MEASURING CONTRIBUTION OF SMALL BUSINESS TO INDUSTRY JOB GROWTH BY DATA IN BUSINESS ASSOCIATION DIRECTORIES

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Report to the Office of Advocacy
of the U.S. Small Business Administration
for Project SBAHQ-97-M-0753
April 30, 1999

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PREFACE

This report was prepared by the NPA Data Services, Inc., for the Office of Advocacy of the U.S. Small Business Administration under contract SBAHQ-97-M-0753.

The objective given by the SBA was to examine the practicalities of using data published in business association directories, to measure the contribution of small business, including new companies, to growth of the respective industries, including newly emergent industries.

The results of this work are summarized in the Executive Summary and presented in full in the following report.

The project was directed and this report was prepared by Nestor E. Terleckyj with assistance by Ruth Oversmith and Tatiana M. Terleckyj. Charles D. Coleman developed the procedures for sampling membership data from the directories examined, conducted the augmentation of these data by cross-references to other business directories and developed the databases for the company samples presented in the appendix to this report.

Many persons helped us to complete this project. In particular, I would like to thank Bruce D. Phillips and Terry E. Bibbens of the Small Business Administration for help in formulating this project and in obtaining the necessary information and Zoltan J. Acs, Robert E. Berney, Charles D. Coleman and Fred A. Tarpley for helpful comments and suggestions received in the course of this work.

I would like to thank Michaela A. Platzer of the American Electronics Association and Anne Griffith of the Software and Information Industries Association for granting permission to release in this report the results of analyses based on data obtained from the membership directories of the respective two Associations. The data for groups of companies are presented in the report in ways that prevent identification of any information for an individual company.

The author alone is responsible for the contents of the report and for any errors that may remain.

Nestor E. Terleckyj
February 1999

EXECUTIVE SUMMARY

Objectives

This report contains the results of a pilot study undertaken to explore the feasibility of using data published in trade association directories to measure contribution of small business to the growth of industries. Special attention was given to high technology industries.

Publicly accessible data for analyzing growth of small firms and emergence of new firms is very scarce and difficult to come by. However, the annual trade association directories in most cases report the number of employees of their members and the date these firms were established. Thus, it is possible to identify the emergence and size changes over time of specific firms which were members of an industry association from its directories for different years.

Business directories were not used previously to gather data for analysis of the contribution of small firms to growth of industry employment. Hence it was necessary in this project to develop methods for gathering the necessary data and for analyzing it.

The conduct of the project and reporting of its results has been subject to the requirement of protecting confidentiality of information about individual firms and of complying with the copyright requirements of associations which publish business directories.

Methods

The project was conducted within the conceptual framework developed by the NPA Data Services, Inc., for measuring contribution of small and new business to growth of an industry over a period of time. This approach requires organization of data for the same firms for at least two points in time with firms classified by their size at the beginning of the period. New firms established during the period are also classified as small because their beginning size was zero. This data arrangement is called longitudinal. The longitudinal arrangement of data is required to measure contributions to growth of firms of different size classes. However, because it is sometimes confused with cross-sectional data by firm size as of each point in time, the extent of bias in measuring the contribution of small firms to industry growth based on the cross-section method is also assessed.

Membership directories of the American Electronics Association (AEA) for 1994-5 and 1997 and of the Software Publishers Association (SPA) for 1994 and 1996 were used to get the data for the present analysis of industry growth. Both sets of directories have data from surveys of members taken two years apart.

In examining data in these directories, it became quite clear early in the conduct of the

project that an intensive effort was required to match the companies' data between the later and the earlier directories. A complete analysis of all entries in the four directories could not be undertaken within the scope of this comparatively small pilot project. Therefore, statistical sampling of entries in the later of the two directories was conducted in each case. Such "retrospective" sampling of the later year data and subsequent tracing of earlier histories of companies in the sample permits assessing the contribution of new companies as well as of the initially small companies to growth of the industry sample over time.

Three random samples, of 100 companies each, were drawn from the 1997 AEA directory and two such samples were drawn from the 1996 SPA directory. The sampling universe of the SPA membership was much smaller because it was limited to developers and publishers of software. All sampling was limited to U.S. domestic firms which were regular members of the respective associations, excluding associate members, foreign subsidiaries, non-profit institutions and firms with primary business in another industry, e.g. consulting. Companies with missing or incomplete employment or date of founding information were rejected and other companies were drawn in their place for the sample.

In the AEA directories, 214 companies out of 300 sampled had the required information for the date established and for employment in both years. In the SPA directories 110 companies out of 200 sampled had the required information. This data collection was augmented by cross-reference first among the directories of the two associations and then also with the larger, more general CorpTech directory (1994 Edition) of technology based firms. These references, especially the latter, increased the coverage significantly, so that in the end, 252 or 84 percent out of 300 AEA companies had data for both years, and 124 out of 200 or 62 percent of companies in the SPA samples had the required data. However, the proportion of employment coverage of the original sample was higher than the proportion of the number of companies. The companies with data for both years in the AEA directory represented over 95 percent of employment in the full sample drawn from the 1997 AEA directory and 90 percent of the full sample employment in the 1996 SPA directory.

Results

1. The most important result of the project in terms of objectives of this pilot study is that meaningful information about the contribution of small business to industry growth can be obtained from business association directories, with a fairly moderate amount of effort. Statistical sampling offers an efficient method for obtaining valid indications of the magnitude of this contribution among the member companies for which information is available for the dates defining the period examined. It is also helpful to supplement the data in industry association directories by reference to more general published business directories, such as the CorpTech directories. This indicates that the data in business association directories are subject to limitations arising from fluctuations in the association membership.

