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Entrepreneurial Uncertainty and Expert Evaluation: An Empirical Analysis

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Abstract. This paper empirically examines the evaluations of 537 ventures in high-growth industries performed by 251 experienced entrepreneurs, investors, and executives. These experts evaluated ventures by reading succinct summaries of the ventures without meeting the founding teams, and their evaluations were not disclosed to the entrepreneurs. We find that experts can differentiate among early-stage ventures on grounds of quality beyond the explicit venture and entrepreneur characteristics contained in the written summaries. They can only do so effectively, however, for ventures in the hardware, energy, life sciences, and medical devices sectors; they cannot do so for ventures in the consumer products, consumer web and mobile, and enterprise software sectors. Our results highlight sector-specific heterogeneity in the information needed to effectively screen ventures, a finding that has implications for the design of optimal investment strategies.

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Keywords: entrepreneurial uncertainty • early-stage firms • screening • expert evaluation • venture financing

1. Introduction

The uncertainty associated with early-stage ventures poses serious challenges for financial intermediaries (Hall and Lerner 2010). Because new ideas defy existing norms and principles, they are inherently difficult to evaluate (Arrow 2012). Even successful investors assert that screening early-stage venture ideas is a noisy process.[1] This sentiment accords with the empirical observation that, among ventures selected by venture capitalists (VCs) for investment, the vast majority fail (Hall and Woodward 2010). The selection preferences of VCs and angel investors—that is, the criteria by which they invest—are well studied (Quindlen 2000, Gompers and Lerner 2001, Bernstein et al. 2017). In contrast, systematic evidence on the effectiveness of screening early-stage ventures is scant, primarily because early-stage ventures that elicit positive evaluation from investors subsequently receive additional resources (e.g., funding, professionalization) that positively influence their trajectories.[2] External evaluation may also alter the amount of effort that entrepreneurs expend on their ventures, resulting in a self-fulfilling prophecy.[3] Understanding the feasibility of idea screening has implications for optimal investment strategy: when screening is ineffective, investors should consider alternative approaches such as "spray and pray" (Kerr et al. 2014b, Nanda and Rhodes-Kropf 2015, Ewens et al. 2018). Building on the insight that a venture's idea quality may be ex ante unobservable, the theoretical literature emphasizes the importance of experimentation and tolerance for early failure in venture financing (Bergemann and Hege 1998, Manso 2011).

This paper provides new empirical evidence on the feasibility of idea screening. We examine whether experienced entrepreneurs, seasoned investors, and start-up experts can effectively evaluate the commercial viability of early-stage ventures in high-growth sectors by reviewing succinct summaries of the ventures without meeting the founding teams. In our empirical setting, expert evaluation is unlikely to influence start-up outcomes via resource allocation or the entrepreneurs' behavior: all the entrepreneurs have access to the same resources, and the evaluation itself is not disclosed. We find that experts can differentiate among early-stage ideas on grounds of quality. However, we also find important variation in the effectiveness of evaluation across venture sectors.

Our empirical setting is the Massachusetts Institute of Technology (MIT) Venture Mentoring Service (VMS), a free educational service that provides advice and mentorship to aspiring MIT-affiliated entrepreneurs

(alumni, researchers, and students). As a research university with a rich history in entrepreneurship (Roberts et al. 2015), MIT provides an appropriate context to source early-stage, high-growth venture ideas. We examine the evaluation of these nascent ventures by a pool of mentors affiliated with VMS.

We collected detailed data on 251 mentors active at VMS between 2005 and 2012. Nearly 70% have start-up founding experience; almost half have start-up investing experience (although, importantly, not while serving as mentors).[4] Fully 80% of the sample has either founding or investing experience. The remaining 20% have worked closely with start-ups by providing functional services (e.g., legal or accounting assistance). The median mentor holds a master's or professional degree and has more than 20 years of professional experience at the beginning of our sample period.

Each month, these mentors receive a digest consisting of concise summaries of ventures recently enrolled at VMS; the summaries are typically drafted by the same VMS staff member and adhere to a standardized structure. On the strength of these summaries alone without meeting the entrepreneurs, mentors decide whether to express interest in mentoring particular ventures. Although an expression of interest does not necessarily lead to a mentoring relationship, it indicates a mentor's willingness to commit time and effort to helping a venture, and mentors do not do so lightly. We use the expression of interest to measure a mentor's subjective evaluation of a venture.

We collected 537 summaries of early-stage, high-growth ventures that mentors reviewed during the sample period. The average summary describes the venture in 182 words: 88 words on its value proposition, 78 words on its status, and 16 words on its founding team. Using these summaries, we coded an extensive list of observed venture characteristics at VMS entry, including venture sector, maturity, equity funding, patenting, origins in academic research, and the education and professional experience of the founding team. The ventures are distributed across the consumer products (13%), consumer web/mobile (32%), enterprise software (19%), hardware/energy (21%), and life sciences/medical devices (15%) sectors. At VMS entry, the majority of the ventures in our sample (58%) are in the concept stage, yet to make concrete progress toward building their product or service; the remainder (42%) report early-stage prototyping and business development but are not fully operational or in business. Despite their nascent nature, these ventures are serious endeavors, not recreational pursuits. At VMS entry, the median prospective entrepreneur's age is late 20s with a graduate degree in science or engineering. In 54% of cases, the entrepreneurs subsequently pursued their ventures full time, forgoing conventional employment and attractive salaries. By 2017, the ventures in our sample had jointly raised nearly $2 billion in venture financing; nearly 28% had achieved commercialization (defined as having recurring revenue and expenses associated with the sale of products and/or services in keeping with the company's business objective).

Our empirical analysis uses panel data at the mentor–venture level to examine how mentors express interest. We first show that mentors are selective in their expressions of interest and do not express interest at random. The average mentor expressed interest in only 4.4% of the summaries that the mentor reviewed. Mentors are systematically more likely to express interest in ventures in the industry sector in which their own experience is concentrated. They are also more likely to express interest in ventures whose summaries indicate evidence of equity funding, plans for intellectual-property (IP) protection, or origins in academic research. None of the reported characteristics of the founding team had a significant influence on mentor interest.

We use a venture's subsequent achievement of commercialization as a proxy for unobserved venture quality. Controlling for the observed venture-summary characteristics and including mentor fixed effects, we find a positive and statistically significant relationship between mentors' expression of interest and ventures' subsequent achievement of commercialization. Ventures that subsequently achieved commercialization are 11% more likely to elicit mentor interest at VMS entry. This result indicates that mentors *can* extract valuable signals on a venture's commercial viability from its written summary—beyond simply recognizing venture characteristics that can be readily codified.

An alternative explanation for our finding is that mentor interest influences a venture's achievement of commercialization via its access to mentoring resources and/or the entrepreneurs' effort. Section 2 discusses several institutional factors that counter this interpretation. In brief, VMS provides entrepreneurs with equal access to its mentoring resources: regardless of the collective mentor interest elicited, each venture is assigned to an initial mentor team standardized in size (between two and four mentors). Entrepreneurs dictate how much mentoring they receive, and neither mentors nor entrepreneurs are told how much interest a venture has elicited. In robustness checks, we show that our key findings hold when we exclude ventures eliciting either very high or very low collective mentor interest. They also hold within the set of ventures that had limited interactions with mentors. We further demonstrate that mentors are recognizing high-quality ideas as opposed to merely excluding nonserious ideas. We also show that mentors are not

simply inferring entrepreneurs' characteristics from the written summaries or predicting the preferences of angel investors and venture capitalists.

Finally, we find important heterogeneity in the link between mentor interest and venture quality by venture sector. Among ventures in research and development (R&D)–intensive sectors (hardware, energy, life sciences, and medical devices), mentor interest is positively and significantly associated with subsequent commercialization. This relationship is particularly strong within the set of ventures in these sectors whose summaries indicate plans for IP protection and/or origins in academic research. By contrast, we find no evidence that mentors can effectively screen ventures in non-R&D-intensive sectors (consumer products, consumer web/mobile, and enterprise software) regardless of a venture's possession of intellectual assets. These findings suggest that the information needed to effectively screen early-stage ventures differs by sector. In R&D-intensive sectors, succinct written summaries drafted at an early stage could provide valuable information about a venture's commercial viability. In non-R&D-intensive sectors, effective screening may be impractical or may require additional and/or different information than that provided in our context. Industry sector should, therefore, be an important determinant of how early-stage investors design their screening and investment strategies.

This paper contributes to a growing body of empirical evidence on the efficacy of screening early-stage ventures in both developed (Astebro and Elhedhli 2006, Howell 2018) and developing economies (Fafchamps and Woodruff 2016, McKenzie and Sansone 2017). Our focus on the earliest stage in a venture's life cycle is noteworthy because young firms are increasingly attracting resources from early-stage financial intermediaries (Cohen and Hochberg 2014). By demonstrating the feasibility of screening based on succinct summaries drafted at an early stage, our results are consistent with prior evidence on the centrality of a venture's core business idea in venture development (Kaplan et al. 2009). Our work is also related to empirical studies on expert evaluation and resource allocation in other contexts, such as scientific research proposals (Li and Agha 2015, Boudreau et al. 2016), theater crowdfunding campaigns (Mollick and Nanda 2015), household consumer products (Kornish and Ulrich 2014), and movie scripts (Goetzmann et al. 2012, Luo 2014).

