DOCUMENT RESUME

ED 331 650 RC 017 678

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| AUTHOR | Barkley, David L.; And Others |
| TITLE | High Tech Entrepreneurs in the Nonmetro West: Who Is Starting What? Community Economics, Jan 1990. |
| INSTITUTION | Western Rural Development Center, Corvallis, Oreg. |
| REPORT NO | WREP116 |
| PUB DATE | Jan 90 |
| NOTE | 22p. |
| AVAILABLE FROM | Western Rural Development Center, Oregon State Univ., Corvallis, OR 97331 ($1.50). |
| PUB TYPE | Reports - Research/Technical (143) |
| EDRS PRICE | MF01 Plus Postage. PC Not Available from EDRS. |
| DESCRIPTORS | Administrator Characteristics; Economic Development; *Entrepreneurship; Rural Areas; *Rural Development; Small Businesses; *Technological Advancement |
| IDENTIFIERS | *Nonmetropolitan Areas; *United States (West) |

ABSTRACT

The new distribution patterns of high technology provide clues for reconsidering vocational education in rural areas. This report examines the founding and development of locally owned, high technology manufacturers in the nonmetropolitan West. A mail survey of all high technology manufacturing firms in 11 contiguous Western states and a follow-up telephone interview identified 82 high-tech firms that had been started since 1976 in nonmetro areas by local entrepreneurs. Sixty-seven of these firms praticipated in the survey. The products of these firms fell into 3 relatively homogeneous groups: electronic components, industrial controls, and instruments; products and equipment related to natural resources; and medical, dental, and health related products. Entrepreneurs had a mean age of 37 at the time of business start-up; 59% had college degrees or more. While 71% of entrepreneurs had lived in the community previously or had other personal ties, 29% chose their business location because it was an attractive place to live. Entrepreneurs preferred towns with populations over 10,000 and counties over 25,000; most selected locations near regional high-tech centers or in areas with abundant amenities. Virtually all entrepreneurs had managerial or technical experience in their previous employment or had previously been owners or partners in a small business. However, the new firms had few supply or market linkages to these "incubator" organizations. Start-up financing came mostly from the founder's personal assets. Over 75% of new firms experienced employment growth since start-up; most employees were full-time and hired locally. This report contains 27 references. (SV)

# High Tech Entrepreneurs in the Nonmetro West: Who is Starting What?



COMMUNITY ECONOMICS

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# High Tech Entrepreneurs in the Nonmetro West: Who is Starting What?

Formation and development of local enterprise is currently perceived as a promising alternative for rural reindustrialization.[1] Advocacy for this strategy is based largely on Birch's (1979, 1987) widely publicized findings that small businesses were responsible for much of the nation's recent job growth and product innovation. Additional support for indigenous firm development is founded on the belief that locally-owned businesses provide greater economic benefits to the host community than do branches of externally-owned corporations. For example, Erickson (1975) noted that branch plants created relatively few employment opportunities outside of their facility because their linkages with the local economy were weak. Moreover, Barkley (1978) has shown that locally-owned firms exhibited greater locational stability because the owner's personal ties to the community reduced the likelihood of plant closure when market conditions change.

An area of small business development that may hold special promise is locally-owned, high technology manufacturing. Markusen, et. al. (1986), Barkley (1988), Miller (1989), and Glasmeier (1989) have shown that production in the high technology sector is decentralizing to rural areas and that the employment growth in this sector greatly exceeds that of the less technical, traditional rural manufacturers. Job quality in the locally-owned high tech manufacturers also appears to be relatively good. Smith and Barkley (1988) reported that rural, owner-operated high tech firms employed significantly higher proportions of skilled and professional labor than locally-owned low tech manufacturers. Also, White (1982) found that small business development is more successful in rapidly growing industries with low capital-to-labor ratios, little vertical integration, and high product sales to industrial markets. These characteristics are consistent with those of many high technology manufacturers.

To take advantage of the potential of these firms, communities need to know more about how they are founded and the people who started them. Cooper (1986) argues that the decision to found a new firm is influenced by three broad factors. These are: (1) the personal characteristics of the entrepreneur, such as background, skills, knowledge, and motivation; (2) the incubator, or source organization, for which the entrepreneur previously worked; and (3) local economic and business factors which may influence the success of any potential new business endeavors. Availability of adequate start-up capital is also an important factor in the development of new firms. Previous research (Storey, 1982; Oakey, 184b; Markusen and Teitz, 1985) reported that new firms relied heavily on personal sources of funds because local bankers were reluctant to invest in high risk, small new businesses. Finally, Cooper (1986) argued that "technical" entrepreneurs had a particularly high tendency to stay in their original location when starting a business. Thus, community characteristics which influence the pool of entrepreneurial talent are of interest.

The purpose of this paper is to investigate the founding and development of locally-owned, high technology manufacturers in the nonmetropolitan counties of the West. Of particular interest are: (1) the characteristics of the individuals responsible for starting new high tech businesses (e.g., age, education, employment history, sources of financing, and linkages to the community), (2) the characteristics of the communities in which these start-ups occurred (e.g., size, location, proximity to metropolitan areas, and availability of educational facilities), and (3) the employment and market linkage impacts of the new firms on the local economies. These profiles of nonmetropolitan communities and firms will be compared with earlier studies of urban high tech entrepreneurs. Based on the results, possible strategies will be provided to enhance the success of rural entrepreneurs and increase the likelihood of high tech start-ups in rural communities.

1. Throughout this paper, metropolitan and urban refer to Metropolitan Statistical Areas (MSA's). Rural and nonmetropolitan will be used interchangeably to refer to non-Metropolitan Statistical Areas (non-MSA's).

## Data and Methodology

The definition of high technology industry varies from study to study. These definitions are, however, similar in that most are based on the following criteria:

(1) a high percentage of an industry's gross revenue or output dedicated to research and development;

(2) a high percentage of scientists and engineers in the industry's workforce; and/or

(3) a high percentage of laborers characterized as highly skilled.

The definition used in this study is that developed in 1983 by Armington, Harris and Odle of The Brookings Institution. This definition classified an industry as high technology if (1) more than 8 percent of its employees were in scientific, engineering and technical occupations, and at least 5 percent of industry employment was in the more narrow class of scientific and engineering occupations, or (2) expenditures for research and development were a relatively large percent of product sales. Twenty-four manufacturing industries (3-digit Standard Industrial Classification S.I.C.) were identified under this criteria. A listing of these industries is provided in Table 1.

The identity and characteristics of new high tech firms in the nonmetro West were collected through a two-stage process. First, in 1986, questionnaires were mailed to all firms listed in the most recent state directories of manufacturing as manufacturers of high technology products (according to the Brookings criteria). In total, 565 questionnaires were mailed to firms in the eleven contiguous Western states: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. Information requested included history of the establishment, principal products, ownership characteristics, location of product and input markets, and labor force characteristics. Sixty-one percent of the firms surveyed (345) returned usable questionnaires. However, information provided in the surveys indicated that many of the firms listed in the state directories as high tech manufacturers were either not in manufacturing or did not have high tech products as their principal output. Eliminating the nonmanufacturing activities and manufacturers of low tech products resulted in a final sample of 280 firms.[2]

The second stage of the survey process was a 1988 telephone interview with some of the 280 respondents considered to be recent high tech business start-ups. The sample consisted of all firms meeting three criteria: (1) the business was founded since 1976, (2) the operation was not a branch or subsidiary of another firm, and (3) the firm was not previously located in another community. This last criterion was selected to insure that the focus was locally generated firms. Eighty-two nonmetro, high tech business start-ups were identified using the above criteria. Sixty-seven of these firms (82 percent) were willing to participate in the survey.[3] Information requested in the survey included: personal characteristics and employment history of the founder(s), sources of financing, employment history of the firm, location of principal suppliers and customers, and perception of the importance of select community characteristics.

