees of freedom). Reject null hypothesis.

*Degrees of freedom equals 2 as a result of combining the partnership and joint venture categories and the sole proprietorship and cooperative categories.

Table 3.21

WAS INNOVATION USED INTERNALLY?

	Large Firms	Small Firms
Yes	72	94
No	79	125
	151	219

H_0: Differences in internal usage of an innovation, with respect to firm size, are not significant.

$\chi^2 = 2.87$

DF = 1

Result: Calculated $\chi^2 < \chi_\alpha^2$ at 5% and $> \chi_\alpha^2$ at 10% ($\chi_\alpha^2 = 3.84$ at 5% with 1 degree of freedom and 2.71 at 10%). Do not reject null hypothesis at 5%; reject null hypothesis at 10%.

Table 3.22

WAS PRODUCT SOLD TO OTHER BUSINESSES?

	Innovations	
	Large Firms	Small Firms
Yes	104	180
No	51	40
	155	220

H_o: Differences in product market are not significant.

$\chi^2 = 9.34$

DF = 1

Result: Calculated $\chi^2 > \chi_\alpha^2$ at 1% ($\chi_\alpha^2 = 6.63$ at 1% with 1 degree of freedom). Reject null hypothesis.

Table 3.23

WAS PRODUCT SOLD TO THE MILITARY?

	Innovations	
	Large Firms	Small Firms
Yes	66	66
No	89	154
	155	220

H_o: Differences in product market are not significant.

$\chi^2 = 5.30$

DF = 1

Result: Calculated $\chi^2 < \chi_\alpha^2$ at 1% ($\chi_\alpha^2 = 6.63$ at 1% with 1 degree of freedom). Do not reject null hypothesis.

Table 3.24

WAS PRODUCT SOLD ABROAD?

	Innovations	
	Large Firms	Small Firms
Yes	82	104
No	73	116
	155	220

H_o: Differences in product market are not significant.

$\chi^2 = .79$

DF = 1

Result: Calculated $\chi^2 < \chi_\alpha^2$ at 10% ($\chi_\alpha^2 = 2.71$ at 10% with 1 degree of freedom). Do not reject null hypothesis.

Table 3.25

WAS PRODUCT SOLD TO DISTRIBUTORS?

	Innovations	
	Large Firms	Small Firms
Yes	91	112
No	64	108
	155	220

H_o: Differences in product market are not significant.

$\chi^2 = 1.88$

DF = 1

Result: Calculated $\chi^2 < \chi_\alpha^2$ at 10% ($\chi_\alpha^2 = 2.71$ at 10% with 1 degree of freedom). Do not reject null hypothesis.

Table 3.26

WAS PRODUCT SOLD TO CIVILIAN GOVERNMENT?

	Innovations	
	Large Firms	Small Firms
Yes	55	59
No	100	161
	155	220

H_o: Differences in product market are not significant.

$\chi^2 = 2.93$

DF = 1

Result: Calculated $\chi^2 < \chi_\alpha^2$ at 5% ($\chi_\alpha^2 = 3.84$ at 5% and 2.71 at 10% with 1 degree of freedom). Do not reject null hypothesis at 5%; reject at 10%.

Table 3.27

WAS PRODUCT SOLD TO RETAIL ESTABLISHMENTS?

	Innovations	
	Large Firms	Small Firms
Yes	30	37
No	125	183
	155	220

H_o: Differences in product market are not significant.

$\chi^2 = .17$

DF = 1

Result: Calculated $\chi^2 < \chi_\alpha^2$ at 10% ($\chi_\alpha^2 = 2.71$ at 10% with 1 degree of freedom). Do not reject null hypothesis.

government; and small firms are more likely than large firms to sell their innovations to other businesses.

As indicated in Table 3.28, a test was conducted to determine whether participation in the telephone interviews was affected by firm size. In order not to bias the test toward the "yes" responses, only those firms which could be characterized as large or small prior to the beginning of the interviews are included in the test. The reason for this is that previously unclassified firms were subsequently classified if they participated in the interview but were not if they declined participation. The results of the test indicate that differences in the rate of participation in the telephone interviews are not significant.

3.7. Calculation of Innovations/Million Employees Using an Estimating Method

In an attempt to determine the category of the unknown records, The Futures Group linked information contained in the literature search data base as well as information obtained from the random sample. The first step in this exercise entailed obtaining a count of the companies that were in the data base and were responsible for the innovations which had already been categorized. The count revealed that 832 firms were responsible for the 2,834 large-firm innovations while 1,410 firms were responsible for the 2,104 small-firm innovations. The average number of innovations per firm (for classified innovations) then, is 3.41 for large firms and 1.49 for small firms.

The usable portion of the random sample used for the telephone interviews had included 132 large firms, 114 small firms, and 226 nonallocable firms. Information collected during the telephone interviews caused the reallocation

of 23 of the unknown firms to the large-firm category and 106 to the small-firm category. The ratio of LF_A:LF_B, where

LF_A = firms which were categorized as large firms subsequent to the interviews,

and

LF_B = firms which were known to be large firms prior to the interview,

is .17 while the equivalent small-firm ratio is .93. If these ratios are related to the literature search data base, they inform us that a number of large firms equivalent to 17 percent of the known large firms are included in the unknown category and a number of small firms equivalent to 93 percent of the known small firms are included in the unknown category. Computing,

$$LF_\ell = 832 \times .17 = 141,$$
$$SF_\ell = 1410 \times .93 = 1311,$$

where LF_ℓ = large-firm estimate and SF_ℓ = small-firm estimate.

Multiplying these estimates by the previously computed average innovation per firm yields 141 x 3.41 = 481 large-firm innovations and 1311 x 1.49 = 1953 small-firms innovations. Adding these estimates to the known innovations results in a total of 3315 large-firm innovations and 4057 small-firm innovations with 702 innovations remaining uncategorized. If a proportional expansion were conducted in order to distribute the 702 innovations remaining uncategorized, the final large-firm total would be 3631 innovations while the corresponding small-firm total would be 4443.

Using the data and the A_i industries employment data from Table 3.5 results in a figure of 313 innovations/million employees for large firms and 745 innovations/million employees for small firms. Small firms thus are shown to innovate at 2.38 times the rate of large firms--a figure not dissimilar to Gellman's figure of 2.5.

3.8. Comparison of TFG and Gellman Findings

The TFG and Gellman findings are compared in Table 3.29. While the TFG study reinforced some of the Gellman findings, differences appeared in other cases:

- TFG found that in D_e industries, small firms in moderately concentrated industries ($0.4 < CR \leq 0.6$) innovate above the average rate per employee of all small firms in D_e industries. Gellman found that this group innovated below the small-firm average.

- TFG found that D_e large firms innovate above average in $0 \leq CR \leq 0.2$ and $0.4 < CR \leq 0.8$ and below average in the ranges $0.2 < CR \leq 0.4$ and $0.8 < CR \leq 1.0$. Gellman found that large firms in decreasing employment industries innovate above the average for all large firms in the range $0 \leq CR \leq 0.4$ and below average in the range $0.4 < CR \leq 0.6$.

- TFG found that small firms and large firms had the same distribution for time to innovation. Gellman found that small firms brought their innovations to market sooner than large firms.

- TFG findings show that large and small firms receive the same frequency of government support for innovative activity. Gellman found that large firms receive more public support.

Table 3.28

WILL YOU PARTICIPATE IN TELEPHONE INTERVIEW?

	Innovations	
	Large Firms	Small Firms
Yes	132	114
No*	41	47
	173	161

H_o: Differences in agreement to participate in telephone survey are not significant.

$x^2 = 1.25$

DF = 1

Result: Calculated $\chi^2 < \chi_e^2$ ($\chi_e^2 = 2.71$ at 10% with 1 degree of freedom). Do not reject null hypothesis.

*The test is only conducted on firms whose category was established prior to the commencement of the telephone interview. As the negative responses could only be allocated to large- or small-firm category based on information in hand prior to the beginning of the interviews--while firms could be added to the yes category based on information collected from previously uncategorized firms during the course of the interviews--using the full complement of positive responses would bias the results.

Table 3.29

COMPARISON OF TFG AND GELLMAN FINDINGS*

	TFG Findings	Gellman Findings
1.	Differences in the frequency of innovation, with respect to firm size, are significant. Small firms introduce about 2.38 times more innovations/employee than do large firms.	Small firms produce 2.5 times more innovations/employee than do large firms.
2.	Differences in the distribution of innovations with respect to industry concentration ratio and firm size are significant.	The differences in the distribution of innovations with respect to industry concentration ratio, and firm size, in P_1 and P_2 industries are not significant.
3.	Large and small firms in industries with expanding employment innovate at a much higher rate than that of large and small firms in industries with declining employment.	The number of innovations per million employees in industries with growing employment differs significantly from that in industries with declining employment. The average rate taken over all small firms is 162 innovations per million. For large firms the rate is 66 per million.
4.	Innovating activity in large and small firms varies with CR. For both large and small firms, the interval $0.2 < CR \leq 0.6$ is the producer of the greatest number of innovations, while the interval $0.6 < CR \leq 1.0$ produces the fewest innovations.	Innovating activity in large and small firms varies with CR. For both large and small firms, the interval $0.2 < CR \leq 0.6$ in P_1 and the interval of $0 \leq CR \leq 0.4$ in P_2 are the major producers of innovations.
5.	In increasing employment industries, the frequency of innovation by small firms in very diffuse industries ($0 \leq CR \leq 0.2$) is below the average rate per employee for all small firms in I_e and the frequency of innovation in slightly and moderately concentrated industries ($0.2 < CR \leq 0.6$) is in excess of the average rate per employee.	Within P_1, the frequency of innovation by small firms in very diffuse industries ($0 \leq CR \leq 0.2$) is well below the average rate per employee for all small firms in P_1, and the frequency of innovation in slightly and moderately concentrated industries ($0.2 < CR \leq 0.6$) is greatly in excess of the average rate per employee.
6.	In decreasing employment industries, small firms in diffuse industries innovate at less than the average rate while firms in moderately concentrated industries ($0.4 < CR \leq 0.6$) innovate above the average rate of all small D_e firms.	Within P_2, small firms in very diffuse industries ($0 \leq CR \leq 0.2$) and in moderately concentrated industries ($0.4 < CR \leq 0.6$) innovate at less than the average rate per employee for all small firms in P_2. Firms with concentration ratios in the interval $0.2 < CR \leq 0.4$ tend to innovate above the average rate per employee.

*Gellman P_1 and P_2 industries are taken to be the equivalent of TFG's I_e and D_e industries, respectively.

Table 3.29 (Cont.)

