A NETWORK SAMPLING PROCEDURE FOR ESTIMATING THE PREVALENCE OF NASCENT ENTREPRENEURS

Charles Palit, Professor, University of Wisconsin Survey Research Laboratory
Paul Reynolds, Coleman Foundation Chair in Entrepreneurial Studies, Marquette University

Introduction

Conventional sampling procedures require that population elements have only one pathway into the sample. For example, a conventional Random Digit Dial sample gains access to the adult population by linking every adult to a housing unit (HU). Every adult in the population is thought of as linked to one and only one HU. An adult can enter the sample if and only if the adult is linked to a sample housing unit. This restriction, ". . . every adult is linked to one and only one HU," simplifies the theory somewhat, and helps to make the determination of the sample selection probabilities a little easier. However, other sampling procedures which relax this restriction and use rules allowing population elements multiple pathways into the sample are possible. These procedures have been referred to as network sampling procedures. The estimation procedures associated with these relaxed rules are called multiplicity estimators (Sirken 1974).

Levy (1977) defines the network sample survey as:

> "A survey with multiplicity is one in which an element (e.g., birth, death, . . ., etc.) may be linked to more than one enumeration unit by an algorithm or counting rule."

Sirken (1974) points out that the class of multiplicity rules ". . . which have the property of supplementing the condition of a conventional rule with other conditions for linking elements to enumeration units" are of special interest because they permit the use of both conventional and multiplicity estimators.

As an example of such rules, Sirken presents the rule which links persons to their own residence, as well as the residences of their siblings and children. He points out that this rule permits four sets of estimates based on the following rules:

> "1. persons are linked to their own residence;
> 2. persons are linked to their own residence and to the residences of their siblings;
> 3. persons are linked to their own residence and to the residences of their children;
> 4. persons are linked to their own residence and to the residences of their siblings and children.

The first rule is a conventional rule. The other rules are multiplicity rules."

The multiplicity rules, i.e., rules 2, 3, and 4 casts nets which produce a greater number of adults in the final sample than the conventional rule 1, even though the number of residences in the sample is the same for all rules.

When the multiplicity rules are used, the selection probability for each adult is a function of the number of residences to which the adult is linked and the selection probabilities attached to those residences.

We use similar multiplicity rules.

Our objective was to obtain a probability sample of Wisconsin residents who are nascent entrepreneurs. The general procedure selected for this was as follows:

1. Select an RDD sample of phone numbers with replacement.

2. From each sample household contained in the RDD sample select a random adult respondent.

3. Ask the random respondent to list a well-defined set of individuals resident in Wisconsin. This list defines the 'net' from which the nascent entrepreneurs will be drawn.

4. Ask the random respondent which of the persons listed, if any, is a nascent entrepreneur. This identifies a pool of potential nascent entrepreneurs.

5. Interview the resulting sample of potential nascent entrepreneurs to determine if they are in fact entrepreneurs.

6. Ask the potential nascent entrepreneur to list the set of individuals resident in Wisconsin equivalent to the set defined in item 3. The count on this list is the size of the net used to catch the respondent. (Subject perhaps to some reporting error.)

We call a net whose size is obtainable as in step 6 a nice net. Not all nets are nice. We can define nets for which the specific net size is unavailable. Subject to one important assumption, and the use of a nice net the above rules allow us to specify the probability of selection for each nascent entrepreneur identified. Armed with this information we can produce valid estimates of the prevalence of nascent entrepreneurs in the population. The assumption is that the random respondent in the RDD sample identifies all nascent entrepreneurs in the net listed by the respondent. If this assumption fails then the prevalence estimate is an estimated lower bound for the true prevalence.

In this study five nice nets were used:

a. Adult siblings by blood or marriage
b. Parents or step-parents
c. Grand-parents
d. Adult children
e. Spouse or Partner

These nets are defined by the response to the following questions. Two questions are used for each net. The question of residency is settled later in the process.

SIBLING NET QUESTIONS

QUESTION 6
My next question is, how many living brothers and sisters, INCLUDING step-brothers, step-sisters, half-brothers and sisters, adopted brothers and sisters do you have, if any?

QUESTION 7
I'd like to ask you some questions about them. Please give me just their FIRST name so that we may refer to them specifically later. What is the first name of one of your brothers or sisters? (BE SURE TO INCLUDE STEP, HALF AND ADOPTED SIBLINGS ON THIS TABLE) (ENTER THE NAME AND SEX, GO TO NEXT ONE)

PARENT NET QUESTIONS

QUESTION 9
Next, how many of your parents or step-parents are still living, if any?

QUESTION 10
I'd like to ask you some questions about your living parents or step-parents. Please give me just their FIRST name so we may refer to them later.

GRAND-PARENT NET QUESTIONS

QUESTION 12
Next, how many of your grand-parents are still living, if any?

QUESTION 13
I'd like to ask you some questions about these people (this person). Please give me just their FIRST name so that we may refer to them specifically later in the interview. What is the first name of one of your grandparents? (ENTER THE NAME AND SEX, GO TO NEXT ONE)

CHILDREN'S NET QUESTIONS

QUESTION 15
How many children, if any, do you have who are age 18 or older, including adopted children and step-children?

QUESTION 16
I'd like to ask you some questions about these people. Please give me just their FIRST name so that we may refer to them specifically later in the interview. What is the first name of one of your children, age 18 or older, including step and adopted children? (ENTER THE NAME AND SEX)

SIGNIFICANT OTHER NET QUESTIONS

QUESTION 18
Are you currently married or living with a partner?
1. MARRIED OR LIVING WITH A PARTNER
2. NOT MARRIED AND NOT LIVING WITH A PARTNER
7. DON'T KNOW
9. NOT ASCERTAINED / REFUSED

QUESTION 19
I'd like to ask you some questions about your spouse or partner. What is your spouse or partner's first name. (ENTER THE NAME AND SEX)

Counting Rules and Weights

For nice nets the selection probability for the entry of a nascent entrepreneur into the sample is determined in good measure by the number of ways that the entrepreneur could enter the sample. For example if the net is defined to be adult siblings, and a particular entrepreneur has no siblings then the net size is one and the probability of selecting the entrepreneur into the sample is

$$p/h_o$$

where p = The selection probability for the entrepreneur's HU
and h_i = The number of adults in the entrepreneur's HU

With two sibling, there are two selection path-ways, the selection probability becomes:

$$p/h_1 + p/h_2$$

where p and h_i are as before.

The first term is for the nascent entrepreneur and the second is for the sibling.

When no siblings exist the selection probability can be determined exactly. However as the number of siblings increase this becomes more problematic. For k siblings the selection probability can be written as the sum of the respondent selection probabilities from each adult in the net, i.e.,

$$p/h_1 + p/h_2 + p/h_3 + \ldots + p/h_k$$

Exact calculation of the probabilities requires a knowledge of the household size for each potential respondent, i.e., h_i. Most of the values for h_i will be unknown to us. However we should always know the size of at least one household in the set, i.e., the value of h_i for the nominators household. So even though we can not compute the exact probability for the net, we can compute an estimate by using the nominator's household size h_i.