The 67 surveyed firms represented a broad cross-section of the high tech industrial spectrum (Table 2). The product types, however, fell into three relatively homogeneous subgroups. Forty-two of the firms were engaged in the production of electronic components, industrial controls, and instruments, businesses that are generally regarded as footloose and skilled-labor intensive. The second group consists of 13 firms producing natural resource-related products and equipment. Machinery and equipment producers for the West's oil and mining industries dominated this subsector. The 12 remaining high tech entrepreneurs produced health related products. Five of these firms manufactured dental products, such as dentures and crowns, and another 5 firms specialized in the production of orthopedic and surgical supplies.

2 The Brookings three digit SIC classification system for high tech firms includes some four digit SIC industries that clearly do not meet the occupational or research and development criteria. For example, gun stock manufacturers were included under SIC 348 (Ordinance and Accessories) and clock cabinet manufacturers were reported under SIC 387 (Watches and Clocks). Manufacturers such as these were excluded from the high tech sample so that the selected firms would more accurately represent high tech activities.

3 The mail and phone surveys followed the Dillman total design method (Dillman, 1978).

**Table 1. High Technology Manufacturing Industries[a]**

| SIC[b] | Industry |
|---|---|
| 281 | Industrial inorganic chemicals |
| 282 | Plastics materials, synthetic resins and other man-made fibers |
| 283 | [illegible]ugs |
| 286 | [illegible]dustrial organic chemicals |
| 28[illegible] | Miscellaneous chemical products |
| 291 | Petroleum refining |
| 348 | Ordnance and accessories |
| 351 | Engines and turbines |
| 353 | Construction/mining, machinery and equipment |
| 356 | General industrial machinery and equipment |
| 357 | Office computing and accounting machines |
| 362 | Electrical industrial apparatus |
| 365 | Radio and television equipment except communication types |
| 366 | Communication equipment |
| 367 | Electronic components and accessories |
| 372 | Aircraft and parts |
| 376 | Guided missiles and parts |
| 381 | Engineering, lab and science research instruments |
| 382 | Measuring and controlling instruments |
| 383 | Optical instruments and lenses |
| 384 | Surgical, medical, dental, instruments and supplies |
| 385 | Ophthalmic goods |
| 386 | Photographic equipment and supplies |
| 387 | Watches, clocks |

[a]See Armington, Harris, and Odle (1983).
[b]1977 Standard Industrial Classification.

**Table 2. Product Types of Surveyed Manufacturers**

| SIC Code | Industry Product Line[a] |
|---|---|
| A. Electronics, Controls, Instruments (ECI) | |
| 3519 | Internal combustion engines |
| 3567 | Industrial process furnaces |
| 3573 | Electronic computing equipment (9)[b] |
| 3576 | Scales and balances |
| 3622 | Industrial controls |
| 3662 | Radio & TV transmitting (6) |
| 3678 | Connectors for electronics (2) |
| 3679 | Electronic components (6) |
| 3728 | Aircraft parts and equipment (3) |
| 3811 | Engineering, lab, and science (3) |
| 3820 | Automatic control devises |
| 3824 | Totalizing fluid meters (2) |
| 3829 | Measuring and control devises (4) |
| 3861 | Photographic equip. (2) |
| B. Natural Resource Related (NRR) | |
| 2821 | Plastics |
| 2899 | Chemicals and chemical preparations |
| 3531 | Construction machinery (2) |
| 3532 | Mining machinery (2) |
| 3533 | Oil machinery |
| 3561 | Pumps and pump priming |
| 3569 | General industrial machinery |
| 3576 | Scales and balances |
| 3622 | Industrial controls (2) |
| 3829 | Measuring and control devises |
| C. Health Related (HR) | |
| 2831 | Bio-products |
| 3842 | Orthopedic and surgical supplies (5) |
| 3843 | Dental equipment (5) |
| 3851 | Ophthalmic equipment |

[a]1977 Standard Industrial Classification
[b]Number of plants in specified industry product line.

## Entrepreneur and Firm Characteristics and Location Patterns

**Personal characteristics of entrepreneur.** Recent studies of high tech entrepreneurs in metropolitan areas noted that founders of new high tech firms were, on average, young and highly educated (Cooper, 1986). The average age of the metro entrepreneurs ranged between 34 and 42 years and between 35 and 55 percent of founders held graduate degrees. High tech entrepreneurs in the rural West were also very young at the time the business was founded (Table 3). The mean age at start-up was 37 years, with almost 70 percent of the founders less than 40 years old and only 10 percent over 50. The rural high tech entrepreneurs, however, did not have the extensive formal education of their urban counterparts. Only 18 percent of the respondents to our survey stated that they had earned graduate degrees. Fifty-nine percent of the founders did have college degrees or beyond, and all but 12 percent had some formal education beyond high school. Thus, the educational level of the rural high tech entrepreneurs is much higher than that of either the rural population as a whole or the average reported in a recent study of nontechnical entrepreneurs (Cooper and Dankelberg, 1981).[4]

An important consideration for local small business development programs is the residence of an

4 All 67 of the cooperating firms did not provide complete information, thus, the number of entrepreneurs in various categories may not sum to 67.

entrepreneur prior to starting a business. In our study of Western, rural, high tech entrepreneurs only 50 percent of those interviewed lived or worked in the community immediately prior to founding the business (Table 3). Another fourteen of the high tech entrepreneurs (21 percent) had personal ties to the community selected, such as previous residence, or friends or relatives who lived in community. The remaining 19 founders (29 percent) listed no personal ties to the community, and stated that the location was selected primarily because they considered the community an attractive place to live. These findings differ significantly from those reported in earlier studies, which indicated that 90 percent or more of the entrepreneurs were local residents (Cooper, 1986).

High tech entrepreneurs in the nonmetro West were not only much more likely to relocate when starting the business, but were also more likely to move great distances. Of the 33 entrepreneurs who moved to start the firm, 22 (67 percent) moved from out-of-state, and 12 of these 22 previously lived in a state that was not contiguous to their selected location (Table 3). The 11 in-state moves did not exhibit the expected pattern either. Four of the entrepreneurs moved from metro areas, while seven of the founders traded one nonmetro location for another. This suggests that nonmetro entrepreneurs differ from their metro counterparts, and that local programs aimed at indigenous entrepreneurial potential may miss important sources of new firms. Nonmetro communities should investigate their attractiveness to outside entrepreneurs and, if possible, develop programs which would be of benefit to both local and nonlocal founders.

**Source organizations.** The organization where an entrepreneur was employed previous to starting his firm, referred to here as the "source" or "incubator" organization, apparently plays an important role in the entrepreneurial process. Previous studies of high tech entrepreneurs in urban areas reported that the incubators were generally "small" firms (less than 500 employees) located in the same general region as the entrepreneur's new business (Freedman, 1986 and Cooper and Dankelberg, 1981). The source firms usually manufactured products similar to those selected by the entrepreneurs, and the founder's role in the source organization was primarily in the areas of management or engineering (Johnson and Cathcart, 1979). In addition, problems with the source firm (negative or "push" factors) were reported as important motivation for deciding to leave and start a new business (Thorre and Ball, 1982).