TFG Findings	Gellman Findings
7. In increasing employment industries, large firms tend to innovate above the average rate per employee (for all large firms in I_e) in industries with slight and moderate concentrations ($0.2 < CR \leq 0.6$) and below the average rate in the upper range of $0.6 < CR \leq 1.0$.	Within P_1, large firms tend to innovate above the average rate (per employee for all large firms in P_1) with slight and moderate concentration ($0.2 < CR \leq 0.6$) and below the average rate in the upper range of $0.6 < CR \leq 1.0$.
8. In decreasing employment industries, large firms innovate above average in the low ($0 \leq CR \leq 0.2$) and moderate-to-high ($0.4 < CR \leq 0.8$) concentration ratios and below average in the slight ($0.2 < CR \leq 0.4$) and very high ($0.8 < CR \leq 1.0$) concentration ratios.	Within P_2, the innovation performance of large firms is similar to that noted in P_1 but shifted toward the lower concentration ratios. The frequency of innovation is above average at the low end ($0 \leq CR \leq 0.4$) and below average for moderate concentration ($0.4 < CR \leq 0.6$).
9. Differences in the frequency of innovation, with respect to capital intensity, are significant. For large firms, the majority of innovations are produced in the less capital-intensive industries ($S < 10$ and $10 < S \leq 15$). For small firms, innovations are more likely for $S \leq 10$ in increasing employment industries and for $S > 20$ in decreasing employment industries.	The frequency of innovations by small firms is not affected by capital intensity. The frequency of innovation by large firms appears to be related to capital intensity. Large firms in the more capital-intensive industries tend to be significantly less innovative than large firms in less capital-intensive industries.
10. Differences in time to introduction of innovation, with respect to firm size, are not significant.	Small firms tend to bring their innovations to market sooner than larger firms.
11. Differences in source of funding are or are not significant, depending on the level of significance chosen for the chi-square test. A higher percentage of large-firm innovations are funded internally, while a higher percentage of small-firm innovations are funded from other private sources. Large- and small-firm innovations receive government funding at approximately the same frequency.	Differences in source of funding are significant. Large firms receive more frequent public funding for innovation-related purposes than do small firms.
12. Differences in the source of the technology embodied in innovations, with respect to firm size, are not significant.	A greater proportion of the innovations introduced by large firms in concentrated industries is acquired from outside the firm than is the case for large firms operating in less concentrated industries. The corresponding hypothesis for small firms is not supported by the data.

Table 3.29 (Cont.)

	TFG Findings	Gellman Findings
13.	A large firm is more or just as likely to use its innovation internally as is a small firm, depending on the level of significance chosen for the chi-square test.	A greater percentage of large-firm innovations are for internal users.
14.	Differences in ownership form, with respect to company size, are significant. A large firm is more likely than a small firm to be a corporation, while a small firm is more likely than a large firm to be a partnership or a sole proprietorship.	Most small firms reporting innovations were closely held at the introduction of the innovation, while 17 percent of the small firms changed their form of ownership following introduction of an innovation.
15.	Large and small firms are just as likely to sell their innovations to the military, distributors, retail establishments, or abroad; are or are not (depending on the level of significance chosen for the chi-square test) just as likely to sell their innovations to civilian government; and small firms are more likely to sell their innovations to other businesses.	The percentage of small-firm innovations introduced into consumer and government markets is greater than that of large firms. A greater percentage of small firms tend to sell their product abroad after introduction.

4. FUTURE DIRECTIONS

4.1. More Information Is Needed on Processes, Services and Management Innovations

While presenting broad industrial coverage, as far as new product introductions are concerned, trade journals report relatively few process, service, and management innovations. This presents two problems: (1) the findings reported in this study can only be related to large- and small-firm product innovations. No determination can be made as to whether the findings would be reinforced or contradicted if a larger percentage of process, service, and management innovations were recorded in the data base; and (2) the general consensus is that large firms produce more process innovations, therefore, to the extent that fewer process innovations are reported, the large firm innovation count is lessened. This bias is thought to be balanced by the fact that large-firm innovations are more likely to be reported in trade journals than are small-firm innovations.

4.2. Assign Nonallocated Records to Either Small- or Large-Firm Categories

The TFG data base contained 2,834 large-firm innovations and 2,104 small-firm innovations but it also contained 3,136 innovations that could be categorized as being either of the large- or small-firm variety. As the telephone interview sample included some of the nonallocable records, the responses of the interview candidates showed that a higher percentage of these previously nonallocable records were small-firm innovations. Furthermore, the estimate of the makeup of the nonallocable records, based on the telephone sample, indicates that the data base does contain more

small-firm innovations than large-firm innovations. If data were collected for all the records in the data base, this finding could be verified.

The number of assigned innovations might be increased through the attempted matching of company names with the millions of records in the SBA Small Business Data Base. All the analyses conducted in the present study (with the exception of the analyses conducted on the telephone interview data) could be replicated. The findings of the present study could be compared with the new findings to determine what impact, if any, the expanded data base had on the results.

4.3. Perform Longitudinal Analyses

The data base presently in place presents other opportunities for additional work. The trade journals utilized in the present study could be consulted for new-product data in a year (or years) other than 1982 and the tests conducted in this study replicated. Such an undertaking would permit detection of trends in the large-firm/small-firm innovation relationship. The effect, if any, of economic fluctuations on the innovating activity of large and small firms could also be detected by such a study.

Appendix 1

DATA ENTRY KEY

DATA ENTRY KEY

A.	TYPE OF INNOVATION	1 - product innovation 2 - process innovation 3 - service innovation 4 - management innovation
B.	INNOVATION SIGNIFICANCE	1 - innovation establishes whole new categories (generative) 2 - innovation is first of its type on market in existing categories 3 - significant improvement of existing technology 4 - modest improvement designed to update existing product
C.	SOURCE OF FUNDING	1 - company generated 2 - client-funded; government contract 3 - client-funded; commercial client 4 - private grant 5 - government grant 6 - venture capital 7 - other
D.	ORIGIN OF TECHNOLOGY	1 - internally developed 2 - licensed or purchased 3 - through acquisition of another entity possessing the technology 4 - other
E.	OWNERSHIP FORM	1 - corporation 2 - partnership 3 - joint venture 4 - sole proprietorship

F. CUSTOMERS FOR INNOVATION
1 - other business
2 - distributors
3 - military
4 - civilian government
5 - abroad

References

Reference sources for innovation data are entered in the following manner:

a/b/c/d/e,

where:

a = the reference number for the source journal; e.g., Sea Technology is referenced by the number 107.

b = the month of the journal, designated by number; e.g., January = 1.

c = the year of the journal. In this case 1 will represent 1982.

d = the page number, entered as is.

e = if magazine is more frequent than monthly, enter day of month as appears on front cover.

Appendix 2

SURVEY OF SELECTED INNOVATING COMPANIES

SURVEY OF SELECTED INNOVATING COMPANIES

Question 1

In what year was the product, process, or service mentioned in the accompanying letter invented?

_____

Question 2

What was the source of funding for the innovation?

_____ Company-generated

_____ Government grant

_____ Private grant

_____ Client-funded, commercial client

_____ Client-funded, government contract

_____ Venture capital

Question 3

If there was more than one source of funding, please indicate

1. Which source contributed the majority of funds _____
2. Whether that source's contribution exceeded 50 percent

_____ Yes _____ No

Question 4

What was the origin of the technology embodied in the innovation?

_____ Internally developed

_____ Through acquisition of an entity possessing the technology

_____ Licensed or purchased

Question 5

Which of the following best describes the innovation mentioned in the accompanying letter?

_____ The innovation establishes whole new categories

_____ The innovation is the first of its type on the market in existing categories

_____ The innovation represents a significant improvement of existing technology

_____ The innovation represents a modest improvement designed to update existing products

SURVEY OF SELECTED INNOVATING COMPANIES (Cont.)

Question 6

1. How many employees were there in the company at the introduction date of the innovation?

   _____

2. How many employees are there in the company now?

   _____

Question 7

What is the ownership form of this company?

_____ Corporation _____ Joint venture

_____ Partnership _____ Sole proprietorship

Question 8

1. Was the innovation used internally? _____ Yes _____ No

2. Was it embodied in sales to any of the following?

_____ Other businesses _____ Distributors

_____ The military _____ Civilian government

_____ Abroad

Appendix 3

SELECTED INDUSTRY STATISTICS

Appendix 3

SELECTED INDUSTRY STATISTICS--MANUFACTURING INDUSTRIES*

SIC CODE	(1,000) TOTAL EMPLOYMENT 1972	(1,000) TOTAL EMPLOYMENT 1977	(%) C[a]	(MILLION $) 1977 GROSS CAPITAL STOCKS	($1,000) CAPITAL INTENSITY RATIO[b]	(1,000) 1977 EMPLOYMENT[c] LARGE FIRM	(1,000) 1977 EMPLOYMENT[c] SMALL FIRM	ANNUAL EMPLOYEE GROWTH** (1972-1977)
2011	157.5	146.2	19	1321.1	9.03	94.3	51.9	- .014
2013	58.1	65.0	23	690	10.6	30.9	34.1	.024
2016	77.6	86.8	16	497.4	5.7	64	20.4	.024
2017	14.6	11.1	21	74.9	6.7	5.4	5.7	- .048
2021	4	2.3	49	42.4	18.4	1.4	.9	- .085
2022	25.2	26.7	35	32.5	1.2	15.1	11.6	.012
2023	12.3	12.3	30	309.1	25.1	9.0	3.3	0
2024	21.1	19.1	28	336.8	17.6	5.7	13.4	- .019
2026	126.1	93.5	18	1442.8	15.4	50.9	42.6	- .052
2032	29.1	26.4	63	4514	17.1	23.7	2.7	- .019
2033	89.8	82.6	22	1216.1	14.1	59.1	23.5	- .016
2034	12.4	14.4	37	229.0	15.9	9.3	5.1	.032
2035	20.8	23.5	55	343.1	14.6	13.5	10.0	.025
2037	42.8	46.8	22	659.6	14.1	37.5	9.3	.019
2038	38.3	41.0	40	548.1	13.4	31.1	9.9	.014
2041	16.1	15.6	33	395.9	25.4	10.2	5.4	- .001
2043	12.9	16.4	89	509.5	31.1	10.8	5.6	.054
2044	4.0	4.8	51	127.9	26.6	3.3	1.5	.04
2045	7.9	8.4	51	117.7	14.0	4.2	4.2	.013
2046	12.2	10.9	63	1140.9	104.7	6.0	4.9	.02
2047	14.3	17.7	58	537.9	30.4	13.2	4.5	.048
2048	4.4	39.1	22	783.5	20	19.9	19.2	- .022
2051	193.5	178.0	33	1825.8	10.3	123.9	54.1	- .016
2052	41.1	43.8	59	524.9	12	34.3	9.5	.013
2061	7.1	8.0	42	504.1	63	5.5	2.5	.025
2062	10.9	10.2	63	408.8	40.1	10.1	.1	- .013
2063	11.5	11.4	67	651.2	57.1	10.9	.5	- .002
2065	60.7	58.0	38	690.6	12	37.6	20.4	- .008
2066	10.0	10.0	73	243.3	24.3	8.8	1.2	0
2067	6.9	7.7	93	144.3	18.7	6.9	.8	.023
2074	5.5	5.2	45	146.2	28.1	1.8	3.4	- .011
2075	9.1	9.4	54	676.3	71.9	8.1	1.3	.007
2076	1.2	1.5	54	34.0	22.7	1.0	.5	.05
2077	11.6	12.4	28	343.3	27.7	4.4	3.0	.014
2079	12.9	12.7	43	481.4	37.9	11.1	1.6	- .003
2082	51.5	44.0	64	2748.5	62.5	40.4	3.6	- .029
2083	1.7	1.6	59	93.7	58.6	.8	.8	- .012
2084	9.4	9.2	49	341.6	37.1	5.2	4.0	- .004
2085	18.4	15.7	52	348.5	22.2	12.7	3.0	- .029
2086	121.1	114.1	15	2161.9	18.9	52.6	61.5	- .012

*Only industries with innovations are used in analyses.

