Constructing a Theory about Organizational Populations: Contextualizing the Meaning of Organizational Size and Age

By

Jerald Hage
Center for Innovation
University of Maryland
College Park, Maryland
United States of America

And

Wilbur C. Hadden
National Center for Health Statistics
Center for Disease Control
Aldephi, Maryland

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Given the many studies of organizational age and size in organizational ecology, one wonders if there is still a need for another study (Baum 1996). Yet, despite the large amount of research, debates persist about the effects of age and size because the findings diverge (Barron *et al.* 1994). Hannan *et al.*, (1998a) evaluated 18 studies finding in about half of them a positive relationship between organizational age and mortality, once organizational size is controlled, and in the other half a negative relationship. In attempting to explain these divergent findings, Hannan (1998) advanced the conceptualisation and measurement of organizational age but his effort fails to reconcile the divergent findings because the logical framework created is at the level of the organization and thus is useful for explaining differences between organizations *within* the same organizational population but not differences *between* organizational populations.[1]

The contention of this paper is that more intellectual progress in reconciling these divergent findings is possible if one begins to construct a theory about organizational populations. By knowing whether or not a specific organizational population has a standardized technology and a mass market, it becomes possible to discern whether there is a greater liability of old age than a liability of young age. Essentially the argument is that with standardized technology and a mass market, there is a process of consolidation over time, and then the problems of the liability of old age emerge because new firms are not being founded. In contrast, in organizational populations with a non-standardized technology and a highly differentiated market, then there is a liability of newness because of the constant founding of new firms. Recently, within several studies of organizational ecology, there has been some discussion about potential dimensions (Barron *et al.* 1994) such as rates of technological change as or potential categories (Hannan *et al.* 1998a ; Hannan *et al.* 1998b) such as finance organizations. But neither of these ideas has been fully developed into a theory about organizational populations nor would they appear to

[1] Unless one wants to characterize an entire organizational population as reflecting only one meaning of organizational age, which would be an unusual case.

be as fundamental as the standardization of the technology or of the market. Indeed, what characterizes many financial organizations is that their technology and market are both standardized, explaining their liability of old age.

A second contention is that we need to explore more thoroughly the relative power of particular measures of organizational size. A number of different ones are now extant in the literature but a careful analysis of which alternatives are most appropriate has not been made. In particular, we explore the relative power of measuring organizational size decomposed into the number of units and average unit size in preference to an aggregate measure.

Finally, a third objective is to suggest that the impact of globalization and of post-industrialization has changed not only dramatically the nature of the ecological space but more critically the variety of technologies and of market demands. The former process has meant a radical expansion in the number of competitors and the variety of countries involved. The latter process has led to a differentiation both of technologies and of markets. The combination of these two social processes has created opportunities for new kinds of organizational forms. More critical is what consequences do these social forces have for the standard findings about organizational age and size and organizational survival.

The objective of this paper is to test the usefulness of contextualizing organizational populations by both their technology and market characteristics in general terms that would allow us to reconcile the divergent findings about organizational age and size. Another advantage of using basic technology and market characteristics is that these generalized market and technology characteristics allow us to synthesize a considerable amount of both the old and new organizational literatures as well as the literature in industrial economics. Furthermore, as can be observed these two dimensions provide a way of describing the changes associated with post-industrialization.

The specific test of the usefulness of the proposed theory about organizational populations developed here is on the industrial sector of the non-rubber footwear industry in the United States over the period of 1940-1989.[2] By combining a number of sources,

[2] The rubber segment of footwear is quite different being highly concentrated in a few tire rubber companies which also produced rubbers as sideline.

we were able to construct a massive data set of 3,804 companies, of which 3,519 are single plant or unit companies and 285 are multi-unit companies, of these 272 are medium in size and only 13 are large (see Table 1). The preponderance of many small firms reflects the presence of a highly differentiated market and the lack of a standardized technology as well as the absence of barriers of entry (Szenberg *et al.* 1977: xv). In many ways, this kind of organizational population is quite different from many of the other studies in organizational ecology that have focused on populations where large firms tend to predominate because of standardized technologies and mass markets. The shoe industry thus represents a deviant case, a useful site for the construction of a general theory (Merton 1957). Finally, this industrial sector is distinctive because it is quite old--some of our companies were founded before the American Revolution--and shoes have been a legitimate form of attire for centuries (Davis 1940). Although the focus of the data analysis is on the period of 1940-89, this can be easily divided into two equal periods of 25 years that allows one a natural experiment in examining the impact of globalization and post-industrialization on the patterns of organizational survival and whether or not the advantages of old vs. young age, or small vs. large size have changed.

Table 1: Distribution of companies by decade of founding and number of plants.

Decade of founding	Number of plants			
	Single plant	2 – 9 plants	>= 10 plants	Total
Total Companies	3519	272	13	3804
Before1940	838	126	9	973
1940s	1048	53	1	1102
1950s	647	28	0	675
1960s	454	35	1	490
1970s	244	20	1	265
1980s	288	10	1	299

Theoretical Framework

As observed by Hannan *et al.* (1998a), a positive relationship between young organizational age and mortality or a liability of newness, once one controls for organizational size, has been found in studies of savings and loan associations in California (Haveman 1992), wineries in the same state (Delacroix *et al.* 1989), producers of recently developed medical devices (Mitchell 1994), and American automobile manufacturers (Carroll & Hannan 1995).[3] Curvilinear patterns were observed in newly founded firms across a number of industries in Bavaria (Bruderl *et al.* 1992), American peace making (Edwards & Marullo 1995) and women's activist organizations (Minkoff 1993), and early telephone companies in Pennsylvania (Barnett 1994; Barnett 1997). Finally, a negative relationship between young organizational age and mortality or a liability of old age, once size has been controlled, has been documented in nine studies: New York life insurance companies Ranger-Moore, 1990), Manhattan banks (Banaszak-Holl 1991) and hotels (Baum & Mesias 1992), American credit unions (Amburgey *et al.* 1994) as well as those in New York City (Barron *et al.* 1994), banks in Illinois (Barnett & Hansen 1996) and in Tokyo (Han and Torres, 1995), day care centers in Toronto (Baum & Oliver 1991) and finally microbreweries (Carroll & Swaminathan 1992) in the U.S.

Several explanations for these divergent findings have been proposed. First, some of the studies have quite truncated histories and this may in some way distort the typical pattern of findings (Barron *et al.* 1994). Second, analysis of organizational size based on a proportional rather than an absolute measure could provide more consistent findings (Hannan *et al.* 1998a), one reason why it is important to adjudicate among alternative measures of organizational size. Third, a number of the nine studies involving a negative relationship are in financial organizations of one kind or another. Banks, credit unions, and insurance companies are not only financial organizations but organizations that provide a largely standardized service. Inherent in this idea is an important clue, namely the presence of a standardized technology catering to a mass market.

[3] One study (Lehrman 1994) of New York life insurance companies is not included here because an opposite pattern with the same population was reported by Ranger-Moore, 1990 and over a longer time period.

The Nature of the Technology-Market Nexus and the Problem of Organizational Age

Without ignoring the importance of the first two possibilities for divergent findings, it is this third idea, namely standardized technologies or designs coupled with mass markets, that we would like to build upon (Chandler 1977; Utterback 1994). Much of the industrial economics literature and the management literature (Donaldson 2001; Guerrieri & Tylecote 1998; Hage 1980; Lawrence & Lorsch 1967; Pavitt 1984; Perrow 1967) have focused theoretical attention on the growth of the large firm with its bureaucracy as a part of its generic form.

Another advantage of building upon the characteristics of the technology and the market is that these ideas provide a definition of organizational form found in the organizational ecology literature (Hannan & Freeman 1977). Standardized technologies usually are associated with the bureaucratic firm. Standardized technologies usually necessitate a large capital investment per worker as represented by the assembly-line and thus economic barriers to entry. Under these circumstances it is relatively difficult for new firms to emerge because they must start large.[4] While this is not impossible, it is extremely rare.[5] Much the same can be said for most of the organizational populations in which the relationship between organizational age and mortality was negative. They had standardized technologies and mass markets.

With this line of reasoning we are led to a counter-intuitive conclusion. One might assume that in an organizational population in which the liability of old age is greater than that of newness, a number of new organizations might be founded. *But in reality in these populations providing standardized services or products new organizations are rare because of the large economic barriers to entry*. New organizations, which are presumably also small ones, cannot enter the market and successfully compete because of the large economies of scale attached to the existing large organizations.