Characteristics of the source organizations for nonmetro high tech entrepreneurs were similar to those reported for urban areas (Table 4). The new firms produced in the same specific industry (e.g., dentures) as their source organizations in 30 percent of the cases, and in the same general product area (e.g., electronic equipment) for another 22 percent of the firms. However, only 9 firms (14 percent) reported any direct linkage to previous employers, and six of these were electronics products firms. No identifiable product linkage was provided for 34 percent of the firms. For example, a rancher, a beekeeper, and two public school teachers started high tech businesses. Thus, examples for individuals "tinkering in their garages" and developing a marketable product did exist, although these cases represented a distinct minority.

The source firms were, in general, relatively small organizations. Excluding entrepreneurs who were previously public employees or owners of a small business, the average size of the source firm was 220 employees for "local" entrepreneurs and 676 employees for "nonlocal" founders.[5] Moreover, 59 percent of the "local" founders and 48 percent of the "nonlocal" entrepreneurs were previously employed in firms with fewer than 100 employees. The founders' positions with the incubator firms were, as expected, predominantly in occupations with management (37 percent) or technical (22 percent) responsibilities. Somewhat surprisingly, 39 percent of the "local" entrepreneurs were individuals whose previous employment was owner or partner in a small business. This is similar to that reported in a study of new high tech firms in Massachusetts (Utterback, et. al., 1983), and further supports the contention

5. One of the nonlocal entrepreneurs was previously employed with a southern California manufacturer with 10,000 employees. Excluding this individual, the mean incubator size for the nonlocal founders was 252 employees.

**Table 3. Personal Characteristics of Principal Founder.[a]**

| Characteristic Category | | Percent of Founders |
|---|---|---|
| A. Age when Business Founded | | |
| 1. 20 to 29 years | | 21.2% |
| 2. 30 to 39 | | 48.5 |
| 3. 40 to 49 | | 19.7 |
| 4. 50 to 59 | | 7.6 |
| 5. 60 and older | | 3.0 |
| B. Education | | |
| 1. High school diploma or less | | 1.8% |
| 2. Some college or technical school | | 29.4 |
| 3. College degree (BA/BS) | | 41.2 |
| 4. MA or Ph.D. | | 17.7 |
| C. Personal Ties to Community where Business Located | | |
| 1. Owner or partner(s) lived there prior to starting business | | 50.0% |
| 2. Founder(s) lived there earlier, but not prior to starting business | | 9.1 |
| 3. Friends or relatives lived in community | | 12.1 |
| 4. No personal ties to community | | 28.8 |
| D. Residence of Founder Prior to Starting Business | | |
| 1. Same community where business was founded | | 50.0% |
| 2. Same state where business was founded | | 16.7 |
| a. metropolitan area | (6.1) | |
| b. nonmetropolitan area | (10.6) | |
| 3. Out-of-state residence | | 33.3 |
| a. contiguous state | (15.1) | |
| b. non-contiguous state | (18.2) | |

[a]Data reflect the characteristics of founders at time business was started.

**Table 4. Employment History of Principal Founder(s)**

| Characteristics of Last Place of Employment | Percent of Founders: All Firms | Local Founders | Non Local Founders |
|---|---|---|---|
| A. Product of Previous Employer | | | |
| 1. Same industry | 29.9% | 24.2% | 34.4% |
| 2. Same general industry | 22.4 | 27.3 | 18.8 |
| 3. Supplier industry | 6.0 | 9.1 | 3.1 |
| 4. Customer industry | 7.5 | 9.1 | 6.2 |
| 5. No identifiable linkage | 34.3 | 30.3 | 37.5 |
| B. Position with Previous Employer | | | |
| 1. Owner/partner | 28.4% | 39.4% | 15.6% |
| 2. Management | 37.3 | 24.2 | 53.1 |
| 3. Technical/engineering | 22.4 | 18.2 | 25.0 |
| 4. Sales/marketing | 3.0 | 6.1 | 0.0 |
| 5. Labor | 4.5 | 6.1 | 3.1 |
| 6. Educator/student | 4.5 | 6.1 | 3.1 |
| C. Size of Previous Employer[a] | | | |
| 1. 0-99 employees | 52.5% | 58.8% | 47.8% |
| 2. 100-499 employees | 32.5 | 29.4 | 34.8 |
| 3. 500-999 employees | 5.0 | 5.9 | 4.3 |
| 4. 1000 + employees | 10.0 | 5.9 | 13.0 |
| D. Market Linkage with Previous Employer | | | |
| 1. No linkage | 71.6% | 66.7% | 78.1% |
| 2. Supplier | 21.0 | 24.2 | 15.6 |
| 3. Customer | 1.5 | 3.0 | 0.0 |
| 4. Linkage to Customers or Suppliers | 6.0 | 6.1 | 6.3 |

[a]Excludes individuals who were previously employed as public employees or owners of a small business.

that a good indicator of indigenous entrepreneurship potential is the availability of experienced entrepreneurs.[6]

Motivations provided for leaving the source organizations were primarily "positive." Opportunity for financial gain, satisfaction of developing a business, and pursuing a market niche that the source company elected to ignore were reasons frequently provided. Only 19 of the founders (29 percent) were motivated to leave by "negative" factors (e.g., no future, plant closed, disagreements with management), and only six of these disgruntled entrepreneurs were "local" founders. The above observations closely parallel earlier studies of nontechnical entrepreneurs (Thorne and Ball, 1982).

One final relationship of interest is the market linkage between the founder and his or her former employer. This study indicates very little reliance on the source firm as either a supplier of inputs or a market for products (Table 4). Specifically, no linkage was reported for 72 percent of the new firms. Twenty-one percent of the manufacturers reported that they were suppliers to the source organizations, however, the proportion of sales going to the incubator was usually insignificant. Only 3 of the new high tech firms reported that the source firm was responsible for over 25 percent of their sales. Thus, this study finds little support for the hypothesis that high tech firms starting in rural areas functioned principally as subcontractors for larger manufacturers.

6. Many of the local and nonlocal founders had entrepreneurial experience. Fifty-five percent of the local founders and 41 percent of the nonlocal entrepreneurs previously had started small businesses.

**Start-up financing and capital.** Our findings for the nonmetro, high tech entrepreneurs (Table 5) reflect the bias towards reliance on personal assets that previous research noted. Over two-thirds of the start-up financing was from personal funds and assets, and only 14 percent came from commercial lenders, the second most important source. Loans from family or friends (3 percent), venture capitalists (5 percent), supplier or dealer credit (2 percent), government programs (3 percent) and sale of corporate stocks (5 percent) contributed, on average, very little to start-up financing. The reliance on alternative sources of funding was similar for local and nonlocal founders, except for the mix between personal funds and commercial bank loans. The founders who resided in the community prior to starting the business relied less on personal funds (59 percent vs. 74 percent) and more on commercial lenders (19 percent vs. 9 percent) than nonlocal entrepreneurs. Apparently, being known personally by the lender or having local "roots" plays a role in obtaining local financing.