2. Business association directories also have the advantage of timeliness over the existing government statistics in capturing the emergence of new industries or industry groupings, especially in the technology intensive field before their separate identities and interrelationships are recognized in official industrial categorizations and statistics are collected for them.

3. A significant substantive result is that the small business, including new companies, contributed much larger share to the growth of the industry represented by the samples of companies than was its share of employment in the initial year. Thus, the new and small AEA member companies with employment data for both years accounted for 25 % of employment in the first year but for 39 % of the increase in the industry employment covered in the three samples. The new and small SPA member companies accounted for 20 % of total employment in the base year but for 30 % of the employment increase.

4. The static cross-sectional method, typical of most government data, credits growth of small companies which became large to large business, and would miss this result completely. A growth calculation based on the cross-section tabulation suggested only a 7 % contribution of small business to the sampled AEA employment growth and only 16 % to the sampled SPA employment growth.

5. Much of the contribution of small business to industry growth was made by the companies which crossed the line between small and large size during the period. They had the highest annual growth rate and accounted together with the new companies for the greater relative proportion of contribution of small business than of large business to industry growth. The small companies, which remained small, grew at about the same rate as the large companies in the samples of both industries.

6. In many regards, the results obtained by these samples were consistent with the life cycle paradigm of industry growth. Thus, in both industries, small companies grew more rapidly than did the large companies, and including new companies the average age of small companies was much younger than of the large companies.

7. The average age of small companies that grew to be large was higher than the age of small companies that remained small, and their average size was considerably larger.

8. Work with copyrighted directories requires permission to copy materials in the directories, to work with it and to release the resulting report. The associations generally required confidentiality protection of data for individual member companies.

Measuring Contribution of Small Business To Industry Job Growth by Data In Business Association Directories

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I. Objectives, Significance and the Approach of the Project.

Objectives of the Analysis

This report contains the results of a pilot study designed to explore the feasibility of using employment data from industry association directories to measure contributions of small firms to employment growth of industries over a period of time. This exploration is conducted with directory data from two high technology industry directories: electronics and software publishing.

This study develops estimates of the contribution of small business to industry employment growth obtained by the dynamic **longitudinal** method where the data for individual companies are classified by their size at the beginning of the period. The longitudinal approach is appropriate for organizing the data of individual companies to identify contribution to growth of groups of companies. These longitudinal estimates are compared with the results of using the static **cross-section** method of data tabulation where companies are classified by their size separately in each given year of the period. The cross-sectional estimates measure the size

distribution of business at any given time or over time, but do not provide any information about the contribution to growth of particular groups of individual companies, e.g. small companies, consistently defined for the whole period over which growth is measured. The cross-sectional data is likely to provide a biased indication of the contribution of small business to growth. Because longitudinal data is rare, especially for small companies, cross-sectional data is sometimes used mistakenly to assess contributions of small businesses to industry growth. However, to the extent that the innovation and technology driven lifecycle model applies to the present day economic process in the United States, tabulations based on the cross-sectional data tend to seriously understate the contribution of small business to growth of new or young industries. Because the cross-sectional results are sometimes mistakenly used as indicators of the contribution of small business to growth, special attention is given in this paper to the difference between the two types of calculation. (See the Technical Note in Appendix B of this report for a discussion of the two methods and a hypothetical example). A recent comprehensive survey of economic literature dealing with the size distribution of firms and plants and to some extent also with the models of company growth was recently published by Sutton (1997).

Sources of longitudinally derived data needed to measure the contribution to growth of new and small businesses are very limited and incomplete. Therefore, the present analysis was undertaken to explore the use of data in membership directories in selected high technology (and hence high growth) industry associations in analyzing the contribution of small businesses to growth of these industries.

Employment is the chosen indicator of company size because employment is a well recognized indicator of company size and is the size indicator most frequently given in business directories. Following the practice of the U.S. Small Business Administration, small companies are defined as firms with fewer than 500 employees and large companies as those with 500 or more employees.

The Conceptual Framework

The underlying rationale for the approach taken in this study is the view that the American economy is becoming increasingly more Schumpeterian[1] in the sense that it is increasingly more driven by entrepreneurship and innovation. While the product and capital markets continue to be dominated by large and often diversified firms, these are not the same firms over time. New firms grow and the old firms decline. Firms, as well as products and technologies, are subject to life cycles.

New successful technologies and firms grow rapidly, while the older firms grow at slower rates and many level off and shrink. The innovative growth originates disproportionately to their initial size in new small firms, specialized in a new product or service. The innovations may come from science and engineering based new technologies but this is not necessary. New concepts of organizations or specialization may start a new service to business or consumers. Similarly, a new way of producing, marketing or financing existing products or services may give rise to new types of business. In all these cases, successful new innovating firms grow in size, multiply in number and eventually result in emergence of entirely new industries.

In this life-cycle view, most of economic growth comes from new small businesses which are successful and grow eventually to be large. Some large older firms also innovate by developing new technologies and products and continue to grow by re-inventing themselves, but some do not. Thus, on the whole more growth comes from the comparatively younger firms in newer industries. An extensive study of job creation by David L. Birch (1987) found that new and

[1] After Joseph A. Schumpeter, the economist who developed the theory of economic growth being driven by technical and organizational innovations.

small companies contributed most to growth of employment in the United States in the 1970's and the early 1980's. Subsequent research by Phillips (1991), based on a set of previously existing longitudinal data, established that over the ten year period 1976-86, small firms (under 500 employees) in high technology industries contributed 38 percent of job increases in these industries while they represented less than 19 percent of employment in the base year 1976. The very small firms under 20 employees, which represented only 3.8 percent of employees in the high technology industries in the base year, contributed 15 percent of the employment growth in the ten year period.

