

# Sources of Financing for New Technology Firms: A Comparison by Gender

Fifth in a series of reports using  
data from the Kauffman Firm Survey

July 2009



## KAUFFMAN

The Foundation of Entrepreneurship

The  
**Kauffman  
Firm Survey**

2004 2005 2006 2007 2008 2009 2010 2011

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# The Kauffman Firm Survey



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Results from the 2004–2007 Data

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## ABSTRACT

In this short report, data was used from the Kauffman Firm Survey to examine the financing sources and strategies, by gender, of high-tech firms. The findings reveal that women entrepreneurs raised significantly smaller amounts of financial capital at startup than men did. When controlled for a variety of firm and owner characteristics, however, there were no significant differences between women and men in terms of total capital raised at startup. Nevertheless, even controlling for other variables, women high-tech entrepreneurs were significantly less likely to use external equity.

## INTRODUCTION

**W**omen-owned firms represent a growing component of the small-business sector. According to data from the U.S. Census Bureau, there were 6.5 million privately held women-owned firms in the United States in 2002 (2002 Survey of Business Owners). These firms generated an estimated \$940 billion in sales and employed 7.1 million people. Although women-owned firms still constitute a minority of all firms (28 percent), their numbers have been growing rapidly. The number of women-owned firms increased by 19.8 percent from 1997 to 2002, compared with a growth rate of 10.3 percent for U.S. firms overall. The number of firms with employees increased 8.3 percent for women-owned firms and just 4.3 percent for U.S. firms overall.

During the same timeframe, however, the revenues for women-owned firms increased by less than 15 percent, compared with 22 percent for U.S. firms overall. Employment by women-owned firms grew by only 1 percent, compared with a growth rate of 7.2 percent for all U.S. firms. Finally, payroll grew by 17 percent, compared with 30 percent for U.S. firms overall. These Census Bureau statistics indicate that, while the number of women-owned firms has grown faster than those owned by men, their relative importance in terms of sales, employment, and payroll actually has decreased over the same period. Women own less than 17 percent

of firms with employees, employ less than 7 percent of the workforce, and account for just 5 percent of payroll. Women-owned businesses appear to have lost ground over the 1997-2002 period.

A number of researchers contend that one of the primary reasons women-owned firms tend to be smaller than firms owned by men is that women tend to concentrate in low-growth retail and service lines of business (Rosa et al., 1996; Du Rietz & Henrekson, 2000). These businesses have a higher risk of failure (Robb, 2002; Fairlie & Robb, 2008; Watson, 2003) combined with a higher level of difficulty in attracting sources of capital due to their limited prospects for growth and profitability (Menzies et al., 2004; Sabarwal & Terrell, 2008). More recently, however, some researchers have begun to attack the “myth” that women do not want high-growth businesses (Brush et al., 2001). They contend that a new generation of women entrepreneurs is willing to “go boldly where no one has gone before” by starting firms in technology and bioscience, where there are opportunities for significant growth and profits.

Technology-based firms have been and will continue to be important contributors to the U.S. economy. For the past two decades, technology firms have been a major source of innovation, business development and growth, and new jobs. Securing funding for new technology-based firms is particularly problematic, however, whether they are

owned by women or men. Many such firms are built on intellectual capital rather than on physical assets, so it is difficult to determine the value and prospects of the firm. The problem of asymmetric or incomplete information is especially acute (Brierley, 2001), often resulting in a shortage of capital or capital that can be obtained only under unfavorable terms and conditions.

In this paper we will examine the financing sources and strategies, by gender, for new technology-based firms using the Kauffman Firm Survey data. We identify not only sources of financing, but also financing gaps that may impede women's ability to launch and grow technology-based firms.

## PRIOR RESEARCH

### A. Financing Technology-based Firms

To date, there have been few research studies specifically targeting the financing strategies of new technology firms, and even fewer dealing with the financing strategy of women-owned technology firms. A review of literature done by Brierley (2001) cited a small number of studies conducted prior to that time. Those studies, however, suggested that new technology-based firms face particular difficulties. These difficulties are associated with a lack of tangible assets that can be used as collateral, products that have little or no track record, and entry into untested markets. Brierley noted that angel investors and venture capitalists who might serve as funding sources to this sector have a difficult time identifying and evaluating the potential of high-tech companies. He observed, however, that firms that were capable of securing Small Business Innovation Research (SBIR) awards or other external sources of funding were more likely to survive.

Brierley's findings were supported by an earlier study of firms that had received SBIR funding conducted by Lerner (Lerner, 1999). Lerner made use of a data set of firms that received SBIR funding between 1983 and 1997 compiled by the U.S. General Accounting Office. He found that SBIR awardees enjoyed substantially greater employment and sales growth than firms that did not receive awards. He also observed that SBIR awardees were more likely to receive venture capital funding. Lerner concluded that receipt of an SBIR award may convey

information to potential investors, thereby at least partially reducing the informational asymmetries associated with new technology-based firms. Audretsch (2002) also addressed the importance of SBIR funding, noting that a significant number of new technology-based firms would not have been started without its support.