Additional insight into financing new firms is provided by an analysis of the principal sources of financing for the nonmetro, high tech firms (Table 6). Fifty-one of the 65 firms responding to this question reported that start-up capital came primarily from a "single" source (defined here as 85 percent or more provided by one source). Thirty-seven firms relied on personal funds, 6 on commercial bank loans, 3 on venture capitalists or corporate stock sales, and only one on government loans or dealer credit. Personal funds were also an important source of capital for the 14 entrepreneurs who reported multiple sources of financing. Ten of these firms relied on a combination of personal funds and commercial loans or personal finances and family loans for start-up capital. Finally, nonmetro technical entrepreneurs relied relatively little on nonlocal sources of funding. Only 8 firms used outside financing, usually in the form of dealer credit, stock sales, or loans from family and friends.[7]

An additional financial consideration for new firm development is adequate funding for start-up capital and initial production

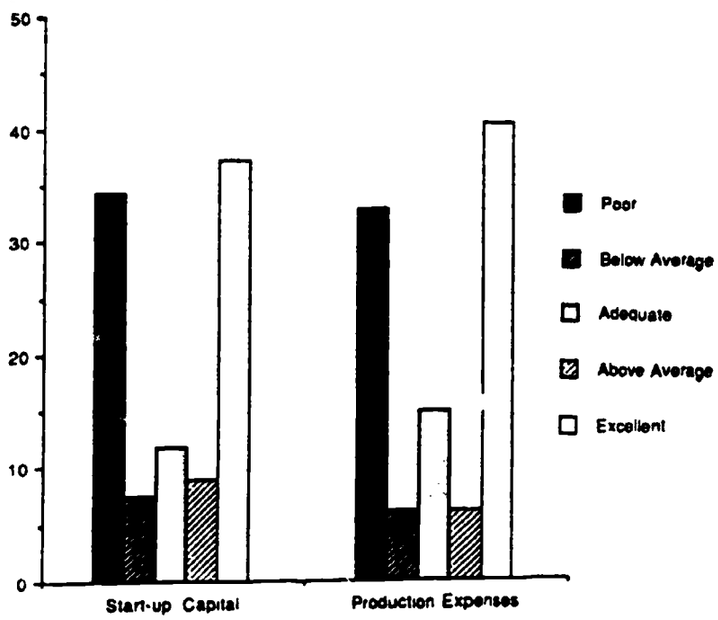
7. The findings show interesting similarities and differences with results of a recent study of small, high technology firms in the San Francisco area (Oakey, 1984a). Both the San Francisco and western nonmetro firms relied heavily on personal savings and assets (59 percent for San Francisco vs. 67 percent for nonmetro firms). Also, government assistance was not important for either group of entrepreneurs. Only 4 of the 60 San Francisco firms and 3 of the 65 nonmetro businesses reported any government assistance at time of start-up. The principal difference between the financing of the metro and nonmetro high tech firms was the use of venture capital funding. Eight of the San Francisco firms were aided by venture capitalists, while this source was used extensively by only three of the nonmetro high tech firms. Thus, it appears that rural high tech entrepreneurs did not have access to or success with as great a variety of financial sources as their urban counterparts.

**Table 5. Sources of Start-up Financing, New High-Tech Entrepreneurs, Western States**

| Sources | Mean Percent of Financing | | | Percent from Local Sources |
|---|---|---|---|---|
| | All Firms | Local Founders | Non Local Founders | All Firms |
| Personal Funds, Assets | 67.1% | 58.5% | 74.0% | 100.0% |
| Loans from Family and friends | 3.4 | 5.2 | 1.8 | 50.0 |
| Commercial Lenders | 13.7 | 19.2 | 3.8 | 92.3 |
| Venture Capitalists | 5.4 | 7.3 | 3.9 | 40.0 |
| Supplier or Dealer Credit | 2.2 | 3.0 | 1.6 | 0.0 |
| GovernmentPrograms | 3.0 | 1.5 | 4.7 | 100.0* |
| Sale of Corporate Stocks | 5.2 | 5.3 | 5.3 | 57.5 |

*Local offices of federal and state programs.

**Figure 1.** Adequacy of financing for start-up capital and initial production expenses, new high tech firms, western states.



expenses. Previous studies have reported that insufficient capital was a major problem for small businesses (Markusen and Teitz, 1985). The results of our survey indicated that many of the rural technical entrepreneurs also considered the availability of funding a serious concern (Figure 1). Adequacy of start-up capital was rated poor or below average by 44 percent of the rural entrepreneurs. Adequacy of financing for first year production expenses was similarly rated. On the other hand, availability of start-up capital and initial production expenses was rated above average or excellent by 45 percent and 46 percent of the founders, respectively. Financial problems were by no means a concern for most of the new firms. No pattern existed relative to the sources of financing (e.g. personal funds, bank loans, sale of stocks, etc.) or the adequacy of these funds. Both local and nonlocal founders provided similar ratings for financial availability, which indicates that financing problems may be due to management conditions more than uncooperative lenders.

**Employment potential and labor force characteristics.** The results of the survey support the perception that high tech firms provide rapid employment growth (Table 7). The firms began quite small, averaging only 5 employees in their first year of operation, including 3 or 4 full-time, and 1 or 2 part-time employees, but growth rates of the firms were very rapid, particularly in health and electronics products firms. These firms added an average of 19 and 22 employees, respectively, resulting in average 1988 sizes of 24 and 27 employees. The resource-related firms grew by an average of only 2.5 employees, for a 1988 size of 6.7

**Table 6. Distribution of Firms by Principal Sources of Financing for Start-up Capital.**

| Sources | Number of Firms | Local Founders | Non Local Founders | Firms Using Non-local Sources |
|---|---|---|---|---|
| *Single Source*[a] | | | | |
| Personal Funds | 37 | 15 | 22 | 0 |
| Loans from Family and Friends | 0 | 0 | 0 | 0 |
| Commercial Lenders | 6 | 4 | 2 | 0 |
| Venture Capitalists | 3 | 2 | 1 | 1 |
| Supplier or Dealer Credit | 1 | 1 | 0 | 1 |
| Government Programs | 1 | 0 | 1 | 0 |
| Sale of Corporate Stock | 3 | 2 | 1 | 1 |
| *Multiple Sources* | | | | |
| Personal Funds and Commercial Loans | 6 | 5 | 1 | 1 |
| Personal Funds and Loans from Family & Friends | 4 | 3 | 1 | 2 |
| Personal Funds and Supplier or Dealer Credit | 1 | 0 | 1 | 1 |
| Personal Funds and Government Programs | 1 | 1 | 0 | 0 |
| Commercial Loans and Government Programs | 1 | 0 | 1 | 0 |
| Corporate Stock and Venture Capitalists | 1 | 0 | 1 | 1 |
| TOTAL | 65 | 33 | 33 | 8 |

[a]More than 85% of the start-up capital was provided by source.

**Table 7. Employment Growth of New Rural High Tech Firms, by Industry Type.**

| Type of Firm | Total Employment | | | Full Time Employment | | | Part Time Employment | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1st Year | 1988 | Change | 1st Year | 1988 | Change | 1st Year | 1988 | Change |
| Resource | 4.3 | 6.7 | 2.6 | 3.2 | 5.8 | 2.6 | 1.0 | .9 | -.2 |
| Health | 5.5 | 24.3 | 18.8 | 3.3 | 23.1 | 19.8 | 2.2 | 1.2 | -.9 |
| Electronics | 5.0 | 27.3 | 22.3 | 4.0 | 23.4 | 19.5 | 1.0 | 3.9 | 2.8 |
| Overall | 5.0 | 22.7 | 18.0 | 3.7 | 19.9 | 16.2 | 1.2 | 2.8 | 1.6 |

employees. The late 1980s have been years of economic depression for these firms, however, particularly with respect to employment.