Let

$$d_i = 1/h_i.$$

Then the net selection probability is

$$\Sigma d_i = kd$$

where

$$d = (1/k)\Sigma d_i .$$

Using $d_o = 1/h_o$, where h_o is the nominator's household size,as an estimate for d, we can estimate the selection probability with

$$kd_o \quad .$$

This probability can be used to estimate the total number of nascent entrepreneurs in the population. For a sample of one entrepreneur the estimate is

$$e = (1/kd_o).$$

Note that this is a biassed estimator. since d_o is a random variable. If m entrepreneurs are found in the sample then the estimated total is

$$e = \Sigma_1^m (e_j/m),$$

where

$$e_j = (1/kd_{jo}).$$

The actual estimator used was adjusted for response rate, and was

$$E=e/R$$

where

$100R$= the response rate.

We were fortunate enough to be able to include one example of a net which is not a 'nice net' in this study. In this net the entrepreneur is reached through

a network made up of friends and work confidants. As with the nets previously discussed the elements of this net are defined by the answers to questions asked of the first phase respondents. The questions are:

WORK CONFIDANT NET QUESTIONS

QUESTION 3
In this part of the study, we are exploring how informal sharing of help among friends and family actually works. We would like to ask you a few questions about those you talk with about work and career issues. First, we will explore how people might rely on each other.

If you were thinking about a major career change, like looking for a job or starting a new business, among the people that you know how many would you talk to about your career change?

QUESTION 4
I'd like to ask you some questions about these people. Please give me just their FIRST name and gender so that we may refer to them specifically later in the interview. What is the first name of one of the people you think you would talk to about your career change? (ENTER THE NAME AND PRESS <ENTER>)

Determining the size of this net is difficult. People who consider themselves part of this net for a given entrepreneur may not be regarded in the same light by the entrepreneur, etc. However in our investigation we decided to use the average size of an entrepreneur's network as reported by the entrepreneur as a value for k. Clearly this is an estimate and its use effects the error distribution of our estimator. It's use has the potential for adding both additional bias and additional random error to the estimate. Nevertheless we thought that this study gave us an opportunity to empirically test the potential effectiveness of such a procedure. We do this by comparing the estimates from each net as well as the variances of these estimates.

Estimating The Variance

We estimate the variance using a replication procedure with,

$$\frac{\sum_i^a (E_i - E)^2}{a(a-1)},$$

where a= Number of replicates,

E_i = The estimate of the number of entrepreneurs from the i^{th} replicate, and

$E = (\sum_i^a E_i)/a$

In practice we used a disproportionate stratified RDD sample for the first phase and two replicates in the variance computation.

Results

Estimates of the number of nascent entrepreneurs in Wisconsin were computed for each type of net. These estimates and their associated standard deviations are displayed in Table 1.

TABLE 1
Estimates of The Number of Nascent Entrepreneurs in Wisconsin Using Different Types of Nets

Net	Estimate	Est. S.D.	Cases
Siblings	81,980	31,088	13
Parents	100,212	114,057	10
Grand-parents	7,689	-	1
Adult Children	71,957	26,892	9
Signify other	164,915	27,297	16
Work Confidant	103,404	67,754	31
No Net	146,870	40,688	8

The "No Net" entry shows the estimates and standard deviation which results if no network is used, i.e., only first phase data is used. This estimate is based only on the randomly selected respondents from the RDD sample used in the first phase.

The grand-parent net clearly fails because the frequency with which grand-parents are nascent entrepreneurs is very low.

The best of the remaining nets are the significant other net, the sibling net, and the adult children net. All three of these have about the same level of precision. There is a large difference between the significant other estimate of 164915 and the other two estimates. However, these differences are not large enough to prove malice, but large enough to raise questions and to suggest that the significant other may be a more reliable informant.

The work confidant net, that is the 'not nice net' seemed to work reasonably well. It's standard deviation is larger than most of the other nets, but that is expected.

Summary And Conclusions

The best single net is the significant other. This suggests that for nascent entrepreneurs the appropriate procedure in the future is to select a sample of households and to screen all adults in these households for nascent entrepreneurs. Such a procedure has the additional advantage of avoiding the tracking loss associated with the network procedure, which is quite high.

References

Levy, Paul S. 1977. Estimation of Rare Events By Simple Cluster Sampling with Multiplicity. American Statistical Association Proceedings of the Social Statistics Section 1977, Part II. Washington, DC: American Statistical Association.

Raj, Des. 1968. Sampling Theory. McGraw-Hill Book Company.

Sirken, Monroe G. 1974. The Counting Rule Strategy in Sample Surveys. American Statistical Association Proceedings of the Social Statistics Section 1974. Washington, DC: American Statistical Association.

Spaeth, Joe L. 1988. A National Probability Sample of Work Establishments and Organizations. Urbana, IL: Survey Research Laboratory, University of Illinois.

Sudman, S., Sirken, M.G., and Cowan, C.D. 1988. Sampling rare and elusive populations. Science 240:991-996.

U.S. Small Business Administration. 1988. Handbook of Small business Data: 1988. Washington, DC: U.S. Government Printing Office.

White, Sammis B., et al. 1989. ES202: The Data Base for Local Employment Analysis. Milwaukee, WI: University of Wisconsin-Milwaukee: Urban Research Center.

AN EFFICIENT NEW DUAL FRAME SAMPLE DESIGN FOR SURVEYS OF SMALL BUSINESS

David A. Hirschberg, U.S. Small Business Administration* and Harold Nisselson, Westat, Inc.
Harold Nisselson, Westat, Inc., 1650 Research Blvd., Rockville, MD 20850

KEYWORDS: Dual Frame, Survey Design, Sampling, Area Sampling, List Sampling

1. Introduction

The use of commercial lists of businesses as a sampling frame for establishment surveys is widespread and relatively attractive from a cost standpoint. It provides flexibility for sampling purposes since businesses in the frame can be stratified by selected characteristics and sampled at varying rates as appropriate. However, relying solely on commercial lists has serious drawbacks for surveys of small businesses, the foremost being the substantial coverage bias due to the fact that these lists tend to miss many of the new businesses and the smallest small businesses. This is true even for lists created by government activities (Birely, 1984; Aldrich, et al., 1988), which in any event, are not generally available outside the agency itself.

Annual net changes in the number of firms do not adequately reflect the large gross flows that affect the business population. In 1992, the number of businesses with employees covered by reports to the U.S. Employment and Training Administration increased by 1 percent. However, new or successor firms over the course of the year represented 15 percent of the initial frame while terminated firms represented 14 percent.

It is necessary to trace sample businesses that cannot be located at the address given in the frame, in order to determine whether they are currently out-of-business. If still in business but at a different location, followup would be needed to obtain interviews from them. These facts entail both costs for followup and bias due to failure to resolve all such cases. It is common experience to find a substantial proportion of the sample out-of-business or moved-and-not-locatable even after followup. Scheirer (1993), for example, reported an experience with a list two years old for which a third of the nonrespondents could not be found by long distance operators. Although the costs of these activities can be controlled by techniques such as subsampling, they still may be relatively large.