The life-cycle view is supported by observation that many of the largest companies of today did not exist twenty years ago, and many of the giants of the past have fallen behind in terms of capitalization and employment and some have shrunk in size or even disappeared entirely.

While the life-cycle model applies to products, technologies and firms, the distinctions between firms, products and technologies are important. They bear on the search for and treatment of data and correspondence of data to the analytical concepts.

One important distinction is between technologies, products, product markets and production units of the firms on the one hand and firms as property (assets) and decision units on the other. The statistical concepts based on standard industrial classification (SIC) in which most business statistics are organized correspond to products, markets, producer units and production technologies. The observable units for these concepts are the establishments which are surveyed and reported according to their standard industrial classification organized into industries. Products, product markets and their prices are subject to specialized economic analyses and, in some cases, to governmental regulation.

On the other hand, firms as decision units are defined by law based on their ownership, as

corporations, partnerships or sole proprietor enterprises. Firms may or may not be limited to one product or a group of related products. Indeed, some large and very diverse conglomerates have existed e.g., firms combining finance and manufacturing. In the software production and publishing industry, which is analyzed here, much of its primary output, i.e. development and publishing of software has been produced not only by specialized software firms, but also by manufacturers of computers and of communication equipment, and by book publishers, especially publishers of reference books such as encyclopaedias and atlases.

Firms as property, legal and decision units have their major interface with the capital markets and governments. Establishments, on the other hand, interface with product and labor markets. In the present analysis the focus is on new and small business firms in innovating industries.

The contribution of small business to the growth of industries can then be identified independently of the changes and development among the large businesses of these industries. The directory of an industry association has the advantage of self-identification of firms with industry groupings. Their common designations correspond to a meaningful delineation of industries in terms of firms somewhat broader than the SIC categories and similar to definitions used in the capital market analyses. These definitions are more fluid and are subject to more rapid evolution than the official statistical categorizations. They also find reflection in industrial subdivisions identified in membership directories.

Another advantage of the business association directories is that the data contained in them is organized into existing, real and meaningful industry groupings long before these industry definitions are embodied in official statistics.

Because small firms are usually narrowly oriented in one or few related products and often have one establishment, the contribution of small business can be measured to the extent that new companies are covered in business directories. Along the full continuum of size and age of

companies, the small business members of industry associations may be expected to be larger than all small and new companies, especially the unincorporated firms. Small companies that maintain their membership over a period of time probably represent the relatively more successful surviving companies. The very newest and very smallest companies may not survive long and may never join an association.

The choice of the period of time for analyzing the contribution of small business to industry growth is a matter of practicality. Here a two year period is examined, because in this very small exploratory project, tracing the identity of individual firms over time would become increasingly more difficult over longer periods, as some early exploratory research done at the beginning of this study showed. Nevertheless, a systematic analysis of directory data over a two year period can show whether small business contributes out of proportion to its initial size to growth of industries as measured by the employment in firms with continuous association membership.

Data Needs for Measuring the Contribution of Small Business to Growth

In order to analyze components of the growth of an industry or of any group of firms, in terms of business size, it is necessary to have longitudinally organized company data showing the company size for the same companies over time as a time series for at least two points in time. The databases with company data compiled by the cross-sectional method often substantially understate the contribution of small businesses to growth of the industry and the economy. The main reason for this is that the companies that were small or did not even exist in the beginning of the period (i.e. had zero employment) and grew to be large at the end of the period are identified in cross-section tabulations as large companies at the end of the period. Thus, the static approach which takes snapshots of the size distribution of firms at two **points in time** cannot reflect the true contribution to growth of individual firms or groups of firms such as the new and small

business **over a period of time.** This distortion is particularly great in growing economies and growing industries, such as the new high technology industries.

However, the longitudinal data sets for small and new firms are quite rare. Until the development of the LEEM (Longitudinal Enterprise and Establishment Micro-data) file in 1998, which is described in a recent publication by the Small Business Administration (1998), all public statistics on company size in the United States were compiled by the cross-sectional method i.e., the companies were allocated to the size classes into which they fell during the given year. Longitudinal data on company histories and their (changing) identities are available only from private sources or from special studies authorized by public agencies in which databases were constructed from longitudinal data or datasets aggregated for firms.

There are good and important private compilations of longitudinal company data time series based on the information required for public disclosure by laws guiding issue of and trading in securities and by other regulations (e.g. of financial institutions and of public utilities). These often very detailed, elaborate, and expensive information sources, often enhanced by detailed information for corporate mergers, acquisitions, divestitures and other changes, however, do not cover many of the smaller businesses or new firms.

II. Development of Analytical Database from Business Association Directories

Directories Selected

This study analyzes information from membership directories for two high technology industry associations for which directory data are available for two recent points in time, the American Electronics Association (AEA) and the Software Publishers Association (SPA). These industries are characterized by high rates of technical innovations. These industries were selected after examining the availability of membership data from a larger number of business associations

of technology intensive industries.