Employment growth in the new, high tech firms was almost entirely in full-time employees. The absolute number of part-time employees decreased in the resource and health related firms, and increased by an average of fewer than three employees in the electronics firms. This increase was due primarily to a large increase in one firm. Moreover, family labor was of little importance to the new firms. Three-fourths of the resource and health related firms had no full-time, hired family labor in either their first year or in 1988. For part-time family labor, half of the resource and health products firms had none in their first year, and three-fourths had none in 1988. Again, the electronics firms were different. In both their starting year and in 1988 about half of the electronics firms had full-time, hired family members, but less than 20 percent had part-time family labor.[8]

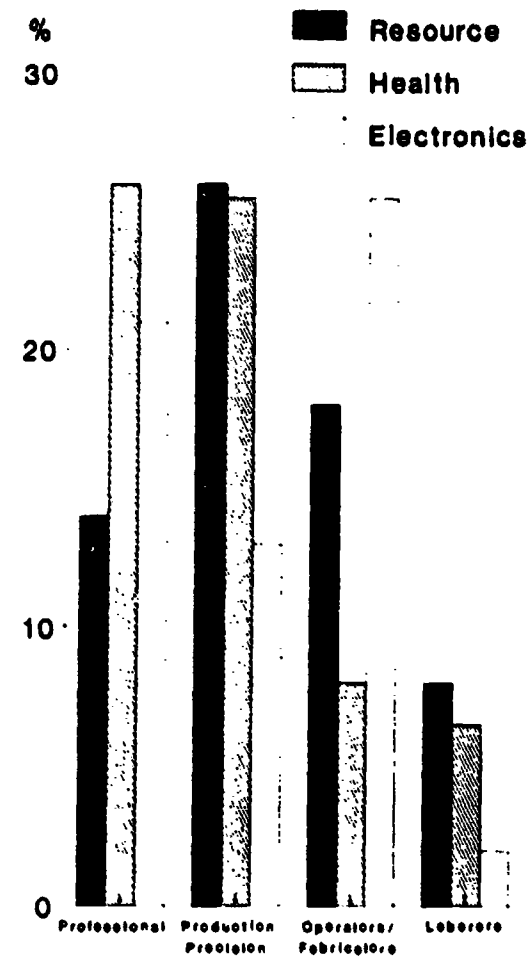
Another positive feature of the new high tech firms is that 75 to 83 percent in each product category registered employment increases. Only 3 of 12 resource firms, 1 of 12 health related manufacturers and 5 of 41 electronics firms had fewer total employees in 1988 than in their first year of operation. Furthermore, a large majority of the firms expected growth to continue. Future employment growth was predicted by 75 percent of the health firms and 89 percent of the electronics firms. None of the health firms, and only one electronics firm, predicted employment decline. The resource firms, on the other hand, were evenly split among predictions of expansion, decline and no change.

The type of jobs provided is an important aspect of the labor force of new high tech firms. These businesses would be expected to employ relatively high proportions of professional and skilled workers because of the novelty of the products and production processes, and because research and development is likely to continue (Markusen, et al., 1985). Communities find this an attractive characteristic of new high tech firms because it upgrades the quality and wage level of the local labor force.

The survey results provide a measure of support for this expectation (Figure 2). The electronics firms, commonly viewed as the archetypal "high tech" manufacturers, met the expectation by employing a relatively high percentage of the highest skilled workers (professionals), and a very low percentage of unskilled laborers. Contrary to expectations, though, the electronics firms employed a relatively large number of semi-skilled production workers (operators/fabricators) and relatively few skilled production workers (precision production). Although involved in considerable product development, apparently many of the nonmetro electronics firms were also engaged in relatively routine assembly of products.

The health products firms, on the other hand, closely fit the expected high tech mold. Over 50 percent of the work force in these firms was in the highest skilled professional and precision production occupations, with less than 15 percent in the two lowest skilled categories, operator/fabricator and laborer. The resource related firms also conformed to occupational distribution expectations of high tech businesses, but to a lesser extent. They employed 40 percent of their workers in the

**Figure 2.** Percentage of employees in selected occupational categories by industry




[8] An average of only one-half the part-time employees and one-fifth the full-time employees were family members in the start-up year. The electronic products firms differed somewhat, in that they had considerably more full-time and less part-time family employment. The number of hired family employees, both full- and part-time, dropped from the firs. year of operation to 1988, particularly part-time

skilled production occupations, and 26 percent in the lower skill categories.[9]

**Input and product markets.** The number of customers and suppliers for the new high tech firms indicated very little market diversification (Table 8). All three types of firms relied on three or fewer customers for almost half of their product sales, and an average of one-quarter of a firm's sales went to one customer. Moreover, with the exception of health related firms, the dependence on limited markets was greater for inputs than outputs. Resource firms purchased 37 percent of their supplies from single sources, and electronics firms 40 percent. The resource and electronics firms also purchased, on average, over half of their inputs from their three largest suppliers.

Major customers varied by product type, as would be expected (Figure 3). Resource related firms sold half their output to extractive industries (agriculture, wood products and forestry, mining), and another 22 percent to manufacturing. The health products firms marketed half their output to retailers, and another 25 percent directly to consumers. The principal customers for the electronics products firms were other manufacturers, taking an average of 45 percent of sales, and government and military markets (19 percent).[10]

The location of customers and suppliers has significant

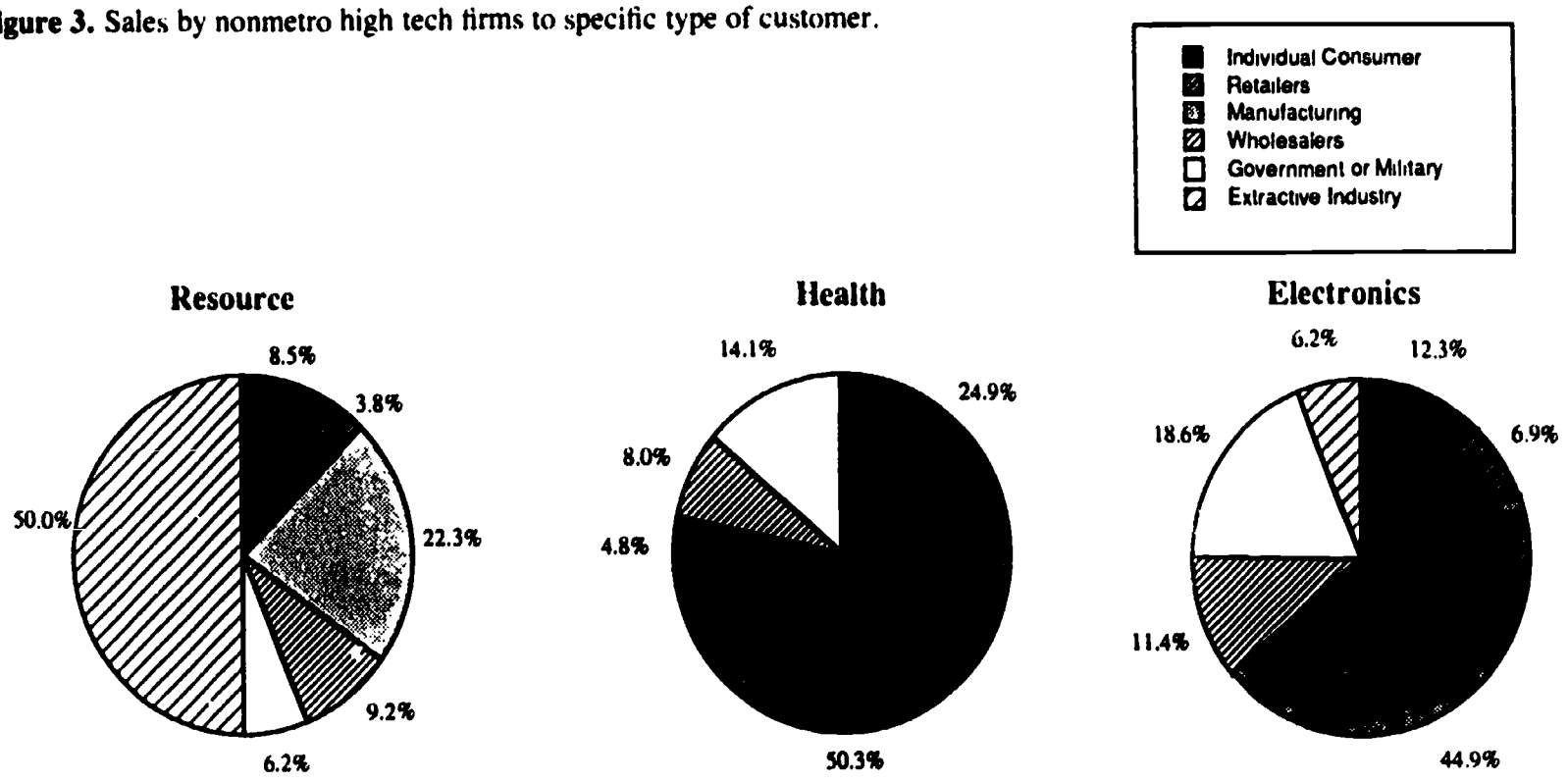
9. The survey findings also indicated that significant employment opportunities for women were provided by the new high tech firms. On average, the labor force of the firms surveyed was composed of 34 percent women. The resource related firms were considerably lower at 18 percent, vs. 37 percent and 39 percent for the health and electronics firms, respectively.