Several studies have stressed the prominence of personal financing for new technology-based firms. They note that technology ventures are more risky than traditional businesses, and their prospects for success are more difficult to predict. In light of that, it is often difficult to obtain either external debt or equity. Moore (1994) surveyed a sample of high-technology firms in Britain to find that personal financing was the most important source of financing at startup. In his study, only 7 percent of technology startups were able to secure bank financing, compared to 40 percent of all firms. Moore further noted that as the firms in his study matured, their financial constraints became less severe, and the firms in his study relied increasingly on banks and external equity as sources for expansion capital. Westhead and Storey (1997) also addressed the problem of financial constraints in a study of small high-tech British firms. Twenty-five percent of the firms they surveyed reported that financing was a "continual" problem. In analyzing the results of their survey, the authors found that more technologically sophisticated firms were more likely to report continual financial constraints than were firms based on less complex technologies.

These findings were echoed in a subsequent study of Danish information technology and biotechnology companies conducted by Bollingtoft et al. (2003). Their findings revealed personal savings as the principal source of capital for new technology firms. The authors concluded, however, that different technology industries rely on different sources of capital. Bollingtoft et al. found that, while firms in IT relied on personal savings and bank loans to some extent, those in biotechnology were much more reliant on external equity in the form of venture capital. Like Westhead and Storey (1997), Bollingtoft et al. concluded that it is more difficult to assess the risks associated with complex technologies. Thus, entrepreneurs in those fields have to put more effort into searching for capital and may have to rely more on external equity obtained from investors who have knowledge and expertise in that field.

Guidici and Paleari (2000) found evidence of financing constraints in a study of Italian technology-based small firms, particularly for newer firms. In their study, 73 percent of startups were financed exclusively with the entrepreneurs' personal wealth. Short- and long-term debt represented the next-most-frequently used source, and only a small percentage of firms used external equity. In interviews with their sample firms, Guidici and Paleari found the entrepreneurs were reluctant to open the firm to outside investors. In instances when outside equity was considered, it was typically used as a means to gain not only additional capital, but additional competencies in the areas of technology or managerial expertise.

In another study of Italian firms, Columbo and Grilli (2007) also found that a financing hierarchy existed. The vast majority of firms in their study relied on internal sources of funding at startup and sought outside financing only when their personal financial resources were exhausted. At that point, the entrepreneurs turned to bank loans as a source of financing and, finally, to outside private equity. Columbo and Grilli found that firms that relied on debt financing as an alternative to external equity raised dramatically less capital, leading the authors to conclude that new technology-based firms suffer from credit rationing. They concluded that, even if technology-based firms were able to get access to

bank loans, the amounts provided were not sufficient to fund their growth.

In a study of German firms, Audretsch and Lehmann (2004) tried to establish a link between financing sources for technology-based firms and subsequent performance. Their findings revealed that venture capital-backed firms outperformed firms that did not receive venture capital. In contrast, firms that were financed by friends and family exhibited substantially lower growth rates. They concluded that venture capitalists specialize in a small group of targeted industries, such as biotech and technology, thus leveraging their expertise in exchange for higher returns. Finally, Audretsch and Lehman found an inverse relationship between the amount of debt and the amount of equity used by technology-based firms, leading them to conclude that traditional banks alone are not sufficient as a source of financing for innovative firms and particularly for technology-based firms.

Several studies provide support for a "life cycle theory" of financing. Freear and Wetzel (1990) conducted an early study of new technology-based firms to find that sources of equity capital shifted as firms matured. They studied 284 technology-based firms launched in New England to find that 38 percent used no outside equity. Of those firms that did use outside sources of equity, the most common source was private individuals, followed by venture capitalists who provided much larger amounts of equity capital on average. Freear and Wetzel also found that, while private investors dominated in the earliest stages of firm development, venture capitalists were more prominent in later rounds of financing.

Manigart and Struyf (1997) conducted an exploratory study of financing sources for a sample of high-technology startups in Belgium. Their results revealed that the entrepreneurs themselves were the most important source of financing, followed by bank financing because it did not require the entrepreneur to relinquish control. In the case of bank financing, however, substantial amounts of collateral were required to combat informational asymmetries. The firms surveyed also used funding from private individuals, venture capitalists, non-financial companies, and universities. Manigart and

Struyf found that only a small number of startups used venture capital, because they did not want to give up control to outside parties, even if that meant hampering the growth of the firm. For those firms that survived, however, almost half used venture capital to fund later stages of growth. The authors concluded that the roles of private investors and venture capitalists are complementary, with private investors playing a larger role in startup financing while venture capitalists play a greater role in funding early growth.

These findings were echoed in a more recent study by Bozkaya and De La Potterie (2008), which examined a sample of new Belgium firms to find support for both the life cycle theory and the pecking order theory. Initially, development funding almost always came from personal savings and family and friends. As firms matured and became less informationally opaque, however, they were able to attract angel investors and venture capital financing. The authors concluded that the longer the entrepreneurial firm was able to survive on its own with internally generated funds, the lower the cost of external capital and the more control retained by the entrepreneur. They also concluded that, as the firm matures and moves through different stages of its "life cycle," different sources of funding become substitutes for each other. Thus, personal sources of financing are replaced by bank financing, which is in turn replaced by angel and venture capital funding.

In contrast, Hogan and Hutson (2005) concluded that the pecking order theory does not do a good job of explaining the capital structure strategies of new technology-based firms. They surveyed a sample of Irish software companies to find that those firm owners not only used more external equity than debt but actually preferred external equity to debt. They noted that banks are not particularly appropriate sources of capital for high-tech firms, because most of their loans are collateralized, and technology firms are based on intellectual rather than physical capital. Hogan and Hutson observed that venture capitalists and angel investors specialize by industry and are able to provide not only capital but also time and expertise. In their study, they found that entrepreneurs were

willing to trade off ownership and control in exchange for the longer-term goals of growth and value. Their findings are consistent with earlier work done by Hustedde and Pulver (1992) using a sample of U.S. firms seeking equity capital. In that study, the authors found that those entrepreneurs who were willing to surrender a higher percentage of equity to outside investors were more successful in raising equity capital.

