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Introduction

Managers of start-up firms make a number of important yet understudied decisions, such as whether or not to develop a new product, whether or not to choose a high-technology product or service, whether or not to use external assistance, and the amount of time and effort they will devote to their new company. These choices are informed by their access to various resources, such as the size of the management team, its education level, its previous experience working at start-ups, and other attributes. In this paper we consider how these resources influence optimal provision of effort, and examine decisions about innovative behavior (i.e., to market a novel or high-technology product) and managerial exertion (i.e., the hours per week spent by the managers and their decision to supplement their own efforts by employing external assistance such as consulting services).

Government and non-profit agencies also spend large sums promoting, developing, retaining, and attracting firms that offer a "high-technology" product or service. Such agencies generally associate high-tech companies with innovation, the creation of high-paying jobs, and other beneficial outcomes (Chrisman, Hoy, and Robinson, 1987; Orser, Hogarth-Scott, and Riding, 2000). Indeed, many communities seek to replicate the successes of high-tech clusters such as Silicon Valley in California, Route 128 near Boston, and Research Triangle Park in North Carolina. What factors motivate entrepreneurs to choose high-tech products? Why might management teams decide to be innovative as opposed to selling existing products and

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services?

Given the multitude of tasks that confront small businesses, not surprisingly managers often seek out external assistance, ranging from tax-preparation advice to help in acquiring skilled new employees. As Evans and Volery (2001) point out, such help allows access to resources that even very talented entrepreneurs might not have; an entrepreneur or start-up team may require information, specialist skills, or both. Federal, state, and local government agencies allocate substantial resources for the purpose of assisting small business managers, often resulting in demonstrably positive economic outcomes (see, for example, Chrisman and Katrishen 1994). What processes do entrepreneurs undertake when deciding whether and to what extent they should use external assistance? What kinds of companies, and what kinds of entrepreneurs or start-up teams, use such services? How is this choice mediated by the existing abilities and skills already possessed by the entrepreneur and the other personnel in the firm?

These questions motivate this paper, which tests a number of hypotheses derived from a recent theoretical analysis by Casamatta (2003). Her study of the decisions of entrepreneurs and advisors in start-up firms provides a useful conceptual framework for thinking about entrepreneurial and managerial activity in such firms. In our application of this analytical scheme, managers of start-ups possess a given amount of uniquely entrepreneurial resources and uniquely managerial resources. These attributes constitute exogenous factors that potentially enhance entrepreneurial or managerial effort in the creation of profit. The presence of such resources can influence the decision by start-up managers to engage in innovative activity, to create a high tech good or service, to use outside assistance, or to spend longer hours in the office. In turn, provision of effort and utilization of pre-existing resources might affect the likelihood of success for start-up firms (we measure performance as annual sales revenue).

To investigate these decisions empirically, we make use of a unique data set that identifies various aspects of a large number of start-up firms: type of product, degree of external consulting use, allocation of time devoted to the firm by the management team (hours per week), and others. This data set was developed from a detailed survey[1] of start-up team principals involved in both high-tech and low-tech firms, many of which used at least some form of available external assistance. We begin by examining the relationship between entrepreneurial resources and entrepreneurial effort; we then turn to how managerial resources affect managerial effort. We also investigate complementarity between resources and effort: whether managerial resources significantly influence entrepreneurial effort and whether entrepreneurial resources influence managerial effort. These concepts are defined and then related to our data. In a series of multivariate statistical tests, we also control for relevant aspects of the entrepreneur's social environment. Our findings illustrate how pre-existing resources influence entrepreneurial and managerial activity in start-ups; we also examine whether pre-existing resources complement effort in their effect on sales revenue.

I. Resources and Effort

A. Conceptual Foundation

The model advanced by Casamatta (2003) portrays the coexistence and interaction of entrepreneurs and advisors. It illustrates that in the absence of moral hazard, both may optimally exert effort. In the presence of moral hazard, if the entrepreneur's effort is more efficient (less costly) than the advisor's effort at the margin, the firm will not hire the advisor and instead will rely on its own internal skills and advice. Her analysis suggests several

[1]We use the Wisconsin Entrepreneurial Climate Study, which was carried out on a sample of firms in Wisconsin during the time period from 1992-1993.

testable hypotheses in this context, one of which predicts that in very innovative lines of business, firms backed by venture capital (VC) would earn greater profits than non-VC-backed firms (in the model, only VCs can provide the specific business advice that would improve the firm's profitability). She also suggests that start-up firms will use consultant services more frequently when the entrepreneur does not possess unique or crucial competencies.

Casamatta's theoretical model considers the case of advisors who also act as investors, a situation typical of firms that receive angel and especially venture capital financing. For a great number of small businesses, however, advisors are not investors: government-sponsored business development agencies, accountants, and lawyers, as examples, commonly give advice to small firms without having an investment stake. In this paper, we focus not on the joint decision of advising and investing but instead consider the firm's decision to obtain advice from *any* entities external to the firm (i.e., to seek "external assistance"), irrespective of their provision of investment funds.

In addition to the external consulting decision, entrepreneurs must choose the type of business they will launch. Local governments especially seek to foster job growth in innovative, high-technology firms, in part because of the higher compensation often offered by such companies. Because the recruitment of innovative firms requires an allocation of scarce government resources, it becomes important to examine what factors influence an entrepreneur's decision to develop and market an innovative or "high-tech" product as opposed to selling an established good.

B. The Entrepreneur's Problem

An entrepreneurial project, a start-up firm, requires various inputs: an initial monetary investment (or physical capital) and some degree each of entrepreneurial and managerial *resources*, interpretable as the pre-existing skills and abilities of the firm's leaders and other personnel.[2] These resources assist entrepreneurial and managerial *effort*, which refers not only to the time allocated but also to specific activities unique to each role. We model resources as exogenous to the effort decision, and we consider two types of both: entrepreneurial and managerial. *Entrepreneurial effort* uniquely involves deciding whether to make and market an established product or an innovative (or high-technology) product or service, whereas *managerial effort* uniquely involves actions that reinforce the efficiency of the labor and physical capital the firm employs. (In reality, and in our empirical analysis, we also consider overlapping aspects of managerial and entrepreneurial roles, which we call *dual-use* types of effort). In light of these definitions, a start-up firm's managerial resources might include the education level of the team principals or their affinity for building or leading new firms; its entrepreneurial resources might include the team's previous start-up experience or their willingness and ability to apply creative ideas to productive activity.

The start-up firm will seek to maximize expected profit. A successful start-up firm will generate enough profit to justify the initial investment, but net profit depends on the initial cost as well as the provision of the two types of effort, each of which also incurs costs. We make the assumption that the two types of resources positively influence the impact of each type of

[2] As Chrisman (1999) discusses, such resources may emanate from within the individual, as in the form of personal skills or experience, or from outside the individual, as in the form of social expectations or support relating to entrepreneurial activity. Blau (1985) and Bates (1990) also incorporate concepts of entrepreneurial and managerial skills into their theoretical discussions of entrepreneurial behavior.

effort on profit. That is, *entrepreneurial resources* enhance the efficiency with which entrepreneurial effort increases profit (or reduces costs), and *managerial resources* enhance the efficiency with which managerial effort increases profit. A given set of resources (e.g., a start-up team's technical skill set) always enhances the productive activity directly associated with those resources. We make no specific assumption, however, about how managerial resources influence the impact on profit of entrepreneurial effort or how entrepreneurial resources influence the impact on profit of managerial effort. Ultimately, these effects depend on the relative complementarity of the two types of effort in the creation of profit, which will vary across firms. We will investigate this empirically.

C. Optimal Entrepreneurial and Managerial Effort: Conceptual to Empirical

Why would an entrepreneur choose to develop an innovative product or service? How much effort will managers optimally devote to the company? Before addressing these specific questions, we must consider how the two types of resources influence the two types of effort in general and how this effort translates to profitability. It follows from above that each unit of entrepreneurial effort will exert a greater marginal impact on profitability in firms that have a higher level of entrepreneurial resources. Since start-up firms, by assumption, seek to maximize expected profit, we can further postulate that greater provision of entrepreneurial effort will take place in firms with greater entrepreneurial resources.[3] Similarly, firms with greater managerial resources would likely exhibit a greater provision of managerial effort.

Interactions between resources and effort may also take place. If managerial resources tend to enhance the impact of entrepreneurial effort on profit, entrepreneurs would likely exert greater entrepreneurial effort when accompanied by more accomplished managerial resources. If entrepreneurial resources tend to enhance the impact of managerial effort on profit, one would expect greater managerial effort in firms that possess higher levels of these resources as well. To put this in perspective, suppose managerial effort essentially involves activities that allow a start-up firm's labor and capital inputs to operate as efficiently as possible. Start-ups that operate more efficiently in this way probably enhance not only the contributions (to profit) of managerial resources but also the contributions of uniquely entrepreneurial activities such as innovation. Uniquely entrepreneurial skills might also enhance managerial contributions, such as when such skills relate to innovative *applications* of labor and capital.

In practice, it becomes difficult to observe entrepreneurial and managerial resources and effort directly. Some resources have a clearly managerial application (e.g., experience supervising a large number of employees in a Fortune 500 corporation), and others are clearly entrepreneurial in nature (e.g., previous experience in generating innovative patents). But other factors, such as the founder's formal education, might conceivably enhance both managerial *and* entrepreneurial effort in our framework. In the empirical analysis, we consider a wide range of independent variables, reflecting both entrepreneurial and managerial resources.