10. The three largest customers of electronics products firms were primarily in another state, with half of these outside the West (mainly states around the Great Lakes and in the Northeast). The largest customers of the resource and health products firms were evenly split between in-state and out-of-state. The out-of-state customers were primarily in the West, though. Of the three largest suppliers, those of the resource and electronics firms were split between in-state and out-of-state locations, but suppliers of the health products firms were primarily out-of-state. Western states were the main input sources for the electronics and resource firms, with both West and non-West firms important suppliers for the health products firms.

**Table 8. Dependence on Largest Customers and Suppliers**

| Product Type | % total sales to largest customer | % total sales to largest three customers | % total materials from largest supplier | % total costs from three largest suppliers |
|---|---|---|---|---|
| Resource | 26.6% | 53.0% | 37.3% | 58.6% |
| Health | 23.3 | 46.6 | 25.8 | 36.6 |
| Electronics | 22.9 | 46.3 | 40.2 | 51.0 |
| All Firms | 23.8 | 48.0 | 36.6 | 49.6 |

**Figure 3.** Sales by nonmetro high tech firms to specific type of customer.



implications for local economic growth. Businesses that purchase higher levels of inputs locally are preferred because they provide a greater stimulus to the local economy. Also, communities desire businesses that sell their products outside the area (export) because this generates higher levels of local jobs and income. Previous research, focusing on regions and urban areas, found that nonlocal product sales and input purchases were extensive among high tech industries. A main reason seems to be that key high tech inputs are produced in a limited number of places (Oakey, 1984b; Hagey and Malecki, 1986; Barkley, Dahlgran, and Smith, 1988).

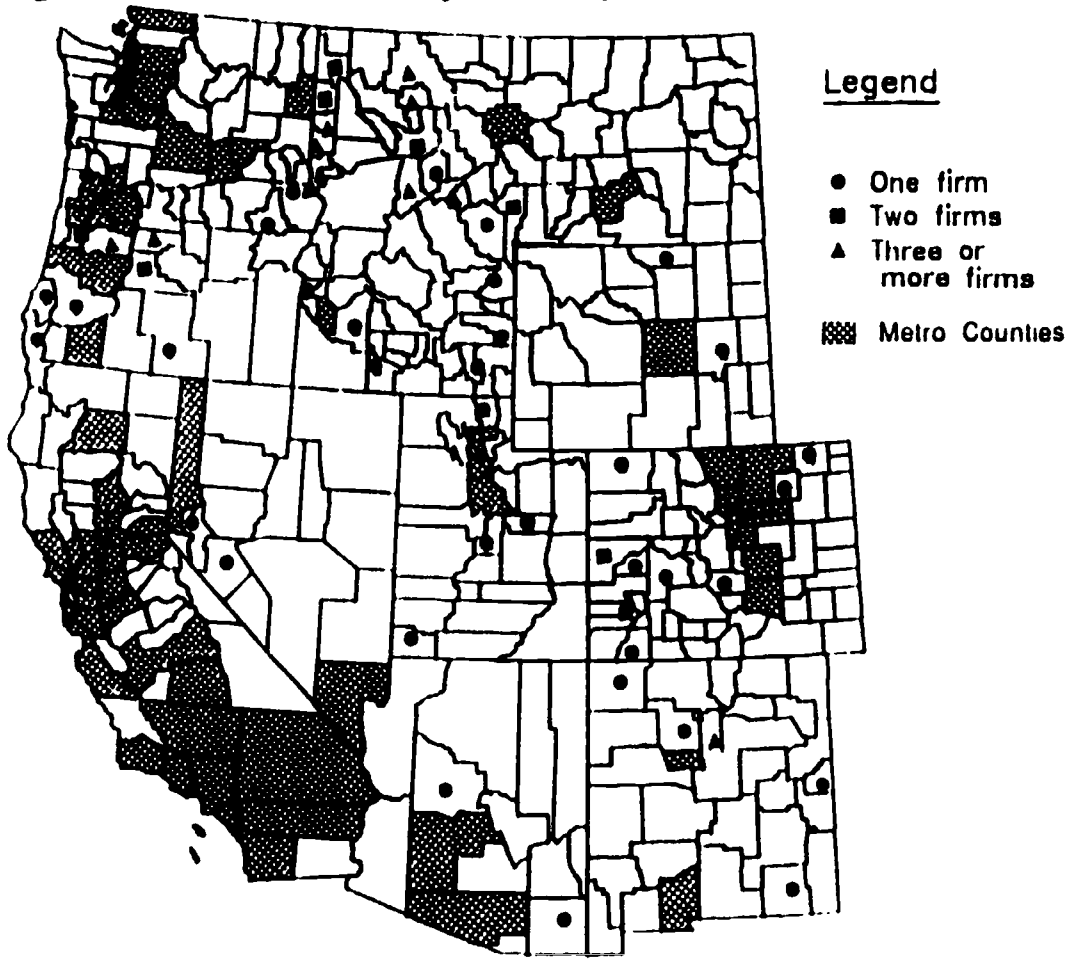
The new high tech firms in the nonmetro West were strongly export oriented, particularly the resource related and electronics products firms (Table 9). These two product types sold 10 percent or less of their products within the county, and over 65 percent outside the state. The health products firms were less export oriented, making over a third of their sales in the county, and only 42 percent outside the state. With respect to input purchases, all types of firms were more locally oriented than for sales. The resource and health firms made about half their purchases in the county, and only 20-30 percent outside the state. The electronics firms purchased considerably less locally (29 percent), and more out of state (41 percent), thus contributing relatively little to the local economy through backward linkages.