The electronics industry is a comparatively older industry, while the software publishing industry is newer and more rapidly growing. In the present project, as indicated earlier, a comparatively short 2-year period was chosen to avoid the risk of massive discontinuities of company data. At the time this project was initiated in September 1997 the most recent AEA directories, issued two years apart, were dated 1994/5 and1997 with employment data reported for 1994 and 1996 respectively. For the SPA the most recent membership directories issued two years apart and dated 1994 and 1996 contain data for late 1993 and 1995 respectively. Thus, a recent two-year period was used for analysis of employment growth for the two industries.

Identifying the same companies over time in detail is a very demanding task because of the dynamic changes in business organization. Companies are established; they merge, sell divisions, acquire other business entities, change names, divest parts of their businesses, sometimes spinning off new firms either by themselves or in joint ventures with other companies or go out of business. Thus, the task of tracing identities of firms requires major efforts of analysis of histories of individual firms even when the detailed company information is publicly disclosed and business statistics for individual companies are compiled by commercial data firms.

In collecting longitudinal data for companies listed in industry association directories it is necessary to examine the membership entries for different years sufficiently to ensure that the companies are actually the same. In a small pilot project it is not practical to examine thousands of member companies for several industry associations, or even all companies in a single directory containing 2000 or more entries. Therefore, a statistical sampling approach was adapted in this study to collect longitudinal company data from business directories.

Statistical Sampling of Directory Data

Initially, three pairs of random representative samples of 100 companies each were drawn for regular members in the two directories. “Retrospective” samples were drawn of 100 companies each from the latest year directory of each of the two associations.

Then matching data for the same companies was searched for in the corresponding earlier directory. It was also possible to identify new companies established during the time period analyzed from the year established information in the later sample year directory.

The memberships of the AEA and SPA overlap. Many manufacturers in electronic industries also develop or publish software and belong to the SPA. The three samples of 100 SPA initially drawn were heavily influenced by large manufacturing or publishing firms members, many of which were also listed in the AEA directories. To reduce the effects of this interaction, sampling of the SPA directory was limited to software publishers and developers, a group of about 600 companies. It was decided to draw only 2 random samples of 100 firms each from this smaller group.

The procedure for forming these random samples was as follows: Company entries in the sections to be sampled in the later year directory were number coded consecutively in order of appearance. Sets of random integer numbers were generated from 1 to the total number of entries in these sections. For the 1996 SPA directory, the sampled sections included only software developers and software publishers. For the 1997 AEA Directory, the sampling included regular members; associate members were omitted.

Only the domestic private business firms which reported both employment and the year the firm was established in the sample year directory were accepted for the sample. Other entries that were drawn by their random number code were rejected including foreign companies, U.S. non-profit organizations, firms without employment or date established information or subsidiaries or

other cross references to other entries. In such cases the next random number in the sequence was used to complete the sample. The successive samples were drawn from the numbers in the random sequences remaining after previous sampling by the same process until the three AEA samples and the two SPA samples were completed. Using this process each firm could be drawn only once.

Companies were matched for the same name and the year established. In some cases the name change was reported in the sample year directory. Then the company could be readily identified with the old name in the earlier directory.

Employment in most cases was reported as a single number. In the few cases where the employment was given as a range the mid-point of the range was used.

The data collection for each sample was completed in three steps. Identifying company data for a sample company in the earlier directory of the same association was Step 1 of the data assembly. Step 2 involved augmentation by search for sample companies by cross-reference among the directories of the American Electronics Association and the Software Publishers Association, taking advantage of the overlap in the membership of these two associations. It was thus possible to obtain information for some additional companies which were not listed in the original association directory for the earlier year. In Step 3 information for sample companies not yet identified in the association directories was searched for in the 1994 Edition of the large CorpTech directory of technology companies.

Data Coverage Achieved

The results of the data assembly in three steps are summarized in Table 1. In Step 1, using only the directories of the same association, employment data were obtained for 69-76 of the 100 companies in the three samples of the AEA directories, and for 52-58 companies respectively in the two samples of the SPA directories. In Step 2, this coverage was raised from 69 to 71

companies in the first AEA sample, but not in the other two samples for which there was no additional information. The number of companies in the two SPA samples was raised to 53 and to 60 respectively. In Step 3, the company coverage for Year 1 was considerably augmented in all cases by reference to the CorpTech directories. In the end, data was obtained for 82-88 of the AEA sample companies and 61 and 63 of the SPA sample companies, respectively.

At each step the proportion of employment covered by the sample companies for which the beginning year data were obtained was, with one exception, much higher than the proportion of companies. This indicates that the companies for which complete data for both years was obtained were on the average larger than the companies with the missing data for the initial year. The proportions obtained by Step 3 were 95-98% of the full sample employment in the AEA directories and somewhat lower, 89-93%, in the two SPA samples. The data generated at Step 3 of this procedure was used to analyze the contribution of small business to growth of employment in the industries represented in the two directories over the two-year period. The details of the data gathered at this stage are given in Appendix Tables A-1 to A-5.

Table 1

Improvements in Earlier Year Coverage of Sample Companies and Company Employment by Cross-Reference with Additional Directories *

A. Number of Companies Sampled

Directory, Sample and Year	Step 1: Original Directories	Step 2: Augmented By SPA/AEA Directory	Step 3: Augmented By CorpTech Directory	Not Identified	Original Sample
AEA R-1 1997	69	71	82	18	100
AEA R-2 1997	69	69	82	18	100
AEA R-3 1997	76	76	88	12	100
SPA R-1 1996	52	53	61	39	100
SPA R-2 1996	58	60	63	37	100

B. Percent of Full Sample Employment

Directory, Sample and Year	Step 1: Original Directories	Step 2: Augmented By SPA/AEA Directory	Step 3: Augmented By CorpTech Directory	Not Identified	Original Sample
AEA R-1-1997	91	91	95	5	100
AEA R-2 1997	92	92	98	2	100
AEA R-3 1997	84	84	95	5	100
SPA R-1 1996	89	90	93	7	100
SPA R-2 1996	51	87	89	11	100

* Step 1 Data in the original association directory.
Step 2 Cross-referencing between AEA and SPA directories.
Step 3 Cross-referencing with the CorpTech directory.