2. Data and Setting

In 2000, MIT established the Venture Mentoring Service to promote entrepreneurship and innovation within the MIT community. The program provides volunteer mentors for prospective entrepreneurs (e.g., alumni, researchers, and students) affiliated with MIT.[5] Confidentially and at no cost to the prospective entrepreneurs, the mentors—largely experienced MIT-affiliated entrepreneurs themselves—provide tailored advice on the prospective entrepreneurs' venture ideas, which are often still in an early form. The VMS model has subsequently been adopted by more than 40 institutions worldwide, including Harvard University, Yale University, Columbia University, and New York University. Given its educational emphasis, VMS imposes only minimal requirements on prospective entrepreneurs: they must possess an idea worthy of a serious commitment to learning about entrepreneurship, be affiliated with MIT, and live in the greater Boston area. We collect data on 251 mentors and 537 ventures actively involved with VMS between 2005 and 2012.[6]

2.1. Sample of Mentors

VMS mentors are experts in business formation and business development; they have typically acquired entrepreneurial experience by founding and growing a new company, leading a new business initiative at an established company, or providing functional services (such as finance, accounting, legal, or human resources) to start-ups. The VMS program carefully constructed its network of mentors; the mentors possess relevant business experience and knowledge, ability to communicate with entrepreneurs, and willingness to make a nontrivial commitment of time (typically more than 100 hours annually). Interviews indicate that mentors' most common motivations for participating are the intellectual appeal of mentoring, engagement in the greater Boston entrepreneurship community, and the satisfaction of promoting the development of new entrepreneurs. VMS screens prospective mentors to minimize conflicts of interest.[7] Every accepted mentor must also agree to a rigorous code of ethics; the program monitors mentors' activity and promptly dismisses any mentor who violates these principles. VMS is managed by a small team of full-time staff members, including two mentors-in-residence who interact with most of the prospective entrepreneurs; we exclude them from our analysis.

During our 2005–2012 sample period, the pool of active mentors increased from 68 to 181, for a total count of 251. We collected information on mentors' backgrounds using the biographies they submitted to VMS and, when available, their LinkedIn profiles. Table 1 reports the mentors' mean professional and demographic characteristics. Not surprisingly, the majority (68.1%) had founded a firm or been a member of a founding team. Nearly half had invested in start-ups, either as venture capitalists or as angel investors. Collectively, 78.9% had experience as an entrepreneur or an investor in start-ups. The remaining 21.1% were

Table 1. Mentor Characteristics ($N = 251$)

	Percentage of total
Entrepreneurial experience	
Start-up founding experience	68.1
Start-up investing experience	47.8
Start-up founding or investing experience	78.9
Primary industry sector experience	
Consumer products	2.4
Consumer web/mobile	7.2
Enterprise software	20.7
Hardware/energy	29.9
Life sciences/medical devices	21.5
Other	18.3
Primary functional expertise	
Business development	28.3
Finance, accounting, legal, or human resources	21.9
Operations	8.0
Research, product development	21.9
Sales, marketing	19.9
Demographics and education	
Male	85.3
Bachelor's degree before 1970	28.7
Bachelor's degree between 1970 and 1980	29.1
Bachelor's degree between 1980 and 1990	30.7
Bachelor's degree after 1990	11.6
Doctoral degree	23.1
Master's degree, no doctoral degree	61.4
No graduate degree	15.5

typically functional experts who had worked extensively with start-ups.

To capture the expertise of the mentor pool in a more fine-grained way, we specify the industry or functional role in which each mentor had spent the most time (as self-reported or extracted from online career histories in 2014). The three most populous sectors are hardware and energy (29.9%), life sciences and medical devices (21.5%), and enterprise software (20.7%). The three most common areas of functional expertise are business development (28.3%); research and product development (21.9%); and finance, accounting, legal, or human resources (21.9%).

Most of the mentors hold a graduate degree: 23.1% have earned a doctoral degree (e.g., PhD or MD), and 61.4% hold a master's or professional degree (e.g., MS or MBA). In 2005, the beginning of our sample period, the majority of mentors had more than 20 years of professional experience (extrapolating from the dates of their bachelor's degrees). Around 85% of mentors are male.

2.2. Sample of Venture Summaries

Mentors rely on concise, standardized venture summaries to determine their interest in committing time to specific ventures.[8] A VMS staff member drafts each summary based on a venture's initial application and a follow-up phone interview. A venture summary focuses on the venture's proposed value proposition—that is, the problem to be solved and the customer segments to be targeted. The summary also describes the progress the venture has already made, such as whether it is still at the conceptual stage or has built a prototype product or service. It may or may not mention the backgrounds of the entrepreneurs (e.g., PhD researchers building out technology originally developed in a laboratory). The summaries are written in plain language and are standardized to exclude subjective commentary.

We collected venture summaries from the archived monthly summary reports emailed to the mentors between 2005 and 2012.[9] We then constructed the venture sample for our analysis using the following criteria: First, we excluded a small number of ventures founded by MIT faculty, whose standing in the university ecosystem might have led to distinct mentorship experiences. Second, we restricted our analysis to ventures in high-growth sectors consistent with the sectors in which angel investors and VCs typically invest; in doing so, we excluded a small number of nonprofit, consulting, and social-enterprise ventures. Finally, we excluded ventures whose summaries indicated that they were already operational or had successfully commercialized before VMS entry; such ventures were seeking mentorship focused on scaling, not building, a venture. Our resulting venture sample consists of 537 ventures.[10]

Table 2, panel A, describes the summaries; panel B provides details on their content. The summaries are concise, averaging 182.1 words, with a standard deviation of 39.2 words. To quantify the content of the summaries, we manually decomposed each summary into subsegments describing the venture's value proposition, the venture's status, and the founding team's human capital. Two annotated anonymized examples appear in Table A.1. Consistent with the stated drafting process, the summaries prioritize discussion of the value proposition (which typically accounts for 88.2 words or around 48.4% of the total length). We identified the primary industry sector in which a venture planned to operate by drawing on the language in the value proposition. As Table 2, panel B, shows, the three most populous sectors were consumer web/mobile (31.8%), hardware/energy (21.0%), and enterprise software (19.2%).

The mean length of the section on the venture's status is 78.3 words—almost as long as the value-proposition section. Using keyword search and manual inspection, we constructed five variables to depict the progress and traction of a venture at the time of VMS entry. We consider a venture to be in the conception stage if the summary indicates that it is still merely an idea; the summaries often say so explicitly, using phrases such as "still an idea," "just a concept," and

Table 2. Venture Summaries, Descriptive Statistics (N = 537)

Panel A: Characteristics of summaries				
	Mean	Standard deviation	Minimum	Maximum
Year when venture summary was written	2009.9	2.0	2005	2012
Month when venture summary was written	6.4	3.4	1	12
Word count, complete venture summary	182.1	39.2	89	339
Word count, subsection on value proposition	88.2	24.8	15	174
Word count, subsection on venture status	78.3	32.1	19	215
Word count, subsection on founding team	15.5	12.3	0	55

Panel B: Venture characteristics reported in summaries	
	Percentage of total
Sector	
Consumer products	13.2
Consumer web/mobile	31.8
Enterprise software	19.2
Hardware/energy	21.0
Life sciences/medical devices	14.7
Status	
In the conception stage	58.3
In the business-planning stage	41.7
Has equity funding	4.3
Has plans for intellectual-property protection	29.8
Originates in academic research	24.0
Founding team	
Summary mentions founding team	80.6
Summary mentions undergraduates	4.8
Summary mentions MBAs/master's	19.9
Summary mentions PhDs/postdocs	22.9
Summary mentions relevant industry experience	19.4
Summary mentions prior startup founding experience	14.3

"design only." In the absence of such explicit indicators, we looked for evidence of whether a venture had made concrete progress toward developing its business, such as having built a prototype or conducted a pilot test. If a venture had not finished building a prototype or performed alpha/beta testing, we classified it as in the conception stage.[11] We assigned a venture to the business-planning stage if it had taken explicit steps to develop the product or service. In our sample, the ratio of ventures in the conception stage to those in the business-planning stage is 58.3% to 41.7%.

We also identified measures of traction on fundraising and technological progress. Unsurprisingly, equity funding is rare given the ventures' nascent nature at VMS entry (4.3%). We considered a venture to have plans for intellectual property (29.8%) if it was considering filing for intellectual-property protection (including cases in which IP protection had already been filed or was in the process of being filed). A venture was designated as having originated in academic research (24.0%) if the summary explicitly linked it to technology developed at a university (usually MIT).[12]

The text describing the founding team is the briefest with a mean length of 15.5 words; nearly 20% of the summaries do not mention the founding team at all. When the founding team is mentioned, the text typically confirms that the team possesses the relevant experiences and skills to move the venture forward. Sometimes the summaries specify the founding team's educational background, noting, for instance, that the team includes MIT undergraduates (4.8%), MBA/master's students or alumni (19.9%), and/or PhD or postdoc students or alumni (22.9%). Around 20% of the summaries report that the team members have relevant industry experience, and 14.3% indicate prior founding experience.

To collect additional information on the demographics of the prospective entrepreneurs, we combined LinkedIn profiles, MIT alumni directory profiles, and VMS archival records. Table A.2 provides mean statistics on the 409 prospective entrepreneurs about whom we found information. More than 80% are male. We inferred age from the year when a prospective entrepreneur received a bachelor's degree; more than three quarters were older than 25 at VMS entry. The most populous age group is 25–29. The vast majority

of the prospective entrepreneurs had received a graduate degree by the time they brought their ventures to VMS, either doctoral (29.3%) or master's/professional (49.9%). Nearly 67% had majored in engineering in college.