Our first hypothesis is:

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[4] Another argument is that small firms can start if they are highly specialized but this assumes that there is some differentiation in the market to support their entry. It is not simply a question of available resources on the fringes of the ecological space.

[5] A good example is the creation of a company to produce cars for the mass market. Willys, the ship and jeep builder, tried after the Second World War and failed.

I. In those organizational populations with a non-standardized technology, the liability of newness is greater than the liability of old age because there are few economic barriers to entry.

The non-rubber footwear industry fits this pattern because of the absence of economic barriers to entry. The estimate of Davis (1940: 54) is that an entrepreneur needed only about $10,000 to rent a full line of machines just before the Second World War. Nor did the situation change much during the ensuring fifty years. Thus, in this industry concentration in the industrial sector or structure has not increased across time (see Table 1 and Davis 1940; Schultz 1951; Szenberg *et al.* 1977). In understanding why there is a stable industrial structure, we are led to appreciate another way in which technology and market or market strategy interact to influence the relative advantages of specific kinds of organizational age and size.

Not only is there is an absence of a standardized design but there are a wide variety of distinctive technologies in the non-rubber footwear industry. Technologies vary because of the way in which shoes are made with some of the more common techniques being cement, McKay stitching, Littleway stitching, Goodyear stitching, pre-welt construction, and stitchdown lasting. Another cause of a non-standardized technology is the variety of distinctive materials that are used in the manufacturing of shoes, each with their distinctive manufacturing operations. Besides cowhide, there is kangaroo, buffalo, pigskin, rubber, Corfam, canvas, and cloth (see FIA 1993). Pigskin is used in the brand name of Hush Puppies; its utilization required the invention of a whole new process of skin-removal, tanning, and manufacturing. Even more radical has been the development of synthetic materials such as the plastic Corfam. More recently one has observed the invention of a number of new ways of constructing highly specialized and one might even say high tech shoes for runners and other athletes.

Organizational populations without a concentrated industrial structure are also characterized by a highly differentiated market with distinctive tastes that allow a number of specialist niches. Differentiation in the non-rubber footwear industry has four major origins, many of which apply to other traditional sectors: (1) preferences as a consequence of age/gender differences in the size of feet; (2) preferences as a

consequence of the variety of activities (dress, casual, various sports, military, dance, different kinds of leisure activities such as jogging, aerobics, mountain climbing, skiing, sailing, etc.); (3) preferences reflecting fashion and fad or novelty; and (4) preferences reflecting the number of quality/price gradients. This diversity of tastes and of technologies allows a large number of small companies to occupy specific market segments preventing the processes of concentration that have been described in many of the organizational ecology studies (Hannan & Carroll 1992). Given the many small firms, this industry fits the classical model of competition (Schultz 1951: 26-27; Szenberg *et al.* 1977: xv). Other industries that share the same or similar characteristics are wineries, clothing, restaurants, home remodeling, toys, etc.

What consequences does variety of tastes have for the meaning of organizational age? When fashion and fad are important, and where many quality/price gradients exist, then organizational age means having some craft experience. This moves beyond the discussion of general capabilities to indicate a specific kind of capability (Hannan *et al.* 1998a). The problem of acquiring craft knowledge implies a strong liability of newness. In addition, the presence of many small firms coupled with few barriers of entry--so that it is easy to found a new firm--also implies an early failure rate that is relatively high, and a half-life that is quite small (Davis 1940).

This line of reasoning leads to our second hypothesis about the characteristics of an organizational population and various liabilities:

II. In those organizational populations where there is a high differentiation of the market, the liability of newness is greater than the liability of old age because of the importance of craft experience.

But craft experience also implies a moment of vulnerability and another meaning associated with the concept of organizational age. In specialized firms, when the passage of the firm along to the next generation occurs, there is a moment of vulnerability. Precisely because so many of these firms are small and family owned, the problem of succession looms large. In the analysis of the different processes associated with organizational age and size, Hannan *et al.*, (1998a) discuss endowments as one of these processes. In this instance, it is the skills of the founder that represent a special kind of

endowment. This moment of vulnerability helps to explain the curvilinear pattern observed in some studies such as newly founded firms across a number of industries in Bavaria (Bruderl *et al.* 1992) and in the early telephone companies in Pennsylvania (Barnett 1994; Barnett 1997) as well as American peace making (Edwards & Marullo 1995) and women's activist organizations (Minkoff 1993), which are also built on craft knowledge and the social networks of their leaders. Furthermore, in the instance of the non-rubber footwear industry, the succession problem is not just a case of finding a relative willing to put in the long hours of work that are characteristic of these family firms--which is hard enough--but finding one with the requisite skills. Although the next generation might have been trained on the job, this does not mean that they have the natural talents for design and fashion, which are critical elements in the craft knowledge of traditional industries, nor the managerial expertise, which is equally important.[6] Thus, the advantages of age *qua* craft experiences are limited because there is a limit to how much can be learned. In other words, the rate of increase in advantage with age declines because techniques are mastered and customer relationships established.

Adjudicating Between Measures of Organizational Size

The discussion of the differences in findings relative to liabilities of age, whether new or old, also requires some consideration of the variety of measures of organizational size that can be found in the literature. Most of the ones that can be found in the organizational literature are listed in Figure One. Consistent with our reasoning above, we suggest that which measure best predicts survival and thus relates to the debate about organizational size and age depends upon the nature of the organizational population and whether it has a standardized technological-market nexus. In the 1980s, the most typical measure used was the organizational size at a specific moment in time rather than age varying measures of size because this was the only measure available. As yet, however, there has been little evaluation of how useful a measure of organizational size this is. Organizational size at birth is most likely to be useful predicting survival in those industrial sectors where the organizational populations do not change their size across time, that is where there is a little growth. This is more common in those organizational

[6] In the shoe industry, the women and children's market segments are especially affected by the success of the design (Szenberg *et al.* 1977).

populations that do not consolidate over time because of the absence of a standardized technology and/or a mass market.

As can be observed in Table 2, almost one quarter of the non-rubber footwear plants *when they opened* produced less than 275 pairs a day (and the percentage is about the same when they closed as well!) while another 23 percent produced between 275 and 975 pairs. In other words, almost one-half of the companies remained small in size. Traditional industries, that is industries with quite long organizational population ages, were imprinted with small craft specialized production in the beginning have few motivations to grow.

Table 2. Distribution of companies by decade of founding and production volume in pairs of shoes per day.

Date of founding	Average Plant Volume at Opening of Company								
	Miss-ing	< 45	46 - 275	276 - 975	976 - 2750	2751 - 4750	4750 - 8500	>= 8501	Total
Total Companies	514	272	623	880	952	320	155	88	3804
Before 1940	24	82	142	206	306	123	60	30	973
1940s	73	51	241	366	301	52	13	5	1102
1950s	118	53	105	151	156	58	28	6	675
1960s	126	28	48	77	110	47	31	23	490
1970s	77	18	42	46	42	17	11	12	265
1980s	96	40	45	34	37	23	12	12	299

More recently, some attention in organizational ecology has been focused on the idea of extremely small organizational sizes. This is an intriguing measure because it is consistent with the theory that there are specialist fringes even in organizational populations where generalists dominate (Carroll & Hannan 2000). In an organizational population with a non-standardized technology and a highly differentiated market, extremely small size organizations are common. In the case of the non-rubber footwear industry a number of the firms produced 50 or less customized shoes or boots per day,

that is a much smaller amount than the modal category of 976 to 1,250 pairs per day. This kind of niche clearly has a survival advantage because customized shoes are less subject to vagaries of shifts in customer tastes or perhaps more correctly they can more easily adapt to fluctuations in taste because of the small production runs. And it is obvious that here we mean the retention of this small size across time rather than any pattern of growth.