## B. Women and Technology-based Firms

Brush et al. (2001) initiated the Diana Project in 2001 with the goal of exploring the experience of women entrepreneurs in high-growth ventures including those in technology and bioscience. As part of that study, the authors found that only 4.8 percent of venture capital investments went to women-owned firms during the period of 1953 through 1998. This had increased to a paltry 5 percent by 2001. Brush et al. noted that women entrepreneurs may lack the managerial experience required by equity investors if they are unable to gain human capital in the form of executive or technical management. The authors also observed that the venture capital industry is a relatively closed and male-dominated network. There are comparatively few women equity investors, and women typically are excluded from decision-making roles in venture capital firms. All these factors conspire to make it more difficult for women to gain access to networks that could provide equity capital.

A relatively small number of studies have specifically examined the experience of women in high-tech firms. Tai and Sims (2005) studied the employees of seven high-tech firms to find that women were significantly more likely to hold supervisory positions, while men held senior management positions, even though the two groups were comparable in terms of education and experience. The authors noted that this pattern poses a particular problem for women who face almost insurmountable barriers in gaining managerial experience at the most senior levels. Feyerherm and Vick (2005) interviewed high-achieving Generation X women managers in high-tech firms, those born between 1965 and 1980, to

find that 50 percent of those interviewed were considering other career opportunities. The women in this study felt stereotyped, undervalued, and underutilized in the male-dominated high-tech culture.

In a study of Irish women, Cross and Lineham (2006) found evidence of occupational segregation within the high-tech sector. The authors interviewed twenty women who were junior or middle managers in high-tech firms to find that their respondents experienced significant difficulties in managing work-life balance. Although some firms had family-friendly policies, managers nevertheless were expected to work long hours and to be available for meetings scheduled after the end of the working day. Women also were excluded from informal networking opportunities, leading them to feel isolated and frustrated. Because of these barriers, the women interviewed felt it would be very difficult for them to reach the senior ranks. At the same time, the authors noted a type of self-imposed glass ceiling, in that a number of their interviewees did not want the increased workload and stress associated with a leadership position.

Hollowell et al. (2006) questioned technology entrepreneurs in Northwest England to find that women reported experiencing greater difficulty because of preconceptions people had about their gender. The women in their study reported difficulties in being taken seriously, as well as the assumption that women lacked entrepreneurial skills. The authors found that dissatisfaction with the male-dominated culture in high tech led women to leave not only technology-based jobs, but the technology industry entirely.

Mayer (2008) studied women-owned high-tech firms in four metropolitan regions in the United States: Silicon Valley, Boston, Washington, D.C., and Portland, Oregon. She found that, in all four regions, women-owned high-tech firms were smaller as measured by average revenues and employment. Further, women entrepreneurs were more likely to participate in female-typed high-tech sectors such as software publishing, computer systems design services, management and consulting services, and research services, whereas men were more likely to be in high-tech manufacturing. Mayer also noted

that male-dominated sectors were more lucrative than those dominated by women, and concluded that women entrepreneurs face two major barriers in the high-tech sector. First, they are unable to gain managerial expertise and work experience that would provide human capital as well as necessary networks and relationships. Second, structural barriers, including capital formation, often prevent women from entering the more capital-intensive and male-dominated high-tech sectors.

Taken together, these studies suggest that women have a difficult time gaining the types of senior management level experience in high tech that would make them attractive to external providers of capital. Further, it appears that women in high tech still are largely excluded from both formal and informal networks that could provide them with either leadership experience or access to capital.

## DATA

The Kauffman Firm Survey (KFS) is a longitudinal survey of new businesses in the United States. This survey collected information on nearly 5,000 firms that started in 2004 and surveys them annually. This cohort is the first large national sample of firm startups that will be tracked over time. These data contain detailed information on both the firm and up to ten business owners per firm. In addition to the 2004 baseline year data, there are three years of follow-up data (2005, 2006, and 2007) now available. Additional years are planned. Detailed information on the firm includes industry, physical location, employment, profits, intellectual property, and financial capital (equity and debt) used at startup and over time. Information on up to ten owners includes age, gender, race, ethnicity, education, work experience, and previous startup experience. The detail provided by these data allows us to compare the financial strategies and the use of both debt and equity for new firms over the period 2004 through 2007. For more information about the KFS survey design and methodology, please see Robb et al. (2009). A public-use dataset is available for download from the Kauffman Foundation's Web site, and a more detailed confidential dataset is available to researchers through a data enclave provided by the National Opinion Research Center (NORC). For more details about how to access these data, please see [www.kauffman.org/kfs](http://www.kauffman.org/kfs).