2.3. Expression of Mentor Interest

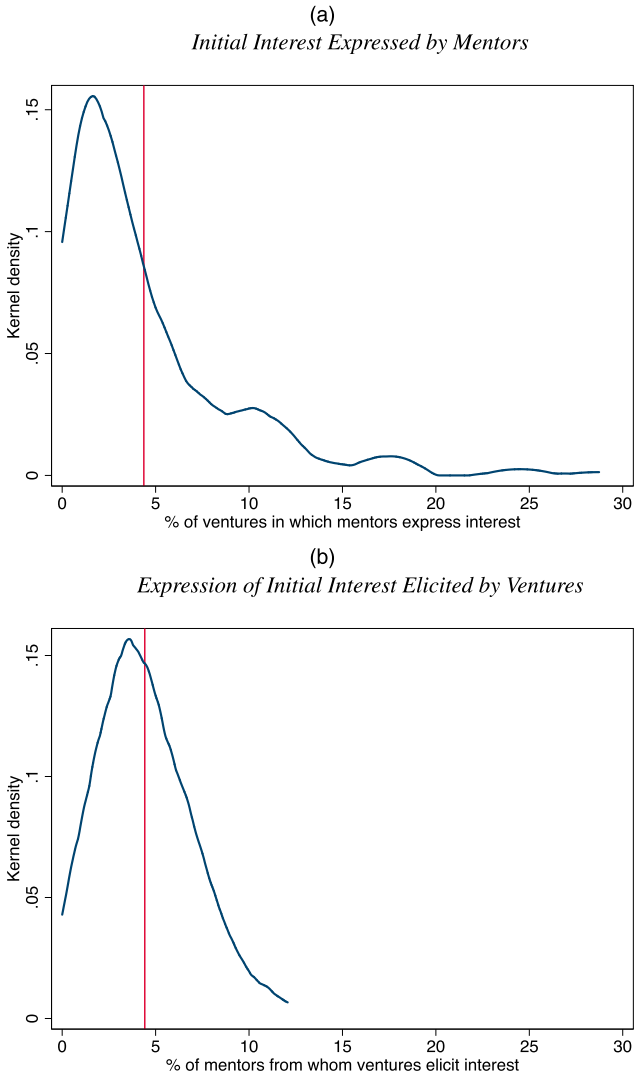
During the sample period, mentors could receive and respond to venture summaries in two ways. First, each month, the mentors received an email digest containing the full summaries of new ventures seeking mentorship; interested mentors could respond by email. Second, mentors could also attend a monthly meeting at which the summaries were delivered both in print and orally; they could indicate interest on paper. Mentors evaluated ventures independently; their responses were kept private, and only VMS staff was aware of the aggregate level of interest in each venture.

Solely on the basis of the venture summaries, mentors expressed interest in mentoring specific ventures. This was a selective process. Figure 1(a) shows that, on average, mentors expressed interest in fewer than 5% of the ventures whose summaries they received. The average mentor received 305.1 summaries and expressed interest in 13.3 of them. Conversely, Figure 1(b) shows that, on average, ventures received expressions of interest from fewer than 5% of the mentors who received their summaries. The average venture summary was reviewed by 142.6 mentors and received expressions of interest from 6.2 of them.

VMS typically compiled the initial mentor team of a venture, drawing on the subset of mentors who expressed interest in the venture.[13] For educational reasons, the program was structured to provide entrepreneurs equal access to mentoring resources regardless of the potential of their idea. Each initial mentor team was limited in size to a minimum of two and a maximum of four mentors (excluding VMS staff members). Mentor interest was used solely to facilitate the initial matching process, not as an internal metric to evaluate ventures nor to restrict access to mentoring. Because more mentors typically expressed interest than could join a mentor team, the initial mentor team consisted of a semi-random subset of interested mentors. VMS assembled this team in light of a set of factors that included mutual scheduling constraints and balancing mentors' loads.[14] Figure A.1 summarizes the standardized venture–mentor pairing procedure employed by VMS during our study period.

Prospective entrepreneurs did not learn about the collective mentor interest they had attracted, nor did they select their initial mentor team. They did, however, control the extent of the mentoring they received because they were responsible for requesting meetings based on their own needs (VMS attempted to accommodate all requests). Figure A.2(a) plots

Figure 1. Distribution of Mentors' Initial Interest in Ventures



Notes. Panel a plots the kernel density of the proportion of ventures in which mentors express interest; the unit of observation is a mentor. Panel b plots the kernel density of the proportion of mentors from whom ventures elicit interest; the unit of observation is a venture. The red lines plot the sample means.

the distribution of the number of VMS-facilitated meetings that a venture had held as of June 2017. More than half of the ventures had held no more than two meetings with VMS. The average venture met with VMS fewer than four times. This pattern shows that, for an average venture, VMS is unlikely to have become as heavily involved in its development as a typical investor.

Furthermore, given the ad hoc nature of the entrepreneur-initiated meetings, the entire mentor team might not have been able to attend each meeting. Thus, it is even less likely for a venture to have met with a specific mentor repeatedly. Figure A.2(b) shows that, among all the mentor–venture pairs

in which the mentor had expressed interest in the venture, 56% had never had a VMS-facilitated meeting as of June 2017. Around 86% of the mentor–venture pairs had met no more than twice.

2.4. Venture Milestones and Outcomes

We collected data on milestones reached and outcomes achieved by the ventures in our sample as of August 2017. We did so, first, by searching the venture and the prospective entrepreneur on Google, AngelList, CrunchBase, and LinkedIn.[15] Because VMS checks in regularly with ventures to assure that its records on their status are up to date, we then verified the results of our public searches with VMS internal records.

We considered three milestones and outcomes, which Table 3 reports. The first is whether the prospective entrepreneur had made a full-time commitment to the venture. At VMS entry, the median entrepreneur in our sample was in the entrepreneur's late twenties, held a graduate degree in engineering (usually from MIT), and likely had attractive conventional employment options.[16] Forgoing such options to pursue entrepreneurship full time, thus, signifies a serious commitment to the venture. Of the 537 ventures in our sample, 288 (53.6%) had the entrepreneur's full-time commitment.

Our second milestone was whether a venture had received angel/VC funding. We searched public fundraising records on AngelList and CrunchBase and used VMS archival data to track very early-stage seed investments that CrunchBase might have missed. A total of 149 ventures in our sample had received angel/VC funding; they had jointly raised around $1.98 billion in venture financing by August 2017.

Our third milestone and key outcome of interest was whether a venture had successfully reached commercialization, characterized by recurring revenue and expenses associated with sales of the products and/or services that embody the company's business objective. Our definition of commercialization excludes revenue from one-off "consulting services," which are often employed as bootstrap financing vehicles but may diverge from the primary business objective. Simply put, commercialized ventures have been validated by the market and have a reasonable expectation of repeat business and new customers.[17]

To determine whether a venture had achieved commercialization, we looked for concrete evidence of repeat sales of products and/or services. We consider a business-to-consumer venture to be commercialized if at least one of the following conditions is met: (1) the venture has a well-developed e-commerce site on which customers can readily purchase its products;[18] (2) the venture has customer reviews on third-party retailers (e.g., Amazon.com), third-party review websites (e.g., Yelp), or social-media websites (e.g., Facebook); or (3) the venture has customer and/or sales metrics reported on its website, in press releases, or in news articles. A small number of ventures have had successful crowdfunding (e.g., Kickstarter) campaigns, whereby potential customers commit up front to purchase a product. We consider those ventures to be commercialized only if the venture delivered its products.

We consider a business-to-business venture to be commercialized if at least one of the following conditions is met: (1) the venture distributes press releases reporting sales partnerships; (2) the venture has a sales team; or (3) the venture has customer and/or sales metrics reported on its website, in press releases, or in news articles. In the rare cases of business models based on licensing (according to the venture summary or public sources), we consider technology-licensing deal(s) as commercialization.

Figure A.3 provides four examples of evidence of commercialization. In two cases, the ventures' websites disclose explicit information on their customers and sales; the other two cases entail sales partnerships with established companies. Overall, around 28% of the ventures in our sample (149 ventures) ultimately achieved commercialization.[19] Notably, of those that reached commercialization, a nontrivial proportion (34% or 50 ventures) did so without raising funding from professional investors.[20]

3. Empirical Strategies and Main Results

3.1. Empirical Strategies

We examine the degree to which a venture's innate quality drives expert evaluation. To motivate our analysis, assume that, at VMS entry, a venture j has innate quality q_j, which determines its probability of subsequent commercialization, and that a mentor i has an internal score s_{ij} for venture j, which determines

Table 3. Venture Milestones as of August 2017 (N = 537)

	Percentage of total
Full-time commitment from entrepreneurs	53.6
Equity funding from angel/VC	27.7
Commercialization	27.7
Commercialization with equity funding from angel/VC	18.4
Commercialization without equity funding from angel/VC	9.3

the mentor's expression of interest. Ideally, if q_j and s_{ij} were both observable to the researcher, one could estimate the equation $s_{ij} = \beta q_j + \varepsilon_{ij}$. The parameter of interest, β, is the average weight that mentors assign to the innate quality of a venture in their evaluation; ε_{ij} is the error term that is uncorrelated with venture quality.

Two key factors influence the sign and magnitude of β: mentors' ability to discern quality and their willingness to use it in their evaluations. The ability to discern quality, in turn, depends on the uncertainty that ventures face (i.e., whether quality is observable at an early stage) and on the written summaries' informativeness about quality. A positive β would imply that mentors are able to differentiate ventures based on the written summaries *and* that they use quality to (at least partially) determine their interest. A negative β would suggest that mentors intentionally express interest in ventures that they perceive as lower quality (or that mentors are entirely incorrect in assessing quality). In the case of a zero β, a range of possibilities exists: that innate quality is simply unobservable because of high uncertainty, that succinct written summaries do not contain useful information about quality, or that mentors form their evaluations based on characteristics of ventures that are unrelated to quality.

In the absence of data on q_j and s_{ij}, we approximate s_{ij} using a mentor's expression of interest in a venture, and we approximate q_j using a venture's subsequent outcome and observed characteristics noted in the written summary. We estimate the following specification:

$$\begin{aligned} &Pr(\text{Interest}_{ij}) \\ &\quad = \alpha + \delta * \text{Commercialization}_j \\ &\qquad + \theta\{\text{Both in Same Sector}_{ij}\} \\ &\qquad + \gamma * \{\text{Venture Summary Characteristics}_j\} \\ &\qquad + \sigma\{\text{Mentor Fixed Effect}_i\} + \varepsilon_{ij}, \end{aligned} \tag{1}$$

where i denotes a mentor and j denotes a venture; Interest_{ij} is one if mentor i expresses interest in venture j and zero otherwise. The sample includes all mentor–venture pairs in which the mentor was active when the venture joined VMS.