Entrepreneurial and managerial effort, the dependent variables for much of our analysis, can also take numerous forms. In this paper, we approximate these by observing behaviors or

[3] Of course, the literature on corporate governance (following Berle and Means 1932) is based on the existence of a wedge between the interests of managers and (dispersed) owners. This is generally not the case for the majority of small, start-up firms, where much investment is the result of accumulated retained earnings or other internal sources of finance. Indeed, even when external investment in the form of angel or venture capital financing is employed, the founder and other managers of small start-ups generally have significant equity stakes in the company, such that any information asymmetry, etc., will, to some extent, serve to align to interests of the manager and the financier.

choices uniquely associated with each type of effort, as suggested above. For *entrepreneurial effort*, we consider the level of innovation of the good or service produced by the start-up. We assume that firms producing an established or low-technology product exhibit less innovative effort than firms that are developing new, high-technology products. One could conceivably investigate other uniquely entrepreneurial activity, such as risk-taking, in this context. However, a focus on innovation seems appropriate in light of the key role start-up firms in general can play in fostering invention and innovation, as discussed by Chrisman, Hoy, and Robinson (1987).

To measure *managerial effort*, we consider how such effort might translate to observable activities of the management team. An obvious measure of managerial effort is the amount of time start-up team principals typically devote to the firm (work hours per week). Another such measure concerns seeking and/or using the advice of external consultants. Jones and Tullous (2002) have found that start-up teams with greater levels of managerial skills (in our framework, managerial resources) exhibit lesser use of external consultants. Similarly, Casamatta (2003) suggested that entrepreneurs would employ outside advice most likely if they lacked some unique or crucial competencies. If more advanced managerial resources enhance the marginal effect on profit of managerial effort, then greater such effort likely translates to a lesser amount of external consulting. One can thus view this aspect of our paper as an empirical test of hypotheses proposed by Jones and Tullous (2002) and Casamatta (2003).

In addition, we also consider complementarities between how managerial resources affect entrepreneurial effort and how entrepreneurial resources affect managerial effort. Carter, Gartner, and Reynolds (1996) and Chrisman (2003) recognized that contact between entrepreneurs and external advisors may greatly impact entrepreneurial outcomes. As Chrisman (p. 47) writes, every entrepreneur has limitations, and so "good advisors can act as sounding boards for new ideas, provide a valuable network . . ., and provide complementary skills" necessary for success. In a different context, Evans and Valery (2001) noted the potential for Internet technology to allow external consultants to leverage a start-up firm's unique resources and capabilities as a way of enhancing entrepreneurial outcomes. Hellman and Puri (2002) make a similar point in the context of venture capitalist involvement in start-up firms: investors (especially venture capital partnerships) may provide external "advice" to such an extent as to require replacement in the initial management team in favor of professional managers. We shall investigate the presence of such complementarities in the empirical analysis.

II. Empirical Analysis: Data and Variables

A. Data

For empirical analysis, we make use of data from the Wisconsin Entrepreneurial Climate Study (WECS), which readily permits analysis of the entrepreneurial and managerial activities discussed above. Compiled under the direction of scholars at Marquette University and the University of Wisconsin-Milwaukee, the "new firms" section of the data set consists of a random sampling of start-up firms that began operation in the state of Wisconsin within the six years prior to the sampling period of 1992-1993. Since external assistance provided to start-up firms tends to vary in availability and nature by state, WECS data seem appropriate for investigating the primary research questions posed here. Chrisman, Hoy, and Robinson (1987) and Chrisman (1999), among others, have also conducted empirical analysis of start-up firms operating in a single state. The WECS tabulates traditional demographic information such as the age, education level, and ethnicity of start-up team principals and, most important for our purposes, objective information on the nature of the firm's product, the extent to which firms

made use of available consulting assistance, team principals' degree of time commitment to the firm, and the nature and form of the firms' relevant entrepreneurial and managerial resources. Figure 1 illustrates the major categories of variables we consider; we describe each in greater detail below.

1. Focus (Dependent) Variables: Entrepreneurial and Managerial Effort

As discussed in Section II, we aim to explain innovation by start-ups firms and the extent to which start-ups exhibit managerial effort. We capture innovation empirically in two ways. In the first approach, we define the dummy variable High-Tech Firm as equal to 1 if the firm operated in any of 57 "high-technology" industries, identified by WECS data compilers using four-digit standard industrial classification (SIC) codes.[4] A complete listing of these industries appears in Appendix I. In a second approach, we define the dummy variable New Product, equal to 1 if the respondent indicated that the product did not exist five years prior to the start-up of the firm and equal to 0 otherwise. While operating in a high-tech industry and producing a new product each seem consistent with innovative activity, not all high-tech start-ups produce new products, and not all start-ups that develop new products operate in high-tech industries. Separate probit models analyzing the probability of each choice will allow us to see the extent to which various entrepreneurial, managerial, and dual-use resources (described below) influence these innovative behaviors in relatively similar or different ways.

We also take two approaches to measuring managerial effort. To capture the use of external assistance, we define the variable External Consulting as equal to the total number of assistance programs available in Wisconsin in which the start-up firm participated. The WECS specified 27 different types of publicly available and non-profit assistance programs a firm might have used, including, as examples, accounting assistance, financial counseling, and marketing research. (See Appendix II for the complete list.) As a result, this variable has values ranging from 0 (the modal response) to 27, with a mean of 4.05 programs used. In its conceptualization, the External Consulting variable resembles the measure of "business problems" constructed by Chrisman, et al (1990).[5]

The use of External Consulting as a measure of managerial effort assumes that the provision of such effort relates directly to the firm's profitability, such that in firms with more managerial resources, each unit of managerial effort exerts a greater marginal impact on profitability. Thus, the use of external assistance provides a glimpse into the decision to provide managerial effort in an indirect, yet profit-maximizing, way. As a second approach to measuring managerial effort, we define the variable Team Work Hours, representing the total number of hours per week the top four team principals commit toward the firm.[6]

2. Measures of Managerial Resources and Approach

To capture managerial resources, we incorporate a set of five variables that relate to specific managerial expertise, practices, or problems. Three of these relate to the importance of scientific expertise, the participation of workers, and the existence of managerial problems (relatively tangible aspects of managerial resources). The dummy variable Technical

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[4] The WECS also solicited the firms' self-nominations of their technical orientation. However, we use the SIC-based definition so as to maintain an objective standard, common to all firms, by which one can judge the meaning of a "high-tech" product.

[5] However, because we focus on the *extent* to which start-up firms seek external assistance, we do not dichotomize the variable.

[6] For teams made up of more than four members, the WECS contains non-missing data of this sort only for the four most prominent members. Since fewer than ten of the start-up firms in the sample contained more than four members, we view these variables as highly representative of the teams under analysis.

Management Critical equals 1 if the respondent indicated that effective management in the start-up required a high level of technical or scientific expertise, while the dummy variable Worker Participation Critical equals 1 if the respondent regarded worker participation in management as a critical part of the firm's competitive strategy. We also define the variable Managerial Problems as equal to the total number of managerial or organizational issues perceived as "major" by the start-up, among a possible 15 types of problem.[7] Managerial Problems takes on values ranging from 0 (the modal value) to 15, with a mean of 2.02 problems cited as "major."

The last two of our five managerial resources variables reflect attitudes or intangible work attributes and emanate from Likert-scale measures. Those included in this grouping represent responses to the following statements: "The best work fully uses all a person's special skills and unique ability" and "Helping to build a major organization could be very rewarding." The variables Special Skills and Helping to Build are each set equal to 1 if the respondent indicated either agreement or strong agreement with those statements and equal 0 otherwise. To the extent that affirmations of these statements reflect a disposition toward leadership, presumably an indicator of managerial effectiveness, these variables may act as reasonable measures of respondent attitudes about managerial resources.

3. Measures of Entrepreneurial Resources

We also incorporate several variables to account for entrepreneurial resources—factors that potentially influence the impact of entrepreneurial effort on profit. The first set of entrepreneurial resource variables concerns *tangible* issues; the second set concerns intangible characteristics. The tangible measures account for basic characteristics of the respondent or start-up team, the nature of the firm and its product, and the firm's methods of production. Among these, the variable Previous Startups, capturing entrepreneurial experience, represents the total number of start-up firms in which the respondent had participated prior to his or her involvement in the current firm. The variable Team Start-Up Percentage represents the whole-number percentage of the top-four team members who had worked as part of a start-up team immediately prior to the current involvement. Teams that have more experience in the founding of start-ups may possess greater entrepreneurial expertise, possibly including any technical expertise likely necessary in the formation of an innovative firm.

With respect to the firm and its product, the dummy variable New Equipment equals 1 if the firm used capital equipment unavailable five years prior to start-up. We also incorporate dummy variables capturing whether respondents view state-of-the-art developments in relevant scientific and technical areas as critical for the firm's future, whether the firm must facilitate major technical changes in its product to remain competitive, whether the firm regards recruiting and retaining qualified scientific and technical personnel as a continuing issue, and whether the firm regards the allocation of resources to research and development as a major priority.