Note: All samples consist of 100 companies.

III. Analysis of Contribution of Small Business to Employment Growth

Longitudinal vs. Cross-section Estimates

The contribution to industry growth of small companies obtained by the longitudinal method is compared for each sample with the contribution obtained by the cross-sectional method and the bias in the cross-section method is assessed. One objective of this project is not only to demonstrate the existence of a bias in the cross-sectional method, but also to assess its extent quantitatively. The results, summarized in Table 2, show that there are very large differences in contribution to growth of employment in the group of companies in the samples calculated with the longitudinal tabulations of company data and those calculated with cross-sectional data in four of the five samples.

Estimates of the contribution of small business based on longitudinal data were much higher than the estimates based on the cross-sectional tabulations. Longitudinally based estimates range from 29 to 55% of industry growth during the period for the AEA samples and from 21 to 39% for the two SPA samples. This is in marked contrast to the cross-sectionally based estimates ranging from 5 to 11% of the total sample growth for the AEA samples and from 11 to 21% for the SPA samples. For all companies sampled in the two association directories, the contribution of small business derived from cross-section tabulations was 7 % for the AEA data and 16 % for the SPA data. Because the cross-sectional data does not offer insights into the sources of industry growth over time, further discussion in this paper is based only on longitudinally derived estimates.

Table 2

Contribution of Small Business, Including New Companies, To Growth of Employment

Comparison of Results of Longitudinal and Cross-section Size of Business Calculation for Five Samples of High Technology Firms over Two Year Periods.

(Percent of Employment Growth Accounted for by Small Companies)

Sample	Longitudinal Definition		Small Companies, Cross-Sectional Definition
	Small Companies	New Companies	
AEA R-1	29%	12%	5%
AEA R-2	55%	3%	11%
AEA R-3	54%	3%	7%
SPA R-1	21%	5%	21%
SPA R-2	39%	6%	11%

Note: For additional information see Appendix Tables A-1 to A-5.

Characteristics and Dynamics of Company Groups

Basic data about structure and changes for the four groups of companies are summarized in Tables 3 and 4. Table 3 combines the data for the three samples from the AEA directories, and Table 4 combines the data for two samples from the SPA directories.

The four groups of companies are as follows : (1) companies which were small and grew to be large during the two year period, (2) companies that were small in the first year and remained small two years later, (3) new companies that were established during the period and (4) companies that were large in the beginning year.

According to sampling theory, the estimates from combined multiple independent samples converge towards the true values of characteristics of population as the number of samples increases. Consequently, the combined data from the three and two samples respectively is likely to give a better approximation to the characteristics of the population sampled than any individual sample. The population sampled are the association members for which data about their employment history two years earlier can be obtained.

Table 3

Characteristics of Groups of Companies with Data for Two Years for Combined Three American Electronics Association Samples

	Small Companies Growing Large	Small Companies Remaining Small	New Companies	Large Companies	All Companies Total
Number of Companies	10	193	21	28	252
Percent of Companies	4%	77%	8%	11%	100%
Employment					
1994	3263	18523	4	64716	86506
1996	7355	22862	2257	81622	114096
Change	4092	4334	2253	16906	27590
Percent of Total Change	15%	16%	8%	61%	100%
Annual Rate of Growth	50%	11%	n.a.	12%	15%
Percent of Employment					
1994	4%	21%	0	75%	100%
1996	6%	20%	2%	72%	100%
Company Size (Average Employment)					
1994	326	96	0	2311	343
1996	736	118	107	2915	453
Average Age in 1994, Years	16.8	15.5	0	21.2	15.1

Table 4

Characteristics of Groups of Companies with Data for Two Years
For Combined Two Software Publisher Association Samples

	Small Companies Growing Large	Small Companies Remaining Small	New Companies	Large Companies	All Companies Total
Number of Companies	3	82	31	8	124
Percent of Companies	2%	66%	25%	6%	100%
Employment					
1993	690	4881	0	22099	27670
1995	1994	6988	738	31572	41292
Change	1304	2107	738	9473	13622
Percent of Total Change	10%	15%	5%	70%	100%
Annual Rate of Growth	70%	20%	n.a.	20%	22%
Percent of Employment					
1993	2%	18%	0	80%	100%
1995	5%	17%	2%	76%	100%
Company Size (Average Employment)					
1993	230	60	0	2762	223
1995	665	85	24	3946	333
Average Age in 1993, Years	11.7	9.3	0	11.5	7.1

Contribution of Small Companies to Growth

Small companies contributed to growth out of proportion of their base (first) year employment even without including new companies. Thus, (Table 3) small companies represented 25 percent of combined employment in the three AEA samples in the first year, but contributed 31 percent to the growth of the employment by all sample companies with continued data between the beginning and the end year of the period. Including new companies, the contribution of small business to growth of the combined AEA samples total was 39 percent. In the SPA case (Table 4), the small companies accounted for 20% of total employment in the two samples in the first year, but for 25% of the period growth, without counting new companies and for 30% including the new companies.