We control for whether the mentor and the venture are in the same sector and for the venture characteristics noted in the summary and described in both panels of Table 2. The inclusion of these controls serves two purposes. First, it helps illustrate mentors' decision-making process. Do mentors express interest randomly, or do they respond to codifiable signals about a venture's progress (e.g., having received equity funding)? Second, it enables us to examine whether mentors can evaluate the residual quality in a venture that is not captured by the codifiable information in the summary on venture progress and traction.

Our parameter of interest is δ, which measures whether mentors are ex ante more likely to express interest in ventures that are ex post more successful, controlling for observed venture summary characteristics. The key threat to identification is that mentor interest may directly influence a venture's probability of commercialization via resource allocation and/or entrepreneurs' behavior. This is unlikely to be the case because, as Section 2 points out, the educational nature of the program equalizes entrepreneurs' access to mentoring resources regardless of the potential of their ideas. Moreover, indication of interest does not necessarily lead to a mentoring relationship, and entrepreneurs, who dictate the degree of mentoring that they receive, are uninformed about the level of collective mentor interest that their ventures elicit. We perform several robustness checks to verify that variation in access to mentoring resources does not drive our key results.

A second threat to identification is that mentors may have heterogeneous effects on the outcomes of the ventures with which they interact. A positive correlation between Interest_{ij} and $\text{Commercialization}_j$ could, thus, be driven by some mentors' superior ability to help ventures achieve commercialization and by more frequent expressions of interest by such mentors than by other mentors. We address this threat by controlling for mentor fixed effects in our baseline specification.

Finally, although our outcome measures aim to capture a venture's subsequent performance, it is possible that some ventures, particularly those in the most recent 2011 and 2012 entry cohorts, were still in the process of achieving commercialization in summer 2017 when we collected our data. Thus, we may underestimate the likelihood that the ventures in our sample reach commercialization, biasing against finding a positive relationship between mentor interest and subsequent commercialization.

3.2. Baseline Results

Table 4 reports the results of estimating Equation (1) in linear probability model (LPM), probit, and logit. Because mentors reviewed venture summaries on a monthly basis, we cluster the standard errors by mentor and by the month and year of a venture's entry into VMS.

Column (1), which uses LPM and includes no controls, shows a strong and positive raw correlation between mentor interest and a venture's subsequent commercialization. On average, mentors are 14.9% more likely to express interest in ventures that subsequently commercialized (a 0.65 percentage-point increase over the baseline probability of 4.36%).

Table 4. Estimated Relationships Between Mentor Interest and Subsequent Commercialization

	Model					
	LPM (1)	LPM (2)	LPM (3)	Probit (4)	Logit (5)	LPM (6)
Venture subsequently achieved commercialization	0.0065*** (0.0017)	0.0048*** (0.0018)	0.0048*** (0.0018)	0.0048*** (0.0017)	0.0048*** (0.0017)	0.0047*** (0.0018)
Venture characteristics coded from summaries						
Venture and mentor in the same sector		0.0514*** (0.0029)	0.0552*** (0.0029)	0.0445*** (0.0020)	0.0438*** (0.0020)	0.0554***(0.0029)
Venture is in the business-planning stage		0.0024 (0.0016)	0.0024 (0.0016)	0.0029* (0.0015)	0.0027* (0.0015)	0.0024 (0.0015)
Venture has received equity funding		0.0112** (0.0045)	0.0113** (0.0045)	0.0086** (0.0034)	0.0082** (0.0033)	0.0114** (0.0044)
Venture has plans for intellectual-property protection		0.0053*** (0.0019)	0.0053*** (0.0019)	0.0051*** (0.0018)	0.0051*** (0.0018)	0.0053*** (0.0019)
Venture originates in academic research		0.0064*** (0.0024)	0.0064*** (0.0024)	0.0055*** (0.0021)	0.0054*** (0.0021)	0.0063*** (0.0023)
Summary mentions founding team		0.0007 (0.0046)	0.0007 (0.0046)	0.0008 (0.0045)	0.0015 (0.0046)	0.0007 (0.0045)
Summary mentions undergraduate students		0.0000 (0.0035)	−0.0000 (0.0035)	−0.0002 (0.0036)	−0.0007 (0.0037)	0.0001 (0.0035)
Summary mentions MBAs/Master's		0.0013 (0.0020)	0.0013 (0.0020)	0.0015 (0.0019)	0.0015 (0.0020)	0.0013 (0.0020)
Summary mentions PhDs/Postdocs		0.0015 (0.0022)	0.0015 (0.0022)	0.0015 (0.0020)	0.0012 (0.0020)	0.0014 (0.0021)
Summary mentions relevant industry experience		0.0010 (0.0022)	0.0010 (0.0021)	0.0012 (0.0021)	0.0012 (0.0021)	0.0010 (0.0021)
Summary mentions prior start-up founding experience		−0.0020 (0.0023)	−0.0021 (0.0023)	−0.0014 (0.0023)	−0.0018 (0.0023)	−0.0020 (0.0023)
Additional venture-summary characteristics	No	Yes	Yes	Yes	Yes	Yes
Mentor characteristics	No	No	Yes	Yes	Yes	No
Mentor fixed effects	No	No	No	No	No	Yes
Mean dependent variable	0.0436	0.0436	0.0436	0.0436	0.0436	0.0436
Number of observations	76,592	76,592	76,592	76,592	76,592	76,592

Notes. This table reports coefficient estimates from OLS, probit, and logit regressions in which the dependent variable indicates whether the mentor expressed interest in the venture. The unit of observation is a mentor paired with a venture that joined VMS when the mentor was active. Additional venture-summary characteristics consist of dummies for venture sector, year of affiliation with VMS, and month of affiliation with VMS as well as log (word count, subsection on value proposition), log (word count, subsection on venture status), and log (word count + 1, subsection on founding team). Mentor characteristics consist of dummies for mentors' entrepreneurial experience, primary industry sector experience, primary functional expertise, and demographics and education as described in Table 1. Standard errors (presented in parentheses) are robust and clustered by mentor, year of venture's affiliation with VMS, and month of venture's affiliation with VMS.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Column (2) adds venture-summary characteristics and an indicator for whether the mentor and the venture are in the same sector. In addition to the variables reported in the table, column (2) also includes dummy variables for venture sector, year joined VMS, month joined VMS, and the log word count of each of the three summary subsections (value proposition, venture status, and founding team).[21] The coefficient estimate on subsequent commercialization remains positive and significant, indicating that the inclusion of additional variables does not fully explain the relationship between mentor interest and subsequent commercialization. However, the magnitude of the coefficient estimate decreases from 0.65 percentage point to 0.48 percentage point. This decrease shows that mentors do not express interest at random and that they express interest based, in part, on venture-summary characteristics that are positively correlated with the probability of commercialization. We find that mentors are significantly more likely to express interest in summaries indicating equity funding, plans for intellectual-property protection, or origination in academic research. These results confirm what we learned from our field interviews: that the appeal of the underlying technology and/or business idea is a primary driver of mentors' interest in a venture. We also find that mentors are more likely to express interest in summaries from their own sectors.

The summaries' information about the founding team does not have any impact on mentors' expressions of interest. This finding does not imply that mentors regard human capital as inconsequential for entrepreneurial success. Instead, given our fairly homogeneous sample of entrepreneurs, it may be difficult to differentiate the founding teams in a meaningful manner using the limited information provided in the written summaries.

Column (3) adds the characteristics of mentors described in Table 1. Columns (4) and (5) report the marginal effects from estimating the same specification as column (3) in probit and logit, respectively. All three columns report estimates similar to those in column (2), suggesting that mentors' ability to evaluate venture quality does not systematically differ by the observed mentor characteristics (e.g., experience and demographics).

Finally, column (6) estimates our preferred specification in LPM, which controls for mentor fixed effects instead of mentor characteristics.[22] The coefficient estimates change little, which shows that our results are not driven by unobserved mentor characteristics (e.g., their ability to help ventures achieve commercialization). Controlling for whether the mentor and the venture are in the same sector, for venture-summary characteristics, and for mentor fixed effects, mentors are 10.8% more likely to express interest in ventures that subsequently commercialize (a 0.47 percentage-point increase from the baseline probability of 4.36%). The estimated relationship is statistically significant, and the magnitude is economically important: subsequent commercialization has an effect on mentor interest comparable to that of having plans for IP protection.

3.3. Robustness Checks and Extensions

Table 5 reports the results of our four robustness checks. Columns (1) and (2) address the concern that mentor interest influences subsequent commercialization through

Table 5. Estimated Relationships Between Mentor Interest and Subsequent Commercialization Across Different Robustness Checks

	Excluding ventures that elicited interest from more than 11 or fewer than 2 mentors (1)	Excluding ventures that met with mentors more than five times (2)	Excluding ventures that never received full-time commitment from entrepreneurs (3)	Controlling for prospective entrepreneurs' demographic information (4)
Venture subsequently achieved commercialization	0.0034* (0.0020)	0.0046** (0.0020)	0.0043* (0.0022)	0.0038* (0.0021)
Additional controls	Yes	Yes	Yes	Yes
Mean dependent variable	0.0419	0.0423	0.0470	0.0446
Number of observations	63,002	62,741	40,036	58,639

Notes. This table reports coefficient estimates from OLS regressions in which the dependent variable indicates whether the mentor expressed interest in the venture. The unit of observation is a mentor paired with a venture that joined VMS when the mentor was active. Each regression includes the full set of controls as in Table 4, column (6). Column (1) excludes ventures that elicited interest from more than 11 mentors (top decile) and ventures that received interest from fewer than two mentors (bottom decile). Column (2) excludes ventures that had more than five VMS-facilitated meetings (top quintile). Column (3) excludes ventures that never received full-time commitment from the prospective entrepreneurs. Column (4) includes only ventures in which additional demographic information on the prospective entrepreneurs is available (beyond the information included in the venture summaries), and it controls for prospective entrepreneurs' gender, age group, educational attainment, and undergraduate field of study. Standard errors (presented in parentheses) are robust and clustered by mentor, year of venture's affiliation with VMS, and month of venture's affiliation with VMS.