**Percentage growth ÷5.

[a]Concentration ratio.

[b]Gross stocks per employee.

[c]Due to rounding, large-firm and small-firm employment may not sum to total.

SELECTED INDUSTRY STATISTICS--MANUFACTURING INDUSTRIES* (Cont.)

SIC CODE	(1,000) TOTAL EMPLOYMENT 1972	(1,000) TOTAL EMPLOYMENT 1977	(%) C[a]	(MILLION $) 1977 GROSS CAPITAL STOCKS	($1,000) CAPITAL INTENSITY RATIO[b]	(1,000) 1977 EMPLOYMENT[c] LARGE FIRM	(1,000) 1977 EMPLOYMENT[c] SMALL FIRM	ANNUAL EMPLOYEE GROWTH** (1972-1977)
2087	10.1	10.5	64	220.2	21.0	10.4	.1	.008
2091	16.0	16.0	52	134.6	8.4	11.5	4.5	0
2092	25.0	34.3	14	162.8	4.7	14.7	19.6	.074
2095	12.9	10.9	61	498.3	45.7	8.6	2.3	- .031
2097	6.8	5.3	24	80.5	15.2	3.2	3.6	- .044
2098	7.3	8.2	36	131.7	16.1	1.8	6.4	.025
2099	66.2	71.5	28	1009.7	14.1	38.6	32.9	.016
2111	38.1	39.0	(D)	856.5	22.0	33.3	5.7	.005
2121	13.5	7.7	56	47.0	6.1	6.7	1.0	- .086
2131	3.3	3.2	81	53.7	16.8	2.6	.6	- .006
2141	11.4	10.7	67	218.2	20.4	7.9	2.8	- .012
2211	121.3	117.2	39	1505.4	12.8	110.9	6.3	- .007
2221	149.7	151.0	42	2324.5	15.4	139.1	11.9	.002
2231	19.4	14.6	31	121.0	8.3	6.2	8.4	- .049
2241	27.1	20.8	17	164.3	7.9	7.6	13.2	- .046
2251	49.5	26.6	50	214.9	8.1	17.8	8.8	- .093
2252	32.6	32.2	20	165.6	5.1	13.9	18.3	- .002
2253	74.4	73.0	17	397.9	5.5	38.0	35.0	- .004
2254	26.0	25.2	42	93.0	3.7	21.1	4.1	- .006
2257	68.1	51.8	20	928.3	17.9	34.0	17.8	- .047
2258	22.0	23.7	26	332.5	14.0	16.9	6.8	- .015
2259	3.9	3.4	30	12.8	3.8	.8	2.6	- .026
2261	25.9	28.8	29	285.1	9.9	22.8	6.0	.024
2262	35.2	37.2	60	635.0	17.1	16.0	21.2	.011
2269	18.5	14.1	30	186.8	13.2	7.6	6.5	- .048
2271	6.5	2.8	67	28.9	10.3	2.0	.8	- .114
2272	50.1	50.2	21	663.9	13.2	34.5	15.7	.0003
2279	3.3	2.8	69	36.3	13.0	2.0	.8	- .030
2281	89.6	93.0	19	1261.4	13.6	75.8	17.2	.008
2282	38.0	30.5	44	556.4	18.2	21.9	8.6	- .039
2283	8.3	4.1	51	31.9	7.8	1.6	2.5	- .101
2284	11.7	12.8	57	146.7	11.5	10.2	2.6	.019
2291	5.0	4.3	58	56.2	13.1	3.3	1.0	- .028
2292	2.9	2.2	51	165.0	7.5	.3	1.9	- .048
2293	4.4	5.2	30	44.0	8.5	1.9	3.3	.036
2294	3.6	3.7	43	25.4	6.9	1.1	2.6	- .006
2295	18.0	13.6	39	251.9	18.5	9.2	4.0	- .049
2296	10.0	9.6	80	197.1	20.5	9.6	0	- .008
2297	10.8	13.0	36	251.1	19.3	9.6	3.4	.041
2298	9.0	9.5	34	80.3	8.5	5.3	4.2	.011
2299	8.3	6.7	21	80.1	12.0	.3	6.4	- .039

*Only industries with innovations are used in analyses.
**Percentage growth ÷5.

[a]Concentration ratio.

[b]Gross stocks per employee.

[c]

SELECTED INDUSTRY STATISTICS--MANUFACTURING INDUSTRIES* (Cont.)

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2311	124.8	98.7	21	173.1	1.8	58.6	40.1	- .042
2321	113.4	114.7	17	194.9	1.7	72.3	42.4	.002
2322	16.0	15.1	61	21.8	1.4	8.2	6.9	- .001
2323	11.1	6.3	27	1.1	.2	2.1	4.2	- .086
2327	91.3	70.9	25	125.4	1.8	46.6	24.3	- .045
2328	89.6	113.7	49	205.5	1.8	88.2	25.5	.054
2329	41.9	43.8	12	76.3	1.7	13.9	29.9	.009
2331	63.0	83.3	12	134.9	1.6	23.2	60.1	.064
2335	211.6	175.3	8	247.6	1.4	23.8	151.5	- .034
2337	75.9	84.7	15	179.9	2.1	20.7	64.0	.023
2339	82.1	104.1	14	194.2	1.9	36.5	67.6	.054
2341	77.5	72.9	22	136.5	1.9	43.3	29.6	- .012
2342	28.0	18.9	36	38.9	2.1	11.5	7.4	- .065
2351	3.2	2.7	19	8.8	3.3	.2	2.5	- .031
2352	11.3	12.4	27	23.3	1.9	5.4	7.0	.019
2361	35.4	35.2	15	64.2	1.8	13.2	22.0	- .001
2363	9.2	6.7	32	12.7	1.9	2.6	5.1	- .054
2369	30.1	29.3	24	48.8	1.7	14.6	14.7	- .005
2371	4.7	4.0	11	4.8	1.2	.4	3.6	- .03
2381	11.9	10.9	44	23.7	2.2	6.7	4.2	- .017
2384	10.0	9.5	25	14.7	1.5	3.0	6.5	- .01
2385	15.4	12.0	41	23.4	2.0	5.6	6.4	- .044
2386	7.0	6.7	16	8.6	1.3	.5	6.2	- .009
2387	10.3	9.4	21	13.5	1.4	2.3	7.1	- .017
2389	7.3	7.8	31	16.0	2.1	2.8	6.0	- .014
2391	33.9	31.7	26	58.6	1.8	11.6	20.1	.013
2392	50.3	47.5	22	205.5	4.3	20.6	26.9	- .011
2393	7.9	8.2	27	34.3	4.2	2.2	6.0	.008
2394	12.9	13.9	17	47.4	3.4	2.7	11.4	.016
2395	16.7	16.1	25	67.1	4.2	5.0	11.7	- .007
2396	27.6	30.9	71	178.0	5.8	14.6	16.3	.024
2397	5.5	6.0	26	26.9	4.5	.9	5.1	.018
2399	31.4	31.1	26	136.5	4.4	12.9	18.5	- .002
2411	80.0	83.3	29	2217.7	12.7	23.3	63.0	.008
2421	166.6	175.2	17	3432.4	19.6	72.5	102.7	.010
2426	31.5	29.1	16	2034.0	7.0	9.1	20.0	- .015
2429	6.4	7.0	11	53.8	7.7	1.4	5.6	.019
2431	70.5	68.6	14	382.8	5.6	26.7	41.9	- .005
2434	38.8	46.2	14	170.0	3.7	10.3	35.9	.038

*Only industries with innovations are used in analyses.

**Percentage growth ÷5.

[a] Concentration ratio.

[b] Gross stocks per employee.

[c] Due to rounding, large-firm and small-firm employment may not sum to total.

SELECTED INDUSTRY STATISTICS--MANUFACTURING INDUSTRIES* (Cont.)

SIC CODE	(1,000) TOTAL EMPLOYMENT 1972	1977	(%) C[a]	(MILLION $) 1977 GROSS CAPITAL STOCKS	($1,000) CAPITAL INTENSITY RATIO[b]	(1,000) 1977 EMPLOYMENT[c] LARGE FIRM	SMALL FIRM	ANNUAL EMPLOYEE GROWTH** (1972-1977)
2435	25.1	22.3	27	205.4	9.2	8.2	14.1	- .022
2436	43.7	46.2	38	1095.1	23.7	35.3	11.0	.011
2439	12.6	13.8	16	93.3	6.8	2.5	11.3	.019
2441	10.7	8.6	15	37.2	4.3	1.2	7.4	- .039
2448	14.3	20.3	6	140.8	6.9	1.1	19.2	.084
2449	11.9	8.9	25	46.4	5.2	2.7	6.2	- .05
2451	71.9	50.5	24	135.4	2.7	3.2	2.3	- .06
2452	25.2	29.0	24	136.4	4.7	11.7	17.3	.03
2491	11.3	12.6	33	231.7	18.4	4.9	7.7	.023
2492	7.7	6.2	48	388.1	62.6	5.5	.7	- .039
2499	63.0	64.6	18	880.1	13.6	25.6	39.0	.005
2511	133.8	141.0	14	788.5	5.6	87.4	53.6	.011
2512	92.0	89.1	15	237.9	2.7	41.6	47.5	- .006
2514	34.4	33.2	13	319.5	4.2	16.8	16.4	- .007
2515	31.4	27.0	21	128.4	4.8	9.8	17.2	- .028
2517	18.9	10.7	45	46.2	4.2	7.5	3.2	- .087
2519	6.9	8.7	39	83.9	9.6	4.4	4.3	.052
2521	11.5	16.0	32	72.2	4.5	5.4	10.6	.078
2522	27.8	29.0	47	222.7	7.7	21.5	7.5	.009
2531	21.0	20.0	23	113.8	5.7	7.4	12.6	- .01
2541	31.2	29.4	6	106.7	3.6	0	29.4	- .012
2542	26.2	28.0	16	230.6	8.2	11.1	16.9	.014
2591	12.1	13.6	46	63.0	4.6	9.3	4.3	.025
2599	14.5	18.1	19	75.2	4.2	5.1	13.0	.05
2611	10.6	16.2	48	2412.6	148.9	15.6	.6	.106
2621	129.9	127.0	23	9769.1	76.9	119.4	7.6	- .004
2631	68.5	67.6	27	6087.6	90.1	63.1	4.5	- .003
2641	37.2	39.7	30	809.3	20.4	31.4	8.3	.013
2642	22.9	22.6	28	243.7	10.8	12.5	10.1	- .003
2643	48.6	48.7	26	772.8	15.9	34.4	14.3	.0004
2645	15.2	14.3	43	138.1	9.7	6.7	7.6	- .012
2646	6.1	4.9	87	152.5	31.1	4.1	.8	- .039
2647	26.3	34.5	65	893.6	25.9	32.5	2.0	.062
2648	14.7	12.6	38	102.9	8.2	7.1	5.5	- .029
2649	18.1	29.4	17	335.3	11.4	13.2	16.2	.125
2651	45.3	44.7	22	659.1	14.7	28.3	16.4	- .003
2652	18.1	13.1	12	99.4	7.6	2.2	10.9	- .055
2653	107.9	101.5	19	1794.4	17.7	70.1	31.4	- .012
2654	35.1	28.7	48	942.3	32.8	23.2	5.5	- .036

*Only industries with innovations are used in analyses.