To capture intangible entrepreneurial resources, we use nine socio-economic "entrepreneurial climate" variables uniquely available in the WECS data set and previously

[7] The WECS asked respondents to characterize the severity of various managerial or organizational problems confronted by start-ups, such as coping with government regulations, preparing business plans, and minimizing start-up team conflict. Respondents then indicated whether they considered a given problem "major" or "minor," it never occurred, or it did not apply. As discussed by Chrisman, Hoy, and Robinson (1987), problems of this sort can lead to the failure of new firms, and their presence can motivate the use of external consulting. Orser, Hogarth-Scott, and Riding (2000) used similar measures as a way to distinguish econometrically between growing and declining firms.

incorporated by Allen (2000). These variables represent responses to the following Likert-scale instruments: "Many male [female] friends have started new firms," "More men [women] (in the respondent's social network) would start businesses with financial assistance," "Bankers and other investors go out of their way to help get new firms started," "Most of my friends and family think successful entrepreneurs made their money by cheating someone else," "We rarely meet entrepreneurs socially," and "State and local governments provide good support for men [women] starting new firms." Higher numerical values imply greater agreement with these statements. A more favorable social environment for entrepreneurship, or more effective networking between nascent entrepreneurs, may enhance the efficiency with which entrepreneurs add value to their start-ups and thus may facilitate greater innovation.

4. Measures of "Dual-Use" Resources

In addition to the variables relating specifically to managerial and entrepreneurial resources and attitudes, we also incorporate a set of resource variables capturing factors that likely influence the impact of both entrepreneurial and managerial effort on value creation within start-ups. We similarly divide this third category of resources into tangible as well as intangible aspects of resources possessed by start-up management teams.

Among the tangible dual-use resources, the variable College Degree Percentage represents the whole-number percentage of the top-four team members who held at least a college degree, thus capturing the formal educational attainment of the start-up team. A start-up team with more formal education may possess greater entrepreneurial and managerial expertise, including technical expertise that informs innovative activity. We also incorporate the start-up's Team Size to capture the possible presence of economies of specialization among entrepreneurial start-up teams. To the extent that more innovative production involves more complex activities than low-tech production, and thus offers gains to specialization, multi-person start-up efforts have the potential to operate more efficiently than individual efforts. This efficiency of size might also translate to the managerial role; compared to smaller firms, firms headed by larger teams might find it less necessary to seek specialized expertise from outside the firm. An additional dummy variable captures whether the firm received assistance from a venture capitalist. In practice, venture capitalist involvement in start-ups generally facilitates more innovative production and may signal the willingness of start-up teams to use outside assistance of any kind.

Among the intangible dual-use resources, we incorporate three additional Likert-scale measures of respondents' preferences for intangible work attributes. Those included in this grouping represent responses to the following statements: "The best work is that where I have a lot of autonomy and independence," "Nothing is more exciting than major challenges in my work," and "I really enjoy my work when I can pursue ideas I find interesting." The variables Autonomy, Challenges, and Pursuing Ideas are each set equal to 1 if the respondent indicated any agreement with these statements and 0 otherwise. Such preferences might plausibly signal a team principal's ability to engage in either innovative activity or to manage a start-up firm.

5. Control Variables

To control for start-up team demographic characteristics, we incorporate variables representing the whole-number percentage of the start-up team that is white or female, a dummy variable equal to 1 if any pair among the start-up team is a married couple, and the average age of start-up team members. Start-up teams involving family members, including married couples, may possess a greater aversion to risk than other teams (a possibility suggested by Mangum and Tansky 1987) and so may show a lesser likelihood of engaging in relatively riskier, innovative production. To capture the industry type in which the firm

operated, we incorporate dummy variables for services and manufacturing; the reference category consists of firms that operated in agricultural, mining, or other industries. We capture the legal structure of the firm using the dummy variable Sole Proprietorship; the reference category consists of firms listed as partnerships, corporations, or other forms. We control for spillover, clustering, and other geographic location effects within Wisconsin by incorporating dummies capturing whether the firm operated in the greater Milwaukee area or in the Central region of the state. Firms located in and around Wisconsin's largest urban center or close to the University of Wisconsin-Madison (located in central Dane County) may have greater access to skilled human resources and markets for high-tech products, perhaps increasing their likelihood of engaging in innovative production relative to firms located in other areas of Wisconsin.[8]

We removed observations due to missing or unusable data, resulting in a working cross-sectional sample of 390 start-up firms. Table I displays descriptive statistics for the variables incorporated in this study.

III. Empirical Methods

To estimate the determinants of innovation (entrepreneurial effort) econometrically, we use maximum likelihood probit analysis, using two different dummy dependent variables: High Tech Firm and New Product.[9] In our empirical models of managerial effort, we also use two different dependent variables: Team Work Hours and External Consulting, but employ ordinary least squares and negative binomial (NB) analysis, respectively.[10]

We present results for two sets of model specifications. In the first set (Table II), we estimate high-technology production and innovation directly as functions of entrepreneurial and dual-use resources, as introduced and defined in Section III. These models will allow us to determine the extent to which the various resources are related to high-technology production and innovation, respectively, in a manner consistent with our conceptual hypotheses. In the second set of models (Table III), we estimate the choice to use external consulting and team work hours directly as functions of managerial and dual-use resources.

Next, we modify the specifications by incorporating the managerial-resource variables

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[8] At a more macro level, previous authors have observed a direct relationship between high-tech business development and the skills base in specific regions of a country. See Chrisman (1999) for a brief survey.

[9] In this setting, retaining terminology from the conceptual discussion, we presume that there exists an underlying regression relationship $e_i^* = \boldsymbol{\beta X_i} + u_i$, where e_i^* represents the unobservable profit-maximizing level of entrepreneurial effort chosen by the ith firm. In practice, we observe the dummy variable $h = 1$ (in the present study, High Tech Firm = 1 or New Product = 1) if $e_i^* > 0$ and $h = 0$ otherwise. This holds with probability $\Pr(e_i = 1) = \Pr(u_i > -\boldsymbol{\beta X_i}) = 1 - F(-\boldsymbol{\beta X_i})$, where $F(\mathrm{X})$ is the cumulative distribution function (CDF) for u. When F takes on the normal distribution, we estimate $\boldsymbol{\beta}$ using probit analysis. For additional details on probit analysis, see Greene (2003).

[10] The latter takes on non-negative integer values only and exhibits overdispersion, a variance significantly greater than its mean. Thus, to estimate determinants of external consulting use in an econometrically efficient manner, we employ negative binomial (NB) regression analysis. A regression-based test due to Cameron and Trivedi (1998) revealed significant overdispersion in External Consulting, thus motivating NB rather than Poisson regression. In applying this test, we estimate the Poisson model to obtain the fitted values $\mu = exp(\boldsymbol{X}\mathrm{N}\boldsymbol{\beta})$ and then regress the statistic $z = (y - \mu)^2/\mu$ on the fitted values absent a constant term. These regressions yielded positive, statistically significant coefficients on the fitted values for each model specification, indicating overdispersion. We observe external assistance use Y_i as the discrete dependent count variable y_i, or the total number of assistance programs used by the ith start-up firm. The negative binomial regression model stipulates that y_i is distributed as negative binomial, with mean λ_i and dispersion δ_i. As discussed formally by Cameron and Trivedi (1998), one customarily captures the unobserved heterogeneity proposed to explain variation in external consulting use as $\lambda_i = exp(\boldsymbol{\beta X_i})$. Within this structure, $\Pr(Y_i = y_i)$ is specified in terms of the NB probability density function, and the resulting likelihood function captures the joint distribution of these counts; $\boldsymbol{\beta}$ is estimated using the method of maximum likelihood.

into the innovation probit models (Table IV) and the entrepreneurial-resource variables into the external-consulting and team work hours regression models (Table V), while retaining the dual-use resource variables and the control variables already present in both models. These more fully specified models will enable us to examine whether, and to what extent, issues that relate to managerial effectiveness complement effort at innovation in start-ups and issues that relate to innovativeness impact the decision to use external assistance or work longer hours. These models may provide some empirical evidence of the role of resource complementarity in start-up firm decision making, as discussed earlier.

Following the estimation of these innovation and managerial-effort models, we finally examine three additional models that shed light on how the various indicators of entrepreneurial, managerial, and dual-use resources—incorporated alongside measures of entrepreneurial and managerial effort themselves—influence the observable *performance* of the start-ups under analysis, measured here as the firms' sales volume (we use the most recent year, 1991, for which we have complete sales data).[11] We regress the variable Sales Revenues on the various resource and effort variables incorporated throughout. Because entrepreneurial and managerial effort are a result of choices made by start-up teams, we also explore how the marginal effects (on sales) change when we statistically control for the endogeneity of those efforts. These regressions will also allow us to investigate the extent to which interactions between resources and effort influence sales, as intimated in Casamatta's (2003) model and in our application.

IV. Empirical Results

A. Probit Analysis: Innovation

1. Innovation as High-Tech Production

Table II displays results from probit analysis of the innovation choice, with High-Tech Firm and New Product specified as the dependent variables. Several of the entrepreneurial-resource variables show a statistically significant relationship with the probability that a start-up firm chooses a high-technology product or service, and the overall results appear consistent with our expectations. Recall that the entrepreneurial-resource variables capture either tangible or intangible characteristics of the start-up firms, including the characteristics of the entrepreneurial climate in which the firms operated.