*$p < 0.10$; **$p < 0.05$.

mentor engagement. Column (1) excludes the ventures eliciting either very high or very low collective mentor interest. Although contrary to VMS principles, it is conceivable that the initial mentor teams of these outliers, although standardized in size, might behave differently in their interactions with the ventures, thereby influencing the amount of effort from the entrepreneurs. Column (2) excludes the ventures that had more than five VMS-facilitated meetings as of June 2017. The remaining ventures are, thus, unlikely to have large variations in the degree and/or quality of mentoring received. In both columns, the coefficient estimates on subsequent commercialization are statistically significant and have similar magnitudes as the baseline estimate in Table 4, column (6).

Column (3) includes only ventures that elicited full-time commitment from their prospective entrepreneurs (either at VMS entry or subsequently). Within this set of serious entrepreneurial pursuits, we still find that mentors are significantly more likely to express interest in ventures that subsequently achieved commercialization. The magnitude of the estimate is only slightly smaller than that of the baseline estimate. Therefore, it is not the case that mentors are simply differentiating between serious and nonserious ideas in their evaluation.

Column (4) adds as additional controls the prospective entrepreneurs' demographic information at VMS entry, described in Table A.2. Although the venture summaries do not systematically contain such information, mentors may be able to infer such information from the summaries and use it in their evaluations. Controlling for prospective entrepreneurs' demographic information has little impact on our key coefficient estimates. This result further supports the explanation that the relationship between mentor interest and a venture's subsequent commercialization is driven by mentors' interpretation of information about the venture idea rather than information about the founding team.

Table 6 explores the role of venture-capital financing. Instead of subsequent commercialization, column (1) uses equity funding as an alternative measure of venture quality. We find that mentors are significantly more likely to express interest in ventures that subsequently received angel or VC funding, suggesting that the VMS mentor pool resembles professional investors in tastes and/or criteria for quality. At the same time, columns (2)–(4) show that our key findings are not driven by mentors' predictions of the preferences of professional investors. In particular, column (4) excludes ventures that ever received angel and/or VC funding (at VMS entry or later), and the correlation between mentor interest and a venture's subsequent commercialization remains strong and significant.

4. Additional Analysis

Section 3 shows that mentors can interpret key signals about a venture's commercial viability from reading succinct summaries. Evaluating a venture at such an early stage requires assessing the uncertainty associated with the underlying idea. For instance, does the idea address a valid customer need? Is the underlying technology feasible? This section examines whether our findings differ on key determinants of the degree and nature of entrepreneurial uncertainty.

As a venture progresses through early stages—developing a business plan, building out prototypes, and/or conducting pilot testing—the entrepreneur may begin to resolve uncertain aspects of an idea or abandon ideas that seem impractical or infeasible. Thus, a venture's stage could impact the efficacy of idea screening. Figure 2(a) reports the coefficient estimates from a regression similar to Equation (1), but instead of using subsequent commercialization as our key independent variable, we interact subsequent

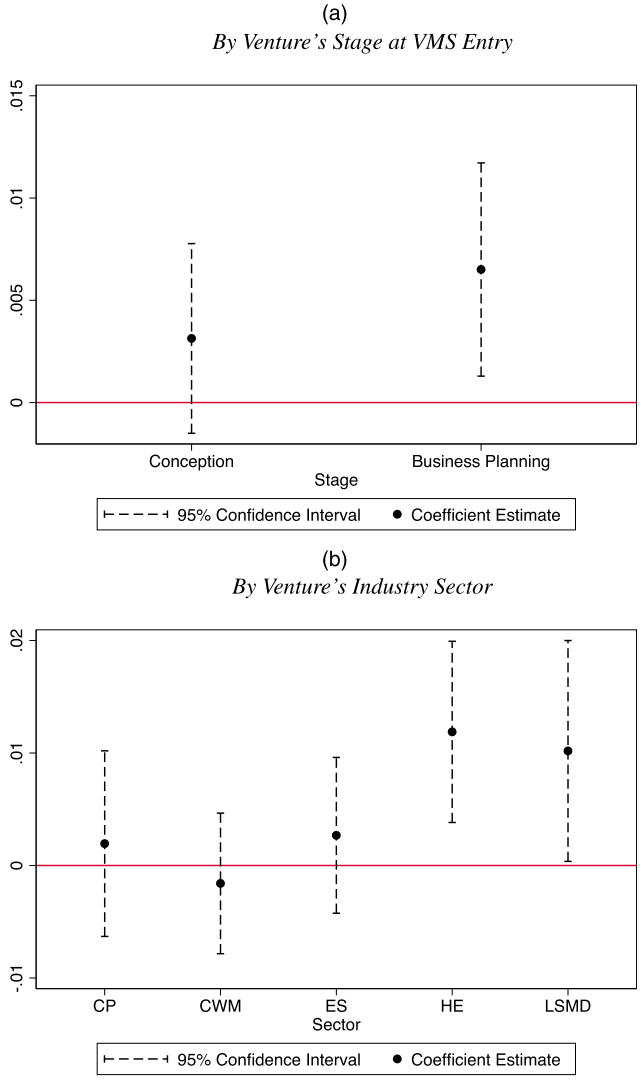
Table 6. Estimated Relationships Among Mentor Interest, Subsequent Equity Funding, and Subsequent Commercialization

	All ventures (1)	All ventures (2)	Including only ventures that subsequently received equity funding from angel/VC (3)	Including only ventures that did not subsequently receive equity funding from angel/VC (4)
Venture subsequently received equity funding from angel/VC	0.0044** (0.0019)	0.0027 (0.0021)		
Venture subsequently achieved commercialization		0.0034* (0.0021)	0.0055 (0.0038)	0.0062** (0.0027)
Additional controls	Yes	Yes	Yes	Yes
Mean dependent variable	0.0436	0.0436	0.0502	0.0411
Number of observations	76,592	76,592	20,620	55,972

Notes. This table reports coefficient estimates from OLS regressions in which the dependent variable indicates whether the mentor expressed interest in the venture. The unit of observation is a mentor paired with a venture that joined VMS when the mentor was active. Each regression includes the full set of controls as in Table 4, column (6). Columns (1) and (2) use the full sample. Column (3) includes only ventures that received angel/VC funding. Column (4) includes only ventures that did not received angel/VC funding. Standard errors (presented in parentheses) are robust and clustered by mentor, year of venture's affiliation with VMS, and month of venture's affiliation with VMS.

*$p < 0.10$; **$p < 0.05$.

Figure 2. Heterogeneity in Estimated Relationships Between Mentor Interest and Subsequent Commercialization by a Venture's Stage or by Its Industry Sector



Notes. These figures plot coefficient estimates and 95% confidence intervals from OLS regressions in which the dependent variable indicates whether the mentor expressed interest in the venture. The unit of observation is a mentor paired with a venture that joined VMS when the mentor was active. The coefficients plotted in panel a consist of the interaction terms between a venture's subsequent commercialization outcome and its stage as described in the written summary; both coefficients are estimated from the same regression. The coefficients plotted in panel b consist of the interaction terms between a venture's subsequent commercialization outcome and its industry sector as described in the written summary; all five coefficients are estimated from the same regression. The sectors are consumer products (CP), consumer web/mobile (CWM), enterprise software (ES), hardware/energy (HE), and life sciences/medical devices (LSMD). Each regression includes the full set of controls as Table 4, column (6). Standard errors (presented in parentheses) are robust and clustered by mentor, year of venture's affiliation with VMS, and month of venture's affiliation with VMS.

commercialization with a venture's stage at VMS entry (the conception stage or the business-planning stage). We then plot the coefficient estimates and confidence intervals for the two interaction terms. Among ventures in the conception stage, subsequent commercialization and mentor interest have a positive but insignificant relationship. In contrast, among ventures in the business-planning stage—which had taken concrete steps (such as prototyping or pilot testing) to resolve the uncertainty associated with their idea—the estimated relationship is strongly positive and statistically significant. The differences between the two coefficient estimates, however, are not statistically significant (F-stats = 0.91).

The industry sector in which a venture plans to operate may also affect the nature of the uncertainty it faces at an early stage and consequently the feasibility of idea screening. For instance, a venture that plans to develop a new treatment for an existing medical condition may face high technological and regulatory uncertainty, but the potential market may be known and well understood. In contrast, a venture that aims to develop a new consumer product may face minimal technological barriers, but may need to identify or even create new market demand. Figure 2(b) interacts subsequent commercialization with a venture's sector as classified based on the value proposition described in the venture summary. We find that the estimated relationship is weak and insignificant for ventures in the consumer products, consumer web/mobile, or enterprise software sectors. By contrast, it is positive and significant for ventures in the hardware/energy or life sciences/medical devices sectors. The coefficient estimates are significantly different in an F-test between hardware/energy and, respectively, consumer products, consumer web/mobile, and enterprise software. They also differ significantly between life sciences/medical devices and consumer web/mobile.