The sampling frame for the KFS is based on the Dun & Bradstreet (D&B) database, which was partitioned into sampling strata defined by industrial technology categories (based on industry designation). The high- and medium-technology strata were defined based on categorization developed by Hadlock et al. (1991), which took into account the industry's percentage of R&D employment and classified the businesses into technology groups based on their Standard Industrialization Classification (SIC) codes. High-technology businesses were oversampled. Specifically, the original sampling design called for 2,000 interviews to be completed among businesses

in two categories of high-technology businesses and 3,000 interviews to be completed among businesses in all other industrial classifications. The industries that make up each technology strata are listed on Table 1. Firms are defined as high tech, medium tech, and non-tech. For more information on the survey methodology and sampling frame, see Robb et al. (2009). A subset of the confidential dataset is used in this research: those firms that are high tech and have data for all three survey years or that have been verified as going out of business over the 2004–2007 period. The sample size for our analyses is 570 businesses. Just over 100 of those firms had a primary owner that was female.

## DESCRIPTIVE STATISTICS

### A. Characteristics at Startup (2004)

Table 2 provides descriptive statistics on sources of startup capital by gender for high-tech firms. These statistics reveal some striking differences between the two groups. Women-owned high-tech firms were more likely to be organized as sole proprietorships or partnerships during their startup year (38.7 percent vs. 24.9 percent). Correspondingly, women were less likely to be organized as either corporations or as limited liability entities (61.3 percent vs. 75.1 percent). This discrepancy in organizational form at startup suggests that, even at that early stage, men anticipated developing larger and more complex firms than women did. The statistics on assets, revenues, and profits bear this out. Women-owned high-tech firms had \$64,638 in assets in their startup years, compared with \$116,430 for men-owned firms. Similarly, first-year revenues and profits for women-owned firms were \$35,968 and \$12,713 respectively, compared with \$87,302 and \$34,324 for men. Thus, men devoted almost twice as many assets to their firms at startup to generate revenues and profits that were more than double those of women-owned firms.



Table 2 also reveals that women-owned high-tech firms were much more likely to be home-based firms than firms started by men (54.5 percent vs. 34.9 percent). Further, women-owned firms were less likely to have employees (44.8 percent vs. 47.3 percent), and had fewer employees on average (2.1 vs. 3.1). The fact that women were much more likely to start their firms out of their homes and were also less likely to have employees may serve as an additional indication that women either anticipated having smaller firms or were operating under resource constraints that did not allow them to

launch firms requiring more assets, employees, or financial resources.

Finally, Table 2 reveals dramatic differences between women- and men-owned high-tech firms in intellectual property. Intellectual property protection can provide a significant advantage, reducing the level of potential competition and increasing the potential for profits. Women-owned firms were much less likely to have some type of intellectual property protection, particularly in the form of patents (9.4 percent vs. 14.1 percent) or trademarks (17.5 percent vs. 22.2 percent). Women-

**Table 1**  
**Technology Strata Definitions**

| Technology Stratum | High Tech  | Industry                                   |
|--------------------|--|--|
| <b>High Tech</b>   | 28   | Chemicals and allied products              |
|                    | 35   | Industrial machinery and equipment         |
|                    | 36   | Electrical and electronic equipment        |
|                    | 38   | Instruments and related products           |
| <b>Medium Tech</b> | 131  | Crude petroleum and natural gas operations |
|                    | 211  | Cigarettes                                 |
|                    | 291  | Petroleum refining                         |
|                    | 299  | Miscellaneous petroleum and coal products  |
|                    | 335  | Nonferrous rolling and drawing             |
|                    | 371  | Motor vehicles and equipment               |
|                    | 372  | Aircraft and parts                         |
|                    | 376  | Guided missiles, space vehicles, parts     |
|                    | 737  | Computer and data processing services      |
|                    | 871  | Engineering and architectural services     |
|                    | 873  | Research and testing services              |
|                    | 874  | Management and public relations            |
|                    | 899  | Services, not elsewhere classified         |
|                    | 229  | Miscellaneous textile goods                |
|                    | 261  | Pulp mills                                 |
| 267                | Miscellaneous converted paper products             |  |
| 348                | Ordnance and accessories, not elsewhere classified |  |
| 379                | Miscellaneous transportation equipment             |  |
| <b>Non-tech</b>    |  | <b>All other industries</b>                |

Table 2  
Characteristics of High-Tech Firms

|                               | 2004     |           | 2007      |           |
|-------------------------------|----------|-----------|-----------|-----------|
|                               | Female   | Male      | Female    | Male      |
| Sole Proprietorship           | 30.7%    | 22.3%     | 26.3%     | 17.8%     |
| Partnership                   | 8.0%     | 2.6%      | 5.0%      | 0.5%      |
| Corporation                   | 35.7%    | 42.0%     | 42.1%     | 47.4%     |
| Limited Liability Corporation | 25.6%    | 33.1%     | 26.6%     | 34.4%     |
| Home-Based                    | 54.5%    | 34.9%     | 44.7%     | 30.7%     |
| Employer Firm                 | 44.8%    | 47.3%     | 52.1%     | 71.4%     |
| Employment                    | 2.1      | 3.1       | 4.0       | 6.9       |
| Patents                       | 9.4%     | 14.1%     | 16.2%     | 17.9%     |
| Copyrights                    | 13.2%    | 11.7%     | 15.2%     | 10.5%     |
| Trademarks                    | 17.5%    | 22.2%     | 25.2%     | 23.5%     |
| Number (for those >0)         |          |           |           |           |
| Patents                       | *        | 6.7       | 2.0       | 5.0       |
| Copyrights                    | 3.6      | 13.0      | 2.2       | 10.2      |
| Trademarks                    | 1.9      | 2.2       | 2.1       | 2.6       |
| Employees                     | 6.4      | 8.0       | 7.7       | 9.7       |
| Revenues                      | \$35,968 | \$87,302  | \$132,483 | \$282,524 |
| Profits                       | \$12,713 | \$34,324  | \$63,917  | \$87,444  |
| Assets                        | \$64,638 | \$116,430 | \$60,887  | \$225,388 |

Source: Confidential KFS microdata; Just high-tech firms. N=570  
\* Too few observations to produce reliable estimates.

owned firms were more likely to have copyrights, however (13.2 percent vs. 11.7 percent). Table 2 indicates that, for those firms that did have intellectual property protection, women-owned firms had, on average, fewer patents, copyrights, and trademarks than men-owned firms.

