

The research program of the Center for Economic Studies (CES) produces a wide range of theoretical and empirical economic analyses that serve to improve the statistical programs of the U.S. Bureau of the Census. Many of these analyses take the form of CES research papers. The papers are intended to make the results of CES research available to economists and other interested parties in order to encourage discussion and obtain suggestions for revision before publication. The papers are unofficial and have not undergone the review accorded official Census Bureau publications. The opinions and conclusions expressed in the papers are those of the authors and do not necessarily represent those of the U.S. Bureau of the Census. Republication in whole or part must be cleared with the authors.

**BUSINESS FAILURE IN THE 1992 ESTABLISHMENT UNIVERSE SOURCES
OF POPULATION HETEROGENEITY**

By

Alfred Nucci*
The Center for Economic Studies
U.S. Bureau of the Census
anucci@info.census.gov

CES 96-13 December 1996

All papers are screened to ensure that they do not disclose confidential information. Persons who wish to obtain a copy of the paper, submit comments about the paper, or obtain general information about the series should contact Sang V. Nguyen, Editor, Discussion Papers, Economic Planning and Coordination, Center for Economic Studies, Washington Plaza II, Room 211, Bureau of the Census, Washington, DC 20233-6101, (301-457-1882)

or INTERNET address snguyen@info.census.gov.

ABSTRACT

This study shows that establishment dissolution declines with age and that age at dissolution differs for broad industry and geography groups, establishment affiliation status, and establishment size. The paper uses Bureau of the Census Standard Statistical Establishment List datasets, a census of establishments with employment for the United States for the year 1992. Hence, the findings constitute a comprehensive source of information on the relation between age and dissolution and place in context similar findings of studies restricted to specific industries and/or geographic areas.

Keywords: Establishment, Business Failure, Business Age, Business Register

*The author wishes to thank David Smith of the University of Texas at Houston, Bruce Phillips of the Small Business Administration, and Larry Long of the Bureau of the Census for comments on an earlier draft of this paper. Any remaining errors are the responsibility of the author.

"The [demography of organizations] considers variation in vital rates for organizational populations: founding rates, merger rates, and disbanding rates....Surprisingly, organizational researchers have devoted little attention to the demography of organizational populations. Thus there is little well-established theory and research on which to base more complicated models of organizational ecology."

Michael Hannann and John Freeman, 1989, page 14.

Recent empirical studies suggest that business failure declines with age, size, access to human and financial capital, and varies across industries and geographic locations. Economists, students of business and entrepreneurship, and sociologists contribute to this growing literature, yet this body of work all too often suffers from John Freeman's "samples of opportunity" comment (Freeman, 1986, p. 26). That is, these studies are based upon different databases, periods of time, business units, business populations, and research designs and hence, it is difficult to compare findings on the relation between age and dissolution across studies. This study addresses this concern through use of the Bureau of the Census 1992 nationwide and industry-wide business register.

The relation between age of establishment and establishment dissolution is the primary concern of this study. The paper makes two contributions to the empirical literature on this topic. One is to establish the relation between age and failure for the most frequently used business populations, those defined by affiliation status, industry, size, and location. The second is to assess the similarity of this relation for specific industry, size, and location pairings.

The paper is divided into the following sections: 1) an overview of empirical work on business survival; 2) a discussion

of data source and methods; 3) a presentation of cross-section dissolution rates, establishment life table survival distributions and the comparison of cumulative survival distributions; 4) summary and conclusion.

I. BUSINESS DISSOLUTION: EMPIRICAL OVERVIEW

That business dissolution declines with age is the most widely reported and most generally accepted empirical finding about business dissolution (Bruderl and Schussler, 1990; Carroll, 1983; Fichmann and Levinthal, 1991; Joel Popkin and Company, 1991; King and Wicker, 1988; Lane and Shary, 1991; Pakes and Ericson, 1989b; Phillips and Kirchoff, 1988; Reynolds and Miller, 1988; Stinchcombe, 1965; Wagner, 1993). Fichmann and Levinthal (1991) argue that the shape of the relation between age and dissolution is an inverted U-shape, or failure declines non-monotonically with age. Thus, the hazard to dissolution increases in the first years after formation and then declines monotonically. Bruderl and Schussler (1990, p. 533) suggest two reasons why the highest risk of disbandment should not be found at the very beginning of an organizational life. One is that organizations can draw upon an initial stock of resources. The second is that an organization will probably not be abandoned by at least minimally rational actors unless a sufficient amount of negative information about performance has accumulated. Empirical evidence supporting this conjecture is available from a variety of sources.