Studying the tangible characteristics first, observe that firms founded or co-founded by individuals involved in startups previously (respondents one might characterize as "serial entrepreneurs") appear less likely to be engaged in high-technology production in the present sample. This may reflect the relative difficulty of founding a succession of innovative companies compared to the relative ease of setting up a series of retail franchises or other traditional businesses generally not involving high-tech production. In addition, firms using relatively new equipment and producing a relatively new product were significantly more likely to be operating in a high-tech industry. These findings make sense given the presumed greater complexity of developing new products and processes necessary for innovation. Consistent with this interpretation, firms that cite research and development as a major priority also show a greater likelihood of high-tech production than those that do not.

The two intangible (entrepreneurial-climate) variables in this model that emerge as statistically significant may suggest how the nature of a firm's environment can affect the development of high-technology production in a given market. The positive coefficients for More Men Would Start Given Financing and Entrepreneurs Cheat Others indicate that

[11] Regrettably, the WECS does not contain data on firms= profits. However, sales revenue is a reasonable proxy for success, especially for start-up firms that we are concerned with in our paper.

respondents who expressed greater agreement with these statements were less likely to engage in high-tech startups. The first result may tell us only that the decision to start a high-tech enterprise depends on factors other than financing; certainly, the conceptual model and other empirical results speak to such factors. The second result, however, suggests that cynicism within a respondent's social network about entrepreneurs and the source of their success can act as an impediment to such innovation. The result seems consistent with the finding by Allen (2000) that greater such cynicism reduces the probability that an individual chooses to become an entrepreneur at all and lends support to the more general suspicion by Evans and Valery (2001) that less effective entrepreneurial networks can slow the development of high-tech firms.

Among the dual-use resources, only Venture Capitalist Assistance emerges as statistically significant, its positive coefficient indicating that start-ups reporting VC involvement more likely engaged in high-tech production than other firms. This result supports findings by Kortum and Lerner (2000) as to the importance of venture capitalist activity for fostering innovation. Several of the control variables emerge as significant. Start-up firms located in Milwaukee were significantly more likely to have a high-tech orientation than firms located in other parts of Wisconsin, and start-ups involved in the services industry appear more innovative along these lines than those operating in the reference industries. With respect to start-up team demographic characteristics, the average age of the start-up team members appears positively related to the firms' inclination for innovation, while teams containing at least one married couple appear significantly less likely to produce in the high-tech sector, as expected. Perhaps consistent with the effect of team size, sole proprietorships appear significantly less likely to produce a high-tech product than firms exhibiting other legal forms.

2. Innovation as New Product Development

Start-up firms can engage in innovative behavior by choosing to operate in high-technology industries or by developing new products and services, whatever their industry orientation. To investigate the extent to which the entrepreneurial and dual-use resources influence innovation in this form, we estimate an additional set of probit models that specify New Product as the dependent variable. The performance of variables relating to entrepreneurial and dual-use resources differs from the earlier innovation specification using High-Tech Firm as the dependent variable.

Among the tangible entrepreneurial resources, observe first that respondents involved in a larger number of previous start-ups appear significantly less likely to have developed new products in their current firm, a result consistent with the earlier finding that "serial entrepreneurs" are less likely to operate in high-tech industries. Not surprisingly, however, firms that did operate in those industries were significantly more likely to have developed new products, other things equal. Overall, the most innovative start-ups studied here appear to have been led by first-time entrepreneurial teams operating in high-tech industries and producing new products. Whereas in the earlier models the use of relatively new equipment and the prioritization of research and development significantly increased the likelihood that firms produced a high-tech product, these variables do not significantly explain innovation as new-product development in the present sample.

More of the intangible, entrepreneurial-climate variables significantly influence new-product development than influenced the firms' high-tech orientation. Earlier results along these lines suggested that start-up firms opt for a relatively low-tech orientation under two intangible circumstances: when respondents feel that more aspirant (male) entrepreneurs would start firms given better financing opportunities, and when their associates believe that

entrepreneurs achieve success by cheating others. In the new-product (probit) model, the first variable takes on a positive, significant coefficient, suggesting that potentially innovative male entrepreneurial aspirants in the networks of the team principals under analysis value financing more for the development of new products than for moving specifically into high-tech industries. Meanwhile, Entrepreneurs Cheat Others becomes statistically insignificant (p = 0.15) in the current model, suggesting that cynicism within entrepreneurial networks suppresses entrepreneurial innovation more in the area of high-tech industry choice than in the development of new products.

Results relating to the dual-use resources change as well. The earlier model indicated that venture capitalist involvement in the start-up firms under analysis tended to increase the probability that these firms operated in high-tech industries. But Venture Capitalist Assistance emerges as a statistically insignificant (p = 0.25) determinant of new-product development, suggesting that, for the present sample of start-up firms, VC involvement facilitates innovation primarily in the form of industry orientation. Larger teams and teams having a greater percentage of members holding college degrees appear significantly more likely to have developed a new product. Team principals who expressed a specific preference for autonomy appear less likely to have done so. These results suggest how start-up team educational attainment, economies of size, and certain intangible work attitudes can facilitate innovation by start-ups in ways other than motivating the production of a specifically high-tech product.

B. Managerial Effort

1. Assistance from External Consultants

External consultants allow managers to "outsource" certain functions, and thereby offer additional effort on behalf of teams that choose to employ them. Table III displays results from our analysis of external assistance use and team work hours. Regarding external consulting, none of the managerial-approach variables cast as managerial resources emerges as statistically significant. The variable Worker Participation Critical comes closest (p = 0.11), its negative coefficient suggesting, reasonably, that firms that possess this relatively more labor-inclusive approach to management exhibit lesser demand for *external* assistance than firms that operate with greater separation between management and workers. Two of the dual-use resources, however, do emerge as significant. Venture capitalist involvement appears to increase firms' use of external assistance, consistent with the notion that management teams that are willing to obtain VC funding (typically accompanied by advice) are also more willing to seek external consulting. As Hellman and Puri (2002) discuss, VC provision of advice can even involve active control of the firm to the extent of replacing inexperienced managers with professionals. Team principals who state a specific preference for pursuing ideas at work also were involved in firms that used more external consulting.

Two of the control variables appear influential as well. Start-up teams made up of a smaller percentage of white individuals and those not containing a married couple used significantly more external consulting services than their respective counterparts, although the former variable has a very small coefficient estimate. One might speculate that government agencies in Wisconsin to some degree marketed assistance programs to minority-owned small businesses, perhaps based on the assumption that minority entrepreneurs traditionally have lesser access to such assistance in the private sector than white entrepreneurs generally have. If start-up teams formed in part by married couples tend to take fewer risks and tend to emphasize relatively low-tech production (as suggested by the probit results in Table II), such teams might require less outside assistance compared to other firms. In addition, married couples that start new firms may possess different, and complementary, skill sets that might mitigate the need to acquire outside assistance.

2. Hours Worked

To explore an alternative operationalization of managerial effort, we estimated a regression model casting Team Work Hours as the dependent variable, measuring the number of work hours per week devoted by the firm's principals. We employed ordinary-least-squares (OLS) regression analysis, and report our results in the right-hand columns of Table III.

In the previousrevious model of managerial effort relating to use of external consulting, the coefficients for Worker Participation Critical and Technical Management Critical, among the measures of managerial approach, were marginally significant ($p = 0.11$) and not significant ($p = 0.66$), respectively, and both had negative signs. In the work-hours model, conversely, these variables emerge as positive and significant. Viewed as a whole, this pattern of results suggests that start-up teams emphasizing these approaches to management tended to use lesser external consulting services and, consistent with that finding, tended to devote more of their *own* time to the firm, resulting in longer hours spent in the office.

Pursuit of ideas is related (negatively) to hours worked, perhaps indicating that management teams that were passionate about solving the firm's intellectual challenges—as opposed to the day-to-day managerial effort that is necessary to settle accounts, track inventory, etc.—were less likely to work longer hours. In addition, the coefficient for team size was both positive and significant as well. This (unsurprisingly) indicates that larger management teams tended to devote more work hours to the firm.

C. Exploring Complementarity

To what extent do managerial resources influence a start-up firm's innovativeness? To what extent do entrepreneurial resources influence the use of external assistance? To address these questions, we estimate innovation probit models that incorporate the managerial-resource variables alongside the variables incorporated in the basic probit model, and we estimate models that incorporate the entrepreneurial-resource variables alongside the variables employed in the basic managerial effort model. Overall, the results, displayed in Tables IV and V, suggest that entrepreneurial resources exert a relatively greater influence on external assistance use than managerial resources exert on innovation.

1. Managerial Resources and Entrepreneurial Effort

Comparing the results in Table IV to those of Table II, first observe that most of the various entrepreneurial-resource and control variables that emerged as significant determinants of a firm's high-tech orientation remain significant in this context. Also observe that none of the managerial-approach variables emerges as a significant predictor of high-tech orientation. In terms of innovation defined as new product development, the initial findings are again robust to the inclusion of the managerial approach variables. In terms of tangible entrepreneurial resources, the coefficients for Previous Startups and High Tech Firm are still positive and significant. Results pertaining to the intangible entrepreneurial resources variables resemble those from the earlier model, with More Women Would Start decreasing slightly in significance (p-value moved from 0.09 to 0.10) and More Men Would Start maintaining a high level of significance. No managerial approach (managerial resource) variable exhibits a significant relationship with either High-Tech Firm or New Product.