Area samples to identify and survey businesses minimize these problems of list sampling but are quite expensive and are not efficient for sampling different binds of businesses at varying rates.

2. A Dual Frame Approach

At the request of the U.S. Small Business Administration, Westat developed, designed and pilot-tested a dual frame approach which minimizes the coverage bias, can be implemented efficiently, and which meets the requirements for coverage and flexibility. The design integrates a commercial list with an area sample to supplement the list. An essential feature is to treat the list as representing a set of business addresses rather than the businesses themselves. This eliminates the need to find the new location of businesses that may have moved from their original sites, as well as giving the businesses that replaced the movers a chance of selection from the list sample. It is supplemented by an area sample of (nonresidential) buildings to help assure completeness of coverage. This is more efficient than supplementing a sample of named businesses. The dual approach avoids many of the problems created by treating the businesses while in a large part, retaining its statistical and cost advantages. It represents the first attempt, known to us, to develop a (national) sample of businesses by developing a (national) sample of business locations.

3. Some Design Considerations

Figure A attached provides an outline of the stages that might be used in a multi-stage design under the dual frame design we explored and an independent area sample design we used as a standard for comparison. In a multi-stage design, the dual frame approach is implemented in the next-to-last stage, the final stage being the list/area samples. The design of the dual frames will vary from country to country.

We suggest that the next-to-last stage be a sample of mail-delivery areas such as ZIP code areas in the U.S.A. The reason for this is that commercial lists show the ZIP code location for almost every establishment they list. In addition, in the U.S.A. tabulations of economic census data are available by ZIP code -- an advantage for stratification and sampling for the list sample component. Finally, maps and boundary descriptions are available for ZIP code areas -- an advantage for the area sample supplement. If ZIP code areas cover a large geographic area, they may be segmented for further sampling.

Segmenting can be automated if a suitable geographic information system is available. In their paper at this conference, Petrucci and Pratesi (1993) describe methods of building an area frame for business establishment surveys using their Geographical Information System (GSI) for geocoding lists of establishments and defining area segments. In the U.S.A., the Census Bureau's TIGER system can be used to perform these functions efficiently. Area segments can also be defined in terms of road patterns which are useful for businesses that do not have an address location or are mobile.

If areas of new nonresidential construction can be identified, they should be sampled separately since they will be nonlist cases.

To compare the dual frame and independent area sample approaches, we compared the expected cost under each approach to achieve a given level of sampling error for a survey estimate. The sample design costed under each approach was optimized for the given approach. Variance and cost parameters utilized were considered reasonable in our experience, but would, of course, vary for different countries. Therefore, the discussion here is intended primarily to provide guidelines to a reasonably efficient survey design.

4. Design Analysis

The sampling variances of survey estimates under either design alternative will have three components corresponding to:

1. The sampling of nonself representing PSUs within strata
2. The sampling of SSUs within PSUs
3. The sampling within SSUs

The structure of the first two components will be the same under either design, since the two alternatives differ only in the design of the sampling within SSUs.

Let Var $(x^{\wedge})$ denote the sampling variance of an estimated total, say x', with a subscript 1 to denote the independent area sample approach and 2 to denote the dual frame approach. Then we can write

$$\text{Var}(x_1) = \text{Var}_1 + \text{Var}_2 + \text{Var}_{13}$$

and

$$\text{Var}(x_2') = \text{Var}_1 + \text{Var}_2 + \text{Var}_{23}$$

where Var_1 denotes the contribution of sampling at the first stage, which arises only from nonself representing strata of PSUs; Var_2 the contribution of sampling at the second state; and $\text{Var}_{()3}$ the contribution at the third stage.

In a multistage sample design, optimization is achieved by optimizing the sampling at each of the successive stages, beginning with the last stage. We assume that the primary and second-stage sampling units are fixed in advance by the frames available and are not subject to optimum determination. Accordingly, our discussion is addressed to the sampling within ZIP code area.

Sampling Variances and Cost-Independent Area Sample

The independent area sample within PSUs represents a three-stage design in which the first stage is the sampling (within sample PSUs) of ZIP code areas. The second stage is the sampling of area segments within selected ZIP code areas and the third stage is the sampling of small businesses within selected segments.

(1) The contribution to the relvariance of a survey estimate arising from the sampling within a ZIP code area can be approximated by (Hansen, et al., 1953, Chapter 9)

$$\frac{\upsilon^2}{\bar{t}\bar{\bar{n}}}\left[\delta_2\bar{t}\bar{\bar{n}} + 1 + \delta_3(\bar{\bar{n}} - 1) + a\right]$$

- υ^2 = relvariance of small businesses within PSU
- $\bar{t}$ = average number of segments in the sample per ZIP code
- $\bar{\bar{n}}$ = average number of small businesses in the sample per segment
- δ_2 = intraclass correlation of small businesses within ZIP codes
- δ_3 = intraclass correlation of small businesses within segments
- a = a term that reflects the variability in size and subsampling rates of segments

The factor in square brackets represents the design effect due to clustering of the sample within PSUs.

(2) The following simple cost function reflects the variable cost of a three-stage design such as that within PSU

$$c = c_1 + c_2\bar{t} + c_3\bar{t}\bar{\bar{n}}$$

where

- c_1 = variable cost per ZIP code in sample
- c_2 = variable cost per segment selected in a ZIP code
- c_3 = variable cost per interview for a small business selected in a segment

c_1 includes the cost of sampling and of obtaining maps of the boundaries of the selected ZIP code areas. c_2 includes the cost of coding the commercial list source addresses in the selected ZIP codes to Census geography, establishing the segment boundaries, selecting the sample segments and listing businesses in the sample segments for the sampling of businesses for interview. c_3 includes the cost of interviewing to achieve a completed interview, as well as the necessary callbacks to achieve a satisfactory response rate.

(3) Following standard theory, the optimum value of the design parameter $\bar{\bar{n}}$ is given by the equation

$$\overset{\Delta}{\bar{\bar{n}}} = \left(\frac{c_2}{c_3}\frac{1 - \delta_3 + a}{\delta_3}\right)^{1/2} \quad (1)$$

and the number of segments per ZIP code by the equation

$$\overset{\Delta}{\bar{t}} = \left(\frac{c_1}{c_2}\frac{\delta_3}{\delta_2}\right)^{1/2} \quad (2)$$

Sampling Variances and Cost - Dual Frame Sample

The dual frame sample within a ZIP code may be viewed as a stratified sample with two strata: (1) the list frame and (2) the area sample frame.

(1) Accordingly, the contribution to the relvariance of a survey estimate arising from the sampling within a ZIP code area can be expressed as

$$\frac{P_L^2 V_L^2}{n_L} + \frac{P_A^2 V_A^2}{n_A}$$

where

P_L = proportion of small businesses represented in the list source

P_A = proportion of small businesses represented by the area sample supplement

n_L, n_A = the sample sizes from the list and area frames, respectively

The first term in the relvariance represents the component arising from the list stratum and the second term the component from the area sample stratum.