King and Wicker (1988, Figure 1), Pakes and Ericson (1989b, Table 1), and Reynolds and Miller (1989, Exhibit 6) show that age-specific rates of dissolution increase immediately after formation and then decrease in subsequent years for a hypothetical formation cohort of retail and service "establishments" drawn from a Southern California sales tax

register, manufacturing, wholesale, and retail Wisconsin firms born in 1979, and retail and "other" Minnesota firms formed in 1984, respectively. The Bruderl and Schussler (1990) model of dissolution among German businesses formed in 1980 in "industry, trade, and services" shows an increase in the hazard in the first year with a decline in subsequent years. Wagner (1993) shows similar results for a population of Lower Saxonian manufacturing firms formed between 1979 and 1982 and surviving to 1990.

A second widely reported finding, particularly in the economics literature, is that business dissolution declines across business size, where size is often determined by the number of business employees (Dunne, Roberts, and Samuelson, 1988; Evans, 1987; Hall, 1987; Pakes and Ericson, 1989a; Troske, 1992). This relation is more controversial. It stems from disagreement on what we mean by "size" and is inextricably caught up in the literature on employment growth (Baldwin and Picot, 1995; Davis, Haltiwanger, and Schuh, 1996; Carree and Klomp, 1996). For our purposes, the size of an establishment represents its long-run "equilibrium size" and remains constant across an establishment's life span. That this is patently not the case is due to transaction costs associated with startup and shutdown costs occurring at different stages in an establishment's life cycle. Further, since employment, generally used as a measure of size, is an input factor, its level is subject to macroeconomic, micro-economic, and idiosyncratic shocks, and to changes in technology for long-lived establishments.

Many studies report that autonomous establishments have higher dissolution rates than affiliated establishments (Bruderl, Preisendorfer, and Ziegler, 1992; Dunne, Roberts, and Samuelson, 1988; Preisendorfer and Voss, 1990) while other studies show that the dissolution rates differ across industries (Bruderl, Preisendorfer, and Ziegler, 1992; Pakes and Ericson, 1989b; Phillips and Kirchoff, 1988; Reynolds and Miller, 1989) and

location (Lane and Schary ,1991, Table 3; Joel Popkin and Company, 1990, Table II-4:C).

These results "make sense" if we remember that the variables affiliation status, industry, and location are proxies for variables such as access to human and financial capital, differing start-up conditions (e.g. capital requirements, barriers to entry, non-profit status), and growth, respectively. Thus, for example, an affiliated establishment is more likely to survive than an autonomous one as it is able to draw upon human and financial resources of its parent enterprise, an advantage not available to autonomous establishments. Start-up costs of establishments in manufacturing industries are widely conceded to be higher than those in other sectors. Hence, manufacturing establishments are likely to have an initial "buffer" against dissolution, the result of a selection process which favors the formation of "likely to survive" establishments. Division may distinguish between growing and non-growing parts of the country where the former represents increased demand for goods and services--and more business start-ups--relative to the latter. Hence, there are likely to be larger numbers of new establishments formed to satisfy increased demand in growing divisions, which are subject to higher rates of dissolution.