2. Entrepreneurial Resources and Managerial Effort

We now return to our measures of managerial effort: external consulting assistance and team work hours. First of all, we find that only one of the entrepreneurial-resource variables—

More Men Would Start—emerges as statistically significant in the more fully specified external-consulting NB regression model (results indicated in the left-hand columns of Table V). Individual respondents who generally felt optimistic that more aspiring entrepreneurs (male aspirants in particular) would start firms given greater financing opportunities tended to use less external consulting. However, by statistically accounting for the entrepreneurial-resource variables, two of the managerial-resource variables become statistically significant determinants of external consulting use where they had been insignificant in the basic model (recall Table III). In the expanded model, respondents who characterize worker participation in management and technical management as essentially non-critical issues used significantly more consulting services than those who regarded these issues as critical, as indicated by the negative coefficients on these two managerial approach variables.

The presence of the entrepreneurial-resource variables in the more fully specified external-assistance model also reinforces the influence of the tangible dual-use resource variables. With respect to these variables, the earlier, basic external consulting model (Table III) indicated only that firms reporting VC involvement tended to use more consulting services. Besides reinforcing this result, the fuller model indicates that larger start-up teams and those made up of a larger percentage of members holding a college degree tended to use more external consulting services. With respect to the intangible dual-use resource variables, team principals who expressed greater optimism that more aspiring (male) entrepreneurs would start firms given greater financing opportunities also used significantly more external assistance, suggesting a way in which an aspect of entrepreneurial social climate can influence a demonstrable activity in the managerial role. In particular, this effect may point to the presence of important constraints on entrepreneurs' ability to obtain financial and other assistance in private markets, constraints that motivate greater use of publicly-available assistance.

For the more fully-specified model relating to team work hours, results are presented in the right-hand columns of Table V. As before, we find a positive coefficient for Worker Participation Critical, but Technical Management Critical loses significance (the *p*-value moves from 0.05 to 0.72). Larger teams remain positively related to the work hours per week. Pursuing Ideas becomes even more significant—and its magnitude increases as well—in the more fully specified model. None of the entrepreneurial resource variables, either tangible or intangible, are associated with managerial effort measured as team work hours.

V. Effort, Resources, and Sales Revenue

To study how managerial and entrepreneurial effort and resources influence the *performance* of the start-up firms under analysis, we estimate three regression models that cast Sales Revenue as the dependent variable (see Table VI). In "naïve" Model 1, we estimate it as a function of the variables incorporated in previous models, including the effort variables New Product and Team Work Hours, uncorrected for any endogeneity. Model 2 replicates Model 1 but substitutes the predicted values of the two effort variables to account for the implied endogeneity of innovation and managerial effort.[12] Model 3 finally extends Model 2 by incorporating interactions between the predicted effort variables and the statistically significant resource variables that emerge in Model 2. Overall, the results give an indication of the relative importance of resources and effort as determinants of firm success.

[12] The predicted values for the probability that a start-up produced a new product represents the inverse Mills ratio associated with that outcome; see Davidson and MacKinnon (2004) for a discussion. We also estimated a set of sales regressions that featured High-Tech Firm and External Consulting (and their predicted values) as the respective entrepreneurial and managerial effort variables. However, these models yielded relatively uncompelling results. Note also that to conserve space, Table 7 omits results pertaining to the control variables, which include a measure of start-up firm age as an identifying exogenous variable.

Examining Model 1, observe that New Product emerges as negative and statistically significant and that Team Work Hours emerges as positive and significant. On the surface, these results would suggest that the firms under analysis engaged in innovative activity (by way of new-product development) to the detriment of revenue generation but that a greater team commitment (work time allocation) significantly contributed to revenue. However, when we correct for the endogeneity of these variables in Model 2, New Product (Predicted) loses its significance, and Team Work Hours (Predicted) retains a reasonable level of significance (p = 0.08). These results suggest that a revenue loss seemingly attributable to the launch of a new product (Model 1) reflects some other, latent effect, and that teams' time commitment makes a truer contribution to revenue generation. For example, it may be the case that firms developing new products have a longer lead time to generating sales compared to firms that merely market an established product or service.

Looking further, observe that two important explanatory variables lose significance from Model 1 to Model 2. The tangible entrepreneurial resource variable Team Start-Up Percentage takes on a positive coefficient in Model 1, suggesting that such experience would tend to enhance firm performance. But the loss of significance of this variable in the endogeneity-corrected Model 2, combined with the robustness of (predicted) Team Work Hours, suggests that the degree of the start-up team's *current* managerial effort, or time commitment, contributed more fundamentally to the generation of revenue. Similarly, although less dramatically, the managerial-approach variable Technical Management Critical takes on a negative coefficient significant at the 1 percent level in Model 1, suggesting that firms with this orientation earned less revenue than reference firms. But this variable is significant at a lower (8 percent) level in Model 2, a change that at least casts greater doubt on the initial evidence that more technically-oriented management teams earn less revenue than other firms. By contrast, College Degree Percentage appears to contribute positively and robustly to revenue in each specification.

Finally, Model 3 incorporates a set of regressors that interact the predicted effort variables with the significant resource variables. Observe that Team Work Hours (Predicted), uninteracted, retains its positive coefficient estimate and moves to a significance level just outside the standard range (p = 0.11). More importantly, the interaction of Team Work Hours (Predicted) and College Degree Percentage emerges as positive and significant (no other interaction emerges as significant). These results suggest that the positive contribution to revenue of the start-up team's weekly commitment functions largely through the team's formal education level, a key dual-use resource.

VI. Conclusion

The primary purpose of this paper was to analyze the decision by start-up firm managers to exert managerial and entrepreneurial effort. We measured managerial effort both directly (using hours worked) and indirectly (via the use of external assistance, such as made available from government programs available at the state level); we also used two measures of innovative effort (either to develop a new product, or to choose a high-tech product or service). To examine these choices, we applied concepts suggested by the theoretical model of entrepreneurial and managerial activity advanced by Casamatta (2003). In this approach, we imagined that an entrepreneur (or a team of entrepreneurs) possesses a certain degree of entrepreneurial and managerial resources at the time of the firm's creation and engages in effort that maximizes the firm's expected profit. This analysis suggests testable hypotheses, which we investigated empirically using data developed from a survey of entrepreneurs involved in new firms. These tests yielded findings that are consistent with many of our predictions.

Policy-makers and economic development authorities concerned with promoting innovation might be intrigued by some of these results. After controlling for a number of other factors, we find that serial entrepreneurs—those who have founded other companies before—were significantly *less* likely to be involved in innovation (defined either as a new product or as a high-tech product). We also find that assistance from venture capitalists and use of new equipment are positively and significantly associated with the choice of a high-technology product, but not with innovation defined as new product development. Management teams with more education are likely to introduce a new product or service (and firms in service industries were more likely to be innovative), but we do not find a comparable result for high-technology industry choice. Larger start-up teams are more likely to be engaged in innovation, defined either as high-tech or new production.

What motivates managers to employ external assistance, such as that offered by regional economic development agencies? The most important criteria seem to revolve around socio-economic factors. For example, married couples—who might already possess complementary skills—appear significantly less likely to use such outside assistance, and the portion of whites in the start-up team is also negatively related to the use of external help. The latter finding may indicate the success of government efforts to target minority entrepreneurs.

In which circumstances do management teams spend more time on the job? Our measure of managerial effort (work hours per week) revealed that attitudes matter: survey respondents who thought that worker participation and state-of-the-art developments were critical worked longer hours. At the same time, managers who liked to focus on pursuing ideas tended to spend less time in the office.

Finally, we considered the relationship between effort, resources, and performance (measured as annual sales revenue in dollars). Controlling for endogeneity in the two types of effort (managerial and entrepreneurial), we find that the number of hours worked per week significantly, positively contributes to sales revenue but that development of a new product does not. We also find that the interaction between high levels of education and work hours is significant and positive.

Some interesting policy recommendations and advice to investors and managers of start-ups arise from our analysis. Economic development agencies that promote innovative firms (those that market new or high-technology products or services) may wish to set up special programs to encourage first-time entrepreneurs to start up new firms; they may also benefit from promoting larger management teams that are associated with innovation. At the same time, managers that prefer to "pursue ideas" tend to use more external consulting services and to work fewer hours, although this did not negatively impact their performance (sales), and may have improved it. We also confirm a finding that might not be unexpected: highly-educated management teams (with a higher portion having at least a college degree) that work long hours perform exceptionally well in terms of generating sales revenue.

As research on these issues continues, additional empirical analysis of start-up firm behavior might examine the role of firms' expectations about and actual success in ways that our data do not allow but that theory might suggest nevertheless. Future researchers might quantify the marginal impact of entrepreneurial and managerial effort on profitability, for example, or assess the extent to which these effects shape start-up firms' innovativeness, their use of external assistance, or other decisions. Since a firm's profitability and resource base plausibly change over time, one might alternatively model these sorts of start-up behaviors in a more dynamic conceptual setting, perhaps aided empirically by panel data on a sample of young firms. We encourage further research to explore these issues more thoroughly.