Another distinction in the conceptualization of organizational size can be made: Total size can be deconstructed into the number of units and average unit size. Why make a distinction between the average production size of the component units and the number of component units? Average unit size is a straightforward argument for economies of scale and as we have seen there are in some industries strong limits as to how large the average unit size can be. But the number of units is not necessarily an economy of scale argument except for certain collective costs such as managerial expertise, interest rates for loans, national advertising, and the like. Proliferation of units allows an organization to have specialized production facilities, each with its own economies of scale. Thus assembly plants and engine plants are quite different in size to say little about the production system for a luxury car as opposed to a mass-produced one. Units thus provide economies of scope, to use Chandler's (1977) phrase, as distinct from economies of scale, which are represented by the average size. In the footwear industry, multi-plant companies would produce women's shoes and men's shoes in different plants in part because they require distinctive production processes and in part because style is so much more critical for women's shoes and thus production runs are shorter.

Still another approach to the problem of age varying size has been reported in recent work. Hannan *et al.* (1998a) suggest that size should be measured relative to the production size of the largest company in each year. This measure of organizational size seems most appropriate in organizational populations with a standardized technology and market such as the automobile industry where economies of scale and therefore economic barriers to entry are especially strong and keep growing across time. Their arguments become less compelling in an industry where the industrial structure remains quite stable over time. But this alternative measurement of size should be at least explored.

Given a highly differentiated market, another way in which we can think about the problem of organizational size is to ask how many market segments are represented in the measure of organizational size. Certainly in traditional industries that are dominated by a diversity of tastes, one would expect that in some way diversity would be reflected in what products are produced or services are provided. This line of reasoning then suggests another way in which organizational size can be reinterpreted and of course has been. It is somewhat commonplace in the organizational ecology literature to assume that large size means being a generalist (Baum 1996). However, in this literature, the assumption is usually that a highly standardized product or service, that is a mass market, is the pattern. But this is not the only way in which generalists can be defined. Another definition, and one that is much closer to the ecological research on newspapers (Carroll 1987), is that generalists produce a variety of products for a number of distinctive market segments, reflecting a diversity of tastes. Given our interest in understanding the many meanings of size, we want to disentangle whether it is large size *per se* measured as either the number of units and/or their average size but relative emphasis on a generalist vs. specialist market position, that accounts for higher survival rates.

One can take the two major dimensions measuring differentiation of the market—the variety of preferences associated with body size and with the nature of activities—to count the number of market segments in which a firm is located. The more segments, the more that the strategy of the firm is a generalist one. This is another important meaning attached to the concept of organizational size. These distinctions represent resource partitioning (see Baum 1996; Carroll 1987), that is ways in which the market context can be differentiated. Here, however, our concern is more with the relationship between the variety of distinct market segments in which the firm is located, on the assumption that diversity is highly protective against fluctuations in market demands, as the organizational ecologists have argued. In this sense, it is the exact opposite line of reasoning found in Peli and Nooteboom (1999) where the idea of geometry of sphere packing is employed to indicate the number of distinct pockets. Here the issue is the number of distinct pockets in which the firm is situated.

In summary, we have five distinctive measures of organizational size to adjudicate among:

1. size at birth
2. exceptionally small size
3. total size deconstructed into a number of units and average unit size
4. relative emphasis on a generalist strategy as measured by number of market segments.
5. a proportional measure of organizational size.

But the problem of organizational age and organizational size is not just limited to which measures one uses for each of these ideas but also whether the pattern of findings remains constant across time. We suggest that the basic pattern of findings that has been described in the organizational ecology literature is not longer operative because of a new historical epoch, the emergence of globalization and of post-industrialization.

Organizational Age and Organizational Size Reconsidered in the a New Historical Epoch

The advent of both globalization and of post-industrialization and at approximately at the same time point has altered considerable the nature of the competitive process between organizations struggling for survival. Post-industrialization has meant the addition of new technologies that allow for considered customization of production and the development of new materials, most notably synthetic ones. Parallel with this has come a proliferation of new tastes because of the creation of highly educated consumers. Globalization has meant the emergence of a radical increase in the number of competitors and especially in the traditional industries where the cost of labor is an important factor in the cost of the product or service.

Within the non-rubber footwear industry, 1965-1989, represents a period in which radical new technologies that are generally called post-Fordist emerged. Paradoxically, and long before Piore and Sabel (1984) wrote their book about the Second Industrial Divide, these technologies (proportional grading and injection molding in 1961, and laser cutting in 1976 as well as other revolutionary changes in between these dates) appeared in the footwear industry (Battelle Memorial Institute 1966; Duchesneau *et al.* 1979; ILO 1992). A particular critical development was the creation of new materials from plastics that allowed for greater uniformity and the use of computer controlled machines (ILO

1992; OECD 1976). Corfam, although a failure, was perhaps the most dramatic example of these new materials and their possibilities.

While the production quantity and quality was shifting dramatically because of technological advances, the market context or demand side was also changing, making new organizational strategies viable. Customers in post-industrial society (Hage & Powers 1992) wanted a variety of new kinds of shoes, especially for a considerable range of leisure time activities from jogging and aerobic exercises to hiking and boating (ILO 1992; OECD 1976). Sports shoes became essentially quite high tech as the emphasis on performance increased. It was essentially new firms like Nike and Reebok (I.D.C.H.: vol v, 372-77; Moody's various years) that explored these technologies and recognized the need for new kinds of shoe products. The failure to adopt new technologies by the large and old existing companies is an example of old age as obsolescence.[7] Furthermore, these new firms exploited the commodity chain, keeping the high value added activities of research, advertising, and design in the U.S. while regulating production to various developing countries under short-term contracts (ILO 1992; Korzeniewicz 1994; Korzeniewicz & Martin 1994; Martin 1999), in effect creating a new organizational form for the non-rubber footwear industry.[8] Furthermore, Nike and Reebok, and a few others, engaged in R&D for product innovation, something quite rare in this industry (one interesting exception prior to this time period is Wolverine which developed hush puppies from pig skin leather) (Battelle Memorial Institute 1966; OECD 1976; Strasser & Becklund 1991). These two companies became new giants during the 1980s, but because most of their production was offshore their rise to prominence is not part of our analysis.

The importance of life style and leisure time activities also helped domestic companies that had specialized in these to suddenly expand, demonstrating the introduction of new tastes in the market place. Examples include Timberland (I.D.C.H., vol 13: 511-14; Moody's various years), Justin Cowboy Boots (I.D.C.H., vol 19: 231-33; Moody's various years), and L.L. Bean outdoor shoes (I.D.C.H., vol 10: 388-90; Moody's various years), among others. Companies, whether new or old, that exploited an authentic

[7] These firms also engaged in a considerable amount of sophisticated research including polymer chemistry to find new kinds of materials for making shoes (Strasser & Becklund 1991).

[8] Commodity chains are a relatively old organizational form but not within this industry until the 1960s when production began to be moved offshore.

American look also did well (ILO 1992). But the shoe companies that gained the most were foreign firms in many of the developing countries that began exporting shoes to the U.S.[9]

A number of individuals (Boyer & Drache 1996; Doremus 1998; Gilpin 2000), have argued against the concept of globalization, meaning by this the volume of international trade, and have suggested that the volume is not much higher today than prior to the First World War. For us, the thesis of globalization is best supported where one can see de-industrialization following an increase in foreign competition, especially from a variety of developing countries. In the traditional industrial sectors where wages represent a sizable proportion of production costs, imports have assumed a large proportion of domestic consumption in the advanced industrialized countries and especially in the U.S. where most organizational ecology research has been concentrated (Baum 1996). The implication of this is that globalization should be studied on an organizational population specific basis.

From this sectorial perspective, the evidence for globalization is much stronger. Certainly the penetration of imports in the sector of footwear was rapid and dramatic, rising from 2 percent in the mid 1950s, to 4 percent in 1960 to 30 percent in 1970 and 81 percent in 1989 (FIA various years; Szenberg *et al.* 1977). Nor is this the only sector in which this penetration occurred.

From the perspective of organizational ecology, globalization can be defined as a dramatic increase in the number of different countries that export goods and services (especially the former). In other words, it represents a rapid increase in the density of the organizational population measured at both the unit and firm level. Another way of conceptualizing globalization is that it can--again this varies by sector because it is only true in some sectors--represent a dramatic change in the rules of the game. Typically, this may mean the importing of products at lower prices (e.g. shoes from Taiwan or South Korea or Indonesia) and/or of higher quality or better design (e.g. Italy or Brazil) (FIA various years). Under these circumstances, one would expect a much lower founding rate (this problem will be explored in another paper) as well as a higher mortality rate.