**Percentage growth ÷5.

[a]Concentration ratio.

[b]Gross stocks per employee.

[c]Due to rounding, large-firm and small-firm employment may not sum to total.

SELECTED INDUSTRY STATISTICS--MANUFACTURING INDUSTRIES* (Cont.)

SIC CODE	(1,000) TOTAL EMPLOYMENT 1972	(1,000) TOTAL EMPLOYMENT 1977	(%) C^a	(MILLION $) 1972 GROSS CAPITAL STOCKS	($1,000) CAPITAL INTENSITY RATIO[b]	(1,000) 1977 EMPLOYMENT[c] LARGE FIRM	(1,000) 1977 EMPLOYMENT[c] SMALL FIRM	ANNUAL EMPLOYEE GROWTH** (1972-1977)
2655	17.3	16.1	54	212.3	13.2	12.0	4.1	- .014
2661	11.6	7.0	51	249.0	35.6	6.2	.8	- .079
2711	348.5	349.9	19	3348.6	9.6	226.7	123.2	.001
2721	66.5	69.9	22	339.8	4.9	33.8	36.1	.010
2731	57.1	59.5	17	444.3	7.5	38.0	21.5	.008
2732	40.9	46.9	25	527.6	11.2	23.7	23.2	.029
2741	38.8	42.1	24	233.8	5.6	19.7	22.4	.017
2751	130.1	110.9	14	1140.0	10.3	25.8	85.1	- .03
2752	184.0	216.3	6	2773.4	12.8	60.8	155.5	.035
2753	9.6	9.8	34	83.2	8.5	3.9	5.9	.004
2754	20.0	19.0	36	453.6	23.9	14.3	4.7	- .01
2761	38.6	45.3	38	737.3	16.3	27.3	18.0	.035
2771	23.5	18.1	77	134.0	7.4	14.5	3.6	- .046
2782	26.6	31.8	43	223.8	7.0	20.2	11.6	.039
2789	25.1	24.1	10	164.8	6.8	4.1	20.0	- .008
2791	26.0	27.2	6	218.5	8.0	3.2	24.0	.009
2793	9.9	5.7	28	59.7	10.5	1.2	4.5	- .085
2794	1.7	.4	52	5.6	14.0	0	.4	- .153
2795	8.9	15.2	17	204.0	13.4	3.5	11.7	.142
2812	13.3	11.8	66	1544.3	130.9	11.2	.6	- .023
2813	9.6	7.5	65	1525.9	203.5	5.7	1.8	- .044
2816	12.8	11.9	54	794.9	66.8	10.1	1.8	- .014
2819	63.8	78.8	33	3312.9	42.0	73.8	5.0	.047
2821	54.8	57.2	22	5430.7	94.9	50.9	6.3	.009
2822	11.8	10.0	60	662.9	66.3	9.4	.6	- .031
2823	17.1	16.0	(D)	659.0	41.2	16.0	.1	- .013
2824	78.2	74.0	78	5118.8	69.2	71.3	2.7	- .011
2831	10.1	15.7	32	182.0	11.6	12.2	3.5	.111
2833	7.8	14.4	65	897.3	62.3	12.1	2.3	.169
2834	112.0	126.4	24	2077.3	16.4	112.2	14.2	.026
2841	31.5	32.1	59	1088.1	33.9	23.0	9.1	.004
2842	25.1	22.1	41	297.6	13.5	10.7	11.4	- .024
2843	6.9	6.6	32	249.3	37.8	3.7	2.9	- .009
2844	48.2	50.9	40	552.8	10.9	39.5	11.4	.001
2851	65.9	61.4	24	817.9	13.3	36.0	25.4	- .014
2861	5.9	4.8	59	166.8	34.8	4.0	.8	- .037
2865	28.2	35.7	42	3552.4	99.5	32.4	3.3	.053
2869	102.4	112.3	38	16427.7	146.3	106.0	6.3	.019
2873	9.4	12.1	34	3030.5	250.5	11.0	1.1	.057

*Only industries with innovations are used in analyses.

**Percentage growth ÷5.

[a] Concentration ratio.

[b] Gross stocks per employee.

[c] Due to rounding, large-firm and small-firm employment may not sum to total.

SELECTED INDUSTRY STATISTICS--MANUFACTURING INDUSTRIES* (Cont.)

SIC CODE	(1,000) TOTAL EMPLOYMENT 1972	1977	(%) C[a]	(MILLION $) 1977 GROSS CAPITAL STOCKS	($1,000) CAPITAL INTENSITY RATIO[b]	(1,000) 1977 EMPLOYMENT[c] LARGE FIRM	SMALL FIRM	ANNUAL EMPLOYEE GROWTH** (1972-1977)
2874	14.9	14.4	35	1,562.0	108.5	13.8	.6	-.007
2875	11.4	12.4	21	251.6	20.3	6.0	6.4	.018
2879	12.2	15.0	44	957.2	63.8	10.6	4.4	.046
2891	14.9	16.7	24	258.6	15.5	9.9	6.8	.024
2892	18.6	12.3	64	115.5	9.4	11.2	1.0	-.068
2893	9.6	10.1	43	107.4	10.6	5.7	4.4	.010
2895	2.9	2.5	70	269.1	107.6	2.3	.2	-.028
2899	37.1	35.3	15	941.5	26.7	19.5	15.8	-.010
2911	100.8	102.5	30	14,614.1	142.6	98.0	4.5	.003
2951	13.9	12.8	17	529.0	41.3	.9	11.9	-.016
2952	15.6	19.5	45	373.6	19.2	15.8	3.7	.050
2992	8.1	10.3	28	205.2	19.9	4.2	6.1	.054
2999	1.1	1.6	67	138.2	86.4	1.0	.6	.091
3011	107.5	114.0	70	3,502.2	30.7	1.3	.1	.012
3021	31.6	19.8	58	118.5	6.0	16.0	3.8	-.075
3031	.9	.9	74	.5	.6	.3	.6	0
3041	31.9	34.4	55	5,457	15.9	31.3	3.1	.016
3069	99.0	98.5	16	1,155.7	11.7	47.0	51.5	-.001
3079	346.9	453.7	7	6,824.7	15.0	234.6	219.1	.062
3111	25.7	23.0	17	170.7	7.4	10.1	13.0	-.021
3131	8.7	8.5	21	31.1	3.7	3.0	5.5	-.005
3142	8.5	8.1	44	17.2	2.1	3.8	4.3	-.009
3143	61.5	55.0	31	119.4	2.2	47.0	8.0	-.021
3144	77.4	57.6	29	88.2	1.5	40.0	17.6	-.051
3149	28.7	24.8	24	59.4	2.4	16.6	8.2	-.027
3151	4.9	5.5	38	12.6	2.3	1.9	3.6	.024
3161	17.1	19.2	40	51.7	2.6	8.7	10.5	.025
3171	22.2	20.3	21	30.4	1.5	4.9	15.4	-.017
3172	11.5	11.9	38	25.1	2.1	5.2	6.7	.007
3199	7.2	8.6	13	18.5	2.2	.9	7.7	.039
3211	20.9	21.9	90	1,024.7	46.8	20.4	1.5	.010
3221	72.9	70.8	54	1,454.3	20.5	67.8	3.0	-.006
3229	45.9	46.2	61	1,035.6	22.4	40.7	5.5	.001
3231	33.7	36.2	31	385.6	10.7	18.1	18.1	.015
3241	38.0	27.8	24	3,279.6	118.0	23.8	4.0	-.015
3251	24.1	20.5	21	377.2	18.4	7.1	13.4	-.030
3253	8.3	7.8	60	97.4	12.5	5.2	2.6	-.012
3255	11.2	11.3	47	233.3	20.6	8.2	3.1	.002
3259	8.2	5.5	40	62.2	11.3	3.4	2.1	-.066

*Only industries with innovations are used in analyses.
**Percentage growth ±5.

[a]Concentration ratio.

[b]Gross stocks per employee.

[c]Due to rounding, large-firm and small-firm employment may not sum to total.

SELECTED INDUSTRY STATISTICS--MANUFACTURING INDUSTRIES* (Cont.)

SIC CODE	(1,000) TOTAL EMPLOYMENT 1972	1977	(%) C[a]	(MILLION $) 1977 GROSS CAPITAL STOCKS	($1,000) CAPITAL INTENSITY RATIO[b]	(1,000) 1977 EMPLOYMENT[c] LARGE FIRM	SMALL FIRM	ANNUAL EMPLOYEE GROWTH** (1972-1977)
3261	9.6	9.2	62	88.7	9.6	7.7	1.5	-.008
3262	5.9	7.3	71	37.3	5.1	5.8	1.5	.047
3263	6.8	4.7	68	25.0	5.3	2.6	2.1	-.062
3264	13.4	11.4	48	148.9	13.1	8.6	2.8	-.030
3269	9.1	10.6	19	62.2	5.9	2.1	8.5	.033
3271	22.8	18.7	4	455.6	24.4	1.5	17.2	-.036
3272	67.7	61.7	9	895.1	14.5	16.7	45.0	-.018
3273	85.7	87.9	5	2,344.8	26.7	15.7	72.2	.005
3274	5.7	5.9	35	350.2	59.4	4.1	1.8	.007
3275	11.2	9.5	79	363.8	38.3	8.5	1.0	-.030
3281	15.0	12.7	14	117.2	9.2	2.0	10.7	-.031
3291	24.5	28.3	58	436.7	15.4	19.3	9.0	.031
3292	21.0	13.9	42	285.2	20.5	11.8	2.1	-.068
3293	27.7	33.0	25	287.8	8.7	21.3	11.7	.038
3295	9.5	11.5	27	459.6	40.0	7.5	4.0	.042
3296	18.0	22.6	72	604.4	26.7	19.9	2.7	.051
3297	8.1	9.1	46	272.5	29.9	7.6	1.5	.025
3299	6.3	7.7	37	156.2	20.3	2.9	4.8	.044
3312	469.1	441.9	45	28,170.6	63.7	433.2	8.7	-.012
3313	9.5	8.9	69	675.6	75.9	8.2	.7	-.013
3315	30.6	31.7	21	535.1	16.9	19.2	12.5	.007
3316	20.1	19.4	37	595.8	30.7	16.7	2.7	-.007
3317	23.6	27.8	24	655.8	23.6	22.2	5.6	.036
3321	138.4	138.8	34	3,013.4	21.7	97.4	41.4	.001
3322	22.5	18.2	54	241.6	13.3	15.2	3.0	-.038
3324	11.2	10.5	56	68.5	6.5	7.1	3.4	-.013
3325	46.7	54.8	26	801.5	14.6	39.9	14.9	.035
3331	17.2	13.1	87	1,405.6	107.3	12.8	.3	-.048
3332	2.8	2.5	100	82.0	32.8	2.5	0	-.021
3333	6.3	4.6	81	251.3	54.6	4.5	.1	-.054
3334	25.6	28.6	76	2,555.5	89.4	28.6	0	.023
3339	6.7	8.6	56	570.0	66.3	7.7	.9	.057
3341	17.8	18.9	22	539.0	28.5	9.1	9.8	.012
3351	37.8	31.3	40	865.3	27.6	27.0	4.3	-.034
3353	31.3	31.4	72	1,894.1	60.3	31.0	.4	.001
3354	27.7	26.5	38	452.0	17.1	20.9	5.6	-.008
3355	4.6	4.7	81	177.7	37.8	4.5	.2	.004
3356	18.1	17.2	42	564.5	32.8	13.3	3.9	-.010
3357	68.8	66.3	40	1,592.1	24.0	53.0	13.3	-.007

*Only industries with innovations are used in analyses.
**Percentage growth ÷5.