These estimates of small business proportions of all business are smaller than the estimates for the total private economy. However, these are industries with considerably smaller proportions of employment by small business than in the economy at large, which has been estimated at 60 percent, including self-employed proprietors. However, the national proportion of small business employment including unincorporated proprietors, as estimated for 1990 by the NPA Data Services in an earlier report to the Small Business Administration (1994), in Electric and Electronic Equipment manufacturing was 28 % and in Instruments and Related Products 23%. These percentages are in line with the small business proportions of the AEA sample employment of 25 % shown in Table 4 for the base year 1994. No comparable national figures are available for software publishers, but the two samples indicate a comparatively small proportion of small business for that industry as well.

Evidence for the systematically greater contribution of small businesses than of large businesses to growth is cumulating rapidly. A recent analysis economy-wide of businesses in continued existence from 1990 to1994, based on the new LEEM database, which together

employed 76.22 million workers in 1990, found that companies that were large (500 and more employees) lost 1.15 million jobs while companies that were small gained 1.45 million.

Importance of New Companies

The new companies established during the two year period analyzed, accounted for a significant proportion of the contribution by all small companies to industry sample growth. The new companies contributed 21 percent of the small company contribution to growth in the AEA samples, and 17 percent in the SPA samples. In two years the new companies contributed 8 percent of the total industry growth in the AEA samples and 5 percent in the SPA samples. Over longer periods, the contribution of the new companies would be much larger.

Growth Rates of Company Groups

Growth rates of different groups of companies in individual samples and for sample data aggregated for all samples in the directories of the two associations are summarized in Table 5. For companies in existence both at the beginning and at the end of the period the growth rates can be calculated. However, growth rate of new companies which start with a zero base cannot be calculated because it is not possible to divide numbers by zero.

The highest growth rates are calculated for the group of companies which were small in the beginning year and grew to be large in the end year of the period, as shown in the first column of Table 5. The annual growth rate for these companies in the three AEA samples were 29, 54 and 69 percent a year over the two-year period. In one of the SPA samples there were no companies that grew from small to large, but in the second sample the annual growth rate of such companies was 70 percent.

Table 5

Annual Growth Rates of Employment in Groups of Companies

Sample	Small Companies Growing Large	Small Companies Remaining Small	All Small Companies Including New	Large Companies	Complete Sample
AEA R-1	69%	12%	34%	19%	22%
AEA R-2	57	11	20	6	10
AEA R-3	29	10	14	8	10
SPA R-1	--	19	23	14	15
SPA R-2	70	21	40	38	39
AEA ALL	50	11	22	12	15
SPA ALL	70	20	32	20	22

By comparison, companies which were small at the beginning of the period and remained small by its end grew considerably less, at rates of 10, 11 and 12 percent respectively in the AEA samples, and 19 and 21 percent in the SPA samples. Including employment of new companies in the second year with the initially small companies yields the growth rates for the small business companies in the aggregate of 34, 20 and 14 percent in the AEA samples, and 23 and 40 percent in the SPA samples.

In all cases the growth rates of small companies exceed the growth rates of large companies in the samples. However, the growth rates of small companies which remained small were about the same as the growth rates of large companies. Thus, the growth rate advantage of all small companies as a group resulted from growth of small companies that grew to be large and from creation of new companies.

For all groups, the growth rates in the two SPA samples combined are higher than in the aggregate of the three AEA samples, probably because software is a younger industry with a

higher growth rate than electronics. However, all the aggregate group rates are quite high, all being in the double-digit range. They seem to be higher than the respective industry growth rates compiled from establishment data. This may mean that the firms which continued in existence and also remained members of industry associations had a stronger growth experience than all firms in the industry, which includes those that declined and those that went out of business.

Distribution of Companies and of Employment Among Groups

The distribution of companies among the four groups differs among the two sets of directories in some respects. In both cases the largest proportions of the number of companies, 77 and 66 percent respectively, are the small companies which remained small. There was a large difference in the proportion of new companies: fully 25 percent in the SPA data, compared to only 8 percent in the AEA directories. Also among the AEA companies sampled, large companies represented a larger proportion of the sample total: 11 vs. 6 percent in the SPA database.

The distribution of employment among the companies is very different. The new companies represent small proportions of employment in the second year and of course zero in the first year, while the large companies account for 75% of employment in the AEA samples and 80% of employment in the first year in the SPA samples.

Size of Firms

The average size of large companies in the base year was 2311 workers in the AEA directories , and a somewhat higher, but similar, 2762 in the SPA directories. Because there were comparatively few large companies in the samples, this difference in the average firm size is not statistically significant.

The average size of the 21 new companies in the AEA data of 107 workers was considerably higher than the average size of 24 workers among the 31 new companies in the SPA

directory. It could be a result of a higher cost of entry into electronic manufacturing than into the software business.

The average size in the first year of companies that grew to be large was much larger in both industries than the average age of the companies that remained small. This appears to show that the companies that crossed over the line were larger to begin with than those that did not.

Age of Firms

The average age of small companies that grew large was somewhat higher than the average age of the companies that remained small among the AEA companies and considerably higher among the SPA companies. The average age was substantially higher among the AEA companies than among the SPA companies: by about 5 years among small companies and by 10 years among the large ones.

IV. Conclusions

Business Directories as Data Sources

Business directories are a useful and readily accessible source of longitudinal information for quite small and new firms before they reach the size at which they become publicly traded and have to disclose information in public reports to the Securities and Exchange Commission and other regulatory bodies. Thus, while the directories may not pick up the very smallest and newest businesses, they provide better coverage at the smaller end of the business size distribution than the sources reporting publicly disclosed company data.