There are few studies of the American business population comparing age-specific dissolution rates by affiliation status, industry, size, and division. Nucci's work (1996) for the 1987 economic census establishment population (Nucci,1996) and the work by Churchill (1955) are the most comprehensive, the latter with limitations.¹

Nucci (1996) finds that establishment dissolution declines non-monotonically with age for business populations defined by affiliation status, industry, region, and size. Affiliated establishments are far more likely to survive than autonomous ones, particularly in the first three to four years after

formation. Establishments operating in manufacturing, wholesale, and service industries are more likely to survive than those operating in construction, retail, finance, insurance and real estate industries. Large establishments are more likely to survive than small ones, and the relation between survival and size is strictly monotonic. Establishments located in growing parts of the country (e.g., the South West, Mountain, and West regions) are more likely to fail than those located in stable or declining regions (e.g., NorthEast). For the most part, patterns of failure by age--by affiliation status, industry, region and size--show similar results. Nucci also assesses the degree to which survival distributions for different industries, regions (etc.), defined by the underlying establishment life tables, are comparable. He shows that, for the most part, they are not similar, with the possible exception of region comparisons.

Churchill's findings, based upon firms operating over the period 1944-1954, show that the "averaged" conditional probability of survival increases with firm age. This pattern of survival increasing with age is roughly the same for firms in different industries. However, there are two differences. First, the level of the survival probability is different across industries. Hence, wholesale firms are more likely to survive than retail ones. Second, the amount of change in the survival probabilities across adjacent ages is different. Thus, retail firms are less likely to survive to an age of one year than wholesale or manufacturing firms while the chance that manufacturing, retail, or wholesale firms survive to an age of 10 years, given survival to an age of nine years is virtually the same (Churchill, 1955, page 15). That is, the conditional probability of survival increases in value more rapidly for retail firms than for wholesale firms over the ages one to 10. Construction and wholesale firms are most likely to survive 10 years while retail firms are least likely (Churchill, 1955, Table

3). Thus, industry differences in survival rates are largest in the first years after formation and any difference diminishes with age.

To summarize, dissolution declines with age and size. Establishments in more "capitalized" sectors, be they manufacturing, wholesale, transportation and utilities, or affiliated, are less likely to fail than establishments in less "capitalized" ones such as retail and autonomous sectors. Lastly, the evidence on geography is unclear, suggesting a weak relation showing lower dissolution rates in "older" areas and higher ones in "younger" locations.

II. DATA AND METHODS

1. The SSEL: Data Source and Variables

The results in this paper are based upon the Bureau of the Census Standard Statistical Establishment List (SSEL), an annual register of establishments first assembled in 1973 (Bureau of the Census, 1979) and the mail register for economic census years since 1977. Consecutive SSEL datasets constitute a continuous (establishment) population register, recording formation, dissolution, and change in ownership. It is a datafile consisting of all businesses with payroll² operating in private and public non-agricultural industries and in the 50 states, the District of Columbia, Puerto Rico, and other territories (e.g., Guam) for a given year. For an overview of relative strengths and weaknesses of the SSEL, see Nucci (1996).

This study's research population is 6,081,097 establishments, operating in private, non-agricultural industries (i.e., not in agricultural production and services, government, and an unclassified grouping), and reporting addresses located in the 50 states and the District of Columbia. The unit of analysis

for this study is an establishment, a physical location producing goods or providing services.

The population of businesses active in 1992 is defined as establishments with any wages during 1992, where wages is the amount of 1992 total earnings (in thousands of dollars) to employees, reported by establishments to either the Internal Revenue Service (IRS) or the Bureau of Census. A 1992 business dissolution is an active 1992 business which "matches" a 1993 business on business identification number and reports no payroll in 1993.³

Age is an ordinal measure, with values zero to 15 years, and is the year for which the business first reported payroll and appeared on the SSEL.⁴ It is likely that age is biased downward, given the difficulty in following autonomous establishment as they change business identification numbers and in identifying new, multi-location businesses between economic census. Age at zero years corresponds to formation in the economic census year 1992. Age at one year corresponds to formation during the year 1991. Age at years five and ten corresponds to formation during economic censuses years 1987 and 1982, respectively. Age at 15 years is an open-ended age interval and represents businesses formed in year 1977 and in prior years.