(2) The following simple cost function reflects the variable cost of a dual frame sample within ZIP code area

$$c = n_L C_L + n_A C_A$$

where

C_L = variable cost per interview for a list sample case

C_A = variable cost per interview for a sample case not represented in the list source

C_L represents the cost of locating a list source business site and interviewing the current business occupant. C_A includes the cost of listing a segment, and matching the listings to the list source frame to identify any small businesses not in the list source frame.

(3) In accordance with standard theory for stratified sampling, the optimum allocation of the dual frame sample of a ZIP code is to take n_L proportional to $P_L V_L/\sqrt{C_L}$ and n_A proportional to $P_A V_A/\sqrt{C_A}$

so

$$\frac{\hat{n}_L}{\hat{n}_A} = \frac{P_L V_L}{P_A V_A}\sqrt{\frac{C_A}{C_L}} \qquad (3)$$

Since the list sample is not clustered within ZIPs, while the area frame sample is a two-stage sample within ZIPs, we can write approximately

$$V_L^2 = V^2$$

$$V_A^2 = V^2 (DEF)_A$$

where V^2 is the relvariance between small businesses within a ZIP and $(DEF)_A$ is the design effect for the area sample supplement. Then we can express the ratio as

$$\frac{\hat{n}_L}{\hat{n}_A} = \frac{P_L}{P_A}\frac{1}{\sqrt{DEF_A}}\sqrt{\frac{C_A}{C_L}} \qquad (1)$$

5. A Numerical Illustration

The following example illustrates the sample design analysis

Independent Area Sample

We assume segments from which the $\bar{\bar{n}}$ will be sampled that will average 60 listings. To be conservative, we take $\delta_3 = 0.10$ and $\delta_2 = 0.0125$, and based on experience in other surveys we take a = 0.5.

For cost factors we assume 3 minutes per listing for the sample segments, consistent with the experience in the pilot study, and a 45 minute interview. With the other cost factors involved we take

$$c_2/c_3 = 210/45 = 4.67$$

and

$$c_1/c_2 = 120/210 = 0.57$$

Then, referring to equations (1) and (2)

$$\overset{\Delta}{\bar{\bar{n}}} = \sqrt{(4.67)(14)} = \sqrt{65.38} \cong 8$$

$$\overset{\Delta}{t} = \sqrt{(.57)(8)} = \sqrt{4.56} \cong 2$$

Accordingly, the independent area sample design would sample 8 small businesses per segment and 2 segments per ZIP code area.

Dual Frame Sample Optimization

Referring to equation (3), it is reasonable to estimate that the list frame might cover 75 percent of small businesses and the area frame 25 percent. Then

$$P_L/P_A = 3$$

The design effect can be expressed approximately in the form

$$1 + \delta_3 (\bar{\bar{n}}^* - 1)$$

where $\bar{\bar{n}}^*$ = average number of businesses per segment not represented in the list frame. If the same design is used as described for the independent area sample, segments of 8 businesses would average 8/4 = 2 businesses not represented in the list frame. Also, it is reasonable to estimate that in a list frame sample perhaps 20 percent might be lost due to post office addresses, business sites no longer in existence, and other reasons. Therefore, the list frame sample should designate 25 percent more businesses than the target to provide for losses.

Then with the cost factors used we take

$$C_A/C_L = 1.6$$

$$\sqrt{C_A/C_L} = 1.3$$

Also, with only an average of 2 businesses added per segment $(DEF)_A$ would be 1.10 and $\sqrt{(DEF)_A}$ would be 1.05. So, referring to equation (3)

$$\frac{\hat{n}_L}{\hat{n}_A} = (3)\left(\frac{1}{1.05}\right)(1.3) = 3.7$$

Then the area sample proportion of a total allocation would be

$$\frac{\hat{n}_A}{\hat{n}_A + \hat{n}_L} = \frac{1}{1+3.7} = \frac{1}{4.7} = 0.21$$

or 20 percent, say, with the list frame accounting for 80 percent.

6. The Pilot Study

Six ZIP code areas were selected in which to conduct a pilot study:

1. An urban area of high-rise (multiple occupancy) office buildings
2. An area of dense retail and service establishments
3. A suburban area simulating a mixture of business clusters and strip-mall development along major streets
4. An area simulating a smaller town with surrounding residential neighborhoods
5. An area of small industry
6. A rural area.

We excluded from the pilot study government operated activities such as schools, hospitals, and the like.

Field staff were given:

a. Area segment maps with boundaries marked
b. Random systematic samples of business locations in each of the six study areas, taken independently from two major commercial list sources.

   Businesses shown in the list frame with only a Post Office Box mail address were excluded from the list frame and assumed to be covered by the area sample. However, there are other ways of dealing with such cases.

Field staff had two tasks:

I. Attempt to find the list sample business locations and report the outcomes in terms of criteria which they were given
II. Independently canvass their assigned area segments. List all business locations they encounter and their current business (or other) occupants. Identify any establishments that could not be matched to listings in the commercial lists.

The definition of business location (BL) involves considerations similar to those for defining "listing units" in a demographic survey, in particular a coverage evaluation survey. To be efficient BLs should be addresses which according to the commercial list have fewer than a designated number of establishments. In larger multi-occupant buildings BLs should be described by specific location (e.g., floor, suite number). Directories displayed in multi-occupant buildings should not be used as the list for the structure. Rather, the building manager should be interviewed, and similarly for shopping malls.

Specific rules to help assure unbiased survey estimates are needed to deal with problems such as variations in the name by which an establishment may be shown in the list frame and the name of the same establishment as observed by an interviewer in the field, and with businesses found to have moved within, say, a given building or ZIP code area, to deal with problems such as possible multiple chances of selection. The field instructions must be readily implemented by the interviewers. The training of field staff in these respects should be as extensive as in demographic surveys, unlike the usual economic survey.

7. Pilot Study Findings

Use of a List Sample

Table 1 summarizes, by list source, the outcomes of the attempts to locate the sample list BLs in the field. The differences between the two list sources are not statistically significant. The percent of listings matched (or with a possibility of match) indicates the percent of the target universe expected to be covered by the list component. The complementary percent indicates how much of the list frame will be lost and, therefore, needed to be covered through the area sample. Our conclusion is that commercial business lists may usefully be considered as a sampling frame in the sense that a high proportion of the listings in the frame can be successfully located in the field. Survey effort may be conserved by limiting, under strict rules, the effort to find listings in individual cases. The effect of failure to find listings is to transfer the coverage of the BLs to the area sample supplement but not necessarily to introduce coverage biases.

Use of an Area Sample

Table 2 summarizes, by list source, the outcomes of the attempts to find occupied area sample listings anywhere in the list source entries for the entire ZIP code area. The area sample cases that could not be found in a list presumably represent undercoverage of the list frame, although in some cases they represent instances of incorrect address locations or incorrect ZIP codes for list source BLs.

Table 3 summarizes, by list source and both sources combined, the percent of cases in each ZIP code area that it was possible in the field to match to a list entry. This table shows that the use of a combination of lists may be cost effective, despite any problems in unduplicating the multiple lists for the list sampling.