A major advantage of information in business association directories is that they permit longitudinal tracking of the same companies over time and thus avoid the bias inherent in the cross sectional comparison of employment by small and large companies that exist at two points

in time.

Another important advantage of information in business directories is the timeliness with which directories reflect the changes in industrial organization, resulting in changes in technology. As technologies evolve, new products and services are developed and newly emerging markets give rise to new groups of businesses with common interests. These groups organize themselves into new associations or are recognized as subgroups of existing associations. In either case, directory information is provided for these new groups long before official statistics identify them.

Information in business directories is readily accessible where industry associations publish the basic information about their members such as the size of their employment, date established, and products. However the information contained in association directories is copyrighted and its use requires permission to reproduce the data in any form.

Methods for Analyzing Directory Data

Data contained in business directories is subject to volatility from changes in association membership. Both small and large firms may change their membership, by joining or leaving an association during the period examined regardless of whether or not they change in any other ways. As a result of the data collection and analysis performed in the course of the present project, it is possible to conclude that the data that may be obtained from membership directories of industries, here specifically of the two high technology industries, may indeed offer meaningful insights into the role of small business. The statistical sampling technique employed here provides a means for efficiently sampling companies' history which can be traced back to an earlier date, and thus capture the growth dynamics including establishment of new companies. The statistical sampling approach allows calculation of meaningful results with moderate effort. It would be prohibitively expensive to attempt to fully account for all members of the association and relating it to the industry. This approach does not provide opportunities for exploring the difference in

disappearance from change in membership and from exit of companies from the industry. However, such approaches can be developed in the future.

How representative are the sample companies? First, of the association membership reported in the directories and second, of all companies in the industry. The retrospective samples are good in identifying new companies. What is not known is how the association membership may have changed. However, the ability to augment the data obtained from the single industry directory by reference to other, especially more general business directories, indicates that there probably were significant fluctuations in membership and that the data coverage can be improved by reference to more general business directories. What the retrospective samples do not address are the companies that may have gone out of business because by definition only companies listed in the directories for the end-year of the period are sampled. However, the ability to trace the history of those companies and substantial proportion of their employment indicates that the sampling provides reasonable indication of the role of small business in the growth of these two high technology industries in particular and probably of other industries as well.

Importance of Longitudinal Measurement

The present study confirms the existence of a large bias in attributing industry growth to companies classified by size in a cross-sectional arrangement. The ability to improve the coverage of the companies by reference to directories other than the industry association membership directories, suggests that more general directories, where available, are likely to augment the sampling of longitudinal universe of large and small businesses of an industry.

Appendix A

(Data Tables for Individual Samples)

Appendix Table A-1
Measuring the Contribution of Small Business to Industry Growth
Augmented Sample No. 1 of 100 Companies in the 1997 AEA Directory

Group of Firms	No. of Cos.	Employment				Growth of Firms, Percent per year
		1994	1996	Total Change		
				Number	Percent of Change	
A. Actual Data for Growth of Companies:						
Small to Large		885	2520	1635	10	69
Small to Small	D	5163	6429	1266	7	12
Large Companies	10	28748	40770	12022	71	19
New Companies	12	4	1963	1959	12	--
Sample Total	82	34800	51682	16822	100	22
B. Longitudinal Analysis of Growth						
Small Firms		6052	10912	4860	29	34
Large Firms	--	28748	40770	12022	71	19
Sample Total	--	34800	51682	16882	100	22
% Small Firms	--	17	21	--	--	--
C. Cross-Sectional Analysis of Growth						
Small Firms		6052	6892	840	5	7
Large Firms*	--	28748	44790	16042	95	25
Sample Total	--	34800	51682	16882	100	22
% Small Firms	--	17	16	--	--	--

D – Not reported to prevent disclosure of individual company information

* Includes new companies that became large

Appendix Table A-2
Measuring the Contribution of Small Business to Industry Growth
Augmented Sample No. 2 of 100 Companies in the 1997 AEA Directory

Group of Firms	No. of Cos.	Employment				Growth of Firms, Percent per year
				Total Change		
		1994	1996	Number	Percent of Change	
A. Actual Data for Growth of Companies:						
Small to Large		1063	2635	1572	26	57
Small to Small	D	6405	7952	1547	26	11
Large Companies	8	22460	25150	2690	45	6
New Companies	5	0	151	151	3	--
Sample Total	82	29928	35888	5960	100	10
B. Longitudinal Analysis of Growth						
Small Firms		7468	10738	3270	55	20
Large Firms	--	22460	25150	2690	45	6
Industry Total	--	29928	35888	5960	100	10
% Small Firms	--	25	30	--	--	--
C. Cross-Sectional Analysis of Growth						
Small Firms		7468	8103	635	11	4
Large Firms	--	22460	27785	5325	89	11
Industry Total	--	29928	35888	5960	100	10
% Small Firms	--	25	23	--	--	--

D – Not reported to prevent disclosure of individual company information

Appendix Table A-3
Measuring the Contribution of Small Business to Industry Growth
Augmented Sample No. 3 of 100 Companies in the 1997 AEA Directory