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Figure 1
Conceptual Scheme of Variables and Results

Dependent Variables:	**Measured As:**	**Results In:**
Entrepreneurial Effort	High-Tech Firm New Product	Tables II, IV
Managerial Effort	Team Work Hours External Consulting Use	Tables III, V
Start-Up Performance	Sales Revenue (Models 1, 2, 3)	Table VI
Independent Variables:		
Managerial Resources	Technical Management Critical, Worker Participation Critical, Managerial Problems, Special Skills, Helping to Build	Tables III, IV, V, VI
Entrepreneurial Resources—Tangible	Previous Startups (Respondent), Team Start-Up Percentage, New Product, New Equipment, State-of-Art Developments Critical, Major Technical Changes, Scientific/Technical Personnel, R&D Major Priority	Tables II, IV, V, VI
Entrepreneurial Resources—Intangible	Men Friends Have Started Firms, Women Friends Have Started Firms, More Men Would Start, Given Financing, More Women Would Start, Given Financing, Bankers Help New Firms Get Started, Entrepreneurs Cheat Others, We Rarely Meet Entrepreneurs Socially, Government Supports Male Entrepreneurs, Government Supports Female Entrepreneurs	Tables II, IV, V, VI
Dual-Use Resources—Tangible	College Degree Percentage, Venture Capitalist Assistance, Team Size	Tables II-VI
Dual-Use Resources—Intangible	Autonomy, Challenges, Pursuing Ideas	Tables II-VI
Controls	Percentage of Team Female, Percentage of Team White, Married Couple in Team, Average Age of Team, Industry: Manufacturing, Industry: Services, Region: Milwaukee, Region: Central, Sole Proprietorship	Tables II-VI
Interactive Terms	Weekly Team Hours (Predicted) * Team Start-Up Percentage, Weekly Team Hours (Predicted) * College Degree Percentage, Weekly Team Hours (Predicted) * Technical Mgt. Critical, New Product (Predicted) * Team Start-Up Percentage, New Product (Predicted) * College Degree Percentage, New Product (Predicted) * Technical Management Critical, New Product (Predicted) * Weekly Team Hours (Predicted)	Table VI, Model 3

Table I
Descriptive Statistics (Sample Size: 390)

	Mean	SD		Mean	SD
Focus (Dependent) Variables			*Dual-Use Resources (Intangible)*		
High Tech Firm	0.133	0.340	Autonomy	0.421	0.494
New Product	0.218	0.413	Challenges	0.374	0.485
External Consulting	4.049	4.397	Pursuing Ideas	0.528	0.500
Team Work Hours	70.772	37.785			
Sales Revenues (Dollars)	351.63	826.46	*Entrepreneurial Resources (Tangible)*		
			Previous Startups (Respondent)	0.454	0.873
Managerial Approach Variables			Team Start-Up Percentage	0.143	0.324
Technical Management Critical	0.467	0.500	New Product	0.297	0.413
Worker Participation Critical	0.308	0.462	New Equipment	0.428	0.495
Managerial Problems	2.021	3.013	State-of-Art Developments Critical	0.554	0.498
Special Skills	0.490	0.501	Major Technical Changes	0.415	0.493
Helping to Build	0.500	0.501	Scientific/Technical Personnel	0.362	0.481
			R&D Major Priority	0.190	0.393
Control Variables					
Percentage of Team Female	0.226	0.374	*Entrepreneurial Resources (Intangible)*		
Percentage of Team White	0.556	0.374	Men Friends Have Started Firms	2.723	0.642
Married Couple in Team	0.200	0.401	Women Friends Have Started Firms	2.956	0.547
Average Age of Team	41.20	8.953	More Men Would Start, Given Financing	1.974	0.629
Industry: Manufacturing	0.103	0.304	More Women Would Start, Given Financing	1.951	0.673
Industry: Services	0.344	0.476	Bankers Help New Firms Get Started	3.105	0.715
Region: Milwaukee	0.221	0.415	Entrepreneurs Cheat Others	3.085	0.673
Region: Central	0.174	0.380	We Rarely Meet Entrepreneurs Socially	2.469	0.659
Sole Proprietorship	0.344	0.476	Government Supports Male Entrepreneurs	2.903	0.721
			Government Supports Female Entrepreneurs	2.823	0.780
Dual-Use Resources (Tangible)					
College Degree Percentage	0.280	0.402			
Venture Capitalist Assistance	0.146	0.354			
Team Size	1.754	0.952			

Table II

Probit Analysis of Innovation

	High-Tech Firm			New Product		
	Coeffi-cient	Standard Error	*p*	Coeffi-cient	Standard Error	*p*
Intercept	-2.100	1.678	0.21	-2.175	1.012	0.03
Entrepreneurial Resources (Tangible)						
Previous Startups (Respondent)	-0.426	0.202	0.04	-0.197	0.118	0.09
Team Start-Up Percentage	-0.003	0.004	0.56	0.001	0.003	0.62
High-Tech Firm	-----	-----	-----	0.760	0.271	0.01
New Product	0.920	0.326	0.00	-----	-----	-----
New Equipment	0.772	0.306	0.01	-0.005	0.187	0.98
State-of-Art Developments Critical	0.513	0.399	0.20	0.182	0.203	0.90
Major Technical Changes	0.325	0.343	0.34	0.254	0.209	0.22
Scientific/Technical Personnel	0.124	0.279	0.66	0.056	0.178	0.31
R&D Major Priority	1.367	0.327	0.00	-0.328	0.247	0.18
Entrepreneurial Resources (Intangible)						
Men Friends Have Started Firms	0.020	0.241	0.94	-0.012	0.155	0.94
Women Friends Have Started Firms	-0.337	0.276	0.22	0.325	0.188	0.08
More Men Would Start, Given Financing	-0.980	0.392	0.01	0.715	0.232	0.00
More Women Would Start, Given Financing	0.115	0.321	0.72	-0.353	0.208	0.09
Bankers Help New Firms Get Started	0.129	0.227	0.57	-0.191	0.134	0.15
Entrepreneurs Cheat Others	-0.573	0.229	0.01	-0.187	0.129	0.15
We Rarely Meet Entrepreneurs Socially	0.345	0.225	0.13	0.158	0.137	0.25
Government Supports Male Entrepreneurs	0.341	0.250	0.17	-0.165	0.175	0.35
Government Supports Female Entrepreneurs	0.153	0.219	0.49	0.070	0.154	0.65
Dual-Use Resources (Tangible)						
College Degree Percentage	-0.004	0.004	0.25	0.005	0.002	0.05
Venture Capitalist Assistance	0.663	0.337	0.05	0.257	0.224	0.25
Team Size	0.249	0.144	0.09	0.213	0.101	0.04
Dual-Use Resources (Intangible)						
Autonomy	0.173	0.288	0.55	-0.306	0.182	0.09
Challenges	-0.139	0.327	0.67	0.320	0.200	0.11
Pursuing Ideas	-0.424	0.319	0.18	0.238	0.203	0.24

Table II
(continued)
Probit Analysis of Innovation

	High-Tech Firm			New Product		
	Coefficient	Standard Error	*p*	Coefficient	Standard Error	*p*
Control Variables						
Percentage of Team Female	0.007	0.004	0.11	0.0001	0.003	0.97
Percentage of Team White	0.004	0.005	0.40	-0.006	0.003	0.03
Married Couple in Team	-0.794	0.409	0.05	-0.316	0.241	0.19
Average Age of Team	0.030	0.017	0.08	-0.014	0.010	0.16
Industry: Manufacturing	0.224	0.435	0.61	0.010	0.285	0.97
Industry: Services	0.772	0.313	0.01	0.442	0.191	0.02
Region: Milwaukee	0.775	0.324	0.02	-0.654	0.233	0.01
Region: Central	0.398	0.397	0.32	0.110	0.228	0.63
Sole Proprietorship	-1.653	0.552	0.00	0.225	0.204	0.27
chi-square (H_0: $\boldsymbol{\beta} = 0$)	163.72		0.00	83.95		0.00

Table III

Negative Binomial and OLS Regression Analysis of Managerial Effort

	External Consulting			Team Work Hours		
	Coeffi-cient	Standard Error	*p*	Coeffi-cient	Standard Error	*p*
Intercept	1.119	0.331	0.00	43.021	10.263	0.00
Managerial Approach						
Technical Management Critical	-0.051	0.117	0.66	6.990	3.573	0.05
Worker Participation Critical	-0.207	0.129	0.11	11.593	3.819	0.00
Managerial Problems	0.002	0.019	0.93	0.370	0.600	0.54
Special Skills	-0.177	0.137	0.20	-1.437	3.891	0.71
Helping to Build	0.145	0.128	0.26	3.616	3.717	0.33
Dual-Use Resources (Tangible)						
College Degree Percentage	0.002	0.006	0.12	-0.0321	0.044	0.47
Venture Capitalist Assistance	0.995	0.147	0.00	2.556	4.698	0.59
Team Size	0.100	0.069	0.15	21.120	2.256	0.00
Dual-Use Resources (Intangible)						
Autonomy	0.020	0.132	0.88	0.228	3.731	0.95
Challenges	-0.010	0.143	0.95	0.409	4.068	0.92
Pursuing Ideas	0.296	0.141	0.04	-7.032	4.268	0.10
Control Variables						
Percentage of Team Female	0.002	0.002	0.17	-0.083	0.054	0.12
Percentage of Team White	-0.006	0.002	0.00	-0.009	0.052	0.86
Married Couple in Team	-0.447	0.159	0.00	4.116	4.786	0.39
Average Age of Team	0.0003	0.006	0.97	-0.266	0.190	0.16
Industry: Manufacturing	-0.095	0.195	0.63	-2.259	5.682	0.69
Industry: Services	-0.018	0.018	0.89	-4.377	3.859	0.26
Region: Milwaukee	0.071	0.142	0.62	1.518	4.390	0.73
Region: Central	0.045	0.157	0.77	-1.531	4.573	0.74
Sole Proprietorship	0.146	0.132	0.27	2.108	3.871	0.59
chi-square (H_0: $\boldsymbol{\beta} = 0$)	73.50 ($p = 0.00$)			-----		
F statistic	-----			10.14		
Adjusted R^2	-----			0.335		