**B. Characteristics in the Third Follow-Up Year (2007)**

Table 2 also provides descriptive statistics for both women- and men-owned high-tech firms that survived into the third follow-up year, 2007. Many of the differences between women- and men-owned firms noted above persist into this fourth year of the firms' existence. Women-owned firms

were again much more likely to be organized as either sole proprietorships or partnerships than men-owned firms (31.3 percent vs. 18.3 percent) and less likely to be organized as either corporations or limited liability companies (68.7 percent vs. 81.8 percent). Thus, by the fourth year, almost one-third of women-owned firms were still organized as sole proprietorships or partnerships compared with less than one-fifth of men-owned firms.

Similarly, the size differential noted between women- and men-owned firms in the startup year in terms of assets, revenues, and profits continued into the fourth year of operation. Women-owned high-tech firms had average total assets of \$160,887 compared to \$225,388 for men, or roughly 40

percent fewer assets. Correspondingly, average revenues and profits for women-owned firms were \$132,484 and \$63,917 respectively, compared with \$282,524 and \$87,444 for men. As in the startup year, women-owned firms had total revenues that were less than half of those for men-owned firms, while their profits were almost 40 percent lower.

By the fourth year of operation, almost half of women-owned high-tech firms were still home-based businesses (44.7 percent), compared to less than one-third of men-owned firms (30.7 percent). Similarly, only 52.1 percent of women-owned firms had employees at that stage, compared with 71.4 percent of men-owned firms. On average, women-owned firms had four employees in their fourth year of operation compared with nearly seven employees for men-owned firms.

Interestingly enough, the gap between women- and men-owned high-tech firms in intellectual property appears to have narrowed somewhat by 2007. At that point, 16.2 percent of women-owned firms had patents, compared with 17.9 percent of men-owned firms. The corresponding percentages for copyrights and trademarks were 15.2 percent and 25.2 percent for women and 10.5 percent and 23.5 percent for men. Thus, women-owned firms were almost as likely to have patents as men-owned firms and more likely to have copyrights or trademarks. In spite of that, however, women-owned firms that had intellectual property had fewer patents, copyrights, and trademarks on average than men-owned firms. It is also noteworthy that by 2007, women-owned firms that had some type of intellectual property employed an average of 7.7 employees, compared with 9.7 employees for men-owned firms. This finding would seem to imply that intellectual property may increase the job-generating potential of firms while also protecting them from competitors.

### C. Sources of Financial Capital

Tables 3 and 4 provide information on the financing sources and amounts for women- and men-owned high-tech firms at startup (2004) and during the third follow-up year (2007). Tables 3 and 4 reveal that women raised smaller amounts of capital at startup and relied more heavily on internal rather

than external sources of financing. In 2004, women raised about \$90,000 on average for their firms, compared with nearly \$150,000 for men. The fact that women raised only 70 percent of the amount that men raised to start their firms has implications for their ability to introduce new products and services, expand geographically, hire additional employees, and survive.

For women-owned firms, the major sources of financing at startup were owner or personal equity (38.5 percent) and outsider debt (41.1 percent). Women used negligible amounts of equity provided by other insiders or by outsiders. In contrast, men-owned firms were less reliant on both owner equity (31.6 percent) and outsider debt (29.9 percent) than women, while roughly one-fourth of their startup financing was provided by outside equity (26.1 percent). Men's greater reliance on outside equity to fund their firms may suggest that they were more open to sharing ownership and control with outsiders. Alternatively, it may suggest that men have greater access to networks that provide investors willing to supply external equity. Whatever the reason, these findings reveal marked differences in financing strategy between women- and men-owned high-tech firms during the startup year.

Tables 3 and 4 indicate that financing differences persisted into the fourth year of the surviving firms' operation. Women continued to be more reliant on internal rather than external sources of financing. In 2007, owner equity, owner debt, and insider debt accounted for 40 percent of financing for women-owned high-tech firms compared to 22.7 percent for men-owned firms. Conversely, men-owned firms relied more heavily on both outside equity and outside debt. Table 3 also reveals that the men-owned firms that raised external equity raised substantial amounts on average (\$407,346). In contrast, the number of women raising external equity by the fourth year was negligible.