Businesses not readily visible are likely to be missed in the area sample supplement. In particular, businesses operated out of private homes with no outward sign of business activity should not be taken to be within the scope of this dual frame approach. Such businesses are best covered by a household survey or, possibly, a list sample from business-income tax records.

Businesses not operated from fixed locations, such as street or road-side vendors, can be accommodated within the scope of the area sample. Special rules should be established to ensure unique probabilities of inclusion.

8. Discussion

The pilot study indicated that a procedure to identify businesses missed in list sources by comparing, on an address basis, listings from an area sample canvass with business locations from list sources is

feasible and practical. The process is not perfect. However, survey statistics from the dual frame approach described are not likely to be substantially biased by failure of the area sample component to detect all undercoverage in the list sample component.

Unit costs for individual survey operations will vary from country to country and, even within a country, from one survey organization to another. Variance components will also vary, particularly in the area sample. Based on our experience, we would expect that the list sample component would account for on the order of 80 percent of the businesses interviewed, and the area sample 20 percent. Thus, about 80 percent of the sample would reflect the efficiencies of list sampling from which an independent area sample would not benefit. Considering variance and cost factors jointly, we conclude that the dual frame approach described can be expected to show cost savings of 20 to 50 percent compared to an area sample approach used alone.

Bilbiography

Aldrich, H., A. Kalleberg, P. Masrsden, and J. Cassell (1988), "In Pursuit of Evidence: Five Sampling Procedures for Locating New Businesses," *Journal of Business Venturing*, 4, 367-386.

Birely, S. (1984), "Finding the New Firm," *Proceedings of the Academy of Management Meetings*, 47, 64-68.

Hansen, M. W., W. N. Hurwitz, and W. G. Madow (1953), *Sample Survey Theory and Methods*, Vol. I, New York: John Wiley & Sons, Inc.

Petrucci, A. and Pratesi, M. (1993), "Listing Frames and Maps in Area Sampling Surveys on Establishments and Firms," *Proceedings of the International Conference on Establishment Surveys*, American Statistical Association.

Scheirer, W. (1993), Personal communication.

* The views expressed are those of the authors and do not necessarily reflect official positions of the SBA.

Table 1. Success in finding list cases in the field

Outcome of attempt to locate list case	Percent of listings attempted	
	List Source 1	List Source 2
Found by match criterion:		
Total	83.3	87.8
Matched on name and address	28.9	26.7
Matched on name	17.8	20.0
Matched on address	11.1	7.8
Residential address:		
Business activity	5.6	6.7
No business activity	18.8	23.3
Other (out-of-scope)	1.1	3.3
Not found but possibility to match with followup	10.0	10.0
Not possible to locate	6.7	2.2
All cases	100.0	100.0

Table 2. Success in finding area sample cases in any list

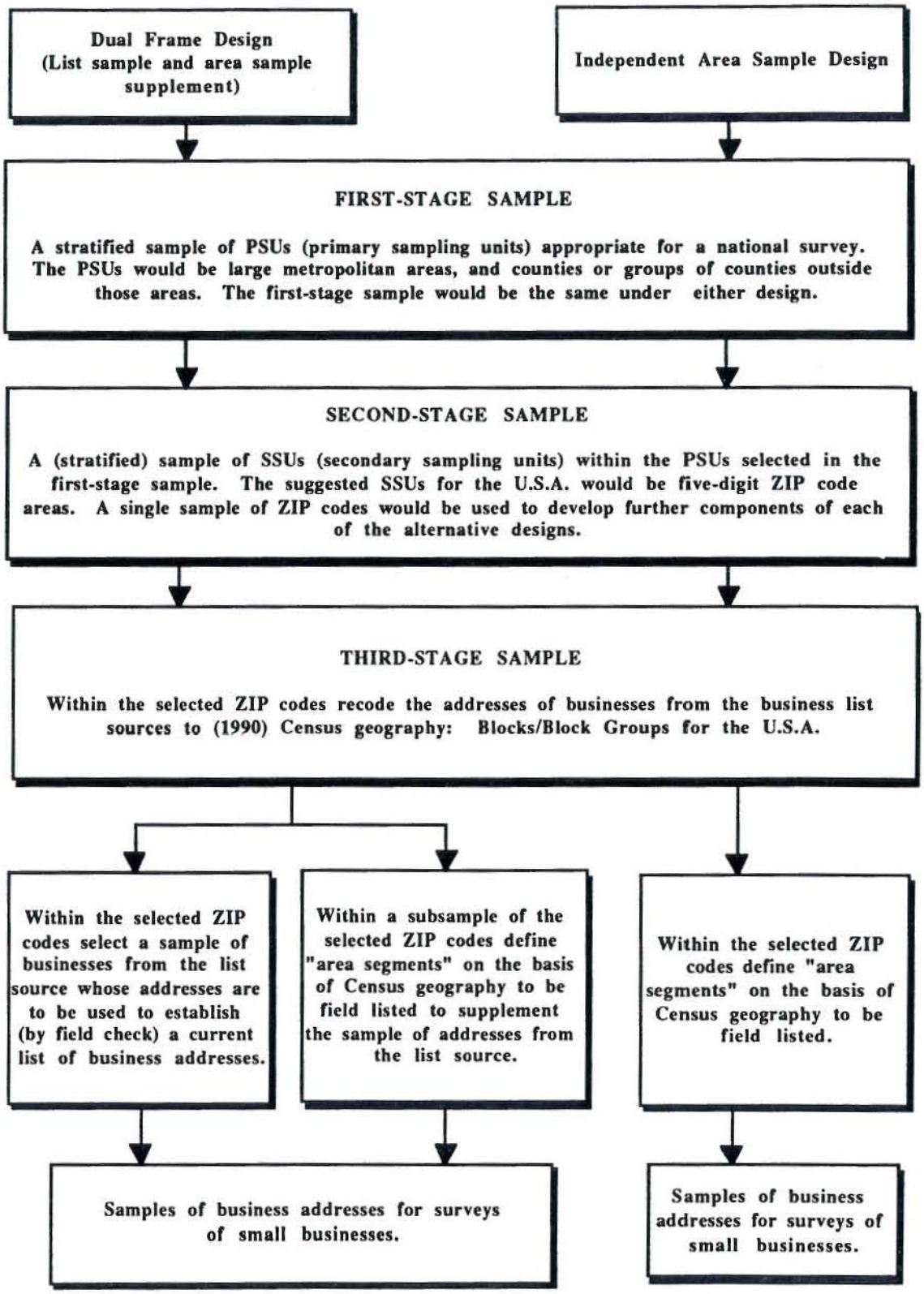
Outcome of attempt to find area sample case in list source	Percent of area sample cases	
	List Source 1	List Source 2
Matched by criterion:		
Total	50.2	56.5
Matched on name and address	30.1	33.0
Matched on name	9.2	10.9
Matched on address	10.9	12.6
No match on criterion but possibility with followup	26.8	21.3
Not possible to find (match)	23.0	22.2
All cases	100.0	100.0

Table 3. Success in finding area sample cases in any list by type of locality

ZIP Code area	Locality	Percent matched*		
		List Source 1	List Source 2	Combined lists
1	Highrise office	98	95	100
2	Dense retail/service	65	80	88
3	Mixed clusters/strip	70	86	90
4	Mixed residential/business	84	91	91
5	Small industry	69	80	93
6	Rural area	79	17	90
	All area sample cases	77	78	92

* Includes cases not matched on criteria but possibility of a match with followup.