Group of Firms	No. of Cos.	Employment		Total Change		Growth of Firms, Percent per year
		1994	1996	Number	Percent of Change	
A. Actual Data for Growth of Companies:						
Small to Large		1315	2200	885	19	29
Small to Small	70	6955	8481	1526	32	10
Large Companies	10	13508	15702	2194	46	8
New Companies	4	0	143	143	3	--
Sample Total	88	21778	26526	4748	100	10
B. Longitudinal Analysis of Growth						
Small Firms		8270	10824	2554	54	14
Large Firms	--	13508	15702	2194	46	8
Sample Total	--	21778	26526	4748	100	10
% Small Firms	--	38	41	--	--	--
C. Cross-Sectional Analysis of Growth						
Small Firms		8270	8624	354	7	2
Large Firms	--	13508	17902	4394	93	15
Sample Total	--	21778	26526	4748	100	10
% Small Firms	--	38	33	--	--	--

Appendix Table A-4
Measuring the Contribution of Small Business to Industry Growth
Augmented Sample No. 1 of 100 Companies in the 1996 SPA Directory

Group of Firms	No. of Cos.	Employment		Total Change		Growth of Firms, Percent per year
		1993	1995	Number	Percent of Change	
A. Actual Data for Growth of Companies:						
Small to Large		0	0	0	0	--
Small to Small	43	2687	3782	1095	17	19
Large Companies	5	17399	22572	5173	79	14
New Companies	13	0	315	315	5	--
Sample Total	61	20086	26669	6583	100	15
B. Longitudinal Analysis of Growth						
Small Firms		2687	4097	1410	21	23
Large Firms	--	17399	22572	5173	79	14
Industry Total	--	20086	26669	6583	100	15
% Small Firms	--	13	15	--	--	--
C. Cross-Sectional Analysis of Growth						
Small Firms		2687	4097	1410	21	23
Large Firms	--	17399	22572	5173	79	14
Industry Total	--	20086	26669	6583	100	15
% Small Firms	--	13	15	--	--	--

Appendix Table A-5
Measuring the Contribution of Small Business to Industry Growth
Augmented Sample No. 2 of 100 Companies in the 1996 SPA Directory

Group of Firms	No. of Cos.	Employment		Total Change		Growth of Firms, Percent per year
		1993	1995	Number	Percent of Change	
A. Actual Data for Growth of Companies:						
Small to Large		690	1994	1304	19	70
Small to Small	39	2194	3206	1012	14	21
Large Companies	3	4700	9000	4300	61	38
New Companies	18	0	423	423	6	--
Sample Total	63	7584	14626	7039	100	39
B. Longitudinal Analysis of Growth						
Small Firms		2884	5623	2739	39	40
Large Firms	--	4700	9000	4300	61	38
Sample Total	--	7584	14623	7039	100	39
% Small Firms	--	38	38	--	--	--
C. Cross-Sectional Analysis of Growth						
Small Firms		2884	3629	745	11	12
Large Firms	--	4700	10994	6294	89	53
Sample Total	--	7584	14623	7039	100	39
% Small Firms	--	38	25	--	--	--

Appendix B

A Technical Note On Longitudinal and Cross-Section Tabulations of Business Size Time Series

A simple hypothetical industry example, described in the following table, will clarify the issues involved in using these two types of data sources for growth analysis. It assumes that there were three companies in an industry group, which had employment size in Years 1 and 2 as shown in Section A. of the Hypothetical Example.

Company 1 was a small company in year 1 and grew to be large in year 2. Company 2 was established between year 1 and year 2 and was still small in year 2. Company 3 was large in year 1; it grew and continued to be large in year 2. In this example Companies 1 and 3 each contributed 25% each to the industry growth of 800 jobs during the period, and Company 2 contributed 50%. What is the contribution of small business to total industry growth?

In this example, small business data defined longitudinally consists of Companies 1 and 2 are tabulated in Section B of the Hypothetical Example. The contribution of small business to industry growth calculated by this method is 600 jobs, or 75 % of the total increase in industry employment of 800 jobs during the period. Large firms, here Company 3, contributed 200 or 25 % of the industry growth. The growth rate of employment by small firms at 150% is much greater than the 33% growth of the large firms. The results of this longitudinal approach are consistent with the widely held view about the sources of growth of the American economy. According to this view the creation and growth of new businesses and growth of younger small companies which grow to be large characterizes the United States business system and accounts for most of growth of employment

By contrast, as shown in Section C of the Hypothetical Example, the static approach

credits all the growth to large companies, and zero growth to the small business. This is because the originally small Company 1 became large by the end of the period and the new Company 2 just replaced the employment that Company 1 had at the beginning of the period. This is a hypothetical example, but it illustrates the potential bias inherent in the cross-sectional approach if applied to sources of growth. The static cross-sectional approach is appropriate for description and analysis of the size distribution of business firms at particular points in time, or its changes over time, but not of the growth dynamics of individual firms or groups of firms over time.

Appendix Table B-1

A Hypothetical Industry Example

Measuring Contribution of Small business to Industry Employment Growth
An Illustrative Example

Type of Firm	Year 1	Year 2	Total Change in Jobs		Growth of Jobs, Percent per year
			Number	Percent of Change	
A. Actual Data for Growth of Individual Companies:					
Company 1	400	600	200	25%	50%
Company 2	0	400	400	50%	n.a.
Company 3	600	800	200	25%	33%
Industry Total	1000	1800	800	100%	80%
B. Longitudinal Analysis of Growth					
Small Firms	400	1000	600	75%	150%
Large Firms	600	800	200	25%	33%
Industry Total	1000	1800	800	100%	80%
% Small Firms	40%	56%	--	--	--
C. Cross-Sectional Analysis of Growth					
Small Firms	400	400	0	0	0
Large Firms	600	1400	800	+ 100%	80%
Total	1000	1800	800	+ 100%	80%
% Small Firms	40%	22%	--	--	--

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