[a]Concentration ratio.

[b]Gross stocks per employee.

[c]Due to rounding, large-firm and small-firm employment may not sum to total.

SELECTED INDUSTRY STATISTICS--MANUFACTURING INDUSTRIES* (Cont.)

SIC CODE	(1,000) TOTAL EMPLOYMENT 1972	(1,000) TOTAL EMPLOYMENT 1977	(%) C[a]	(MILLION $) 1977 GROSS CAPITAL STOCKS	($1,000) CAPITAL INTENSITY RATIO[b]	(1,000) 1977 EMPLOYMENT[c] LARGE FIRM	(1,000) 1977 EMPLOYMENT[c] SMALL FIRM	ANNUAL EMPLOYEE GROWTH** (1972-1977)
3361	45.7	52.2	23	605.7	11.6	23.0	29.2	.028
3362	15.4	12.6	16	120.3	9.5	4.0	8.6	-.036
3369	20.3	17.3	20	173.2	10.0	5.3	12.0	-.030
3398	17.2	16.9	24	262.3	15.5	3.7	13.2	-.003
3399	7.9	9.0	24	286.5	31.8	5.8	3.2	.028
3411	68.5	59.8	59	1901.4	31.8	56.7	3.1	-.025
3412	10.2	12.4	34	209.4	16.9	6.3	6.1	.043
3421	13.4	14.9	53	149.2	10.0	10.2	4.7	.022
3423	39.3	47.0	25	451.8	9.6	30.4	16.6	.039
3425	6.6	7.6	53	94.7	12.5	4.4	3.2	.030
3429	99.9	99.2	39	1054.4	10.6	72.2	27.0	-.001
3431	11.2	8.1	54	111.7	13.8	6.2	1.9	-.055
3432	18.6	19.3	33	207.1	10.7	11.7	7.6	.008
3433	30.9	25.8	14	204.8	7.9	13.5	12.3	-.033
3441	104.3	95.4	10	852.7	8.9	32.2	63.2	-.017
3442	70.7	65.8	8	353.1	5.4	29.1	36.7	-.014
3443	93.0	123.5	26	1430.5	11.6	71.8	51.7	.066
3444	74.0	77.4	10	677.1	8.7	22.7	54.7	.009
3446	20.9	20.8	17	143.0	6.9	7.8	13.0	-.001
3448	12.5	22.7	22	230.9	10.2	13.6	9.1	.163
3449	19.5	16.3	28	167.6	10.3	9.6	6.7	-.033
3451	40.5	43.8	7	579.3	13.2	7.0	36.8	.016
3452	60.1	60.9	13	1034.5	17.0	39.3	21.6	.003
3462	34.3	39.1	25	850.1	21.7	23.8	15.3	.028
3463	5.8	5.4	77	124.7	23.1	4.3	1.1	-.014
3465	123.3	132.4	65	2724.1	20.6	107.8	24.6	.015
3466	8.1	7.9	53	137.9	17.5	6.0	1.9	-.005
3469	92.0	103.2	9	1054.6	10.2	38.2	65.0	.024
3471	54.6	61.2	8	489.0	8.0	7.0	54.2	.024
3479	27.6	32.3	22	394.8	12.2	8.3	24.0	.034
3482	13.9	10.3	86	186.2	81.1	9.8	.5	.052
3483	54.9	18.9	52	55.1	2.9	17.1	1.8	-.131
3484	16.1	17.5	58	180.0	10.3	15.3	2.2	.017
3489	24.6	23.6	48	66.3	2.8	21.7	1.9	-.008
3493	8.5	8.2	44	93.2	11.4	5.0	3.2	-.007
3494	94.3	108.7	13	1324.3	12.2	82.4	26.3	.031
3495	23.7	21.7	29	172.6	8.0	10.2	11.5	-.017
3496	33.2	32.4	10	295.3	9.1	9.1	23.3	-.005
3497	5.4	9.4	49	175.2	18.6	6.7	2.7	.148

*Only industries with innovations are used in analyses.
**Percentage growth ±5.

[a]Concentration ratio.

[b]Gross stocks per employee.

[c]Due to rounding, large-firm and small-firm employment may not sum to total.

SELECTED INDUSTRY STATISTICS--MANUFACTURING INDUSTRIES* (Cont.)

SIC CODE	(1,000) TOTAL EMPLOYMENT 1972	1977	(%) C[a]	(MILLION $) 1977 GROSS CAPITAL STOCKS	($1,000) CAPITAL INTENSITY RATIO[b]	(1,000) 1977 EMPLOYMENT[c] LARGE FIRM	SMALL FIRM	ANNUAL EMPLOYEE GROWTH** (1972-1977)
3498	17.5	28.2	18	300.3	10.6	14.6	13.6	.122
3499	61.8	70.8	13	686.6	9.7	23.4	47.4	.029
3511	46.2	40.8	86	897.6	22.0	39.0	1.8	-.023
3519	69.9	88.8	49	1703.7	19.2	84.7	4.1	.054
3523	104.6	131.3	46	1595.3	12.2	91.3	40.0	.051
3524	20.7	19.6	30	207.8	10.6	15.8	3.8	-.011
3531	133.8	155.3	47	2537.0	16.3	131.7	23.6	.032
3532	21.3	31.4	37	318.9	10.2	24.2	7.2	.095
3533	35.9	58.6	30	945.8	16.1	49.4	9.2	.126
3534	15.0	10.2	52	95.7	9.4	6.9	3.3	-.064
3535	21.2	32.9	19	197.6	6.0	15.7	17.2	.042
3536	66.3	15.8	16	125.1	7.9	9.2	6.6	-.006
3537	25.8	28.8	45	373.3	13.0	19.4	9.4	.023
3541	52.5	59.5	22	739.8	12.4	40.3	19.2	.027
3542	24.1	23.7	18	314.2	13.3	15.3	8.4	-.003
3544	97.8	105.6	8	1298.1	12.3	15.9	89.7	.016
3545	46.7	54.1	20	606.4	11.2	28.1	26.0	.032
3546	23.1	27.7	50	286.0	10.3	25.4	2.3	.040
3547	10.4	7.9	62	180.2	22.8	5.6	2.3	-.048
3549	13.6	19.4	15	164.1	8.5	7.2	12.2	.085
3551	13.9	36.3	14	341.8	9.4	18.4	17.9	.028
3552	32.7	26.0	22	281.4	10.8	12.7	13.3	-.041
3553	13.7	10.3	35	100.4	9.7	4.0	6.3	-.050
3554	15.3	16.4	40	155.5	9.5	6.9	9.5	.014
3555	23.9	25.5	40	276.4	10.8	14.6	10.9	.013
3559	72.6	70.6	13	690.1	9.8	39.2	31.4	-.006
3561	55.5	63.0	17	792.4	12.6	49.9	13.1	.027
3562	50.9	50.6	56	1107.7	21.9	46.2	4.4	-.001
3563	22.9	32.0	45	358.6	11.2	27.8	4.2	.079
3564	23.5	28.0	17	207.5	7.4	17.3	10.7	.038
3565	8.5	9.3	9	72.0	7.7	.5	8.8	.019
3566	22.5	25.3	29	465.0	18.4	16.7	8.6	.025
3567	13.6	15.2	26	98.2	6.5	7.2	8.0	.024
3568	27.7	32.5	26	472.9	14.6	25.1	7.4	.035
3569	37.0	57.5	10	457.9	8.0	24.5	33.0	.111
3573	144.8	192.7	44	2237.2	11.6	165.1	27.6	.066
3574	22.5	17.1	59	164.9	9.6	14.8	2.3	-.048
3576	6.7	7.1	50	49.7	7.0	4.7	2.4	.012
***3579	34.5	42.4	60	574.1	13.5	37.4	5.0	.046

*Only industries with innovations are used in analyses.
**Percentage growth ÷5.
***As of 1972 Census, 3572 and 3579 data are combined.

[a]Concentration ratio.

[b]Gross stocks per employee.

[c]Due to rounding, large-firm and small-firm employment may not sum to total.

SELECTED INDUSTRY STATISTICS--MANUFACTURING INDUSTRIES* (Cont.)