The affiliation status variable is nominal and has values autonomous and affiliated. An autonomous establishment is a business operating at a single, physical location when first listed on the SSEL. An affiliated establishment is owned by a business operating at more than a single location when first listed on the SSEL.⁵

Industry is a nominal variable with eight values and represents the economic activity of an establishment as defined by the 1992 four-digit Standard Industrial Classification (SIC) scheme. Values are based upon Census Bureau surveys and/or industry coding at the Internal Revenue Service and Social

Security Administration. This paper uses the traditional eight economic sectors--mining, construction, manufacturing, transportation and public utilities (TPU), wholesale, retail, finance, insurance and real estate (FIRE), and services.

Establishment size is measured by March 12th 1992 employment and has nine employment groupings. These are zero employees, 1-4 employees, 5-9 employees, 10-19 employees, 20-49 employees, 50-99 employees, 100-249 employees, 250-499 employees, and 500 and more employees. (A zero employee establishment is a business unit formed after the first quarter 1992 or one with nonresponse on employment.)

Geographic area is the Census Bureau nine divisions. They are New England, Middle Atlantic, South Atlantic, East South Central, West South Central, East North Central, West North Central, Mountain, and Pacific.

2. Methods: Dissolution Ratios and Life Tables

Dissolution ratios are calculated as the number of businesses dissolving during year 1992 divided by the number of active businesses for 1992. The dissolved establishments are a subset of active businesses, so the ratio of dissolved to active establishments provides a direct estimate of the probability of dissolution. Age-specific dissolution probabilities are the ratio of the number of dissolving businesses at age one, say, divided by the number of active businesses at age one. Age-specific dissolution probabilities represent the basic information required to construct establishment life tables.

The life table technique, widely used in the study of mortality in natural and artificial populations, is based upon the assumptions that the schedule of age-specific dissolution probabilities is stationary in time and that dissolution rates equal formation rates.⁶ See Smith (1989) and Shyrock and Siegel

(1976) for an introduction to life tables. A more formal treatment is available in Elandt-Johnson and Johnson (1980) and Namboodiri and Suchindran (1987).

An example illustrates how one obtains survival probabilities from age-specific ratios in a life table. Given a dissolution rate from age zero to one of .20 and a hypothetical cohort size of 100,000 establishments at age zero, the number of establishments "surviving" to age one is 80,000, or a survival probability of .80. Survival probabilities at subsequent ages are calculated recursively from the establishment population at age x and the dissolution rate between ages x and $x+1$. Establishment life tables are constructed for the populations defined by affiliation status, industry, size, and division.⁷

The similarity of 1992 life tables, calculated for a characteristic such as industry, may be determined by the log rank statistic.⁸ The test assumes that two survival distributions, manufacturing and wholesale or employment sizes 1 - 4 and 5 - 9, are the same at each age and large values of the statistic, produced by the curves differing at many ages, reject this hypothesis. The statistics are presented in a fashion similar to a variance-covariance matrix, where each entry is a comparison of two industries, regions (etc.). (Such a matrix is symmetric and hence, only the upper half is presented.)

III. RESULTS

1. Descriptive Statistics: Cross-Sectional Dissolution Rates

The 1992 business population of this paper comprises 6,081,797 active establishments, of which 11 percent (671,312 establishments) fail during 1992. Approximately one-third exceed 10 years of age while less than 12 percent were formed in 1992

(Table 1). The percentage of establishments declines consistently from under 12

Autonomous establishments dominate the active population with 80 percent of the total number of establishments while over a third operate in service and a quarter, in retail industries. The number of establishments decreases sharply and consistently from size class 1-4 employees to 500 and more employees, while the class with zero employees constitutes about 10 percent of establishments. Location divides the active establishment population into two groups, those representing over ten percent of the total (Middle Atlantic, East North Central, South Atlantic, West South Central, Pacific) and those, with less than ten percent (New England, West North Central, East South Central, Mountain).

The distribution of the number of dissolving establishments, while similar in pattern to that of active establishments, is more concentrated. Thus, the largest percentage of dissolving establishments are of age zero and are autonomous. Further, the largest percent of dissolving establishments operate in retail and services industries, belong to size class 1-4 employees, and operate in the Middle Atlantic, East North Central, South Atlantic, West South Central, and Pacific areas.