Furthermore, venture stage and sector may interact in influencing the feasibility of idea screening. Table 7 reports the results of interacting subsequent commercialization with both variables. Following the National Science Foundation (2006), we define hardware/energy and life sciences/medical devices as R&D-intensive sectors and consumer products, consumer web/mobile, and enterprise software as non-R&D-intensive sectors. We find that our key results are largely driven by ventures in R&D-intensive sectors that have made concrete progress toward developing their product or service. Among ventures in R&D-intensive sectors that are still in the conception stage, the estimated relationship is less strong but still

Table 7. Heterogeneity in Estimated Relationships Between Mentor Interest and Subsequent Commercialization by a Venture's Stage and Industry Sector

	(1)
Venture subsequently achieved commercialization × In the conception stage × In non-R&D-intensive sectors	0.0009 (0.0028)
Venture subsequently achieved commercialization × In the business-planning stage × In non-R&D-intensive sectors	0.0012 (0.0029)
Venture subsequently achieved commercialization × In the conception stage × In R&D-intensive sectors	0.0069* (0.0039)
Venture subsequently achieved commercialization × In the business-planning stage × In R&D-intensive sectors	0.0166** (0.0047)
Additional controls	Yes
Number of observations	76,592

Notes. This table reports coefficient estimates from a single OLS regression in which the dependent variable indicates whether the mentor expressed interest in the venture. The unit of observation is a mentor paired with a venture that joined VMS when the mentor was active. The regression includes the full set of controls as in Table 4, column (6). R&D-intensive sectors consist of hardware/energy and life sciences/medical devices. Non-R&D-intensive sectors consist of consumer products, consumer web/mobile, and enterprise software. Standard errors (presented in parentheses) are robust and clustered by mentor, year of venture's affiliation with VMS, and month of venture's affiliation with VMS.

*$p < 0.10$; **$p < 0.05$.

positive and significant. In contrast, among ventures in non-R&D-intensive sectors in either stage, mentor interest has only a weak and insignificant relationship with ventures' subsequent commercialization. Figure 2 and Table 7, thus, indicate that industry sector plays a crucial role in determining whether mentors can effectively evaluate venture quality. Although venture stage is also a meaningful factor, its impact is secondary.

We empirically investigate the possible sources of this heterogeneity by sector. Table A.3 compares the mean venture-summary characteristics of ventures in R&D-intensive and non-R&D-intensive sectors. The average length of each subsection of the summary is similar for the two groups, indicating that the summaries are consistently written. However, there are important differences in the observed venture characteristics described in the summaries. Compared with ventures in non-R&D-intensive sectors, ventures in R&D-intensive sectors are four times as likely to have received equity funding at VMS entry, three times as likely to have plans for IP protection, and more than five times as likely to have origins in academic research.[23]

Table 8 examines how evidence of intellectual assets (having plans for IP protection and/or origins in academic research)—a key characteristic that differentiates between ventures in R&D-intensive and non-R&D-intensive sectors—influences the relationship between mentor interest and subsequent commercialization within each subset of sectors. We find that this relationship is statistically significant only among ventures in R&D-intensive sectors whose summaries contain evidence of intellectual assets. Among ventures in non-R&D-intensive sectors, mentor interest has a weak and insignificant relationship with subsequent commercialization regardless of evidence of intellectual assets. This is not a result of mentors evaluating these ventures casually because they are responding to important signals of quality (e.g., equity funding, plans for IP protection, and origins in academic research). Table 8 also demonstrates that the venture summary characteristics that mentors value differ between non-R&D-intensive and R&D-intensive sectors.[24]

Finally, Table 9 examines the role of mentors' backgrounds and expertise in evaluating ventures in R&D-intensive sectors. It shows that the correlation between mentor interest and venture quality does not depend on (1) whether the mentor and the venture occupy the same sector, (2) whether the mentor has experience in R&D-intensive sectors, (3) whether the mentor's primary functional expertise is in research and development, or (4) whether the mentor has a doctoral degree. These results suggest that mentors' evaluations do not center on the scientific merit of the underlying technology, whose assessment often requires advanced scientific or technical knowledge. Importantly, these results also suggest that our contrasting findings about R&D-intensive and non-R&D-intensive sectors are not an artifact of the composition of the pool of VMS mentors in our sample.

Taken together, the results in this section demonstrate that a venture's industry sector plays an important role in the efficacy of expert evaluation. Mentors can differentiate ventures on grounds of quality within the sets of ventures in R&D-intensive sectors whose summaries contain evidence of intellectual assets (having plans for IP protection and/or origins in academic research). In contrast, there is no evidence that mentors can effectively evaluate the commercial

Table 8. Heterogeneity in Estimated Relationships Between Mentor Interest and Subsequent Commercialization by Venture-Summary Characteristics

	Including only ventures in R&D-intensive sectors (1)	Including only ventures in non-R&D-intensive sectors (2)
Venture subsequently achieved commercialization × Summary contains evidence of intellectual assets at VMS entry	0.0150*** (0.0040)	–0.0054 (0.0041)
Venture subsequently achieved commercialization × Summary contains no evidence of intellectual assets at VMS entry	0.0062 (0.0055)	0.0032 (0.0023)
Venture characteristics coded from summaries		
Venture and mentor in the same sector	0.0705*** (0.0045)	0.0224*** (0.0046)
Venture is in the business-planning stage	0.0060**(0.0030)	0.0004 (0.0018)
Venture has received equity funding	0.0085 (0.0060)	0.0145* (0.0076)
Venture has plans for intellectual-property protection	0.0044 (0.0030)	0.0072*** (0.0027)
Venture originates in academic research	0.0031 (0.0034)	0.0091** (0.0037)
Summary mentions founding team	0.0140 (0.0087)	–0.0011 (0.0054)
Summary mentions undergraduate students	0.0089 (0.0099)	0.0007 (0.0037)
Summary mentions MBAs/Master's	0.0008 (0.0041)	0.0012 (0.0022)
Summary mentions PhDs/Postdocs	–0.0020 (0.0033)	0.0036 (0.0029)
Summary mentions relevant industry experiences	–0.0032 (0.0041)	0.0050** (0.0025)
Summary mentions prior start-up founding experiences	–0.0120*** (0.0044)	0.0020 (0.0026)
Additional controls	Yes	Yes
Mean dependent variable	0.0550	0.0374
Number of observations	26,840	49,752

Notes. This table reports coefficient estimates from OLS regressions in which the dependent variable indicates whether the mentor expressed interest in the venture. The unit of observation is a mentor paired with a venture that joined VMS when the mentor was active. Column (1) includes only ventures in the hardware/energy and life sciences/medical devices sectors. Column (2) includes only ventures in the consumer products, consumer web/mobile, and enterprise software sectors. Evidence of intellectual assets includes plans for intellectual-property protection and/or origins in academic research. Each regression includes the full set of controls as in Table 4, column (6). Standard errors (presented in parentheses) are robust and clustered by mentor, year of venture's affiliation with VMS, and month of venture's affiliation with VMS.

*$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

viability of ventures in non-R&D-intensive sectors. It may be that these ventures face high uncertainty at an early stage, making it difficult to observe their innate quality; alternatively, effective evaluation of such ventures might require additional, or different, information than is contained in the summaries. Our data does not allow us to distinguish between these two scenarios.

One possible explanation for our findings is that ventures in different industries face varying degrees of market uncertainty and technological uncertainty (Kline and Rosenberg 1986). Although novel perspectives on customer needs and behaviors may yield entrepreneurial opportunities, they may also hamper critical evaluation of those opportunities because their novelty is at odds with established market views and evidence. We suspect that in non-R&D-intensive sectors, where technological barriers to entry are relatively low, ventures are often premised around such market assumptions. For entrepreneurial opportunities originating from novel technologies, initial market uncertainty may also affect the efficacy of evaluation. For instance, challenges in surfacing and evaluating initial customer applications often hinders the early development of rare and revolutionary technologies (e.g., telephone or electricity) (Rosenberg 1996). However, ventures in R&D-intensive sectors are often developing or deploying novel technologies in a manner that releases prior technological constraints to fulfill existing customer needs (e.g., new medical treatments that target known disease populations).[25] We speculate that evaluating the commercial viability of these ventures may be feasible because there exist not only corroborative market evidence, but also an established technological development "playbook" to tackle the technological uncertainty (e.g., Fitzgerald et al. 2011).

5. Conclusion

The feasibility of screening ventures is a central question in entrepreneurial finance. If screening is feasible, investors should target their resources at the ventures that potentially offer the highest returns. If not, investors should pursue alternative approaches to manage uncertainty and maximize returns. But, because the distinct ways that investors can add value are often conflated—investors provide resources to ventures they positively evaluate—it is difficult for researchers to isolate and study the efficacy of screening. By using a unique setting in which expert evaluations are unlikely to influence venture outcomes, this paper demonstrates that it is feasible to screen early-stage ventures. Moreover, we find important heterogeneity across industry sectors.

Table 9. Heterogeneity in Estimated Relationships Between Mentor Interest and Subsequent Commercialization by Mentor Characteristics

	Including only ventures in R&D-intensive sectors			
	(1)	(2)	(3)	(4)
Venture subsequently achieved commercialization × Mentor and venture in the same sector	0.0143* (0.0074)			
Venture subsequently achieved commercialization × Mentor and venture in different sectors	0.0116** (0.0035)			
Venture subsequently achieved commercialization × Mentor is from R&D-intensive sectors		0.0127** (0.0047)		
Venture subsequently achieved commercialization × Mentor is from non-R&D-intensive sectors		0.0120** (0.0042)		
Venture subsequently achieved commercialization × Mentor's primary business expertise is in R&D			0.0168** (0.0061)	
Venture subsequently achieved commercialization × Mentor's primary business expertise is not in R&D			0.0104** (0.0038)	
Venture subsequently achieved commercialization × Mentor has a doctoral degree				0.0127* (0.0071)
Venture subsequently achieved commercialization × Mentor does not have a doctoral degree				0.0123** (0.0037)
Additional controls	Yes	Yes	Yes	Yes
Number of observations	26,840	26,840	26,840	26,840

Notes. This table reports coefficient estimates from OLS regressions in which the dependent variable indicates whether the mentor expressed interest in the venture. The unit of observation is a mentor paired with a venture that joined VMS when the mentor was active. Each regression includes the full set of controls as in Table 4, column (6), and includes only ventures in the hardware/energy and life sciences/medical devices sectors. Standard errors (presented in parentheses) are robust and clustered by mentor, year of venture's affiliation with VMS, and month of venture's affiliation with VMS.