SIC CODE	(1,000) TOTAL EMPLOYMENT 1972	(1,000) TOTAL EMPLOYMENT 1977	(%) C[a]	(MILLION $) 1977 GROSS CAPITAL STOCKS	($1,000) CAPITAL INTENSITY RATIO[b]	(1,000) 1977 EMPLOYMENT[c] LARGE FIRM	(1,000) 1977 EMPLOYMENT[c] SMALL FIRM	ANNUAL EMPLOYEE GROWTH** (1972-1977)
3581	10.5	8.8	46	69.8	7.9	5.9	2.9	-.032
3582	4.8	4.6	46	21.2	4.6	1.6	3.0	-.008
3585	150.8	138.6	41	1,576.6	83.5	114.1	24.5	-.016
3586	7.2	7.4	50	56.1	7.6	6.0	1.4	-.006
3589	24.4	32.1	11	178.0	5.5	16.2	15.9	.063
3592	26.7	32.2	52	419.8	13.0	28.9	3.3	.041
3599	157.8	190.5	2	2,117.2	11.1	14.7	175.8	.041
3612	46.8	43.3	56	448.3	10.4	37.2	6.1	-.015
3613	69.2	72.0	51	538.9	7.5	60.2	11.8	.008
3621	90.3	96.9	42	1,045.3	10.8	83.0	13.9	.015
3622	51.1	55.4	42	354.6	6.4	42.4	13.0	.017
3623	15.5	17.5	47	165.8	9.5	11.5	6.0	.026
3624	11.3	12.1	80	369.4	30.5	9.9	2.2	.014
3629	20.2	16.5	28	139.4	8.4	10.4	6.1	-.037
3631	23.3	25.4	51	218.3	8.6	22.7	2.7	.018
3632	34.1	35.8	82	367.4	10.3	34.8	1.0	.010
3633	23.6	19.4	89	265.2	13.7	18.9	.5	-.036
3634	51.3	47.3	46	329.5	7.0	40.7	6.6	-.016
3635	11.2	10.4	83	106.2	10.2	9.3	1.1	-.014
3636	5.3	8.2	83	90.3	11.0	7.0	1.2	.109
3639	14.0	15.7	52	148.5	9.5	14.3	1.4	.024
3641	31.5	28.7	90	457.2	15.9	26.8	1.9	-.018
3643	50.4	43.9	26	340.6	7.8	34.7	9.2	-.026
3644	25.7	25.8	25	281.5	10.9	20.8	5.0	.001
3645	26.5	23.7	25	81.4	3.4	9.5	14.2	-.021
3646	18.8	15.6	30	126.7	8.1	8.1	7.5	-.034
3647	13.6	14.5	(D)	232.5	16.0	12.2	2.3	.013
3648	12.7	12.8	25	121.4	9.5	7.4	5.4	.002
3651	86.5	74.6	51	474.5	6.4	59.0	15.6	-.028
3652	20.3	23.1	48	150.6	6.5	14.1	9.0	.028
3661	134.4	124.4	(D)	1,489.3	12.0	117.1	7.3	.024
3662	319.2	334.1	20	2,248.8	6.7	289.7	44.4	.009
3671	11.4	36.7	58	482.0	13.1	34.0	2.7	.444
3673	20.5	28.9	--	--	--	--	--	.082
3674	97.6	114.0	42	1,932.2	16.9	100.9	13.1	.034
3675	27.6	28.9	47	187.1	6.5	23.8	5.1	.009
3676	20.5	21.3	38	170.7	8.0	18.3	3.0	.008
3677	24.2	20.7	20	68.5	3.3	8.2	12.5	-.029
3678	18.1	26.0	45	255.1	9.8	21.4	4.6	.087
3679	100.5	125.9	29	1,258.5	10.0	65.5	60.4	.051

*Only industries with innovations are used in analyses.
**Percentage growth ÷5.

[a]Concentration ratio.

[b]Gross stocks per employee.

[c]Due to rounding, large-firm and small-firm employment may not sum to total.

SELECTED INDUSTRY STATISTICS--MANUFACTURING INDUSTRIES* (Cont.)

SIC CODE	(1,000) TOTAL EMPLOYMENT 1972	(1,000) TOTAL EMPLOYMENT 1977	(%) C[a]	(MILLION $) 1977 GROSS CAPITAL STOCKS	($1,000) CAPITAL INTENSITY RATIO[b]	(1,000) 1977 EMPLOYMENT[c] LARGE FIRM	(1,000) 1977 EMPLOYMENT[c] SMALL FIRM	ANNUAL EMPLOYEE GROWTH** (1972-1977)
3691	22.1	25.9	57	429.6	16.6	22.8	3.1	.034
3692	8.4	11.0	87	139.7	12.7	9.3	1.7	.062
3693	12.1	30.9	32	210.8	6.8	25.0	5.9	.311
3694	57.9	63.8	62	847.9	13.3	53.3	10.5	.020
3699	19.3	20.7	27	165.1	8.0	8.2	12.5	.015
3711	339.2	343.6	93	5208.9	15.2	340.0	3.7	.003
3713	42.6	34.8	33	230.5	6.6	15.7	19.1	-.037
3714	400.9	450.7	62	9196.7	20.4	408.8	41.9	.025
3715	24.7	28.1	43	176.8	6.3	18.5	9.6	.028
3721	231.8	222.7	59	1660.3	7.5	219.8	2.9	-.008
3724	104.7	106.1	74	1472.1	13.9	95.6	10.6	.003
3728	102.2	102.0	45	986.3	9.7	87.3	14.7	-.0004
3731	144.6	176.4	43	1269.1	7.2	154.4	22.1	.044
3732	40.6	143.8	11	136.7	1.0	52.1	91.7	.508
3743	50.8	56.3	52	638.6	11.3	51.5	4.8	.022
3751	17.6	15.6	66	117.1	7.5	10.6	5.0	-.023
3761	118.4	94.0	64	703.8	7.5	93.8	.2	-.041
3764	20.8	18.6	69	217.7	11.7	18.4	.2	.190
3769	20.9	7.2	76	63.6	8.8	6.3	.9	-.131
3792	37.1	26.3	31	77.9	3.0	12.2	14.1	-.058
3795	5.9	12.4	87	70.8	5.7	11.6	.8	.220
3799	16.1	10.3	35	98.7	9.6	4.0	6.3	-.072
3811	36.7	42.3	25	279.5	6.6	27.3	15.0	.031
3822	30.7	39.0	59	197.5	5.1	34.1	4.9	.054
3823	35.6	46.5	32	279.1	6.0	36.2	10.3	.061
3824	8.8	15.9	43	144.1	9.1	13.7	2.2	.161
3825	54.7	66.5	33	392.8	5.9	50.6	15.9	.043
3829	24.6	32.3	25	181.0	5.6	20.8	11.5	.063
3832	18.8	30.0	30	209.8	7.0	18.9	11.1	.119
3841	34.5	43.2	32	316.9	7.3	31.5	11.7	.050
3842	43.9	53.9	38	389.3	7.2	36.0	17.9	.046
3843	12.4	16.3	33	92.0	5.6	9.2	7.1	.063
3851	26.6	30.0	45	210.4	7.0	18.9	11.1	.026
3861	96.0	111.7	72	2677.6	24.0	98.7	13.0	.033
3873	30.8	31.5	58	158.1	5.0	25.5	6.0	.005
3911	32.6	42.1	18	161.0	3.8	11.7	30.4	.058
3914	13.1	10.8	51	97.6	9.0	7.3	3.5	-.035
3915	8.0	8.3	17	47.0	5.7	1.6	6.7	.008
3931	24.5	25.2	31	104.7	4.2	18.4	6.8	.006

*Only industries with innovations are used in analyses.
**Percentage growth ÷5.

[a]Concentration ratio.

[b]Gross stocks per employee.

[c]Due to rounding, large-firm and small-firm employment may not sum to total.

SELECTED INDUSTRY STATISTICS--MANUFACTURING INDUSTRIES* (Cont.)

SIC CODE	(1,000) TOTAL EMPLOYMENT 1972	(1,000) TOTAL EMPLOYMENT 1977	(%) C[a]	(MILLION $) 1977 GROSS CAPITAL STOCKS	($1,000) CAPITAL INTENSITY RATIO[b]	(1,000) 1977 EMPLOYMENT[c] LARGE FIRM	(1,000) 1977 EMPLOYMENT[c] SMALL FIRM	ANNUAL EMPLOYEE GROWTH** (1972-1977)
3942	10.2	9.1	37	47.0	26.6	3.4	5.7	-.022
3944	61.5	53.1	34	396.3	7.5	36.1	17.0	-.027
3949	61.0	57.2	21	402.7	7.0	28.1	29.1	-.012
3951	10.9	13.2	50	143.2	10.8	6.5	6.7	.042
3952	7.1	6.6	49	47.6	7.2	3.7	2.9	-.014
3953	8.1	7.4	29	37.7	5.1	1.5	5.9	-.017
3955	5.7	4.6	47	42.3	9.2	2.1	2.5	-.039
3961	21.4	25.0	23	63.1	2.5	7.6	17.4	.034
3962	4.8	5.0	38	16.3	3.3	.6	4.4	.008
3963	4.0	3.2	35	24.3	7.6	.8	2.4	-.040
3964	20.2	17.7	50	209.4	11.8	10.6	7.1	-.025
3991	17.5	16.5	20	110.0	6.7	6.2	10.3	-.011
3993	49.8	49.7	6	247.7	5.0	4.4	45.3	-.0004
3995	14.8	12.0	36	82.3	6.9	4.3	7.7	-.038
3996	5.8	6.4	90	172.1	26.9	6.0	.4	.021
3999	65.1	67.3	18	425.7	6.3	21.9	45.4	.007

*Only industries with innovations are used in analyses.

**Percentage growth ÷5.

[a]Concentration ratio.

[b]Gross stocks per employee.

[c]Due to rounding, large-firm and small-firm employment may not sum to total.

SOURCE: 1972 and 1977 Census of Manufacturers; Special Report of the Census Bureau to the U.S. Small Business Administration;

Appendix 3A

SELECTED INDUSTRY STATISTICS--SELECTED NONMANUFACTURING INDUSTRIES

SIC CODE	(1,000) TOTAL EMPLOYMENT 1972	(1,000) TOTAL EMPLOYMENT 1977	(MILLION $) 1977 GROSS CAPITAL STOCKS	($1,000) CAPITAL INTENSITY RATIO	(1,000) 1977 EMPLOYMENT LARGE FIRM	(1,000) 1977 EMPLOYMENT SMALL FIRM	ANNUAL EMPLOYEE GROWTH* (1972-1977)
0161	NA	NA	NA	NA	NA	NA	NA
0173	NA	NA	NA	NA	NA	NA	NA
0179	NA	NA	NA	NA	NA	NA	NA
1021	36.4	33.1	2197.6	66.4	25.7	7.4	-.018
1031	7.7	7.1	208.7	27.1	0	7.1	-.016
1311	116.6	139.7	NA	NA	39.4	100.3	.04
1382	9.8	17.8	234.8	13.2	0	17.8	.163
1389	58.2	99.3	2114.6	21.3	8.8	90.5	.141
1422	30.0	29.1	1413.3	48.6	NA	NA	-.006
1452	.9	1.3	40.4	31.1	NA	NA	.089
1473	.8	.7	NA	NA	0	.7	-.025
1629	286.2	412.7			303.3	109.4	.088
1761	NA	NA			NA	NA	NA
4212	NA	NA					
4213	NA	NA					
4222	NA	NA					
4311	NA	NA					
4411	NA	NA					
4613	NA	NA					
4783	NA	NA					
4811	NA	NA					
4899	NA	NA					
4922	NA	NA					
4923	NA	NA					
4931	NA	NA					
5013	246.1	235.7			45.3	190.4	-.008
5043	36.0	14.2			NA	NA	-.121
5051	121.3	189.6					-.113
5063	136.3	99.5					-.054
5064	62.7	42.7					-.064
5065	58.1	52.1			12.4	39.7	-.021
5074	61.5	72.7			NA	NA	-.036
5081	183.5	92.9			62.6	30.3	-.099
5082	67.4	76.1			16.4	59.7	.026
5084	137.2	129.5			33.7	95.8	-.018
5085	123.8	110.5			NA	NA	-.021
5086	89.9	92.5					.006
5099	36.3	36.3					0
5111	28.4	24.2					-.03
5122	87.6	62.2			29.2	33.0	-.058
5133	42.0	31.2			NA	NA	-.051
5141	101.3	110.2					.018
5142	29.3	31.8					.017
5143	53.2	26.8					-.099
5146	15.5	16.7					.015
5147	85.4	69.6					-.037

*Percentage growth ÷5.