Table 3  
Financial Capital Injections of High-Tech Firms

|  | Female    |                |       | Male      |                |       |
|--|-----------|----------------|-------|-----------|----------------|-------|
|  | All Firms | Just Firms > 0 | N > 0 | All Firms | Just Firms > 0 | N > 0 |
| <b>2004 Initial Capital Injections</b>                 |           |                |       |           |                |       |
| Total Financial Capital                                | \$87,888  |                |       | \$148,108 |                |       |
| Owner Equity   | \$33,867  | \$ 42,788      | 80    | \$ 46,805 | \$62,146       | 351   |
| Insider Equity   | *         | *              | *     | \$2,044   | \$44,394       | 21    |
| Outsider Equity  | *         | *              | *     | \$38,705  | \$330,338      | 56    |
| Owner Debt   | \$3,127   | \$7,771        | 43    | \$4,637   | \$15,177       | 141   |
| Insider Debt   | \$7,102   | \$43,481       | 17    | \$11,691  | \$80,917       | 67    |
| Outsider Debt  | \$36,113  | \$90,691       | 41    | \$44,226  | \$101,148      | 202   |
| <b>2007 New Capital Injections for Surviving Firms</b> |           |                |       |           |                |       |
| Total Financial Capital                                | \$163,380 |                |       | \$117,910 |                |       |
| Owner Equity   | \$27,329  | \$61,577       | 32    | \$18,340  | \$ 54,873      | 118   |
| Insider Equity   | *         | *              | *     | \$2,232   | \$62,861       | 13    |
| Outsider Equity  | *         | *              | *     | \$29,855  | \$407,346      | 25    |
| Owner Debt   | \$8,733   | \$25,939       | 25    | \$4,751   | \$21,750       | 83    |
| Insider Debt   | \$29,420  | \$204,195      | 9     | \$3,711   | \$49,812       | 29    |
| Outsider Debt  | \$57,963  | \$108,436      | 37    | \$59,021  | \$118,783      | 181   |

Source: Confidential KFS microdata; Just high-tech firms. N=570  
\* Too few observations to produce reliable estimates.

## MULTIVARIATE ANALYSIS

Multivariate analysis was employed to expand upon the insights provided by our descriptive statistics. Table 5 provides the results of dprobit models in which various sources of financing were used as the dependent variable. Independent variables include firm and owner characteristics shown by previous research to have an effect on financing strategy. Gender was included as a dichotomous independent variable to denote differences between women- and men-owned firms. All the models

included in Table 5 are based upon 2004, or startup, data for high-tech firms.

In the first model, outside debt was used as the dependent variable. Table 5 reveals that younger owners, owners who worked longer hours, and owners who had less previous work and startup experience had a significantly lower probability of using outside debt as a source of financing. Younger and less-experienced owners may not have developed relationships with providers of outside debt. Similarly, they may lack personal assets that can be used as collateral on loans. Home-based businesses were also significantly less likely to use outside debt, while firms that claimed some type of comparative advantage had a significantly higher

probability of using it. Home-based businesses may have minimal requirements for financing, and, because they are operated out of the home, their owners may be more risk-averse. Although women were less likely to use outside debt than men, there were no significant differences between women- and men-owned firms in terms of the probability of using outside debt at startup.

Our results were similar for the model in which bank loans were the dependent variable. In this model, college graduates had a significantly lower probability of using bank loans than non-graduates did, possibly because they are more aware of the risks associated with debt. Conversely, older firm owners were significantly more likely to use bank loans, perhaps because they have had the opportunity to develop banking relationships over

time. As in the case of the “outside debt” model, although women were less likely to use bank loans, there were no significant differences between women- and men-owned firms in the probability of using bank loans as a source of startup financing.

Differences in financing strategy do become more evident when we used outside equity as the dependent variable in our model. In this instance, consistent with the results from our descriptive statistics, women-owned firms had a significantly lower probability of using outside equity as a financing source at startup. Conversely, older owners, owners who worked longer hours, and owners who had previous startup experience had a significantly higher probability of using outside equity. As suggested by prior research, these owners may have developed the networks and contacts

**Table 4**  
**Financial Capital Investments of High-Tech Firms**

|  | Female       | Male          | All           |
|--|--------------|---------------|---------------|
| <b>2004 Initial Capital Injections</b>                 |              |               |               |
| Total Financial Capital                                | \$87,888     | \$148,108     | \$ 137,347    |
| Owner Equity   | 38.5%        | 31.6%         | 32.4%         |
| Insider Equity   | *            | 1.4%          | 1.7%          |
| Outsider Equity  | *            | 26.1%         | 23.6%         |
| Owner Debt   | 3.6%         | 3.1%          | 3.2%          |
| Insider Debt   | 8.1%         | 7.9%          | 7.9%          |
| Outsider Debt  | 41.1%        | 29.9%         | 31.1%         |
| <b>Total</b>   | <b>91%</b>   | <b>100.0%</b> | <b>100.0%</b> |
| <b>2007 New Capital Injections for Surviving Firms</b> |              |               |               |
| Total Financial Capital                                | **           | \$117,910     | \$125,217     |
| Owner Equity   | 16.7%        | 15.6%         | 15.8%         |
| Insider Equity   | *            | 1.9%          | 1.7%          |
| Outsider Equity  | *            | 25.3%         | 24.9%         |
| Owner Debt   | 5.3%         | 4.0%          | 4.3%          |
| Insider Debt   | 18.0%        | 3.1%          | 6.3%          |
| Outsider Debt  | 35.5%        | 50.1%         | 47.0%         |
| <b>Total</b>   | <b>75.6%</b> | <b>100.0%</b> | <b>100.0%</b> |

Source: Confidential KFS microdata; Just high-tech firms. N=570

\* Too few observations to produce reliable estimates.

\*\*Two elements that make up this total had too few observations to make reliable estimates, therefore the total is not presented.