Table IV

Determinants of Innovation: Exploring Complementarity

	High-Tech Firm			New Product		
	Coeffi-cient	Standard Error	*p*	Coeffi-cient	Standard Error	*p*
Intercept	-2.320	1.738	0.18	-2.175	1.012	2.287
Entrepreneurial Resources (Tangible)						
Previous Startups (Respondent)	-0.429	0.206	0.04	-0.223	0.120	0.06
Team Start-Up Percentage	-0.002	0.004	0.59	0.002	0.003	0.51
High-Tech Firm	--	--	--	0.749	0.276	0.01
New Product	0.864	0.335	0.01	--	--	--
New Equipment	0.797	0.312	0.01	0.042	0.190	0.83
State-of-Art Devel. Critical	0.397	0.420	0.34	0.160	0.214	0.45
Major Technical Changes	0.254	0.369	0.49	0.243	0.218	0.27
Scientific/Technical Personnel	0.116	0.298	0.70	0.090	0.188	0.63
R&D Major Priority	1.294	0.331	0.00	-0.374	0.251	0.14
Entrepreneurial Resources (Intangible)						
Men Friends Have Started Firms	-0.018	0.248	0.94	-0.016	0.158	0.92
Women Friends Have Started Firms	-0.275	0.286	0.34	0.310	0.193	0.11
More Men Would Start, Given Financing	-0.958	0.403	0.02	0.771	0.237	0.00
More Women Would Start, Given Financing	0.128	0.325	0.69	-0.343	0.211	0.10
Bankers Help New Firms Get Started	0.092	0.239	0.70	-0.205	0.137	0.14
Entrepreneurs Cheat Others	-0.590	0.235	0.01	-0.193	0.131	0.14
We Rarely Meet Entrepreneurs Socially	0.339	0.228	0.14	0.156	0.140	0.27
Government Supports Male Entrepreneurs	0.381	0.255	0.14	-0.164	0.179	0.36
Government Supports Female Entrepreneurs	0.123	0.227	0.59	0.068	0.157	0.67
Managerial Approach						
Technical Management Critical	0.312	0.344	0.37	0.172	0.212	0.42
Worker Participation Critical	0.151	0.329	0.65	-0.230	0.194	0.46
Special Skills	-0.191	0.342	0.58	-0.023	0.030	0.264
Helping to Build	0.162	0.300	0.59	0.009	0.192	0.96
Managerial Problems	-0.014	0.047	0.76	-0.023	0.030	0.46

Table IV
(continued)
Determinants of Innovation: Exploring Complementarity

	High-Tech Firm			New Product		
	Coeffi-cient	Standard Error	*p*	Coeffi-cient	Standard Error	*p*
Dual-Use Resources (Tangible)						
College Degree Percentage	-0.004	0.004	0.26	0.005	0.002	0.03
Venture Capitalist Assistance	0.664	0.341	0.05	0.292	0.227	0.20
Team Size	0.224	0.166	0.18	0.269	0.108	0.01
Dual-Use Resources (Intangible)						
Autonomy	0.189	0.312	0.54	-0.207	0.192	0.28
Challenges	-0.125	0.331	0.70	0.348	0.204	0.09
Pursuing Ideas	-0.485	0.346	0.16	0.285	0.218	0.19
Control Variables						
Percentage of Team Female	0.006	0.004	0.14	0.0003	0.003	0.92
Percentage of Team White	0.004	0.005	0.41	-0.006	0.003	0.03
Married Couple in Team	-0.807	0.415	0.05	-0.362	0.249	0.15
Average Age of Team	0.032	0.017	0.06	-0.015	0.010	0.14
Industry: Manufacturing	0.293	0.462	0.53	-0.033	0.292	0.91
Industry: Services	0.811	0.319	0.01	0.409	0.196	0.04
Region: Milwaukee	0.735	0.331	0.03	-0.686	0.240	0.00
Region: Central	0.467	0.414	0.26	0.113	0.230	0.62
Sole Proprietorship	-1.546	0.556	0.01	0.265	0.207	0.20
chi-square (H_0: $\boldsymbol{\beta} = 0$)	166.55		0.00	88.64		0.00

Table V

Determinants of Managerial Effort: Exploring Complementarity

	External Consulting			Team Work Hours		
	Coeffi-cient	Standard Error	*p*	Coeffi-cient	Standard Error	*p*
Intercept	2.219	0.687	0.00	76.199	20.085	0.00
Managerial Approach						
Technical Management Critical	-0.240	0.137	0.08	1.530	4.277	0.72
Worker Participation Critical	-0.280	0.128	0.03	10.678	3.827	0.01
Managerial Problems	-0.200	0.134	0.14	0.006	0.610	0.99
Special Skills	0.122	0.127	0.34	-1.586	3.893	0.68
Helping to Build	-0.002	0.019	0.91	3.531	3.769	0.35
Dual-Use Resources (Tangible)						
College Degree Percentage	0.003	0.002	0.07	-0.032	0.046	0.49
Venture Capitalist Assistance	0.985	0.148	0.00	3.595	4.798	0.45
Team Size	0.116	0.071	0.10	22.010	2.279	0.00
Dual-Use Resources (Intangible)						
Autonomy	0.047	0.126	0.71	0.716	3.824	0.85
Challenges	-0.068	0.145	0.64	3.112	4.133	0.45
Pursuing Ideas	0.282	0.138	0.04	-8.344	4.327	0.06
Control Variables						
Percentage of Team Female	0.002	0.002	0.28	-0.073	0.055	0.18
Percentage of Team White	-0.006	0.002	0.00	-0.036	0.053	0.50
Married Couple in Team	-0.459	0.158	0.00	4.454	4.791	0.35
Average Age of Team	-0.0002	0.006	0.98	-0.268	0.192	0.16
Industry: Manufacturing	-0.188	0.199	0.34	-5.720	5.836	0.33
Industry: Services	-0.052	0.127	0.68	-5.398	3.890	0.17
Region: Milwaukee	0.050	0.144	0.73	-0.368	4.445	0.93
Region: Central	0.036	0.155	0.82	-2.100	4.657	0.65
Sole Proprietorship	0.219	0.137	0.11	3.109	4.002	0.44

Table V
(continued)
Determinants of Managerial Effort: Exploring Complementarity

	External Consulting			Team Work Hours		
	Coeffi-cient	Standard Error	*p*	Coeffi-cient	Standard Error	*p*
Entrepreneurial Resources (Tangible)						
Previous Startups (Respondent)	-0.084	0.071	0.24	-0.908	2.046	0.66
Team Start-Up Percentage	0.001	0.002	0.54	0.075	0.055	0.18
New Product	0.016	0.142	0.91	-6.350	4.307	0.14
New Equipment	0.133	0.126	0.29	-5.054	3.759	0.18
State-of-Art Developments Critical	0.111	0.141	0.43	10.113	4.249	0.02
Major Technical Changes	0.223	0.144	0.12	1.578	4.331	0.72
Scientific/Technical Personnel	0.156	0.125	0.21	3.798	3.750	0.31
R&D Major Priority	0.029	0.151	0.85	1.817	4.610	0.69
Entrepreneurial Resources (Intangible)						
Men Friends Have Started Firms	-0.101	0.101	0.32	-3.309	3.111	0.29
Women Friends Have Started Firms	-0.089	0.121	0.46	-2.268	3.625	0.53
More Men Would Start, Given Financing	-0.303	0.146	0.04	-2.005	4.399	0.65
More Women Would Start, Given Financing	0.186	0.129	0.15	-0.335	4.002	0.93
Bankers Help New Firms Get Started	-0.029	0.083	0.72	-1.493	2.598	0.57
Entrepreneurs Cheat Others	-0.008	0.086	0.93	-2.640	2.564	0.30
We Rarely Meet Entrepreneurs Socially	0.057	0.088	0.52	2.277	2.717	0.40
Government Supports Male Entrepreneurs	-0.093	0.105	0.37	-5.015	3.393	0.14
Government Supports Female Entrepreneurs	-0.069	0.095	0.47	-1.277	2.988	0.67
chi-square (H_0: $\boldsymbol{\beta} = 0$)	101.30		0.00		-----	
F statistic	-----			6.50		
Adjusted R^2	-----			0.359		

Table VI

Determinants of Start-Up Performance (Dependent Variable: Sales Revenue)