SELECTED INDUSTRY STATISTICS--SELECTED NONMANUFACTURING INDUSTRIES (Cont.)

SIC CODE	(1,000) TOTAL EMPLOYMENT 1972	1977	(MILLION $) 1977 GROSS CAPITAL STOCKS	($1,000) CAPITAL INTENSITY RATIO	(1,000) 1977 EMPLOYMENT LARGE FIRM	SMALL FIRM	ANNUAL EMPLOYEE GROWTH* (1972-1977)
5149	140.6	75.9	NA	NA	NA	NA	-.092
5161	77.9	52.9					-.064
5172	41.8	43.7					.009
5191	130.1	121.3					-.014
5198	22.9	15.8					-.062
5199	148.8	123.3					-.034
5311	NA	NA					NA
5411	NA	NA	NA	NA	NA	NA	NA
5941	NA	76.9					NA
5961	121.9	126.2					.007
6059	NA	NA					NA
6145	NA	NA					
6211	NA	NA					
6311	NA	NA					
6399	NA	NA					
6519	NA	NA					
6711	NA	NA					
7011	711.1	894.1			645.1	294.0	.051
7213	65.6	61.4			25.3	36.1	-.012
7299	NA	NA			NA	NA	NA
7362	179.1	331.5					.170
7372	NA	NA					
7374	NA	NA					
7379	NA	NA					
7391	72.5	48.5			26.2	22.3	-.066
7392	143.2	208.8			28.1	180.7	.092
7393	212.0	279.9			143.9	136.0	.064
7395	44.4	64.3			29.4	34.9	.09
7397	22.5	25.3			4.3	20.9	.025
7399	NA	NA			NA	NA	NA
7813	16.9	NA					
7819	12.0	NA					
8911	292.6	NA					
8931	NA	NA					

*Percentage growth ÷5.

SOURCE: 1972 and 1977 Census of Mineral Industries; 1972 and 1977 Census of Selected Service Industries; 1972 and 1977 Census of Retailers; 1972 and 1977 Census of Wholesalers; Special Report of the Census Bureau to the U.S. Small Business Administration; TFG calculations.

Appendix 4

DISTRIBUTION OF INNOVATIONS BY FOUR-DIGIT SIC CODE

DISTRIBUTION OF INNOVATIONS BY FOUR-DIGIT SIC CODE

SIC CODE	DESCRIPTION	INNOVATIONS			TOTAL
		LARGE FIRM	SMALL FIRM	NOT ALLOCABLE	
0161	Vegetables and melons	2	0		2
0173	Tree nuts	1	0		1
0179	Fruits and tree nuts, nec	1	0		1
1021	Copper ores	1	0		1
1031	Lead and zinc ores	6	0		6
1311	Crude petroleum and natural gas	56	1		57
1382	Oil and gas exploration services	10	0		10
1389	Oil and gas field service nec	11	0		11
1422	Crushed and broken limestone	1	0		1
1452	Bentonite	0	1		1
1473	Fluorspar	17	0		17
1629	Heavy construction, nec	24	2		26
1761	Roofing and sheet metal work	0	1		1
2011	Meat packing plants	1	2		3
2013	Sausages and other prepared meats	0	3		3
2016	Poultry dressing plants	8	1		9
2017	Poultry and egg processing	1	2		3
2022	Cheese, natural and processed	17	1		18
2023	Condensed and evaporated milk	0	1		1
2026	Fluid Milk	14	0		14
2032	Canned specialties	1	0		1
2033	Canned fruits and vegetables	4	1		5
2034	Dehydrated fruits and vegetables, soups	2	1		3
2035	Pickles, sauces, and salad dressings	1	1		2
2037	Frozen fruits and vegetables	4	1		5
2038	Frozen specialties	9	1		10
2041	Flour and other grain mill products	4	1		5
2043	Cereal breakfast foods	5	2		7
2045	Blended and prepared flour	0	2		2
2046	Wet corn milling	6	0		6
2047	Dog, cat, and other pet food	0	0	1	1
2048	Prepared feeds, nec	3	2		5

		INNOVATIONS			
		LARGE FIRM	SMALL FIRM	NOT ALLOCABLE	TOTAL
2051	Bread, cake, and related products	0	3		3
2052	Cookies and crackers	1	0		1
2061	Raw cane sugar	3	0		3
2062	Cane sugar refining	4	0		4
2066	Chocolate and cocoa products	1	0		1
2074	Cottonseed oil mills	2	0		2
2075	Soybean oil mills	1	1		2
2079	Shortening and cooking oils	4	0		4
2082	Malt beverages	5	0		5
2085	Distilled liquor, except brandy	5	0		5
2086	Bottled and canned soft drinks	2	0		2
2087	Flavoring extracts and sirups, nec	4	24		28
2092	Fresh or frozen packaged fish	8	11		19
2098	Macaroni and spaghetti	0	1		1
2099	Food preparations, nec	5	12		17
2111	Cigarettes	9	0		9
2211	Weaving mills, cotton	1	0		1
2221	Weaving mills, synthetics	1	1		2
2231	Weaving and finishing mills, wool	1	1		2
2241	Narrow fabric mills	0	2		2
2258	Warp knit fabric mills	0	1		1
2295	Coated fabrics, not rubberized	0	2		2
2311	Men's and boys' suits and coats	3	1		4
2328	Men's and boys' work clothing	2	0		2
2381	Fabric dress and work gloves	0	1		1
2392	House furnishing, nec	0	2		2
2394	Canvas and related products	0	6		6
2399	Fabricated textile products, nec	4	0		4
2421	Sawmills and planing mills general	1	0		1
2431	Millwork	4	0		4
2441	Nailed wood boxes and shook	0	4		4
2499	Wood products, nec	1	1		2
2511	Wood household furniture	2	1		3
2514	Metal household furniture	0	5	1	6
2521	Wood office furniture	1	1		2
2522	Metal office furniture	25	3		28
2531	Public building and related furniture	1	4		5

SIC CODE	DESCRIPTION	INNOVATIONS			TOTAL
		LARGE FIRM	SMALL FIRM	NOT ALLOCABLE	
2541	Wood partitions and fixtures	2	2		4
2542	Metal partitions and fixtures	5	10		15
2591	Drapery hardware & blinds & shades	2	0		2
2599	Furniture and fixtures, nec	0	7		7
2611	Pulp mills	1	0		1
2621	Paper mills, except building paper	10	0		10
2631	Paperboard mills	4	0		4
2641	Paper coating and glazing	4	2		6
2643	Bags, except textile bags	5	0		5
2645	Die-cut paper and board	2	0	1	3
2647	Sanitary paper products	0	2	1	3
2648	Stationery products	1	0		1
2649	Converted paper products, nec	13	1		14
2651	Folding paperboard boxes	1	2		3
2652	Set-up paperboard boxes	0	3		3
2653	Corrugated and solid fiber boxes	2	0		2
2654	Sanitary food containers	2	0		2
2661	Building paper and board mills	4	0		4
2711	Newspapers	5	0		5
2721	Periodicals	0	1		1
2731	Book publishing	3	0		3
2741	Miscellaneous publishing	0	1	1	2
2751	Commercial printing, letterpress	3	1		4
2752	Commercial printing, lithographic	0	4		4
2761	Manifold business forms	1	0		1
2771	Greeting card publishing	1	0		1
2782	Blankbooks and looseleaf binders	2	2		4
2812	Alkalies and chlorine	4	0		4
2813	Industrial gases	7	2		9
2816	Inorganic pigments	5	1		6
2819	Industrial inorganic chemicals, nec	32	8		40
2821	Plastics materials and resins	30	15		45
2822	Synthetic rubber	0	4		4

SIC CODE	DESCRIPTION	INNOVATIONS			TOTAL
		LARGE FIRM	SMALL FIRM	NOT ALLOCABLE	
2831	Biological products	1	4		5
2833	Medicinals and botanicals	27	5		32
2834	Pharmaceutical preparations	120	13		133
2841	Soap and other detergents	7	4		11
2842	Polishes and sanitation goods	13	19	1	33
2843	Surface active agents	2	10		12
2844	Toilet preparations	41	18		59
2851	Paints and allied products	6	11		17
2861	Gum and wood chemicals	1	3		4
2865	Cyclic crudes and intermediates	1	1		2
2869	Industrial organic chemicals, nec	17	3	1	21
2879	Agricultural chemicals, nec	24	0		24
2891	Adhesives and sealants	7	11		18
2892	Explosives	1	0		1
2893	Printing ink	1	2		3
2895	Carbon black	1	0		1
2899	Chemical preparations, nec	11	7		18
2911	Petroleum refining	14	0		14
2952	Asphalt felts and coatings	0	2		2
2992	Lubricating oils and greases	0	8		8
3011	Tires and inner tubes	11	0		11
3041	Rubber and plastics hose and belting	2	0		2
3069	Fabricated rubber products, nec	5	4		9
3079	Miscellaneous plastics products	22	82	3	107
3142	House slippers	0	1		1
3143	Men's footwear, except athletic	1	0		1
3161	Luggage	0	1		1
3199	Leather goods, nec	0	3		3
3211	Flat glass	12	0		12
3221	Glass containers	6	0		6
3229	Pressed and blown glass, nec	11	2		13
3231	Products of purchased glass	2	4		6
3261	Vitreous plumbing fixtures	0	1		1
3264	Porcelain electrical supplies	5	1		6
3275	Gypsum products	1	0		1
3291	Abrasive products	0	3		3
3293	Gaskets, packing and sealing devices	2	3		5
3295	Minerals, ground or treated	0	1		1
3296	Mineral wood	2	1		3
3299	Nonmetallic mineral products, nec	0	2		2

SIC CODE	DESCRIPTION	INNOVATIONS			
		LARGE FIRMS	SMALL FIRMS	NOT ALLOCABLE	TOTAL
3312	Blast furnaces and steel mills	10	1		11
3315	Steel wire and related products	0	1		1
3316	Cold finishing of steel shapes	3	0		3
3317	Steel pipe and tubes	0	1		1
3321	Gray iron foundries	15	1		16
3325	Steel foundries, nec	13	1		14
3331	Primary copper	0	1		1
3334	Primary aluminum	5	0		5
3339	Primary nonferrous metals, nec	1	0		1
3351	Copper rolling and drawing	0	1		1
3357	Nonferrous wire drawing & insulating	0	3		3
3361	Aluminum foundries	1	2		3
3362	Brass, bronze, and copper foundries	0	0	1	1
3369	Nonferrous foundries, nec	1	0		1
3398	Metal heat treating	0	1		1
3399	Primary metal products, nec	8	3		11
3411	Metal cans	6	1		7
3421	Cutlery	4	0		4
3423	Hand and edge tools, nec	27	11	1	39
3425	Hand saws and saw blades	2	3		5
3429	Hardware, nec	8	16	1	25
3431	Metal sanitary ware	0	2		2
3432	Plumbing fittings and brass goods	10	6		16
3433	Heating equipment, except electric	8	14		22
3442	Metal doors, sash, and trim	1	7		8
3443	Fabricated plate work (boiler shops)	29	9		38
3444	Sheet metal work	1	5		6
3446	Architectural metal work	0	2		2
3448	Prefabricated metal buildings	9	5		14
3449	Miscellaneous metal work	0	1		1
3451	Screw machine products	1	0		1
3452	Bolts, nuts, rivets, and washers	2	3		5
3462	Iron and steel forgings	6	1	1	8
3465	Automotive stampings	2	0		2
3469	Metal stampings, nec	2	10		12
3471	Plating and polishing	0	3		3