[9] Unfortunately, in the import data it is impossible to separate how much the imports reflect American companies and how much reflect non-American companies. Estimates of the former are about one-third (New York Times, July 3, 1969).

In contrast to the various theses of globalization, many scholars have long accepted the idea of post-industrialization or a new economy (Bell 1973; Hage & Powers 1992; Toffler 1981).[10] Most typically, post-industrialization is interpreted as a movement towards flexible manufacturing (Piore & Sabel 1984) and the emergence of competition over the innovation of new products, especially for new life styles, as we have already noted.

Both of these tendencies reinforce each other and represent another meaning of age, namely epoch. The consequences of globalization for the organizational ecology of traditional industry are a radical increase in organizational density because of imports from a large diversity of companies. The impact of post-industrialization creates different competitive pressures because of new technologies and products, frequently associated with new organizational forms. Together, these two large social forces of social change alter the competitive "rules of the game".

But the more interesting question is which firms are more likely to be feeling the brunt of the impacts of globalization and post-industrialization. Do the standard advantages of age *qua* experience and size *qua* number of production units and variety of market segments still hold? Given a new set of competitive rules, namely the availability of flexible manufacturing which allows for the production of a variety of shoes on the same production line and the proliferation of new tastes for various kinds of products, the older and larger plants with dedicated production lines will have great difficulty in changing their production systems and developing new products. Precisely because they have done well with the older rules of competition, they will be reluctant to change their established procedures. In other words, success breeds inertia.

Therefore our hypothesis is:

III. With globalization and post-industrialization, the hazard rate of dissolution for older and larger organizations increases.

[10] The concept of globalisation means a variety of different things including cultural homogenization, the flow of international capital, as well as trade.

Another way of stating the same argument is that while age *qua* experience and/or size provide buffers in normal times, when the rules of competition change they also produce rigidities and slowness in responding to changed competitive conditions.

As can be observed in Tables 1 and 2, despite the impact of globalization and post-industrialization, companies founded in the 1980s could still aspire to be either medium or large in size. It demonstrates that new organizations that experiment *and if they have the correct strategy* can expand rapidly because they fit the existing market tastes well. A good example is Munro Shoe Co., which produces a large volume of shoes for Wal-Mart, its neighbor in Arkansas.

The Methodology

The focus of this study is the traditional industry of U.S. non-rubber footwear, which covers most of the consumer tastes relative to how to cover one's feet. The rubber market segment is not included because it was dominated by 12 major rubber manufacturers (Goodyear, Firestone, Goodrich, etc.). It thus had a radically different industrial structure, being highly concentrated and essentially a sideline of multi-divisional corporations. Furthermore, all of these companies left this market segment during the 1970s as one consequence of globalization and post-industrialization.

The construction of the data set for the non-rubber footwear industry required the pooling of information from a variety of sources. Much of the basic plant data were obtained from the American Shoemaking Directory of Shoe Manufacturers, which was published annually beginning a few years after the start of the 20th century. From this was obtained the founding date of plants if they existed in 1940 and, starting in 1909 when these data were first reported, the daily production volume of plants in shoe pairs. To obtain data on companies founded prior to 1907 (the year of the earliest volume for the American Shoemaking Directory in the Library of Congress), information was obtained from the The Pocket Directory of Shoe Manufacturers which replaced the Classified Directory of Shoe Manufacturers According to Type and Grade of Shoe, Hide and Leather, which started being published in 1880. For those companies founded prior to 1880, information was obtained from various editions of Ward's Directory of the Largest Corporations, which reports dates of earliest plant. The founding dates of only

two companies created prior to 1880 are unknown and they were given the date of 1879, a conservative estimate of age.

These two directories were excellent for obtaining information about shoe plants but were less adequate for information about shoe companies and especially who owned them. Besides consulting Ward's, we relied extensively on Moody's Industrials Manual, which allowed us to track which plants belong to what companies and when. There was considerable transfer of plant ownership and of companies, especially during the 1970s and 1980s. Moody's also helped us in cross-checking with American Shoemaking Directory of Shoe Manufacturers and eliminating plants that produced only components of shoes (e.g. wooden heels or soles). This correction allowed us to drop about 300 units in our original data set, a considerable correction. What made identifying plant ownership difficult was that some shoe manufacturing companies reported their production under separate shoe divisions in the American Shoemaking Directory of Shoe Manufacturers; for instance, during the 1980s Interco had separate divisions for Florsheim and for Converse. And some companies, e.g Diamond Shoe Company, went so far as to operate each plant as if it were a separate company with quite disparate names. Other complications included the problem of companies leasing plants or the production of other plants.

Starting in the 1950s, the fashion of conglomerates began to spread even to this traditional industry, and various holding companies or multi-divisional firms began to purchase shoe companies. To obtain some sense of this quite dramatic change in form, we consulted America's Corporate Families, The Directory of Corporate Affiliations, and Mergers and Acquisitions. For example, Northwest Railroads bought Acme Shoe in 1956 and then expanded it. Some 35 conglomerates moved into the footwear industry over the course of the next several decades including some surprizing examples: Shering-Plough, Chesebrough-Ponds, Gulf and Western, Consolidated Packing, and Food Fair Stores among others. Rarer was the movement in the opposite direction, that is horizontal expansion into other product lines by traditional shoe manufacturers. Only a few of the largest of the original shoe producing companies moved into apparel and only 3 went beyond this (specifically Melville, Interco, and Brown). None of these corporate transitions were reported in the shoe plant directories but were discerned in the above

inter-corporate directories. In other words, this traditional industry largely remains focused on non-rubber footwear manufacturing for most of the time period that concerns us but it is invaded to some extent by conglomerates.

Since our concern is with domestic production, we do not report production of these companies that occurs offshore, whether in Canada or Puerto Rico (actually few plants in either case) or in plants located elsewhere in the world. The globalization of shoe production into commodity chains by some American companies, most notably Nike, Reebok, Timberland, Nine West, Caressa, etc. is another study that should be done but would be quite difficult to complete.

Sample Size

During the course of 50 years, 3,804 distinct shoe manufacturing companies existed. Of these, 973 were born prior to 1940, 1,102 in the next decade (see Table 1), 675 in the decade of the 1950s with another drop to 490 in the 1960s. What is most interesting about Table 1 is that more companies were founded in the 1980s than in the previous decade. This provides a considerable number of foundings and failings and thus corrects, in our opinion, for any difficulties in not having the entire history of this organizational population in the U.S.; there are sufficient population dynamics upon which statistical estimates can be based.

In 1940 there were 1161 plants, of which 245 (21%) were in multi-unit companies and at the end of the period in 1989, there were 536 plants of which 185 (34%) were in multi-plant companies. Table 3 provides the information about the concentration of production in multi-plant companies by both measures of size. It might be noted that the percent of plants in multi-plant companies reached a peak of 43% in 1977 and then steadily declined after that, indicating some of the interesting effects of globalization and post-industrialization. The ILO (1992) reports that the strategy of flexible specialization in smaller plants appeared to help some companies survive the impact of globalization.

The cessation of all domestic footwear manufacturing is defined as company mortality even if the company continued to import shoes from another country or to pursue some other line of business. Interestingly enough we have two multi-plant

companies that stopped all production and then some time later moved back into shoe production. We have counted these as separate multi-plant companies.

Table 3: Several measures of concentration in the US non-rubber footwear industry: percent distributions of plants and production, 1940-1989

Period	Single Plant	2 – 9 Plants	>= 10 Plants	Total
Plants				
1940s	78	14	8	100
1950s	73	16	11	100
1960s	68	20	12	100
1970s	59	24	17	100
1980s	60	24	16	100
Production				
1940s	59	22	19	100
1950s	56	24	20	100
1960s	53	29	18	100
1970s	42	36	22	100
1980s	45	30	24	100

Company age is defined as duration from the date the company started to operate. If the company was formed by a merger, then we chose the age of the oldest component in the merger.

Not all companies reported organizational size as measured by shoe production in pairs per day or the type of production in the directories. Indeed, as can be seen in Table 2, there are 514 companies for which we do not have shoe production size. We experimented with different procedures for estimating the size of these companies but found that it was best to include a dummy variable for this category. We might have assumed that these plants were extra small but this does not appear to be the case. Instead they are spread among several different shoe product size categories.