The dissolution rates of Table 1 confirm findings discussed in previous sections. Thus, dissolution declines with age, though non-monotonically. Autonomous establishments are about one and a half times as likely to fail as affiliated ones. Establishments operating in manufacturing and wholesale industries have the lowest failure rate (less than 10) while establishments operating in construction industries have the highest failure rate (14). The surprise is the relatively low failure rates for establishments operating in service industries (10), largely a result of the inclusion of long-lived tax-exempt establishments. As reported elsewhere, dissolution rates

decline with size, with the largest size class showing approximately one third the value of the (non-zero) smallest size class. The Pacific geographic divisions have the highest failure rates (13), followed by those of the Mountain, West South Central, and New England divisions (11).

The age structure of these populations follows predictable patterns, expected from that of the dissolution rates discussed above. Thus, affiliated establishment are older than autonomous one (5.7 to 5.1) and mining and manufacturing establishment are older than construction and transportation and public utilities ones (8 to 4.5). Further, the oldest establishments are the largest ones while the median age of the smallest (non-zero) size class is about five. Establishments operating in East North Central, Middle Atlantic, and West North Central have the largest median age (6) while establishments operating in the Mountain and Pacific divisions have the smallest (4.5).

Dissolution declines non-monotonically with age, regardless of affiliation status, industry, most size groupings, and region (Figures 1,2,3, and 4). Further, the variability of the rates declines with age. For example, young, autonomous establishment are far more likely to fail than are young, affiliated establishments, although the difference in dissolution rates gradually erodes over the years. Similarly, industry dissolution rates are higher and more variable in early years than in later ones, the mining sector aside. Size divides the establishment population into two groupings: 1) a population consisting of the two smallest size classes (zero and one to four employees) with relatively high and variable rates; 2) the remaining size classes with low and progressively less variable dissolution rates. The region rates move together, begin at values between .17 and .22 and decline, non-monotically in variability and value. (Supporting is available from the author.)

2. Descriptive Statistics: Establishment Life Tables

The data of Table 2 comprise a life table for the establishment universe⁹. The life table probability of dissolution, ${}_nq_x$, declines non-monotonically with age from a value of .15 to .07 at age 14. The survival probability, l_x , declines from a value of 1.0 at age zero to a value of .18 at age 15. The partial life expectancy, ${}_fe_x$, values decline from a value of 6.5 years at age zero to a value of .97 years at age 14. The more traditional life expectancy data, e_x , show that life expectancy increases with age and is likely not an appropriate measure of life expectancy, given the unknown maximum number of business years active (i.e. life span).

What is the chance an establishment survives one, five, 10, or 15 years? We obtain these survival probabilities (l_x) from establishment life tables by selecting l_x values for $x =$ one, five, 10, and 15 years of age. Affiliated establishments are more likely to survive than autonomous establishments at each age with probabilities at five years of .587 and .455, respectively (Table 3). Industry survival rates show that the probability a wholesale establishment survives to year five is .471 (the highest), followed by service, manufacturing, and FIRE establishments. Construction establishments have the lowest five-year survival rate, .360. Ten years later, the pattern remains much the same with two exceptions. Manufacturing, wholesale, and services establishments have the highest values at about .11. Mining establishments have the smallest 15-year survival rate, .135, and FIRE establishments no longer appear among the most likely to survive. Establishments of size 100-249 employees have the highest five-year and 15-year survival rates, while establishments of size one-four employees have the lowest five-year and 15-year survival rates (aside from establishments of zero employees). Establishments located in the East North

Central region have the highest five-year survival rate while 10 years later, establishments located in the West North Central region now do. Establishments with the lowest five-year and 15-year survival rates are located in the Pacific region.

These results are not terribly surprising. That is, dissolution declines with age for individual affiliation status, industries, size classes, and regions. The exceptions are the low age-specific dissolution rates for the service industry, possibly due to the inclusion of tax-exempt establishments, and the low age-specific dissolution rates for the largest size classes, relative to the 50-99 size class, implying that size and dissolution show a non-monotonic relation.