SIC CODE	DESCRIPTION	INNOVATION			TOTAL
		LARGE FIRM	SMALL FIRM	NOT ALLOCABLE	
3479	Metal coating and allied services	0	3		3
3483	Ammunition, exc. for small arms, nec	21	0		21
3494	Valves and pipe fittings	20	33	1	54
3496	Misc. fabricated wire products	4	2		6
3498	Fabricated pipe fittings	0	5		5
3499	Fabricated metal products, nec	12	17	6	35
3511	Turbines and turbine generator sets	7	2		9
3519	Internal combustion engines, nec	13	2		15
3523	Farm machinery and equipment	13	17		30
3524	Lawn and garden equipment	2	2		4
3531	Construction machinery	11	10		21
3532	Mining machinery	0	7		7
3533	Oil field machinery	0	2		2
3534	Elevators and moving stairways	3	3		6
3535	Conveyors and conveying equipment	4	17	1	22
3536	Hoists, cranes, and monorails	1	9		10
3537	Industrial trucks and tractors	13	20		33
3541	Machine tools, metal cutting types	18	7		25
3542	Machine tools, metal forming types	1	4		5
3544	Special dies, tools, jigs & fixtures	0	6	1	7
3545	Machine tool accessories	1	5		6
3546	Power driven hand tools	14	7		21
3547	Rolling mill machinery	1	0		1
3549	Metalworking machinery, nec	3	3		6
3551	Food products machinery	37	12	1	50
3552	Textile machinery	11	13		24
3553	Woodworking machinery	3	0		3
3554	Paper industries machinery	6	1		7
3555	Printing trades machinery	6	13		19
3559	Special industry machinery, nec	43	21		64
3561	Pumps and pumping equipment	18	16		34
3562	Ball and roller bearings	0	4		4

SIC CODE	DESCRIPTION	INNOVATIONS			
		LARGE FIRM	SMALL FIRM	NOT ALLOCABLE	TOTAL
3563	Air and gas compressors	2	5		7
3564	Blowers and fans	10	8		18
3566	Speed changers, drives and gears	4	3		7
3567	Industrial furnaces and ovens	12	9		21
3568	Power transmission equipment, nec	4	7		11
3569	General industrial machinery, nec	54	13		67
3572	Typewriters	0	59		59
3573	Electronic-computing equipment	158	227	10	395
3574	Calculating and accounting machines	9	1		10
3576	Scales and balances, exc. laboratory	4	21		25
3579	Office machines, nec	67	10		77
3585	Refrigeration and heating equipment	10	14	1	25
3586	Measuring and dispensing pumps	0	2		2
3589	Service industry machinery, nec	2	19		21
3592	Carburetors, pistons, rings, valves	1	0		1
3599	Machinery, except electrical, nec	5	12		17
3612	Transformers	5	11	4	20
3613	Switchgear and switchboard apparatus	15	6		21
3621	Motors and generators	39	10		49
3622	Industrial controls	15	46		61
3623	Welding apparatus, electric	2	4		6
3624	Carbon and graphite products	2	0		2
3629	Electrical industrial apparatus, nec	0	5		5
3631	Household cooking equipment	2	2		4
3632	Household refrigerators and freezers	0	1		1
3633	Household laundry equipment	1	0		1
3634	Electric housewares and fans	47	6		53
3635	Household vacuum cleaners	3	0		3
3636	Sewing machines	1	1		2

SIC CODE	DESCRIPTION	INNOVATIONS			TOTAL
		LARGE FIRM	SMALL FIRM	NOT ALLOCABLE	
3641	Electric lamps	0	3		3
3643	Current-carrying wiring devices	2	3		5
3644	Noncurrent-carrying wiring devices	0	1		1
3645	Residential lighting fixtures	2	0		2
3651	Radio and TV receiving sets	35	4	1	40
3661	Telephone and telegraph apparatus	2	7	3	12
3662	Radio and TV communication equipment	83	72	2	157
3673	Electron tubes, transmitting	0	5		5
3674	Semiconductors and related devices	91	29	2	122
3675	Electronic capacitors	3	0	2	5
3676	Electronic resistors	0	3		3
3677	Electronic coils and transformers	0	3		3
3678	Electronic connectors	0	3		3
3679	Electronic components, nec	54	73	1	128
3691	Storage batteries	22	0		22
3692	Primary batteries, dry and wet	0	1		1
3693	X-ray apparatus and tubes	17	10		27
3694	Engine electrical equipment	3	0		3
3699	Electrical equipment & supplies, nec	3	7		10
3711	Motor vehicles and car bodies	29	1		30
3713	Truck and bus bodies	12	0		12
3714	Motor vehicle parts and accessories	22	6		28
3721	Aircraft	31	1		32
3724	Aircraft engines and engine parts	4	0		4
3728	Aircraft equipment, nec	9	3		12
3731	Ship building and repairing	5	0	2	7
3732	Boat building and repairing	2	0		2
3743	Railroad equipment	2	0		2
3751	Motorcycles, bicycles, and parts	2	0		2
3761	Guided missiles and space vehicles	14	0		14
3764	Space propulsion units and parts	1	0		1

SIC CODE	DESCRIPTION	INNOVATIONS			TOTAL
		LARGE FIRM	SMALL FIRM	NOT ALLOCABLE	
3769	Space vehicle equipment, nec	0	1		1
3792	Travel trailers and campers	1	0		1
3799	Transportation equipment, nec	0	5		5
3811	Engineering & scientific instruments	43	83		126
3822	Environmental controls	22	10		32
3823	Process control instruments	68	93	4	165
3824	Fluid meters and counting devices	6	10		16
3825	Instruments to measure electricity	28	47	2	77
3829	Measuring & controlling devices, nec	3	45	4	52
3832	Optical instruments and lenses	12	21	1	34
3841	Surgical and medical instruments	30	36		66
3842	Surgical appliances and supplies	30	33	4	67
3843	Dental equipment and supplies	0	2		2
3851	Ophthalmic goods	9	2		11
3861	Photographic equipment and supplies	79	9		88
3914	Silverwave and plated ware	3	0		3
3944	Games, toys and children's vehicles	3	0		3
3949	Sporting and athletic goods, nec	5	15		20
3951	Pens and mechanical pencils	4	0		4
3952	lead pencils and art goods	1	0		1
3953	Marking devices	0	6		6
3964	Needles, pins, and fasteners	2	1		3
3991	Brooms and brushes	0	7		7
3993	Signs and advertising displays	1	2		3
3999	Manufacturing industries, nec	11	3		14
4212	Local trucking, without storage	0	1		1
4213	Trucking, except local	1	0		1
4222	Refrigerated warehousing	0	2		2
4311	U.S. Postal service	1	0		1
4411	Deep sea foreign transportation	0	1		1
4613	Refined petroleum pipe lines	2	0		2

SIC CODE	DESCRIPTION	INNOVATIONS			TOTAL
		LARGE FIRM	SMALL FIRM	NOT ALLOCABLE	
4783	Packing and crating	0	1		1
4811	Telephone communication	4	0		4
4899	Communication services, nec	1	4		5
4922	Natural gas transmission	5	0		5
4923	Gas transmission and distribution	6	0		6
4931	Electric and other services, combined	1	0		1
5013	Automotive parts and supplies	5	0	1	6
5043	Photographic equipment and supplies	4	3		7
5051	Metals service centers and offices	2	3		5
5063	Electrical apparatus and equipment	6	9		15
5064	Electrical appliances, TV and radios	15	3		18
5065	Electronic parts and equipment	22	2		24
5074	Plumbing & hydronic heating supplies	1	1		2
5081	Commercial machines and equipment	2	8		10
5082	Construction and mining machinery	0	2		2
5084	Industrial machinery and equipment	0	10	1	11
5085	Industrial supplies	0	4		4
5086	Professional equipment and supplies	7	12	1	20
5099	Durable goods, nec	0	3		3
5111	Printing and writing paper	1	0		1
5122	Drugs, proprietaries, and sundries	1	2		3
5133	Piece goods	0	2		2
5141	Groceries, general line	1	0		1
5142	Frozen foods	0	1		1
5143	Dairy products	3	0		3
5146	Fish and seafoods	1	1		2
5147	Meats and meat products	0	1		1

SIC CODE	DESCRIPTION	INNOVATIONS			
		LARGE FIRM	SMALL FIRM	NOT ALLOCABLE	TOTAL
5149	Groceries and related products, nec	0	4		4
5161	Chemicals and allied products	4	0		4
5172	Petroleum products, nec	1	0		1
5191	Farm supplies	1	0		1
5198	Paints, varnishes and supplies	0	2		2
5199	Nondurable goods, nec	0	2		2
5311	Department stores	1	0		1
5411	Grocery stores	2	0		2
5941	Sporting goods and bicycle shops	2	0		2
5961	Mail order houses	4	0		4
6059	Functions related to banking, nec	0	1		1
6145	Licensed small loan lenders	4	0		4
6211	Security brokers and dealers	0	1		1
6311	Lif insurance	0	1		1
6399	Insurance carriers, nec	1	0		1
6519	Real property lessors, nec	5	0		5
6711	Holding offices	58	11	8	77
7011	Hotels, motels, and tourist courts	1	0		1
7213	Linen supply	5	0		5
7299	Miscellaneous personal services	1	0		1
7362	Temporary help supply services	0	1		1
7372	Computer programming and software	9	7		16
7374	Data processing services	7	5		12
7379	Computer-related services, nec	15	1		16
7391	Research & development laboratories	5	10	1	16
7392	Management and public relations	1	2		3
7393	Detective and protective services	1	0		1
7395	Photofinishing laboratories	1	0		1
7397	Commercial testing laboratories	1	1		2
7399	Business services, nec	0	2		2
7813	Motion picture production, except TV	1	0		1
7819	Services allied to motion pictures	1	0		1

SIC CODE	DESCRIPTION	INNOVATIONS			TOTAL
		LARGE FIRM	SMALL FIRM	NOT ALLOCABLE	
8911	Engineering & architectural services	20	3		23
8931	Accounting, auditing & bookkeeping	1	0		1
NA	Not allocable	4	15	3057	3076
	Totals	2834	2104	3136	8074