**Location of new firms.** The locations of the recent high tech start-ups in the nonmetropolitan West are provided in Figure 4. While all states except California and Washington were represented, the new firms and product types were not distributed proportionately across the remaining nonmetro areas of the West. The greatest concentration of new, nonmetro high tech firms was in western Oregon. Sixteen of the 20 Oregon firms were engaged in the production of electronics equipment, instruments, and controls. The remaining 4 businesses manufactured medical and dental supplies. Another grouping of new firm activity was in the lake

**Table 9. Average Percentage of Sales and Purchases Made in the County and Out of the State, by Industry Type.**

| Location of Sales and Purchases | High Tech Entrepreneurs | | | |
|---|---|---|---|---|
| | Resource | Health | Electronics | All Firms |
| Average percent sales in county | 10.3% | 36.2% | 8.5% | 13.9% |
| Average percent sales out of state | 65.3 | 41.9 | 70.4 | 64.2 |
| Average percent purchases in county | 45.8 | 50.4 | 29.5 | 36.4 |
| Average percent purchases out of state | 20.0 | 31.7 | 41.3 | 35.6 |

**Figure 4.** Location of nonmetro high tech entrepreneurs, 1986.



country of northern Idaho and western Montana. All 3 types of high tech manufacturing (resource related; health related; and electronics, instruments, and controls) were well-represented in this area. The third concentration of new manufacturing activity was along the western slope of the Rocky Mountains between Denver and Albuquerque. These firms were dominated by production of goods for the mining and oil industries. Isolated cases of new high tech unit plants (resource related and electronics equipment manufacturers) were reported in Arizona, Nevada, Utah and Wyoming.

The characteristics of the communities chosen, and the reasons for selecting them, are of interest to those desiring to promote entrepreneurship. Among these characteristics are the sizes of towns and counties in which the high tech entrepreneurs have located; whether the counties are adjacent to metropolitan areas or are genuinely "rural;" how far the locations are from metropolitan cities and interstate highways; and key factors favoring or hindering the choice of a rural location. Table 10 summarizes the demographic and locational attributes of the nonmetro communities which experienced high tech start-ups.

The high tech entrepreneurs exhibited a propensity for starting their businesses in the more populous nonmetro towns and counties and in counties near metropolitan areas. For example, counties with populations greater than 25,000 represent only 96 out of the 340 western nonmetro counties (28 percent), yet, 65 percent of the new start-ups occurred there. The 82 adjacent counties (24 percent of nonmetro total) were selected by 46 percent of the new high tech manufacturers.

Differences in the location choices of new manufacturers were more evident when firms were disaggregated according to product type. The resource-related firms were significantly more likely to start in smaller counties (54 percent) than either the manufacturers of health products (33 percent) or electronics equipment (29 percent). This was not unexpected, since the principal markets for the resource related firms would be the less densely populated mining and oil exploration regions. The health products firms had the strongest preference for large towns (average population 22,033) and for counties not adjacent to metro areas (75 percent). These firms are local-market oriented, so larger cities and distance from urban competitors would be desirable.

The electronics products manufacturers exhibited a much greater proclivity for locating near metropolitan areas (56 percent) than either the resource related (31 percent) or health products (25 percent) firms. The result is that, on average, the electronics firms were 50 to 70 miles closer to metro cities than the other types. An explanation of this locational pattern may lie with both market and input factors. Industries that are market oriented tend to locate closer to major urban areas, where both final consumers and intermediate users are. Electronics product firms are also likely to require specialized human, physical, and service inputs that are primarily available near metropolitan areas. This is characteristic of industries in relatively early stages of development, as many of the new electronics product firms are.

Additional insight into the entrepreneurs' location decision was provided in responses to

**Table 10. Location Characteristics of New Rural High Tech Firms by Type of Product.**

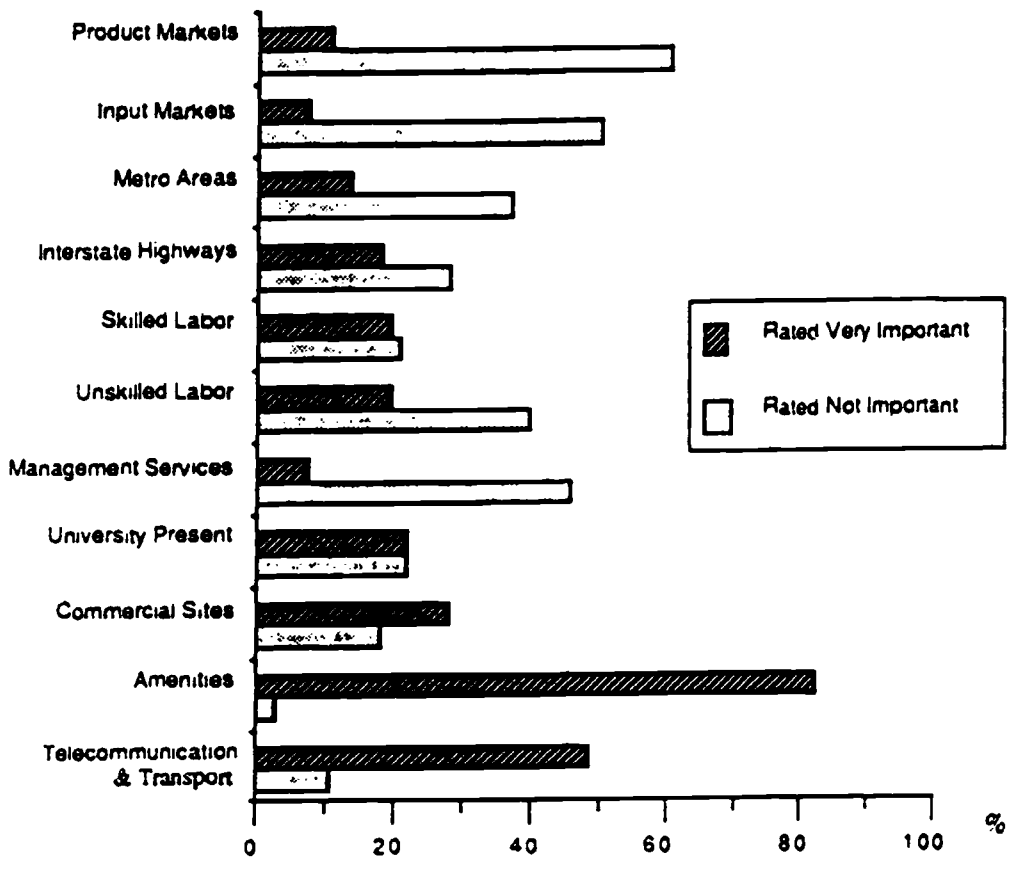
| Characteristic | Product Type | | | |
|---|---|---|---|---|
| | Resource | Health | Electronics | All Firms |
| Average population of town | 16,303 | 22,033 | 14,430 | 16,128 |
| Average population of county | 30,592 | 46,932 | 45,231 | 42,657 |
| % firms in towns ≥ 10,000 | 61.6 | 66.6 | 58.5 | 60.6 |
| % firms in counties ≥ 25,000 | 46.1 | 66.7 | 70.7 | 65.1 |
| Average miles from MSA | 147 | 160 | 94 | 116 |
| Average miles from interstate | 42 | 36 | 40 | 40 |
| % firms in adjacent county | 30.8 | 25.0 | 56.1 | 45.5 |

pertinent survey questions. The founders of the new firms were requested to rate the importance of 11 community characteristics on a scale of 1 (not important) to 5 (very important). Proximity to product markets, input markets, and metropolitan areas, and the availability of unskilled labor and management services were considered *not important* by almost half of the new firms (Figure 5). Local amenities along with the quality of telecommunications and transport services were rated "very important" by 82 percent and 49 percent of the founders, respectively. Approximately equal numbers of firms rated the availability of skilled labor, proximity to a university, and availability of commercial sites as not important and very important. The above findings are consistent with common perceptions that proximity to markets or specialized services is not critical. Otherwise a metro site would be selected originally.