*$p < 0.10$; **$p < 0.05$.

We study subjective evaluations of 537 venture ideas by 251 experts, both affiliated with the MIT Venture Mentoring Service. The evaluations in our context are based on succinct written summaries that primarily describe the ventures' value propositions and early-stage status. Our measure of a venture's quality is its subsequent achievement of commercialization—a necessary precondition for entrepreneurial success. We find that experts are able to assess the commercial viability of an early-stage venture, but that they can do so only for ventures in R&D-intensive sectors. Our results, thus, highlight the heterogeneity in the efficacy with which early-stage ideas can be evaluated, a finding that has implications for the design of optimal investment strategies.

Investors have multiple approaches to reduce uncertainty. In addition to evaluating project quality, they may prioritize screening of the founding team (Bernstein et al. 2017). They may also broaden their set of initial investments, providing modest funding and limited governance to a wider array of founders and venture projects to gain information before deciding to make a significant commitment (i.e., spray and pray). The extent to which a venture's quality can be observed ex ante affects how early-stage investors add value and, consequently, the types of projects that they fund (Bergemann and Hege 1998; Manso 2011). On the one hand, screening restricts resources to a select set of founders and projects, allowing these ventures to plan and develop over a longer time horizon (and potentially yielding the benefits of earlier commitment). On the other hand, a cost-effective experimental process may democratize entry for less-proven founders as well as for more long-shot bets (Nanda and Rhodes-Kropf 2015). Empirical evidence points to the growing popularity of experimentation in certain sectors as costs have declined (e.g., because of the introduction of cloud computing) (Ewens et al. 2018). Our results suggest the merits of screening should not be dismissed, particularly in R&D-intensive industries. The design of an optimal investment strategy depends critically on the industry sector in which investors and entrepreneurs operate.

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Appendix. Additional Tables and Figures

Figure A.1. Overview of the Initial Venture/Mentor Pairing Process

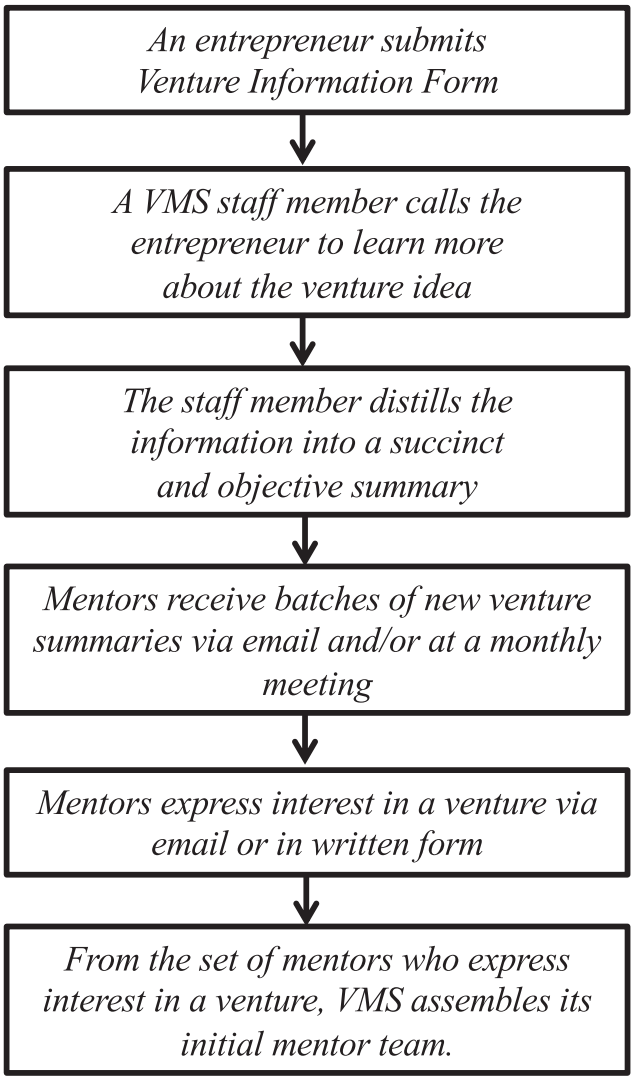
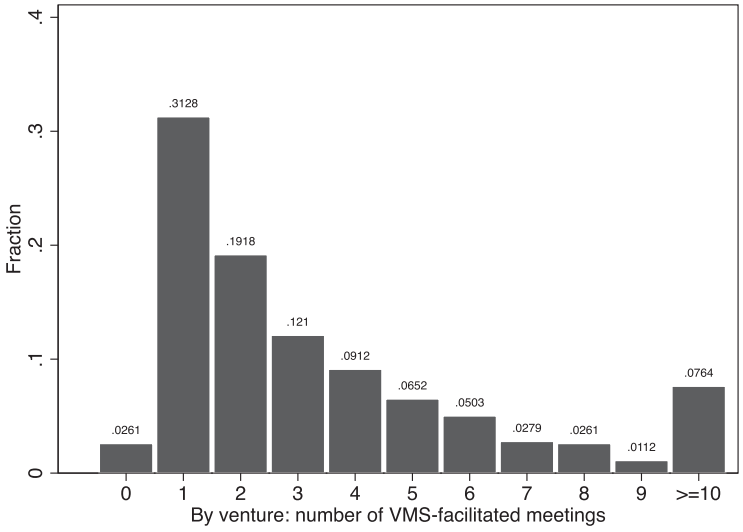


Figure A.2. Interactions Between Ventures and Mentors at VMS

(a)

By Venture: Number of VMS-Facilitated Meetings as of June 2017



(b)

*By Mentor*Venture: Number of VMS-Facilitated Meetings as of June 2017*
Conditional on Expression of Interest

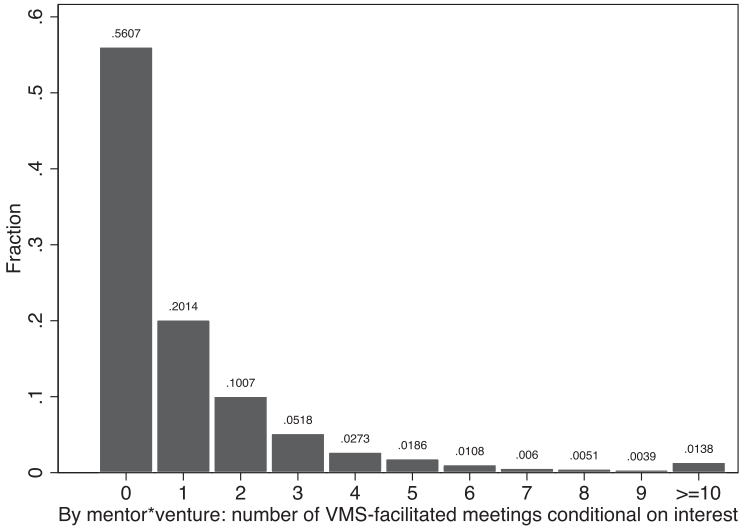
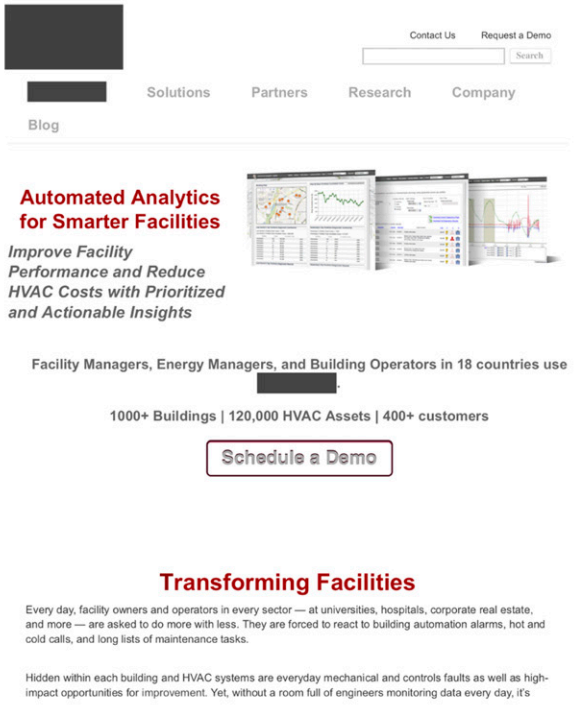
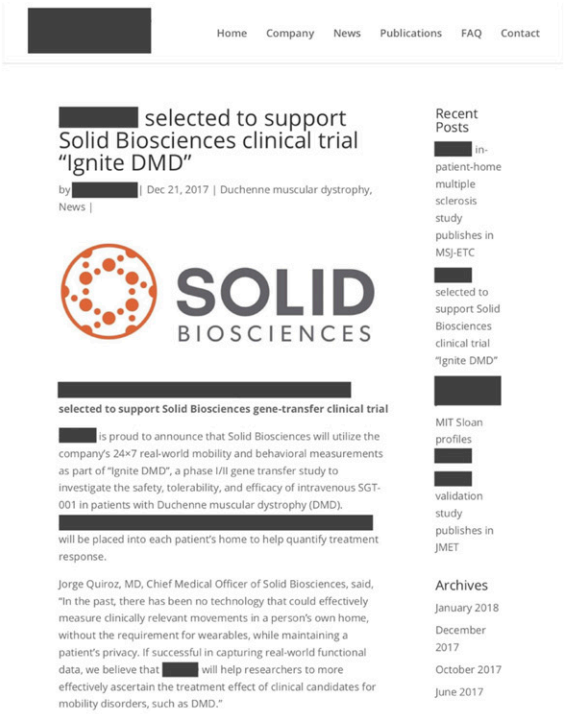


Figure A.3. Sample Screenshots from Websites and Press Releases of Commercialized Ventures