Figure A
Outline of Stages in Alternative
Sample Designs



CAPITAL STRUCTURE LIFE CYCLE: STATIC PROCESS OR DYNAMIC EVOLUTION?

Joel Shulman, Babson College; Rick Cooper, Wayne State University; David Brophy, University of Michigan
Joel Shulman, 229 Tomasso, Babson College, Wellesley, MA 02157

KEY WORDS: Capital Structure, Life Cycle

INTRODUCTION

Small firm owner/managers (entrepreneurs) often encounter financial obstacles in the early stages of growth when the delicate tradeoffs of wealth and control must be faced. While rational investors attempt to maximize wealth through growth and external financing, some entrepreneurs may not be willing to surrender associated control of their firm by soliciting outside funds. Alternatively, some firms may be able to manage growth through internally generated funds, informal sources of funds, or venture capital. Whatever the outcome, it seems clear that small firm capital structures may not remain static. Rather, small firm capital structures may experience a dynamic evolution as the firm grows. This paper examines small firm capital structures using a newly-released, comprehensive data set of small private firms and reports developments based on age, industry and cash-flow considerations. Results are analyzed in the context of traditional capital structure theory and contrasted with prior empirical work which has thus far been limited to studies of publicly-traded, large firms or small samples of private firms.

PECKING ORDER, STATIC PREFERENCE, AGENCY COSTS, INFORMATION ASYMMETRIES AND OPTIMAL CAPITAL STRUCTURE

Capital structure theories, beginning with Modigliani and Miller (1958) have addressed issues related to corporate optimal capital structure, tax benefits and bankruptcy costs related to debt. Donaldson (1965) discussed how corporations might opt for a target debt-to-total assets ratio. These theories, while useful in describing rational manager behavior within the large organization, have been less useful in describing financing difficulties for the emerging small firm owner/manager. However, agency costs and information asymmetries theories as described by Jensen and Meckling (1976), Fama (1980), Barnea, Haugen and Senbet (1981), Petit and Singer (1985) and Myers and Majluf (1984) may be very important in explaining differing capital structures between small and large firms.

These articles describe how agents of the firm may attempt to consume corporate perquisites at the expense of other stakeholders. As a result of agency costs, potential external sources of equity and debt including financial institutions, venture capitalists and common shareholders attempt to limit their risk exposure by imposing high monitoring standards, collateral requirements, or restrictive covenants on the firm raising the funds. These actions are designed to limit managerial freedom. Additional theories posited by Myers (1984) and Myers and Majluf (1984) describe pecking order and static trade-off approaches to corporate financing. The pecking order theory suggests that firms utilize funds in a sequential fashion beginning with internal funds and then later switching to external sources once all internal sources are relinquished. The static trade-off theory on the other hand, implies that firms will borrow funds up to the point where the debt tax write-off equals the bankruptcy tax shield. Although none of the theories have been specifically targeted toward small firms, studies by Churchill and Lewis (1986) provide a discussion on bank lending practices and the problems experienced by small borrowing firms, while James (1986) describes information disclosures required of small firm owner/managers in bank related financing transactions.

With the emergence of expanded small firm data bases, researchers are now afforded unprecedented opportunities to explore small firm capital structure differences and similarities with large firms. Moreover, recent surveys have included questions on disclosure requirements, contracting arrangements, types of financing, rates, fees, term, and sex/race of borrower. Each of these questions enable more refined analyses of agency costs and information asymmetries issues, as well as, tests of discrimination. This study explores the evolving

nature of emerging small firm capital structures. We offer a life cycle hypothesis and compare it with existing theories.

CAPITAL STRUCTURE DIFFERENCES: RECENT EVIDENCE

Early tests of capital structure differences suggest small firms have less debt than large firms (Martin and Petty 1978). Other studies which examined differences in small firm and large firm capital structures have provided inconclusive results due to the paucity of small firm capital structure data. For instance, Day, Stoll, and Whaley (1985) and Kester (1986) found no capital structure differences between large and small firms using a COMPUSTAT data base of 7000 public firms. However, as several researchers later pointed out, even the smallest, publicly-traded firms in the COMPUSTAT data base are much larger and, accordingly, much different than the average, small private firm.

Petersen and Shulman (1987) using a data set of 3600 small, private firms from 12 countries found distinct capital structure differences between smaller, younger firms and older, more established firms. They attributed the differences to a capital structure evolution during the firm's product life cycle. In their "life cycle" capital structure model, they discuss how emerging small firms initially rely on self-financing and relatives/friends. As the firm grows, self-and-relative financing declines due to lack of personal diversification as well as inefficiencies in borrowing amounts, terms, independence and control (relatives and friends are poor intermediaries). They found weak evidence supporting the life cycle theory including differences in access to capital depending on age of the firm and geographic location. They associated the change in capital structure to less costly and more efficient sources of funds made available as the firm grew or matured. They hypothesized that information asymmetries and agency costs may be involved.

More recently, Mull and Winters (1991) used a data set of 34 IPOs in examining the life cycle hypothesis. They compared capital structures between public and private firms and find private firms use more debt compared to public firms. They infer from this result that as firms move from private to public ownership changes occur in the relationships between the determinants of capital structure and firm debt levels. They hypothesize in the same vein as Peterson and Shulman (1987), that as firms move through their life cycle of ownership, they gain access to more efficient capital markets and lower transaction costs.

Norton (1991), on the other hand, used survey responses from 117 private US firms and finds that factors dealing with bankruptcy costs, agency costs and information asymmetries play an insignificant role in affecting capital structure policy. He argues that financial officers follow a "pecking order" (i.e. use-up cash, then debt, then equity.. etc.), and are principally concerned with market conditions and their own preferences. He found no data to support the static preference theory which balances a firm's debt-related tax benefits with a firm's potential bankruptcy costs. Moreover, Norton found little evidence to support the notion that firms have a target capital structure to which they adhere. The target capital structure theory, first proposed by Donaldson (1965), is frequently discussed in finance textbooks, but has had little support since its origins.

Ou (1991) uses a Small Business Administration (SBA) and Federal Reserve survey of 3400 private US firms and reports that the incidence and timing of outside equity support depends on such things as the rate of growth, the level of profits, the timing of operating cash flows and the initial infusion of equity capital. He also finds that a firm's debt-equity relationship is influenced by the age, company organization, and borrowing frequency. For example, he finds that younger firms have lower equity ratios, but that it varies by corporate classification. In addition, the rate of growth affects the equity ratio in an inverse manner.