The Measures

1. The Meanings of Age--endowments, capabilities, and epochs.

Since much of our reasoning has centered on the variety of meanings of age, it is obvious that one would want to be meticulous in selecting a function for describing age. A number of recent studies have fitted age with a piece-wise step function to allow age to assume any functional form found (Hannan *et al.* 1998b; Sorensen & Audia 2000). Figure 1 shows a nine parameter piece-wise model of an age effect but it is not an

improvement over a simpler model. In this figure, it might be noted that almost 20 percent of new companies are closed after only one year of operation. At the end of the second year, another 16 percent of the remaining companies are closed, and then in the third year another 13 percent of the remaining ones. Given this extreme liability of newness the inverse of age and the inverse of age squared fit the data well, as one can observe in Figure 1, and are more parsimonious than the piece-wise model.

However, these two measures do not model all the specific aspects of the mortality; we use two other parameters to model the effect of age. First, we created a dummy variable, Age0, to control for what is essentially an artefact of the data coding. We calculate age by subtracting year of birth from current year. In the year a company begins operation its age is therefore zero years. Shoe companies can begin and end in their zero year if plant ownership changes rapidly. However, in the underlying data set on plants, openings and closings are coded to different years; a plant cannot close in the same year it is opened. The closure of companies is dated to the first year the last or only plant is not listed in the yearbooks. Because of this very few companies close in their age-zero year.

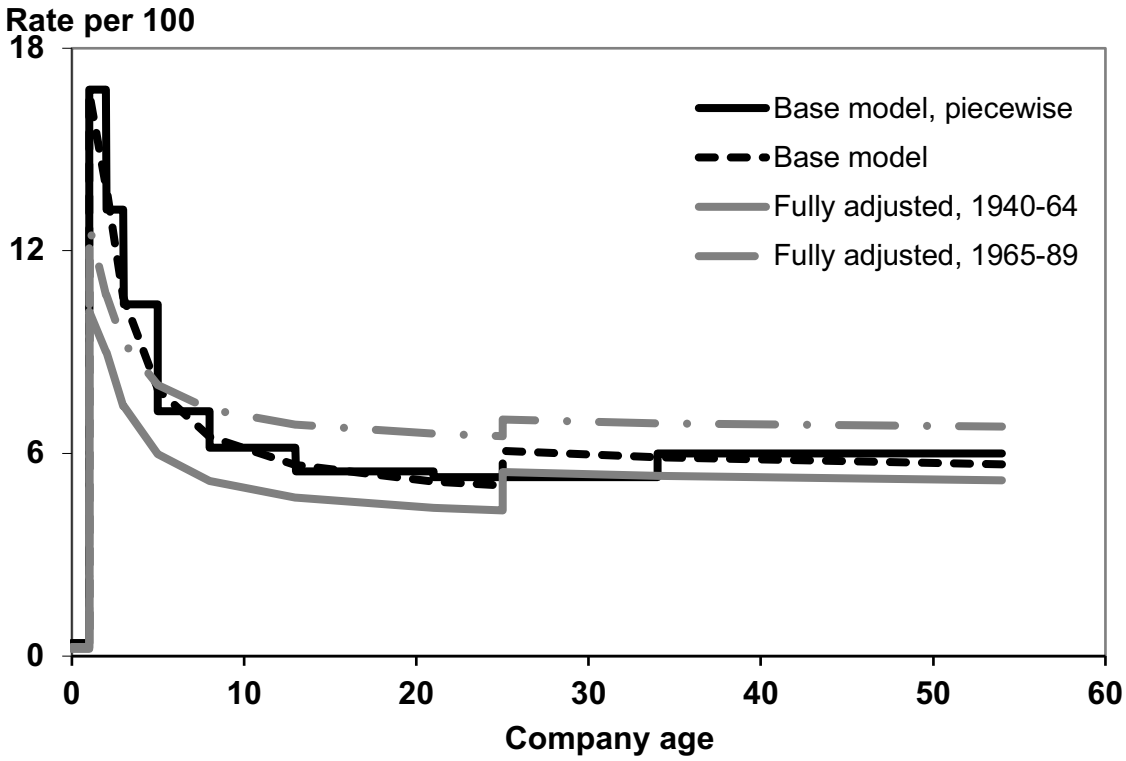

Figure 1. Predicted failure rate of US shoe manufacturing companies by company age, 1940 - 1989.

Second, as can be observed in Figure 1, there is a slight up-tick in the mortality rate after age 25 years. The inverse functions of age cannot capture this and we have, therefore, added a dummy variable to account for what we believe to be mortality due to a succession crisis, that is, for not finding some relative willing (or capable) of managing a family business. This would be a measure of endowment and capability.

Although we have tried to diminish the problem of left censoring by determining a precise plant age and size at opening we recognize that companies that survived until the beginning of our analytical period clearly had developed some superior craft skills. To further control for left censoring, we have created a dummy variable that represents birth prior to 1940 and thus experience in learning how to survive.

The period of 1965-1989 or the last twenty-five years of our data analysis is a new epoch as we have suggested. But we need to separate as much as we can the globalization arguments from those involving post-industrialization, our main concern

here. Below we discuss how we model global company density so that the dummy variable for the period of 1965-1989 primarily reflects the impact of post-industrialization when the development of flexible manufacturing in this industry as well as the creation of new organizational forms such as the commodity chain, inter-organizational relationships and small high tech companies occurred. We expect the hazard rate for older and larger firms to increase in this period relative to the preceding period of 1940-1964.

2. Company Size--average production size and number of units, absolute and relative measures, extra small size and other considerations.

Size can be measured in both absolute and relative terms as Hannan *et al.* (1998a) have recently argued. Furthermore, the aggregate size can be deconstructed into component parts. For our 285 multi-unit companies, we can compute an average plant size as well as count of the number of units or plants. At the large end, there were extremes even at the beginning of the 20th century. D. C. Douglas, for example, a firm that was founded in 1876, produced 17,000 pairs a day in a single plant in 1909, when production data first becomes available, and advertised itself as the largest in the world. During the 1960s, some of the slipper companies were producing 100,000 pairs a day, but it should be remembered that many slippers were made of cloth. Given these extremes, when analyzing company size and average plant size as continuous variables, we employ a logarithmic transformation.

The other measure of organizational size, the number of units belonging to the same company (see Figure 2), is more straightforward although it is difficult to disentangle the meanings of this from experience in coordinating plants.[11] At one extreme is International Shoe (Interco), which at its peak had 61 plants in operation, twice as many as the next largest company in terms of plant count (Moody's various years, cross-checked with the American Shoemaking Directory). Again, the log of the number of plants was used in the analysis to compensate for the extreme skewness.

[11] In future work, we intend to spend some time attempting to measure number of plants, their age and age as experience separately.