Table 5  
DPROBITS on Having Sources of Financing 2004

| Coefficient                 | Outside Debt               | Outside Equity            | Bank Loan                  | Insider Financing         |
|-----------------------------|----------------------------|---------------------------|----------------------------|---------------------------|
| Female                      | -0.0340<br>(0.0625)        | -0.0375**<br>(0.0190)     | -0.0298<br>(0.0517)        | 0.0638<br>(0.0463)        |
| Black                       | 0.0566<br>(0.111)          | 0.0541<br>(0.0666)        | -0.0828<br>(0.0825)        | 0.173*<br>(0.0936)        |
| Asian                       | -0.113<br>(0.115)          | 0.0703<br>(0.0693)        | -0.105<br>(0.0811)         | -0.0176<br>(0.0752)       |
| Other                       | -0.320***<br>(0.0841)      | 0.0140<br>(0.0559)        | -0.233***<br>(0.0292)      | -0.0424<br>(0.0790)       |
| Hispanic                    | -0.0788<br>(0.133)         | 0.0130<br>(0.0486)        | -0.0579<br>(0.0963)        | 0.0922<br>(0.108)         |
| Age                         | 0.0425***<br>(0.0135)      | 0.00109***<br>(0.000418)  | 0.00233***<br>(0.000870)   | -0.000181<br>(0.000714)   |
| Age Squared                 | -0.000365***<br>(0.000135) | 0.00504<br>(0.00517)      | 0.0358***<br>(0.0110)      | -0.00420<br>(0.00752)     |
| Work Experience             | -0.00488**<br>(0.00234)    | -0.0000533<br>(0.0000504) | -0.000316***<br>(0.000109) | 0.00000446<br>(0.0000744) |
| Hours Worked (week)         | 0.00310***<br>(0.00105)    | 0.968***<br>(0.0209)      | 0.102<br>(0.201)           | 0.0372<br>(0.157)         |
| Startup Experience          | -0.0823*<br>(0.0471)       | 0.921***<br>(0.110)       | 0.0248<br>(0.162)          | 0.0387<br>(0.131)         |
| High School Graduate        | 0.0456<br>(0.205)          | 0.972***<br>(0.0537)      | -0.0630<br>(0.152)         | 0.00898<br>(0.129)        |
| Some College                | -0.0191<br>(0.185)         | 0.986***<br>(0.0298)      | -0.0787<br>(0.146)         | 0.0112<br>(0.132)         |
| College Degree              | -0.126<br>(0.180)          | 0.000230<br>(0.000919)    | -0.00362*<br>(0.00201)     | 0.000539<br>(0.00164)     |
| Graduate School or Degree   | -0.168<br>(0.175)          | -0.00340<br>(0.0179)      | -0.0559<br>(0.0401)        | 0.0259<br>(0.0305)        |
| Team Ownership              | 0.0532<br>(0.0493)         | 0.110***<br>(0.0263)      | -0.00934<br>(0.0419)       | 0.00703<br>(0.0338)       |
| Firm Credit Score           | 0.00156<br>(0.000996)      | -0.000212<br>(0.000388)   | 0.000708<br>(0.000876)     | -0.00105<br>(0.000683)    |
| Home-Based                  | -0.158***<br>(0.0503)      | -0.0272<br>(0.0212)       | -0.123***<br>(0.0413)      | -0.0352<br>(0.0342)       |
| Intellectual Property       | -0.0507<br>(0.0542)        | 0.0164<br>(0.0220)        | -0.0260<br>(0.0463)        | 0.0557<br>(0.0399)        |
| Comparative Advantage       | 0.113**<br>(0.0493)        | 0.0278<br>(0.0183)        | 0.0611<br>(0.0408)         | 0.0526<br>(0.0326)        |
| Product Offerings           | 0.0470<br>(0.0648)         | 0.0317<br>(0.0201)        | 0.0628<br>(0.0518)         | 0.0190<br>(0.0409)        |
| Product & Service Offerings | -0.0503<br>(0.0551)        | -0.0349*<br>(0.0196)      | -0.0464<br>(0.0458)        | 0.00668<br>(0.0377)       |
| Observations                | 536                        | 536                       | 536                        | 536                       |

Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Dprobit fits maximum-likelihood probit models and is an alternative to probit. Rather than reporting the coefficients, dprobit reports the marginal effect, that is, the change in the probability for an infinitesimal change in each independent, continuous variable and, by default, reports the discrete change in the probability for dummy variables.

necessary for attracting external equity investors. Since the process of securing external equity is extremely labor intensive, it also stands to reason that owners who work longer hours would have a greater likelihood of success in attracting equity investors. Table 5 also reveals that owners with higher levels of education had a higher probability of using outside equity. Like prior experience, education is a measure of human capital that would be considered and valued by equity investors. Finally, firms that were owned by teams rather than by individuals had a significantly higher probability of using outside equity. Team ownership has the effect of increasing the levels of both human and financial capital available to the firm, thus increasing its chances for success.

The final model included in Table 5 used insider financing (both debt and equity) as the dependent variable. Although women-owned firms had a higher probability of using insider financing than men-owned firms, the results were not significant. Black- and Hispanic-owned firms were more likely to use insider financing than white-owned firms were, however. In the case of black-owned firms, the differences were significant.

Table 6 provides the results of a regression model in which the log of total financial capital in 2004 was used as the dependent variable. It reveals that, when we control for other firm and owner characteristics, there were no significant differences between women- and men-owned firms in terms of total financial capital raised at startup, although, as noted in Table 5, the sources of financial capital differed significantly. Thus, women high-tech entrepreneurs appear to be as resourceful as men in generating the capital required to start their firms.