EMPIRICAL TEST AND METHODOLOGY

This study uses the Small Business Administration and the Federal Reserve database consisting of 3400 observations. We use the database to test capital structure differences among small and large firms. We also test the SBA/Federal Reserve data for evidence of monitoring provisions, types of financing, borrower costs, potential bias against minorities or females and other borrower-specific

information. Finally, we examine the data for evidence supporting the "pecking order", "static preference", "agency cost", "asymmetric information" and "life cycle" theories. Standard statistical differences and ordinary least squares regression techniques are employed and shown in Tables 1-8.

Figure 1 shows the basic life cycle model. We hypothesize that firms borrow progressively more funds from traditional sources (i.e. bankers) as they mature and establish a financial track record. Borrowing may depend on such factors as: 1) whether or not the firm is in a capital intensive industry; 2) the timing of payments to suppliers and cash receipts (i.e. cash conversion cycle); 3) the level of sales and asset growth; 4) the profit level of the firm; 4) the geographical location of the firm; 5) initial capital infusions from the principals; 6) prior experience among principals and their net worth; 7) race or gender of borrowing parties; 8) organizational type; 9) age/asset size or number of employees, and 10) asset collateral or loan covenants.

Early sources of commercial bank debt are presumed to be short-term in nature due to the reduced risk to the lenders and the restrictive nature of loan covenants and lender guarantees. As the firm matures (i.e. increases number of employees) additional sources of funds are presumed available at a more attractive price. The greater access to funds is derived from the reduced risk to the lending parties (fewer loan covenants and provisions) and greater loan amount economies of scale (lower transactions cost on a percentage basis) as the firm develops. Consequently, the life cycle model which we propose offers a blend of agency cost, information asymmetry, static trade-off and pecking order theories. We believe firms follow a pattern of minimizing costs consistent with the pecking theory (Myers 1984). Greater efficiencies (lower transactions costs) accrue as the firm matures enabling firms greater access to new fund sources. Agency costs and information asymmetries presumably decrease with maturity since the corporation is establishing a profile by which to judge future performance. Moreover, we hypothesize that many firms pursue a public equity issuance in order to facilitate investment liquidity or continue asset growth. This would be consistent with the static trade-off theory, (i.e balanced bankruptcy/tax shield), as described by Myers (1984).

Table 1 shows the frequency of organization type based on the number of employees in the firm. In excess of 33% of all firms in the database are in the form of proprietorship. Most of the proprietorships exist among smaller firms (employees < 4), whereas Subchapter S and C corporations dominate whenever a firm has 5 or more employees. Table 2 shows minority and female representation in the database. Interestingly, 255 out of 3404 of the observations are minority controlled whereas only 421 firms are controlled by females. Clearly, minority representation in this sample more closely resembles the overall percentages in the U.S. compared with the female representation. Table 2 demonstrates how both minority and female control declines as firm size increases. Several explanations could explain this finding. For example, bias in lending behavior or discrimination in the financial markets might prevent minorities and women from growing their firms. This might be consistent with agency cost or information asymmetries arguments. Alternatively, minorities and women might cluster in certain industries which by their nature do not grow beyond a certain employee base. Table 3, for instance provides support for this argument. Minorities and women tend to operate in retailing and service industries (shown in Table 3 as SIC groups 3 and 4) and may plateau at an earlier level than say, a manufacturing firm (shown in Table 3 as SIC 2).

Table 4 shows the most recent type of financing broken down by corporate maturity (number of employees). Not surprisingly, more than one-half of the smallest firms (0-1 employees) have not yet used (or were not able to get) traditional forms of financing. Access to financing increases as firms mature. This should be obvious given the larger representation of different financing categories in the later stages of maturity. Moreover, access to longer-term or permanent sources of funds increases with maturity. Both of these findings are consistent with the pecking order theory as well as agency cost and information asymmetries theories. Firms may follow a path of financing which becomes more accessible and less expensive. Additionally, Table 4 supports the notion that firms pursue sources of financing in a manner consistent with the life cycle hypothesis. Close

examination of Table 4 suggests a financing pattern evolves as the emerging firm grows.

Tables 5-8 illustrate simple regressions which test relationships among employees, short-term debt, long-term debt, equity and principle owner debts. Table 5, demonstrates how short-term debt at first increases with firm maturity and then later declines (employees is significantly positive and the employees^2 term is significantly negative). In addition, Table 5 shows how short-term debt is negatively related to proprietorship ownership and positively related to profits. These findings are consistent with pecking order, asymmetric information, agency cost, static trade-off and life cycle hypotheses.

Table 6 shows how principle owner debts are positively related to corporate organization (intercept t statistic = 4.5), negatively related to minority controlled firms and negatively related to public ownership. Moreover, the positive t statistic for employees (t = 2.09) and negative t statistic for employees^2 suggests that principle owners basically lend money to their organizations early in corporate life. The public variable is consistent with an explanation that any firm which has issued public stock need not borrow money from its principles. Both the corporate organization and the public variables are consistent with the life cycle hypothesis. They are also consistent with static trade-off and pecking order theories. A negative minority t statistic (-3.36) might be indicative of agency cost or information asymmetry theories and suggests that minority owned firms either do not need cash from principle owners or can not get cash from principle owners (i.e. they don't have it).

Table 7 shows how equity to total assets levels move positively with proprietorships and inversely with profits and Subchapter S corporations. This information suggests low-profit proprietorships in the early stages of development rely heavily on equity funds whereas subchapter S corporations don't. This regression is consistent with Tables 1 and 4 which showed how small firms (i.e. proprietorships) in the early stages of growth often had no traditional forms of bank capital.

Table 8 provides additional evidence that long-term debt does not exist with proprietorships or immature firms. The t-statistic for proprietorship is (-2.7) and employees and employees^2 are (-2.9 and 2.49 respectively. In addition, the t-statistic for Profit (1.62) shows how long-term debt is more pronounced with corporate profits. Each of these results is consistent with the overall life cycle hypothesis.

CONCLUSIONS

While prior studies have tested for differences between small and large firms, difficulties stemming from inadequate data on small, private firms have allowed only tentative conclusions. However, an extensive database, recently developed by the SBA and Federal Reserve, may enable researchers to address many questions which have been left unanswered. For example, capital structure issues involving agency costs, information asymmetries, static trade-off and pecking order theories can now be discussed in the context of a broader life cycle hypothesis.

Although the results in this paper are preliminary in nature, they nevertheless indicate that small firm capital structures undergo an evolutionary process. We believe maturing firms have increasing access to less expensive sources of financing. Thus, depending on the industry, growth, timing of payments and organizational type and maturity level, institutional sources and costs will vary. The life cycle hypothesis presented in this paper appears to be supported by the SBA data and consistent with other existing theories of capital structure.