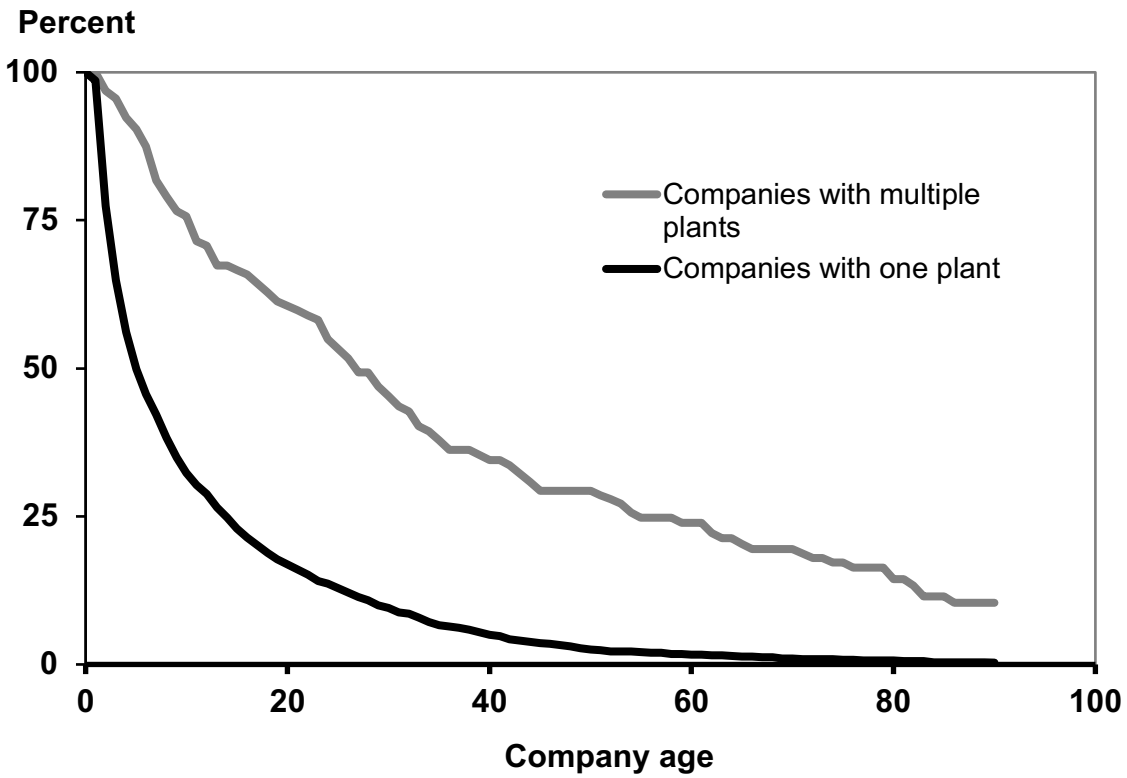

Figure 2. Survival of US shoe manufacturing companies by company age, 1940-1989

Besides these absolute measures, proportional measures can be computed as well. Plant size was computed as the proportion of the largest plant in operation in any specific year. Similarly single unit companies as well as multi-unit companies were provided with a proportion measure relative to the company with the largest number of units in a specific year. Obviously these proportions changed dramatically across time, especially with the rapid downsizing of International Shoe during the 1960s and 1970s.

One can also measure growth and again with the two measures, average plant size and number of units. But just as age is heavily skewed because of the very high failure rate in the first few years, so is production size. We found it necessary to create seven size categories that corresponded to distinct kinds of production systems. The first category (see Table 2) is customized production of under 45 pairs per day, while the second is 46 to 275 pairs. The modal one is the fourth category, 976 to 2750 pairs with 25 percent. In creating the categories we made the range of each category larger and larger. This has an effect similar to taking logs. The movement from one category to another is used as a measure of growth. This is the best way of avoiding some large percentage

changes. The second growth variable measures the impact of adding additional plants. To measure extremely small production sizes, we chose the first category, less than 45 pairs, as the range that reflected this idea. Total production is average plant size times number of plants. In the analysis, we assess whether the total production figure is as effective as the two disaggregate measures, namely average plant size and the number of plants.

3. Characterizing the Organizational Populations as having a Market Demand for Many Tastes--age/gender distinctions and product diversity for activities.

As we have already suggested, what has prevented concentration from occurring in this industry until relatively recently is the considerable diversity of tastes. There are two fundamental dimensions to this: (1) the many age/gender categories, which are themselves divided into a variety of combinations of length and width and (2) the variety of products that reflect alternative life styles or activity situations, both of which obviously also included the problem of different size feet. The age/gender categories are the infants, children, boys and youth, misses, men and women. Examples of product variety are high style, work shoes, boots, moccasins, sandals, and slippers. Fourteen varieties of products were distinguished fairly consistently in the directories over the years. Extreme forms of specialization such as burial shoes and ice skates were grouped as other.

Almost 40 percent of our companies produce shoes for only one kind of customer, typically either men or women, reflecting the craft specialization of the industry. Only 16 percent of the companies produced for four or more age/gender categories. Thus, by this dimension of niche width, wide niches are not common (read Hansen 1959: for an excellent discussion of the different combinations of producers during the 1950s in the footwear industry). The number of products essentially tells the same story about the craft specialization of this industry. Two-thirds of the companies produced a single product, whether dress or casual shoes.

4. Measuring the Size of the Ecological Space--consumption, production, and global density.

In evaluating the alternative meanings of organizational age and size, it is useful to include a number of control variables that in various ways attempt to assess the size of

the ecological space. An expanding environment is measured by the growth in domestic production and the growth in personal consumption with the idea that these should increase the number of companies, assuming no changes in the average plant size. A variety of alternative measures for personal consumption were tested but they are all highly correlated. It might be noted that across the half-century the average number of shoes purchased per capita increased.

The most important aspect of the ecological space is the extent of the competition that exists. Typically this has been estimated by company density and company density squared. These measures have not included a global dimension and for good reasons. In most cases the boundaries of the ecological space are defined either by a city, region, or the nation-state. Furthermore, many organizational population studies' time periods end in the 1960s or before the time when globalization was a major factor in the competitive struggle.

But for the footwear industry and because our data continues until 1989, when imports represented almost 90 percent of the shoes purchased in the U.S., we are required to confront the impact of globalization that in this industry started in the early 1960s. To do so, we combined the number of imports, measured in millions, with the American company density to estimate the relevant global density. The logic is, of course, that as imports expand, by definition company density is growing even if more and more of the companies are overseas. Beyond this, it means that company density can grow even as the number of American companies is declining as it was. Therefore, this becomes a more appropriate way of determining the density and thus the extent of competition in the ecological space. In other words, the meaning of globalization is that the ecological space is expanding and especially to include developing countries.

Statistical modeling

In order to model and test these effects statistically we use discrete time event history models (Tuma & Hannan 1984). Conceptually the dependent variable is the hazard rate for closing a company. The models that we use are estimated with a complementary log-log function (Allison 1982). Denoting the hazard as π_τ the general form of the model is:

$$\text{Log}(-\log(\pi_\tau)) = \alpha + \beta X + \beta X_\tau + e$$

In this model the baseline hazard rate is constant but it is modified by two sets of independent variables. The first, without the subscript, have only one value for each company for the entire period. The second change value on an annual basis, denoted by the subscript t. This model can be extended so the baseline hazard rate is also a function of time, and to cover effects that change over time by interacting the independent variables with a variable representing time, as follows:

$$\text{Log}(-\log(\pi_\tau)) = \alpha_1 + \alpha_2 f(t) + \beta X + \beta X_\tau + \beta X_\tau f(t) + e$$

We fit the model with maximum likelihood methods using the SAS procedure LOGISTIC (SAS 2000). With these methods model fit and the contribution of individual variables can be evaluated with likelihood ratio tests.

In the models involving interaction effects, each of these were plotted to be sure that in fact there was a true interaction effect. In each instance, this was the case. These graphs are not reported.

The Research Findings

Before reporting the analysis of the many meanings of organizational age and size, let us consider the effects of our measures on the size of the ecological space because there are some surprising findings (see the control variables in Table 4). The measure of total shoe production is significant in only two models, 3 and 6, which as we shall see have less robust measures of size. In contrast, personal consumption is significant but in a direction opposite of what would expect; it is positively related to mortality. Despite the growth in the amount of money spent, which did translate into the purchase of more pairs of shoes per capita, and thus a growing ecological space, there is steadily higher mortality. Exports is associated, as one would assume, with a lower hazard rate for dissolution.

Global density and global density squared are both associated with increased mortality. In this pattern, which is not the expected U-shaped curve as in many other studies where globalization has not been modeled (see Hannan & Carroll 1992), one observes a constant increase in the extent of competition that is not compensated for by rising standards of living.