3. Descriptive Statistics: Comparison of Establishment Life Tables

The log rank statistics show that relatively few industry and size class survival distributions are similar, with a partial exception for the division results. The TPU and FIRE, TPU and retail, and the wholesale and services log rank values indicate that the respective survival distributions are virtually indistinguishable. The construction and mining, manufacturing and wholesale, and manufacturing and services log rank values, although not statistically similar, show smaller chi square values than the remaining comparisons (Table 4A). The log rank statistic value for the size class comparisons--21-49 and 500 +, 50-99 and 250-499--indicate that the respective survival distributions are virtually indistinguishable, while log rank values for the three comparisons--10-20 and 21-49, 10-20 and 500+ and 100-249 and 250-499, although not statistically similar, show smaller chi square values than the remaining comparisons from a possible 36 combinations groupings (Table 4B). Four division comparisons--New England-East South Atlantic, East South Central-

Middle Atlantic, South Atlantic-West South Central, and South Atlantic-Mountain--indicate that the respective survival distributions are virtually indistinguishable, while log rank values for a number of other comparisons, although not statistically similar, show smaller chi square values than the remaining ones (Table 4C).

IV. SUMMARY AND CONCLUSION

Our findings show that dissolution declines non-monotonically with age and that a similar pattern is evident for most affiliation status, industry, size, and region sub-populations. There is substantial variability in dissolution rates by age, size, and to a lesser extent, industry. Affiliated establishments and large establishments are far less likely to fail than autonomous or small ones. Establishment life table survival probabilities show that the survival distributions are different for sub-populations defined by affiliation status, industry, size and region. Thus, relatively few life tables are similar.

These findings, though unique and useful in themselves, act as "guide posts" for the ongoing development of longitudinal establishment datasets at the Census Bureau. This latter project can provide answers to questions raised in this, and the earlier 1987, study such as the stationarity of dissolution probabilities, movement among sectors, size classes, and affiliation status. How the findings of this study compare with those based upon generational establishment life tables is but another question awaiting such an answer.

This work--and similar research by others--lay the foundations for the study of "demography of organizations." Hence, these findings address Hannan and Freeman's concern outlined at the beginning of the paper and avoid Freeman's

admonition about "samples of opportunity."

REFERENCES

Baldwin, John R. and G. Picot. 1995. "Employment Generation by Small Producers in the Canadian Manufacturing Economy." Small Business Economics 7:317-331.

Bruderl, Josef and Rudolf Schussler. 1990. "Organizational Mortality: The Liabilities of Newness and Adolescence." Administrative Sciences Quarterly 35:530-547.

Bruderl, Josef, Peter Preisendofer, and Rolf Ziegler. 1992. "Survival Chances of Newly Founded Business Organizations." American Sociological Review 57:227-242.

Churchill, Betsey C. 1955. "Age Life Expectancy of Business Firms." Survey of Current Business (December, 1955):15-19, 24.

Carroll, Glenn. 1983. "A Stochastic Model of Organizational Mortality: Review and Reanalysis." Social Science Research. 12:309-329.

Carree, Martin and Luuk Klomp. 1996. "Small Business and Job Creation: A Comment." Small Business Economics 8:317-322.

Davis, Stephen J., John C. Haltiwanger, and Scott Shuh. 1996. Job Creation and Destruction. Cambridge, Massachusetts: The MIT Press.

Dunne, Timothy, Mark J. Roberts, and Larry Samuelson. 1988. "Patterns of Firm Entry and Exit in U.S. Manufacturing Industries." Rand Journal of Economics 19(4):495-511.

Elandt-Johnson, R.C. and N. L. Johnson. 1980. Survival Models and Data Analysis. New York, New York: John Wiley & Sons.

Evans, David S. 1987. "The relationship Between Firm Growth, Size, and Age: Estimates for 100 Manufacturing Industries." The Journal of Industrial Economics XXXV:567-581.