Table 6 also indicates that owners who worked longer hours raised significantly larger amounts of capital. Similarly, firms that were owned by teams and had some type of comparative advantage or intellectual property raised significantly larger amounts of total financial capital, while home-based businesses raised significantly less. Since women-owned firms have less in the way of intellectual property and are more likely to be home-based (Table 2), these findings suggest potential disadvantages for women high-tech entrepreneurs.

**Table 6**  
Regression on Level of Startup Capital (2004)

| Coefficient                 | Log of 2004<br>Financial Capital |
|-----------------------------|----------------------------------|
| Female                      | 0.372<br>(0.327)                 |
| Black                       | 0.314<br>(0.478)                 |
| Asian                       | -0.207<br>(0.792)                |
| Other                       | 0.0191<br>(0.367)                |
| Hispanic                    | 0.266<br>(0.840)                 |
| Age                         | 0.197***<br>(0.0751)             |
| Age Squared                 | -0.00172**<br>(0.000735)         |
| Work Experience             | -0.01000<br>(0.0138)             |
| Hours Worked (week)         | 0.0268***<br>(0.00641)           |
| Startup Experience          | 0.247<br>(0.289)                 |
| High School Graduate        | 2.376<br>(1.608)                 |
| Some College                | 1.782<br>(1.579)                 |
| College Degree              | 1.637<br>(1.573)                 |
| Graduate School or Degree   | 1.181<br>(1.600)                 |
| Team Ownership              | 1.000***=<br>(0.279)             |
| Firm Credit Score           | 0.00527<br>(0.00595)             |
| Home-Based                  | -1.172***<br>(0.312)             |
| Intellectual Property       | 0.507*<br>(0.307)                |
| Comparative Advantage       | 1.265***<br>(0.339)              |
| Product Offerings           | 0.125<br>(0.398)                 |
| Product & Service Offerings | -0.276<br>(0.347)                |
| Constant                    | 0.328<br>0.193                   |
| Observations                | 536                              |
| R-squared                   | 0.193                            |

Standard errors in parentheses: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## SUMMARY

A review of the descriptive statistics provided in Tables 2-4 reveals striking differences between women- and men-owned high-tech firms in terms of both firm characteristics and financing strategy. Women-owned high-tech firms were more likely to be organized as either sole proprietorships or partnerships than as corporations or limited liability companies. Further, women-owned firms were more likely to be home-based businesses and less likely to have employees. Women-owned high-tech firms were smaller than men-owned firms in their first year of operation in terms of average total assets, revenues, profits, and employees. Finally, women-owned firms were less likely to have some type of intellectual property in the form of patents or trademarks. For those firms that had intellectual property, women-owned firms had fewer patents, copyrights, and trademarks on average than men-owned firms.

Some of the differences between women- and men-owned firms at startup can be explained by differences in financing strategy. Women started their firms with smaller amounts of capital and relied more heavily on internal rather than external sources of equity in particular. These results were confirmed by multivariate analyses (Table 5), which indicate that women-owned firms had a significantly lower probability of using external equity, in spite of the fact that there were no significant differences between women and men in terms of the total amount of financial capital raised when we controlled for other firm and owner characteristics (Table 6).

As noted above, women may have chosen to avoid external sources of equity because they did not want to share control of the firm. Alternatively, they may have been closed out of external sources of equity financing because they lacked access to funding networks, or because they lacked sufficient amounts of personal capital that could be used as the seed funding necessary to attract larger amounts of external equity. Whatever the cause, the fact that women raised dramatically lower amounts of

external equity capital at startup has implications for their ability to introduce new products and services, expand into new territories, bring in additional expertise by hiring employees, or even to survive. Further, equity investors often provide not only financing, but expertise and valued contacts in the form of financing sources, customers, and key managers or advisors.

Tables 2 through 4 also reveal that differences between women- and men-owned high-tech firms persisted into 2007, the fourth year of the firms' operation. At that point, women-owned firms still were more likely to be organized as sole proprietorships or partnerships and less likely to be organized as corporations or limited liability companies. Almost half of women-owned firms were still home-based businesses by year four, compared to less than one-third of men-owned firms. Similarly, the size differential between women- and men-owned firms in terms of average total assets, revenues, profits, and employees remained. Nevertheless, by year four, women-owned firms had made some progress in closing the intellectual property gap. At that point, roughly the same percentage of women-owned firms had patents as men-owned firms, and a higher percentage of women-owned firms had copyrights and trademarks. Simultaneously, however, for those firms that had patents, copyrights, and trademarks, women-owned firms had fewer of each on average than men-owned firms did. According to our descriptive statistics, women actually raised more total financial capital on average in 2007. In spite of that gain, however, women continued to be heavily reliant on internal rather than external sources of financing. At that stage, 75 percent of the financing for men-owned high-tech firms came from either outsider equity or debt compared to 35.5 percent for women-owned firms. It is noteworthy that, although external equity represented 25.3 percent of total financing for men in year four, it remained negligible for women.

These findings suggest that, over time, women-owned high-tech firms were able to make progress



in terms of developing intellectual property, which can be an advantage competitively and in raising substantial amounts of capital to sustain their firms. Nevertheless, women-owned firms continued to lag men-owned firms in performance measures such as revenues, profits, assets, and employment, and they remained unwilling or unable to develop external sources of equity capital that could be used to fund further innovations, employment, or growth.

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