Table 4: The many meanings of organizational age and size and their consequences for survival								
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	Control variables							
Shoe production	-0.0276 (0.0305)	-0.0518 (0.0306)	-0.0665 (0.0306) p =.0297	-0.0558 (0.0307)	-0.0478 (0.0306)	-0.0805 (0.0312) p =.0099	-0.0412 (0.0323)	-0.0319 (0.0324)
Personal consumption	0.0778 (0.0090) p <.0001	0.0949 (0.0092) p <.0001	0.0482 (0.0092) p <.0001	0.0930 (0.0093) p <.0001	0.0616 (0.0092) p <.0001	0.1167 (0.0110) p <.0001	0.1141 (0.0165) p <.0001	0.1122 (0.0166) p <.0001
Exports	-0.6129 (0.0960) p <.0001	-0.6181 (0.0956) p <.0001	-0.5982 (0.0959) p <.0001	-0.6222 (0.0957) p <.0001	-0.6065 (0.0960) p <.0001	-0.5883 (0.0967) p <.0001	-0.6169 (0.0993) p <.0001	-0.6126 (0.0993) p <.0001
Global density	0.0608 (0.0141) p <.0001	0.0510 (0.0142) p =.0003	0.0604 (0.0141) p <.0001	0.0514 (0.0142) p =.0003	0.0563 (0.0141) p <.0001	0.0260 (0.0144)	0.0486 (0.0165) p =.0033	0.0497 (0.0165) p =.0025
Global density squared	0.0268 (0.0054) p <.0001	0.0280 (0.0054) p <.0001	0.0281 (0.0054) p <.0001	0.0280 (0.0054) p <.0001	0.0291 (0.0054) p <.0001	0.0295 (0.0054) p <.0001	0.0272 (0.0060) p <.0001	0.0274 (0.0060) p <.0001
	Organizational age variables							
Period before 1940	-0.3310 (0.0572) p <.0001	-0.3387 (0.0577) p <.0001	-0.1152 (0.0719)	-0.3530 (0.0752) p <.0001	-0.3453 (0.0577) p <.0001	-0.2898 (0.0578) p <.0001	-0.2875 (0.0753) p =.0001	-0.2737 (0.0757) p =.0003
Age zero	-3.8542 (0.2801) p <.0001	-3.9093 (0.2805) p <.0001	-3.8982 (0.2805) p <.0001	-3.9130 (0.2805) p <.0001	-3.8950 (0.2806) p <.0001	-3.8915 (0.2806) p <.0001	-3.9077 (0.2805) p <.0001	-3.9128 (0.2806) p <.0001
Age inverse	3.4581 (0.2609) p <.0001	2.2350 (0.2700) p <.0001	2.5714 (0.2721) p <.0001	2.0359 (0.2757) p <.0001	2.6305 (0.2677) p <.0001	2.7118 (0.2682) p <.0001	2.9054 (0.3499) p <.0001	2.6079 (0.3542) p <.0001
Age inverse squared	-2.0673 (0.2322) p <.0001	-1.3082 (0.2375) p <.0001	-1.5078 (0.2385) p <.0001	-1.1669 (0.2410) p <.0001	-1.5569 (0.2358) p <.0001	-1.6040 (0.2362) p <.0001	-1.7848 (0.2996) p <.0001	-1.6061 (0.3021) p <.0001
Age more than 25 years	0.1027 (0.0618)	0.1957 (0.0618) p =.0016	0.2186 (0.0626) p =.0005	0.2223 (0.0625) p =.0004	0.1531 (0.0620) p =.0135	0.1623 (0.0617) p <.0086	0.0563 (0.0940)	0.0631 (0.0941)
	Organizational size variables							
Log number of plants		-0.9424 (0.1071) p <.0001		-0.9270 (0.1093} p <.0001			-0.9411 (0.1069) p <.0001	-1.3488 (0.2014) p <.0001

Production size unknown		0.1902 (0.1144)	1.0598 (0.0855) p <.0001	0.3193 (0.1211) p =.0083	-0.0901 (0.1058)	1.2642 (0.0947) p <.0001	0.2385 (0.1145) p =.0373	0.0966 (0.1498)
Log average plant size		-0.0644 (0.0149) p <.0001		-0.1760 (0.0287) p <.0001			-0.0637 (0.0149) p <.0001	-0.1139 (0.0197) p <.0001
Small size		-.7013 (0.1000) p <.0001		-0.6652 (0.1007) p <.0001	-1.0087 (0.0956) p <.0001	-0.8182 (0.0994) p <.0001	-0.7013 (0.1001) p <.0001	-0.8554 (0.1360) p <.0001
Market span (square root)		-0.3597 (0.0160) p <.0001		-0.3548 (0.0160) p <.0001			-0.3669 (0.0161) p <.0001	-0.4519 (0.0225) p <.0001
Production size at birth			0.0359 (0.0107) p =.0008	0.1345 (0.0263) p <.0001				
Add plants			-0.4827 (0.2063) p =.0193	-0.2233 (0.1768)				
Increase in size category			-0.0989 (0.0156) p <.0001	-0.0113 (0.0172)				
Total production size					-0.1356 (0.0134) p <.0001			
Relative production size						-0.0842 (0.0143) p <.0001		
Relative number of plants						-0.7094 (0.0840) p <.0001		
	Epoch interactions							
1965 - 1989							0.1561 (0.1190)	-0.4704 (0.0228)
Period before 1940 * 1965 - 1989							0.2098 (0.1286)	0.1835 (0.1288)
Age inverse * 1965 - 1989							-1.7424 (0.5599) p =.0019	-0.8890 (0.5683)
Age inverse squared * 1965 - 1989							1.1945 (0.5036) p =.0177	0.6456 (0.5057)
Age more than 25 years * 1965 - 1989							-0.0072 (0.1354)	-0.0377 (0.1353)

Log number of plants * 1965 - 1989								0.5784 (0.2363) p =.0144
Production size unknown * 1965 - 1989								0.3660 (0.2311)
Log average plant size * 1965 - 1989								0.1073 (0.0299) p =.0003
Small size * 1965 - 1989								0.4041 (0.2021) p =.0456
Market span * 1965 - 1989								0.1763 (0.0324) p <.0001
Chi square	1540	2549	1822	2581	1892	1975	2591	2661

The Many Meanings of Organizational Age

In column one of Table 4 are the various ways in which organizational age has been measured. The combination of age inverse and age inverse squared reflect the strong liability of newness in this specific population of footwear manufacturers that has already been observed (Figure 1). In general, older companies live longer. There is a slight, but statistically insignificant, increase in the mortality rate of companies that are over the age of 25. This reflects the difficulty of finding successors in family firms, which are the norm in this specific industry. Consistent with this idea, there is a considerable difference between the half-life of single plant companies, 6.3 years, and multi-plant companies, 33.3 years (see Figure 2). Interestingly enough, studies of the shoe industry indicate that the half-life prior to 1940 was about three years, suggesting a remarkable consistency in the liability of newness over more than a century of time (Davis 1939).

As expected companies founded prior to 1940 have developed superior management skills via organizational learning and this reduces their mortality rate relative those founded after 1939.

The Many Meanings of Organizational Size

Organizational size has been measured by a number of indicators that reflect four general approaches that one finds in the organizational ecology literature. The first

approach and the one that we recommend, is to deconstruct organizational size into three major components: (1) average unit or plant size; (2) number of units or plants; and (3) relative emphasis on a generalist strategy. In addition, picking up on some recent work, we have added the category extra small size, which is the opposite of these first three measures and is a recognition of the idea that narrow specialist niches can co-exist with large generalist companies. Finally, we must include a dummy variable for those organizations for which we do not have organizational size measures. These results are reported in column two.

Alternative approaches for the measurement of size are provided in models three through six in Table 4. In columns three and four are tests of the measures of size at birth and the two kinds of growth, first separately and then in combination with the other measures of size. Column five reports the total production size to determine whether this is a satisfactory substitute for either set of size measures. Column six reports the new approach of using proportional measures of size rather than absolute measures.

Column two, the test of the preferred approach to measuring organizational size, has five measures: (1) average plant size; (2) the number of plants; (3) production size unknown; (4) extra small size; and (5) emphasis on a generalist strategy. Four of the five reduce the mortality rate as hypothesized and all four measures are highly significant, indicating that different measures of size have quite different meanings. Perhaps the most interesting findings are that both large size measured in three ways including a generalist strategy and small size reduce mortality, reflecting that this is an industry with both generalists and specialists. Unknown production size is not significantly associated with mortality. The model is quite robust with a χ^2 of 2549. It should be observed that the inclusion of either five or six distinct indicators measuring size does not change the pattern observed with organizational age. Each of the hypotheses about age remains supported as are those about organizational size. Age is not a substitute for size or vice-versa.

Since the organizational ecology literature has relied on a variety of measures of organizational size including size at birth and various growth measures, we explored three of these measures (see column three). More specifically we examined company size when founded, change in size category or growth in production volume of shoe pairs and

change by expansion in the number of plants. Two of these three measures of organizational size are associated with a lowering of the company mortality rate. But size at birth is positively related to mortality when combined with the two growth measures indicating that those studies that relied upon this measure of size may be in error. In addition, the χ^2 value, 1822, is considerably reduced in comparison to the previous model reported in column two, suggesting that these measures, when available, underestimate the effects of organizational size. In this model unknown production size becomes significant, again suggesting that this model is less robust.