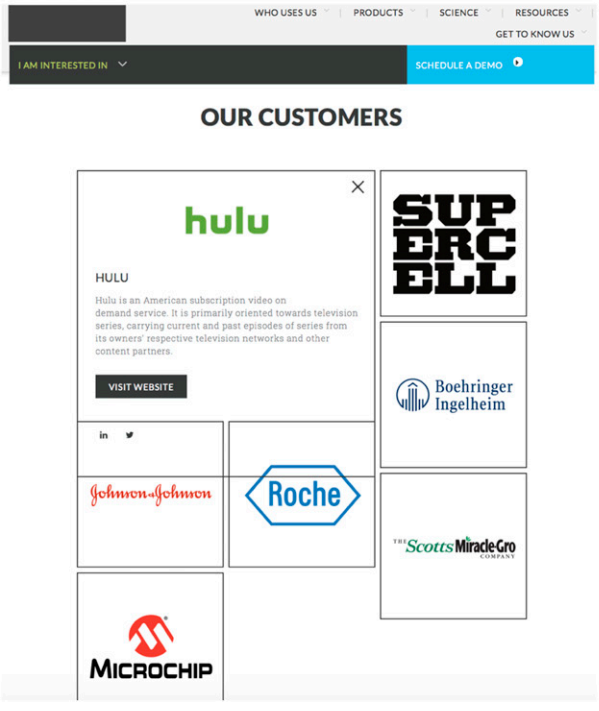


Table A.1. Anonymized Sample Venture Summaries

1. **The company is developing software that assesses [a certain medical condition] by capturing and analyzing [relevant characteristics]. This software provides the first objective measure of [the condition] based on analysis of physical characteristics rather than on a subjective evaluation. This will permit healthcare organizations and practitioners to diagnose and monitor [the condition] more effectively and at lower cost.** ***The team is experienced in systems development and in medical research.*** **So far they have developed and filed provisional patents on the core algorithms, and they have completed several studies in local hospitals demonstrating the feasibility of their approach. They are now in conversations with a potential client to develop the software for a pilot. They seek guidance from VMS on negotiations and also on organizational issues, IP portfolio strategy, marketing, and funding.**

2. **The idea is to deliver [a certain content service] to subscribers, customizing the content delivered according to each subscriber's interests and tastes. The service will feature a proprietary behavioral system which monitors user behavior and solicits user tagging and feedback to teach the system. The venture also will offer tools for sharing interests among close friends to create an "addicting social network." Revenue will come from targeted advertising based on users' interests and demographics, and from partnerships with magazines and newspapers.** ***Two student founders are doing the technical development.*** **They have finalized the design and are currently building the prototype. They have come to VMS for practical advice on their business plan, getting to market, building a team, and obtaining funding.**

Value Proposition | ***Founding Team*** | **Venture Status**

Table A.2. Mean Characteristics of Prospective Entrepreneurs at VMS Entry (N = 409)

	Percentage of total
Male	83.6
Younger than 25	24.2
Between 26 and 30	36.4
Between 31 and 40	27.1
Older than 40	12.2
Doctoral degree	29.3
Master's degree, no doctoral degree	49.9
No graduate degree	20.8
Majored in engineering in college	66.5
Majored in sciences in college	15.9
Majored in other fields in college	17.6

Table A.3. Venture Summaries, Descriptive Statistics by Venture Sector

Panel A: Characteristics of summaries			
	Ventures in R&D-intensive sectors	Ventures in Non-R&D-intensive sectors	*T*-statistic
N	192	345	
Year when venture summary was written	2009.6	2010.0	1.90*
Month when venture summary was written	6.5	6.4	0.29
Word count, complete venture summary	185.3	180.3	1.42
Word count, subsection on value proposition	87.8	88.5	0.31
Word count, subsection on venture status	81.2	76.7	1.56
Word count, subsection on founding team	16.3	15.1	1.10
Panel B: Venture characteristics reported in summaries			
	Ventures in R&D-intensive sectors, %	Ventures in Non–R&D-intensive sectors, %	*T*-statistic
Status			
In the conception stage	62.0	56.2	1.29
In the business-planning stage	38.0	43.8	1.29
Has equity funding	8.3	2.0	3.49***
Has plans for intellectual-property protection	53.6	16.5	9.77***
Originates in academic research	50.5	9.3	12.07***
Founding team			
Summary mentions founding team	82.3	79.7	0.72
Summary mentions undergraduates	3.1	5.8	1.38
Summary mentions MBAs/master's	18.8	20.6	0.51
Summary mentions PhDs/postdocs	41.1	12.8	7.92***
Summary mentions relevant industry experience	18.8	19.7	0.27
Summary mentions prior start-up founding experience	13.0	15.1	0.65

Notes. R&D-intensive sectors consist of hardware/energy and life sciences/medical devices. Non–R&D-intensive sectors consist of consumer products, consumer web/mobile, and enterprise software.

Two-sample t-test for equal means: *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Table A.4. Mean Characteristics of Prospective Entrepreneurs at VMS Entry by Venture Sector

	Ventures in R&D-intensive sectors, %	Ventures in Non–R&D-intensive sectors, %	*T*-statistic
N	141	268	
Male	87.2	81.7	1.43
Younger than 25	18.4	27.2	1.98**
Between 26 and 30	38.3	35.4	0.57
Between 31 and 40	27.0	27.2	0.06
Older than 40	16.3	10.1	1.83*
Doctoral degree	48.9	19.0	6.63***
Master's degree, no doctoral degree	38.3	56.0	3.48***
No graduate degree	12.8	25.0	2.92***
Majored in engineering in college	69.5	64.9	0.93
Majored in sciences in college	19.1	14.2	1.31
Majored in other fields in college	11.3	20.9	2.42**

Notes. R&D-intensive sectors consist of hardware/energy and life sciences/medical devices. Non–R&D-intensive sectors consist of consumer products, consumer web/mobile, and enterprise software.

Two-sample t-test for equal means: *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Endnotes

[1] Sam Altman of Y Combinator, among the most prominent seed investors in Silicon Valley, observes that "for all of the really good seed investments I've made, other investors I respected thought they were bad ideas" (Altman 2014).

[2] A lengthy literature discusses the influence of angel investors (Kerr et al. 2014a, Lerner et al. 2018), venture capitalists (Gorman and Sahlman 1989, Sahlman 1990, Lerner 1995, Hellmann and Puri 2002, Hsu 2004), and early-stage government grant programs (Lerner 1999, Howell 2017) on such ventures' subsequent performance.

[3] Howell (2018) finds that participants in new-venture competitions are significantly more likely to abandon their ventures after receiving negative feedback.

[4] VMS does not accept active investors as mentors to avoid conflicts of interest.

[5] At MIT, VMS complements a rich array of other services, centers, programs, clubs, and initiatives, both academic and extracurricular, that support innovation and entrepreneurship. For example, the Martin Trust Center for MIT Entrepreneurship is a hub for current students' entrepreneurial activities, and the Deshpande Center for Technological Innovation helps researchers take new discoveries from the lab bench to commercialization.

[6] We exclude the cohorts from VMS's first five years of operation, when both ventures and mentors were few in number and may have been selected by virtue of connections with VMS's founders. By late 2004, VMS had grown substantially, increased awareness of its services within the larger MIT community, and introduced systematic electronic record keeping.

[7] For instance, although many mentors have experience investing in start-ups, active venture capitalists and angel investors are excluded from the program.

[8] The same staff member drafted almost all of the summaries during our sample period.

[9] We recovered nearly all of the monthly summary reports distributed during our sample period with the exception of two from 2012.

[10] They comprise 84% of the summaries contained in the VMS internal records during the study period. The excluded summaries do not differ from our sample in length, structure, or other summary characteristics.

[11] This classification includes ventures in the process of building a prototype.

[12] Although a faculty member may have directed the originating research, the entrepreneurs were students, postdocs, or alumni and not MIT faculty members.

[13] Over time, the mentor team may change as different kinds of knowledge, skills, and experience become more useful. Later-stage mentors are not limited to those who initially expressed interest in the venture.

[14] In the rare cases of insufficient mentor interest, VMS recruited additional mentors to complete the teams.

[15] We used the Wayback Machine to recover obsolete versions of a company website in cases in which the current website was no longer functional.

[16] Average starting salaries for MIT graduate-degree earners are $70,000–$120,000 per year (Hastings et al. 2010).

[17] For educational reasons, VMS does not treat its ventures' rate of commercialization as a metric for internal program evaluation. As a VMS staff member remarked, "We think it's a success if the prospective entrepreneur decides there isn't a viable business, or that they really don't want to be an entrepreneur now that they get what you really have to do [to be successful]."

[18] Merely suggestive evidence of sales channels, such as a general "contact us" form on the website, is not sufficient.

[19] Of these 149 ventures, 142 have an informative web presence indicating their commercialization outcomes. Our key findings are robust to excluding the seven ventures whose commercialization was determined via VMS archival records.

[20] Similarly, Catalini et al. (2017) examine a large sample of business registration records and find that firms often achieve growth outcomes (e.g., initial public offering) without raising venture capital.

[21] We used log (word count + 1) for the subsection on founding team because some summaries contained no information on the founding team.

[22] We estimate this equation in LPM because estimating fixed effects models in probit and logit is problematic (Wooldridge 2010). Estimating the equation using the conditional logit model yields similar results.

[23] At the same time, a larger proportion of ventures in R&D-intensive sectors was in the conception stage at VMS entry (although the differences are not significant in a T-test). These ventures may have made considerable progress developing the underlying science in a laboratory but have yet to transition to business development or to develop prototypes for commercial uses.

[24] Table A.4 compares the mean characteristics of prospective entrepreneurs by sector. In unreported regressions, we find that the key coefficient estimates in Table 8 do not change when we control for the prospective entrepreneurs' characteristics using the same controls as in Table 5, column (4).

[25] See Shane (2000) for case studies.

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