TABLE 1

Frequency of Organization Type

Number of Employees	0-1	2-4	5-14	15-24	25-49	50-99	100-249	250 +	Total
Category									
Proprietorship	296	692	216	22	14	10	4	1	1,255
Partnership	30	113	76	19	12	12	8	4	274
Subchapter S	29	106	135	38	40	65	49	14	476
Corporation	60	181	526	125	146	187	115	39	1,379
Total	415	1192	853	204	222	284	176	58	3,404

TABLE 2

Minority and Female Representation

Number of Employees	0-1	2-4	5-14	15-24	25-49	50-99	100-249	250+	Total
Category									
Minority	40	112	51	11	23	11	6	1	255
Female	60	199	95	21	14	22	4	6	421
Overall Total Sample	415	1192	853	204	222	284	176	58	3404

TABLE 3
Minority and Female Representation By SIC Code

Number of Employees	0-1	2-4	5-14	15-24	25-49	50-99	100-249	250+	Total by SIC
Minority 1	8	19	7	0	1	0	1	0	36/473
Female 1	3	5	8	5	1	0	1	0	23/473
Minority 2	0	13	5	2	6	3	1	0	30/525
Female 2	1	12	13	4	5	7	1	2	45/525
Minority 3	18	44	22	5	10	6	1	0	106/1468
Female 3	31	120	47	9	6	7	2	1	223/1468
Minority 4	14	36	17	4	6	2	3	1	83/938
Female 4	25	62	27	3	2	8	0	3	130/938

Categories: 1 = Mining and Construction; 2 = Manufacturing;
3 = Retailing; 4 = Service

TABLE 4
Most Recent Financing Experience

Number of Employees	0-1	2-4	5-14	15-24	25-49	50-99	100-249	250+	Total
Financing									
Commercial Bank	89	358	347	89	108	145	93	261	1255
S&L	45	179	142	25	34	33	18	9	485
Savings Bank	16	51	57	16	20	24	12	10	206
Credit Union	2	21	17	4	8	16	9	2	79
Finance	1	1	1	6	3	5	1	3	21
Insurance	0	3	2	3	3	7	8	3	29
More Than 1	26	91	51	13	12	13	7	1	215
No Funding (or response)	236	488	236	48	34	41	28	3	1114
Total Sample	415	1192	853	204	222	284	176	58	3404

Table 5

Relationship Between Short-Term Debt, Employees and Organization Type

Retailing Industry

Variable Name	Coefficient	Standard Error	t-statistic	Adjusted R^2
Intercept	-0.01532	0.28570	-0.054	
Employees	0.00077	0.00033	2.355	
Employees^2	-0.00000	0.00000	-2.044	
Gender	-0.02736	0.01905	-1.436	
Proprietorship	-0.04457	0.01649	-2.703	
Partnership	-0.02439	0.02555	-0.955	
Subchapter S	-0.00911	0.02127	-0.428	
Profit	0.03827	0.00739	5.177	
Adjusted R^2				0.028

Table 6

Principle Debt, Employees, Organization Type and Ownership
Manufacturing Industry

Variable Name	Coefficient	Standard Error	t-statistic	Adjusted R^2
Intercept	4005186	899017	4.50	
Employees	2262	1084	2.09	
Employees^2	-6	3	-1.75	
Minority	-465797	138683	-3.36	
Proprietorship	-71260	327577	-0.22	
Partnership	-65510	139596	-0.47	
Subchapter S	11552	66037	0.18	
Public	-1733828	449391	-3.86	
Adjusted R^2				0.18

Table 7

Equity, Employees, Organization Type and Profits
Construction/Mining Industry

Variable Name	Coefficient	Standard Error	t-statistic	Adjusted R^2
Intercept	0.355	0.558	0.636	
Employees	-0.001	0.000	-1.726	
$Employees^2$	0.000	0.000	1.231	
Gender	-0.026	0.042	-0.607	
Proprietorship	0.175	0.036	4.829	
Partnership	0.079	0.056	1.407	
Subchapter S	-0.089	0.047	-1.918	
Profit	-0.041	0.016	-2.481	
Adjusted R^2				0.033

Table 8

Long-Term Debt, Employees, Organization Type and Profits
Manufacturing Industry

Variable Name	Coefficient	Standard Error	t-statistic	Adjusted R^2
Intercept	0.349	0.351	0.994	
Employees	-0.001	0.000	-2.906	
$Employees^2$	0.000	0.000	2.489	
Gender	-0.069	0.063	-1.108	
Proprietorship	-0.142	0.052	-2.704	
Partnership	-0.122	0.092	-1.326	
Subchapter S	0.069	0.047	1.483	
Profit	0.043	0.026	1.627	
Adjusted R^2				0.022

REFERENCES

Barnea, Amir, Haugen Robert A., and Senbet, Lemma W., "Market Imperfections, Agency Problems, and Capital Structure: A Review", Financial Management, Summer 1981, pp 7-22.

Churchill, W. C. and V. L. Lewis, "The Five Stages of Small Business Growth", Harvard Business Review (November-December 1983).

Day, T, Stoll, H., and Whaley, R. 1985, Taxes, Financial Policy and Small Business. Lexington MA; Lexington Books.

Fama, Eugene F. "Agency Problems and the Theory of the Firm", Journal of Political Economy, 88 (April 1980), pp 288-307.

James, Christopher, "Some Evidence on the Uniqueness of Bank Loans", Journal of Financial Economics, Vol 19, 1987, pp. 217-235.

Jensen, Michael C. and Meckling William H., "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure,", Journal of Financial Economics, 3 (October 1976), pp. 305-360.

Joreskog, Karl and Dag Sorbom, 1984 LISREL VI: Analysis of Linear Structural Relationships by Maximum Likelihood, Instrumental Variables, and Least Squares Methods. Mooresville, Ind.: Scientific Software, Inc.

Kester, Carl "Capital and Ownership Structure: A Comparison of United States and Japanese Manufacturing Corporations", Financial Management, (Spring 1986), 5-22.

Modigliani, Franco and Merton Miller, "The Cost of Capital, Corporate Finance and the Theory of Investment", American Economic Review, 48 (June 1958), 261-297.

Mull, R., and Winters, D., "A Life Cycle Hypothesis of Firm Capital Structure: An Empirical Examination of the Differences Between Public and Private Firms", working paper September, 1991.

Myers, S.C., "The Capital Structure Puzzle", Journal of Finance, July 1984, 575-592.

Myers, S., and Majluf, N., "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have", Journal of Financial Economics, June 1984, pp. 187-222.

Norton, Edgar, "Capital Structure and Small Public Firms", Journal of Business Venturing, 6, 287-303, July 1991.

Ou, Charles, "The Debt-Equity Relationship For Small Business--An Alternative Explanation", working paper, 1991.

Peterson, Rein and Shulman, Joel, "Capital Structure of Growing Firms: A 12-Country Study on Becoming Bankable", International Small Business Journal, Journal 5,4 1987/1988 pp. 10-22.

Petit, R., and Singer, R., "Small Business Finance: A Research Agenda", Financial Management, Autumn, 1985, pp. 47-60.

Titman, S., and Wessels, R., "The Determinants of Capital Structure Choice", Journal of Finance, Vol. XLIII, No. 1, March, 1988, 1-18.

Walker, Ernest. and Petty, J. William, "Financial Differences Between Large and Small Firms" Financial Management, (Winter 1978), 61-68.