When these three measures are combined with the previous ones (column four), then we discover that the two measures of growth lose significance. First year production size is again positively associated with mortality. This perhaps is as should be expected because we now have eight measures of size counting the dummy variable for missing size. The log of average plant size, the log of the number of plants, extra small size and the generalist strategy maintain their hypothesized negative relationships. Again, it is worth observing that even with these different ways of tapping the meaning of size, all of the age variables remain quite robust.

Still a second alternative approach to the measurement of company size is total production volume as an age varying measure. One might reason that this simple measure would capture just as much information as each of the disparate elements that have been modelled in columns two. But as is evident in column five, this measure is much weaker with a χ^2 value of 1892! Clearly, it is better to assess the importance of size with its component parts, the average unit size, the number of units and an emphasis on a generalist strategy at least in this organizational population.

Finally, a third alternative approach is to use relative measures of organizational size as opposed to absolute measures. The results are reported in column six. As can be easily observed, using the χ^2 value as a criterion, which provides a value of 1975, this approach is much weaker than the absolute measures at least in this industrial sector.

Reconceptualizing the Many Meanings of Organizational Age in the Context of a Historical Epoch

Much has been written about globalization and post-industrialization but little has been said about these epochal changes in the rules of competition within organizational ecology (for two exceptions but ones that remain skeptical see). One way in which a new epoch might be revealed in our findings is through changes in the relative advantage of increased age. Does age in the guise of experience mean that one is not prepared for the new set of competitive rules?

When a dummy variable for the period 1965-1989 is introduced into the data analysis (see column seven), by itself this dummy variable is not significant. The pattern of age variables is not changed except in one case. Age more than 25 years loses significance. Given the importance of global density and global density squared it would be appear that at least for the non-rubber footwear industry, globalization is the more potent part of this historical epoch.

Two of the four interactions with different age measures are significant and reverse in sign from the pattern. Specifically age inverse is now negative and age inverse squared is now positive, indicating that the liability of newness is now replaced by a liability of oldness in this most recent period when contrasted to the previous period. Presumably in this instance old age reflects obsolescence, that is not developing new products for the new epoch.

Reconceptualizing the Many Meanings of Organizational Size in the Context of a Historical Epoch

The addition of the dummy variable for period 1965-89 modifies the previous findings relative to organizational size and more strikingly so than it did with the age measures. The interaction effects with two of the age-varying measures of organizational size--log of average plant size and generalist strategy--are strongly significant ($p \leq .0001$) while the log of the number of plants and very small size is weakly so ($p \leq .05$). The interaction with unknown production size is in contrast not significant. In other words, with the advent of post-industrialization generalist companies are more likely to disband given the new rules of competition, and the advantage of large plants nearly

disappears while the advantage of multiple plants is considerably eroded. Even the advantage of extra small size loses it protection, again suggesting the idea of a new set of rules about competition including the need for new kinds of shoes.

The reduction of the protective qualities of both a generalist and a specialist strategy is the most interesting finding. Carroll (1987) has hypothesized that in turbulent times generalists are at a disadvantage. Although disadvantage might be too strong a term it seems to be the case for the U.S. footwear industry that generalists lost much of their advantage. Others (Hage & Powers 1992) have suggested that post-industrial society is one in which new kinds of specialists are favored and again the loss of protection by companies of a very small size supports this assertion.

The addition of these four measures of organizational size also alters the findings regarding the liability of old age in the new epoch reported in the previous column. The overall effect of the period and the interactions of the period with age inverse and age inverse squared are no longer significant. In other words, the impact of the new epoch is to reduce the advantages of large size and being a generalist rather than to reduce the advantages of age *per se*.

Discussion and Implications

Perhaps the most important findings are that organizational age and size must both be contextualized by industrial sector and historical epoch. Of these two research results, the contextualizing by industrial sector is especially relevant because it allows us to handle various discrepancies of findings about the liability of newness and the liability of old age. As these data indicate, the liability of newness is most powerful in traditional industries where there is variety of tastes, few barriers to entry, the absence of a standardized product and slow technological change. In traditional manufacturing craft skills are important and unless they are learned prior to the establishment of a business in some guild or technical training program, a company is in danger until this experience is acquired. This should also apply to restaurants (especially gourmet), wineries, and many other kinds of small businesses. These findings thus substantiate the work of Delacroix and Swaminathan (1991).

In contrast, the liability of old age is evident in the opposite set of circumstances such as those studied by Barron, West, and Hannan (1994). For credit agencies, banks,

railroads, automobiles, and breweries (in countries such as the U.S. with mass tastes) there is essentially one standardized product or service and there are large economies of scale (or of power attached to size). Under these conditions concentration does occur, leaving only old firms to fail. It is difficult under these circumstances for a new company to begin and hence little liability of newness.

Not only are there differences across industrial sectors in the meaning of age and size but there are also differences across historical epochs as well. Since the 1960s both globalization and post-industrialization have changed the rules of the game and, as a consequence, large size in its various manifestations may have become a liability. Our analysis suggests that globalization is probably the more important force for at least this industrial sector. Furthermore, relative to those who are sceptical about there being globalization because the percent of GNP involved in trade in the early 1990s was not too different from what it had been in the 1910s, the important conclusion is that globalization should not be measured in the aggregate but instead on a sector basis. In this sector, not only did a number of American companies close their doors and many people lost their jobs but the imports came from many developing countries, and the title global is appropriate.

Another important conclusion is that the epoch 1965-1989 (and it still continues) was a double blow to some traditional American organizational populations. Besides globalization, the process of post-industrialization also unfolded and eliminated many of the advantages of large size and age as experience. The results relative to old age are less stable. Without the interaction effects of size, then old age is a liability but when the large size interaction terms are included, this pattern diminishes and loses significance. In both circumstances, old age and large size produce rigidities in companies making it difficult for them to adapt to new competitive rules. Then small and relatively new firms are likely to do well. In fact, they can become giants themselves, even sometimes in a short time period, because they have little competition from existing companies, as Nike, Reebok, and Timberland have demonstrated. Ideally future research can more successfully distinguish between globalization and post-industrialization than we have been able to accomplish in this study.

As organizational ecology would predict (Aldrich 1979), a new historical epoch is greeted by the emergence of new organizational forms (technology, structure, product niche, and strategy). In the shoe industry, it has been the commodity chain of production that engages in basic research and has developed new products as well as new marketing strategies. The book Swoosh (Strasser & Becklund 1991) describes how these emerged in the instance of Nike. The arrival of post-industrialization also helps us understand some findings in other research studies in the organizational ecology literature, in particular the emergence of microbreweries. Again, it is the differentiation of tastes associated with the processes of post-industrialization that allows new opportunities for small firms to emerge with quite different products and marketing techniques.

But one of the more interesting findings, at least for us, is that, although the organizational ecology literature has emphasized the selection of firms, especially large and old ones, via mortality, in the shoe industry we have observed another side to the selection coin. Because large and old firms no longer measure up to the new rules of competition small and sometimes even old firms that are positioned in quite narrow niches, with new rules of competition suddenly become important as the variety of tastes both expands and shifts. In the footwear industry, the most dramatic example is the surge in interest, especially overseas, in cowboy boots accounting for some of the rare exports of the U.S. during this time period. But it is equally true for outdoor shoes of various kinds and accounts for the rise of Timberland and the success of L. L. Bean (I.D.C.H., vol 13: 511-14; Moody's various years). Not only can a new historical epoch select “out” but it also can select “in”.

The organizational ecology literature has employed a variety of measures of organizational size and one of our contributions has been to explore a considerable number of these both separately and in combination. As we have demonstrated, total production size is not a good substitute for the disparate aspects of organizational size, namely the number of plants, the average plant size and the emphasis on a generalist strategy. Total production volume is not an adequate substitute for them because each component taps a different competitive process. Number of components and a generalist strategy represent economies of scope while the average production size represents more economies of scale. It should be remembered that this is an industry where a generalist

strategy consists of adding together a number of specialist niches just as a generalist newspaper covers a variety of specialized topics. In other words, future organizational ecology studies should attempt to measure age and size at both the component level and the company level even though it means a lot more work.

But the large and more non-trivial conclusion is that organizational ecology must study the contextual meaning of industry as well as of historical epoch. As this is done, these disparate literatures will be synthesized into a more satisfying organizational theory that respects social space and time.

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