Fichman, Mark and David A. Levinthal. 1991. "Honeymoons and the Liability of Adolescence: A New Perspective on Duration Dependence in Social and Organizational Relationships." The Academy of Management Review 16(2):442-468.

Freeman, John. 1986. "Data Quality and the Development of Organization Science: An Editorial Essay." Administrative Science Quarterly 31:298-303.

Hall, Bronwyn H. 1987. "The Relationship Between Firm Size and Firm Growth in the U.S. Manufacturing Sector." The Journal of Industrial Economics XXXV:583-606.

Hannan, Michael T. & Freeman, John H. (1989) Organizational Ecology Cambridge, Massachusetts: Harvard University Press.

Joel Popkin and Company. 1991. "Business Survival Rates by Age Cohort of Business." U.S. Small Business Administration, Office of Advocacy.

King, Jeanne C. 1993. A Demographic Study of Retail and Service Establishments in the Greater Los Angeles Area. Doctoral Dissertation. Claremont, California: Claremont Graduate School.

King, Jeanne C. and Allan W. Wicker. 1988. "The Population Demography of Organizations: An Application in Retail and Service Establishments." Forty-Eight Annual Meeting of the Academy of Management, Anaheim, California (Best Papers Proceedings).

Kramer, Michael S. 1988. Clinical Epidemiology and Biostatistics. New York: Springer-Verlag.

Lane, Sarah J. and Martha Schary. 1991. "Understanding the Business Failure Rate." Contemporary Policy Issues IX:93-105.

McGuckin, Robert and Alfred Nucci. 1991. "Survival Patterns for Small Business: Who Survives?" Internal Revenue Service, 1991 Research Conference, November 14-15, 1991, Washington, D.C.

Namoodiri, Krishnan and C. M. Suchindran. 1987. Life Table Techniques and Their Applications. New York: Academic Press.

Nucci, Alfred. 1996. The Demography of Business Failure. Mimeo. Washington, D.C.: Bureau of the Census, Center for Economic Studies.

Pakes, Ariel and Richard Ericson. 1989a. "Empirical Implications of Alternative Models of Firm Dynamics." National Bureau of Economic Research, Working Paper 2983.

Pakes, Ariel and Richard Ericson. 1989b. "Technical Appendices for: Empirical Implications of Alternative Models of Firm Dynamics." National Bureau of Economic Research, Working Paper 2983.

Phillips, Bruce D. and Bruce A. Krichoff. 1989. "Formation,

Growth and Survival; Small Business Dynamics in the U.S. Economy." Small Business Economics. 1:65-74.

Preisendorfer, Peter and Thomas Voss. 1990. "Organizational Mortality of Small Firms: The Effects of Entrepreneurial Age and Human Capital." Organization Studies. 11:107-129.

Reynolds, Paul and Brenda Miller. 1989. "New Firm Survival: Analysis of a Panel's Fourth Year." Strategic Management Research Center, University of Minnesota (Discussion Paper #115).

Smith, David P. 1992. Formal Demography. New York: Plenum Press.

Stinchcombe, Arthur L. 1965. "Social Structure and Organizations." in Hames G. March (ed.) Handbook of Organizations. Chicago:Rand McNally.

Shyrock, Henry C. and Jacob S. Siegel. 1976. The Methods and Material of Demography. New York: Academic Press.

Troske, Kenneth R. 1992. "The Time Series Pattern of Firm Growth in Two Industries." U.S. Bureau of the Census, Center for Economic Studies (Its CES 92-10).

United States Bureau of the Census. 1979. The Standard Statistical Establishment List Program. Washington, D.C.:Bureau of the Census (Technical Paper 44).

Wagner, Joachim. 1993(?). "Success or Failure? The Post-entry Performance of New Small Firms in Manufacturing Industries, Lower Saxony, 1979-1990."

Endnotes

1.

1. King, (1993), Pakes and Ericson (1989b), and Reynolds (1989) are examples of an empirical literature that presents age-specific dissolution rates by industry for specific regions (Southern California, Wisconsin, Wisconsin). Hall (1987) and Evans (1987) are examples of studies where age enters into formal models as selection specification, largely restricted to the manufacturing sector.