Interesting differences in the community characteristics ratings became evident when the high tech firms were disaggregated by product and ownership type (Table 11). Proximity to product markets and the availability of unskilled labor were ranked relatively high by the health products firms. The electronics equipment manufacturers rated proximity to metro areas and a university, and availability of skilled labor, markedly higher than did the resource or health related firms. These preferences were anticipated given the relatively high technical requirements of the electronics firms. Finally, local and nonlocal founders reported very similar ratings for most of the location factors, however, proximity to input markets and metro areas, and the availability of unskilled labor, were rated much higher by nonlocal founders. Thus, the nonlocal founders' locational preferences were more similar to those of nonmetro manufacturers in general than the preferences expressed by indigenous entrepreneurs.

In summary, distinct geographical patterns of new firm activity were evident in the sample of nonmetro West high tech manufacturers. Thirty-six of the 82 new starts were located in counties near regional high tech centers (e.g., Oregon's Willamette Valley, Salt Lake City, Denver, Albuquerque). Of the remaining 46 firms, 25 were located in or near the university towns and recreation-oriented areas of Idaho and western Montana, and 11 manufacturers were in the mining and oil-based communities on the western slopes of the Rocky Mountains. Thus, relatively few of the new firms were started in communities that lacked obvious locational advantages or desirable amenities.

**Figure 5.** Relative importance of community characteristics.



## Conclusions and Implications

Rural economic development strategies have taken on two new characteristics in the 1980s. One is an increasing focus on business generated by local entrepreneurs. The second is a great interest in high tech industries. Communities hope a combination of these two will help rebuild the foundation for economic growth that has largely been lost through the decline of the traditional rural resource and manufacturing industries. This paper examined the potential for and impacts of new high tech entrepreneurs and their firms in the rural West. Specific aspects investigated were the personal characteristics and employment background of the entrepreneurs; start-up financing and capital; characteristics of the firms labor force, input and product markets, and locational preferences. The purposes were to determine the extent to which these characteristics may contribute to rural economic development goals, and to identify factors that development policy might influence in order to attract and enhance the success of entrepreneurs.

Clearly, rural communities are viable locations for high tech entrepreneurs, even for those who were not previously local residents, as half of the founders were of nonlocal origins. All types of communities are not equally likely to be chosen, however. The entrepreneurs preferred towns with populations over 10,000 and counties over 25,000, and founders of electronics products firms preferred locations relatively close to metro areas. In addition, most of the entrepreneurs selected locations either near regional high tech centers, or in areas with abundant amenities.

The new firms contributed positively to the rural communities' economies. Although beginning very small, they grew rapidly and the employment growth was almost all permanent, full-time, with 90 percent drawn from local residents. The types of jobs provided were generally those expected from high tech with relatively high proportions of the work force in skilled occupations. The new firms also were strongly export oriented, with respect to both the county and the state, creating local jobs and income from nonlocal earnings.

An interesting exception to the above typology is the electronic products manufacturers. These firms employed a relatively high number of unskilled workers and they purchased much of their nonlabor inputs from outside the county. These characteristics indicate a sector not too unlike traditional rural manufacturers. However, the electronics products firms were rapidly growing and provided employment opportunities for professionals, two characteristics not commonly associated with rural low tech firms.

In general, high tech entrepreneurs are a valuable addition to the local economy, and local development programs tailored to the needs of these individuals

**Table 11. Ranking of Community Characteristics by Product and Ownership Type.[a]**

| | All Firms | Product Type | | | Ownership Type | |
|---|---|---|---|---|---|---|
| | | Resource | Health | Electronics | Local | Nonlocal |
| Product Markets | 1.9 | 2.1 | 2.9 | 1.7 | 2.0 | 1.9 |
| Input Markets | 2.0 | 2.6 | 1.3 | 2.1 | 1.7 | 2.3 |
| Metro Areas | 2.5 | 2.4 | 2.3 | 2.7 | 2.1 | 3.0 |
| Interstates | 2.7 | 3.0 | 2.6 | 2.8 | 2.7 | 2.8 |
| Skilled Labor | 3.2 | 2.8 | 2.9 | 3.4 | 3.1 | 3.3 |
| Unskilled Labor | 2.6 | 1.8 | 3.3 | 2.6 | 2.4 | 2.8 |
| Management Services | 2.3 | 2.5 | 2.8 | 2.1 | 2.5 | 2.1 |
| University | 3.0 | 2.3 | 3.0 | 3.3 | 2.9 | 3.1 |
| Commercial Sites | 3.3 | 2.9 | 3.4 | 3.3 | 3.2 | 3.4 |
| Amenities | 4.7 | 4.5 | 4.8 | 4.7 | 4.7 | 4.6 |
| Telecommunications and Transportation | 4.0 | 4.0 | 4.0 | 3.9 | 3.8 | 4.1 |

[a]Characteristics were ranked as follows: 1 = not important, 2 = below average importance, 3 = average importance, 4 = above average importance, 5 = very important.

warrant investigation. The results of this study also suggest, however, that high tech entrepreneurs are a diverse group with dissimilar needs, and as a result, no specific program will provide significant benefits to most of the new high tech firms. Taking these dissimilarities into consideration, five areas of concern should be addressed when structuring local policy to assist high tech entrepreneurs. First .he entrepreneurs are relatively young and well-educated, and they have considerable prior experience as owners, or managers, or professionals. Based on apparent capabilities and experience, most entrepreneurs would be best served by sophisticated and well-focused educational or assistance programs.

Second, heavy reliance on personal funds to start businesses may reflect an original lack of interest by traditional lending sources. Certainly, government programs played an insignificant role, and traditional private sector sources a minor role in providing initial capital requirements. Government programs may not have been available in these rural locations, or the entrepreneurs may not have been aware of them. If either of these were reasons, one solution may be a local, publically financed, revolving venture capital fund. Another may be a public-private effort to provide financial information and advice at a central location.

Third, identification of markets is often a problem for new rural businesses. Although markets were not specifically mentioned as serious problems, the reliance on one or two large customers could be risky. Furthermore, growth and diversification were goals of the entrepreneurs and efforts to help local firms broaden and diversify their product markets would be beneficial. A specific focus could be to make large companies in other areas, particularly metro areas, aware of the products of local firms.

Fourth, a goal of rural economic development programs should be to increase local input expenditures by indigenous firms. The relatively low levels of input purchases by the electronics products firms indicate considerable potential. Communities should undertake programs to determine what inputs are purchased nonlocally, and then try to bring together local suppliers with these purchasers. It may be difficult to go beyond existing levels for many high tech firms, however, because of the specialized nature of many inputs.

Finally, the results indicate a continuing role for traditional community economic development programs. These include promoting an area's environmental, cultural or economic advantages; gathering labor market information; and compiling community economic preparedness materials. These efforts originally were intended to attract and assist nonlocal businesses. As 50 percent of the founders were previously nonlocal residents, such programs and information may positively influence the location decision of a new high tech firm.

According to this study, new high tech entrepreneurs in the rural West cannot be placed into general categories or types. Any entrepreneurial development program must be flexible enough to address a variety of people and circumstances. This study has only considered what must be defined as successful entrepreneurs, who have survived for several years and are optimistic about the future. Programs that address the problems of the unsuccessful entrepreneurs, or those without experience, substantial education, or without personal financial resources, may be a key to generating continued entrepreneurial activity.

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A Western Regional Extension Publication

January 1990/WREP 116



**Price: $1.50**