	Model 1			Model 2			Model 3		
	Coeffi-cient	SE	*p*	Coeffi-cient	SE	*p*	Coeffi-cient	SE	*p*
Intercept	-628.63	637.8	0.33	-3012.6	1707	0.08	-2615.7	1769.7	0.14
Managerial Effort									
New Product	-276.97	137.7	0.05	-----	-----	-----	-----	-----	-----
Weekly Team Hours	4.441	1.694	0.01	-----	-----	-----	-----	-----	-----
New Product (Predicted)	-----	-----	-----	-333.993	378.5	0.38	-692.375	879.46	0.43
Weekly Team Hours (Predicted)	-----	-----	-----	37.896	21.17	0.08	34.533	21.629	0.11
Interaction Variables									
Weekly Team Hours (Predicted) * Team Start-Up Percentage	-----	-----	-----	-----	-----	-----	-0.074	0.076	0.33
Weekly Team Hours (Predicted) * College Degree Percentage	-----	-----	-----	-----	-----	-----	0.143	0.059	0.02
Weekly Team Hours (Predicted) * Technical Mgt. Critical	-----	-----	-----	-----	-----	-----	-2.232	4.115	0.59
New Product (Predicted) * Team Start-Up Percentage	-----	-----	-----	-----	-----	-----	-6.466	4.718	0.17
New Product (Predicted) * College Degree Percentage	-----	-----	-----	-----	-----	-----	-2.333	4.642	0.62
New Product (Predicted) * Technical Management Critical	-----	-----	-----	-----	-----	-----	96.802	398.8	0.81
New Product (Predicted) * Weekly Team Hours (Predicted)	-----	-----	-----	-----	-----	-----	4.302	7.568	0.57
Entrepreneurial Resources (Tangible)									
Previous Startups (Respondent)	-22.467	72.92	0.76	2.139	76.7	0.98	-19.163	78.508	0.81
Team Start-Up Percentage	3.254	1.726	0.06	0.610	2.398	0.80	7.771	5.732	0.18
New Equipment	-1.463	116.9	0.99	183.450	155.5	0.24	185.6	156.89	0.24
State-of-Art Developments Critical	131.688	139.9	0.35	-209.072	248.4	0.40	-201.515	251.9	0.42
Major Technical Changes	131.148	139.3	0.35	84.362	140.7	0.55	133.522	142.2	0.35
Scientific/Technical Personnel	16.307	118.5	0.89	-113.33	137.7	0.41	-141.253	140.67	0.32
R&D Major Priority	-129.965	144.8	0.37	-189.58	146.3	0.20	-151.938	150.5	0.31

Table VI

(continued)

Determinants of Start-Up Performance (Dependent Variable: Sales Revenue)

	Model 1			Model 2			Model 3		
	Coeffi-cient	SE	*p*	Coeffi-cient	SE	*p*	Coeffic-ient	SE	*p*
Entrepreneurial Resources (Intangible)									
Men Friends Have Started Firms	108.043	96.7	0.27	183.992	116.2	0.12	156.37	120.2	0.19
Women Friends Have Started Firms	103.650	113.8	0.54	227.513	128.6	0.08	237.993	132.3	0.07
More Men Would Start Given Financing	61.096	133.7	0.65	182.814	163.4	0.26	244.612	176.3	0.17
More Women Would Start Given Financing	-71.979	118.0	0.54	-87.307	121.1	0.47	-133.094	124.1	0.29
Bankers Help New Firms Get Started	-2.546	81.3	0.98	22.672	88.3	0.80	15.310	91.49	0.87
Entrepreneurs Cheat Others	45.112	80.9	0.58	82.024	98.1	0.40	46.937	100.1	0.64
We Rarely Meet Entrepreneurs Socially	59.369	85.3	0.49	-17.337	99.9	0.86	-20.798	99.69	0.84
Government Supports Male Entrepreneurs	-78.656	109.6	0.47	96.796	145.8	0.51	128.522	147.4	0.38
Government Supports Female Entrepreneurs	93.493	94.9	0.33	135.525	97.5	0.17	100.497	99.65	0.31
Managerial Approach									
Technical Management Critical	-346.584	134.9	0.01	-359.06	137.3	0.08	-240.280	349.3	0.49
Worker Participation Critical	165.8	116.3	0.16	-260.712	248.2	0.30	-291.032	254.5	0.25
Special Skills	-14.244	122.9	0.91	-15.689	127.9	0.90	-31.164	129.3	0.81
Helping to Build	-132.173	121.6	0.28	-246.135	138.8	0.08	-234.788	139.3	0.09
Dual-Purpose Resources (Tangible)									
College Degree Percentage	3.085	1.454	0.04	4.485	1.605	0.01	-3.150	4.105	0.44
Venture Capitalist Assistance	18.523	154.1	0.90	-32.754	173.5	0.85	-40.435	173.6	0.82
Team Size	-0.613	78.6	0.99	-689.263	474.1	0.15	-669.96	480.5	0.16
Dual-Purpose Resources (Intangible)									
Autonomy	-10.792	120.4	0.93	-48.182	118.3	0.68	-100.830	122.3	0.41
Challenges	162.576	129.7	0.21	85.020	148.7	0.57	140.966	152.5	0.36
Pursuing Ideas	80.049	136.6	0.56	387.250	223.1	0.08	386.964	230.1	0.09
F-Statistic	1.68 (p = 0.01)			1.56 (p =0.02)			1.56 (p = 0.02)		
Adjusted R^2	0.087			0.068			0.08		

These models also incorporated control variables, as seen in earlier models.

APPENDICES

Appendix I

"High-Technology" Industry Classifications,
Wisconsin Entrepreneurial Climate Study, 1992-1993

SIC	Industry Description	SIC	Industry Description
2833	Medicinal Chemicals and Botanical Products	3728	Aircraft Parts and Auxiliary Equipment, Not Elsewhere Classified
2834	Pharmaceutical Preparations	3761	Guided Missiles and Space Vehicles
2835	In Vitro and In Vivo Diagnostic Substances	3764	Guided Missiles and Space Vehicle Propulsion Units and Propulsion Unit Parts
2836	Biological Products, Except Diagnostic Substances	3769	Guided Missile and Space Vehicle Pars and Auxiliary Equipment, Not Elsewhere Classified
2869	Industrial Organic Chemicals, Not Elsewhere Classified	3812	Search, detection, Navigation, Guidance, Aeronautical, and Nautical Systems and Instruments
3571	Electronic Computers	3821	Laboratory Apparatus and Furniture
3572	Computer Storage Devices	3822	Automatic Controls for Regulating Residential and Commercial Environments and Appliances
3575	Computer Terminals	3823	Industrial Instruments for Measurement, display, and Control
3577	Computer Peripheral Equipment, Not Elsewhere Classified	3824	Totalizing Fluid Meters and Counting Devices
3578	Calculating and Accounting Machines, Except Electronic Computers	3825	Instruments for Measuring and Testing of Electricity and Electrical Signals
3579	Office Machines, Not Elsewhere Classified	3826	Laboratory Analytical Instruments
3596	Scales and Balances, Except Laboratory	3841	Surgical and Medical Instruments and Apparatus
3625	Relays and Industrial Controls	3844	X-Ray Apparatus and Tubes and Related Irradiation Apparatus
3629	Electrical Industrial Apparatus, Not Elsewhere Classified	3845	Electromedical and Electrotherapeutic Apparatus
3661	Telephone and Telegraph Apparatus	7371	Computer Programming Services
3663	Radio and Television Broadcasting and Communications, Equipment	7372	Prepackaged Software
3669	Communications, Equipment, Not Elsewhere Classified	7373	Computer Integrated Systems Design
3671	Electron Tubes	7374	Computer Processing and Data Preparation and Processing Services

Appendix I
continued

"High Technology" Industry Classifications, Wisconsin Entrepreneurial Climate Study, 1992-1993			
SIC	Industry Description	SIC	Industry Description
3674	Semiconductors and Related Devices	7375	Information Retrieval Services
3675	Electronic Capacitors	7376	Computer Facilities Management Services
3676	Electronic Resistors	7378	Computer Maintenance and Repair
3677	Electronic Coils, Transformers, and Other Inductors	7379	Computer Related Services, Not Elsewhere Classified
3678	Electronic Connectors	8071	Medical Laboratories
3679	Electronic Components, Not Elsewhere Classified	8731	Commercial Physical and Biological Research
3695	Magnetic and Optical Recording Media	8732	Commercial Economic, Sociological and Educational Research
3699	Electrical Machinery, Equipment, and Supplies, Not Elsewhere Classified	8733	Noncommercial Research Organizations
3721	Aircraft	8734	Testing Laboratories
3724	Aircraft Engines and Engine Parts		

Source: Reynolds and White (1995).

Appendix II

Available External Assistance Types,
Wisconsin Entrepreneurial Climate Study, 1992-1993 (Alphabetical Listing)

Accounting assistance; Business advocacy groups; Business incubator; Business feasibility review; Business plan development; Business start-up or expansion; Continuing education courses; Financial counseling; Information on financing resources; General business management; Government procurement assistance (assistance in selling to government); Information on laws and regulations; Information systems assistance; International trade assistance; Manufacturing systems technical; Marketing-demographic profiles; Marketing program assistance; Marketing research assistance; Minority business assistance; Networking-making contacts; Patent and trademark assistance; Retail/service business location; Site location assistance; Technology development assistance; Tourism business assistance; Women's business assistance.

Source: Reynolds and White (1995).