2. When a business starts is an issue. The definition used in this paper is the hire of a business' first employee (legally). It is not possible to identify businesses without employees or business start-ups which precede the hiring of employees. Related work by Center staff has addressed this issue (McGuckin and Nucci, 1991).

3. The 1992 SSEL does not contain 1993 wages. Therefore, an active establishment's 1993 wages are obtained from a match of the 1992 dataset to the 1993 dataset on business I.D. Thus, an active 1992 business that survives throughout 1992 is defined by the presence of 1993 wages. An active business that is a dissolution in 1992 is one that 1) does not have match on business I.D. from the 1993 dataset; 2) has a 1993 match on business I.D. but has zero wages in 1993.

Since the paper studies the dissolution experience of businesses based upon the adjacent years 1992 and 1993, the difference between ownership and location ought to be small. This project is studying how accurate this statement is for multi-establishments. More troubling are reorganizations of businesses not captured in the Bureau of the Census multi-establishment program (e.g., a single-establishment switch of ownership from parent to child or from proprietorship to corporation).

This paper occupies an intermediate position between defining a continuing business as business ownership and defining a continuing business as physical location, regardless of ownership change. The business ownership I.D. is used in a first stage match of 1992 and 1993 establishments, and non-matched 1992 establishments ownership I.D.'s are matched to non-matched 1993 establishments prior year business I.D.'s. This two stage matching operation has a bias toward matching multi-establishments and not matching single establishments. This is because of the annual survey operation at the Bureau of the Census for multi-establishments.

About 710,000 establishments of the 6,268,000 1992 establishments with positive payroll and a matching 1993 ownership I.D. show no positive payroll in 1993. About 50,000 establishments with positive 1992 payroll do not match to 1993 SSEL establishments and about 34,000 of these match to a 1993 establishment's prior

year I.D. and show positive payroll in 1993.

4. Establishments with no age value or inaccurate values (about 230) were grouped separately and were distributed among those establishment with a valid age based upon their frequency. About 4,700 establishments showed an age value of "1993". This paper treated these establishments as formed in 1992 and recoded their value to 1992. Assuming similar numbers were "misplaced" in the other years, a proportion of each year's establishments (using the 1992 proportion) were remove from each year and placed in the prior year until the open-ended age category 14.

5. Affiliated establishments were identified from a permanent location variable (called the "permanent plant number"). This variable, first used in the 1977 economic censuses, identifies those establishment which have changed ownership over this period and provides information on the affiliation status of the original (if any) owner as of 1977. Thus, the re-organization experience of establishments before 1977 is not captured.

6. Demographers make a third assumption. The population is closed to migration. The concept of migration has received little attention in the formal literature on business demography and we are thus in the awkward position of not knowing how to define, let alone measure, this phenomenon.

How reasonable are these assumptions? In the virtual absence of information on age-specific dissolution rates, assessing the reasonableness of the stationarity assumption relies upon findings by many studies of similar pattern of these rates, if not identical values. It is also difficult to assess whether dissolution and formation rates are equal. Again, there is little information available. What is available indicates that formation rates are higher than dissolution rates, though not dramatically so.

7. To the extent that 1992 values measures are those of the business at its startup, the values for these variables are age-independent. This should be the case for division values and is assumed to be so for size. Businesses may change affiliation status from autonomous to affiliated status or shift from manufacturing to wholesale industries over their life span. The affiliation status value is derived from either 1) the current status where there is no indication of a change or 2) the status prior to the current one, where there has been a change in status. We assume that establishments rarely move from one industry (e.g., manufacturing) to another, although this may not be the case for more detailed industries (e.g., food processing).

9. It is calculated in two steps: 1) the difference between the expected number of dissolutions minus the observed number divided by the expected number; 2) the sum of the differences for each of two life tables. See Kramer (1993), pages 248-253, for a brief overview of the calculations. Smith (1992), pages 113-117, discusses the use of the similar Mantel-Haenzel test.

9. The individual affiliation status, industry, size, and division life tables are available from the author.