Evaluating Early-Stage Ideas: Evidence from Venture Mentoring*

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Abstract

Collaborating with Massachusetts Institute of Technology's Venture Mentoring Service (MIT VMS), we collect detailed data on the initial evaluation, entry characteristics, and outcomes of 655 early stage venture ideas across a wide range of industry sectors. Contrary to the existing literature and popular belief, we provide systematic evidence that it is possible to assess venture uncertainty even in the idea stages. We show that venture ideas that receive a higher aggregate level of interest from a large set of skilled practitioners (i.e., the mentors at VMS) are significantly more likely to raise funding from professional investors, generate meaningful economic activities, and achieve successful commercialization with recurring revenue and expenses in the future. This relationship is not driven by differential degrees of mentoring and is present even after controlling for a rich set of venture characteristics. Furthermore, we find that the relationships between aggregate mentor interest and future validations from the market are only strong and statistically significant for technology-based ventures. Our results have important implications for the resource allocation in various entrepreneurial contexts.

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1 Introduction

New ventures with unproven technologies and/or business models present the greatest potential for value creation, growth, and contribution to the larger economy. As such, considerable resources, both public and private, are allocated to assisting these ventures reach their potential.[1] Evaluating the inherent uncertainty of these new ventures is a critical component in almost any type of resource allocation in this entrepreneurial context – from incubation and government grants to private entrepreneurial financing. Yet, it remains unclear whether new ventures can be effectively evaluated and, if so, under what conditions. Sam Altman, the president of Y Combinator, states that "great companies often look like bad ideas at the beginning."[2] This is a sentiment widely held by others in the entrepreneurial community, and borne out in the existing data. Bessmer Venture Partners goes so far as to publicly share their Anti-Portfolio, honoring some of the great investment opportunities for which they elected not to invest.[3] Fred Wilson of Union Square Ventures acknowledges that he "missed the best startup to come [his] way in the past few years," when he chose not to invest in AirBnB.[4] The data indicates this sentiment extends beyond one-off missed opportunities, as Kerr, Nanda, and Rhodes-Kropf (2014) and Kerr, Lerner, and Schoar (2014) find limited correlation between the assessed quality of a venture at the time of venture financing and its future success.

In contrast to the growing literature on the evaluation of scientific ideas (Cole et al., 1981; Chubin and Hackett, 1990; Marsh et al., 2008; Lamont, 2009; Lee et al., 2013; Boudreau et al., 2014), there is little systematic empirical evidence regarding the screening of venture ideas due to several empirical challenges. First, there are data limitations. Typically, researchers only obtain data ventures that have already been screened, e.g., ventures that received incubation or investment. It is rare to observe the full choice set of all the ventures that were under consideration by the incubators or investors. Even if one were to see the choice set at the time of evaluation, tracking ventures' outcomes across time, particularly for those ventures not selected for investment or other types

[1] In 2013, the U.S. venture capital invested $29.7 billion dollars. The Small Business Innovation Research (SBIR) program awarded $1.9 billion to 5,000 small, technology-based ventures.

[2] http://blog.samaltman.com/black-swan-seed-rounds

[3] http://www.bvp.com/portfolio/antiportfolio. Some of their notable passes include eBay (a "no-brainer pass"), PayPal ("rookie team, regulatory nightmare"), and Fedex, which was declined by BVP seven times.

[4] http://avc.com/2011/03/airbnb/

of treatment, has been almost impossible. Furthermore, the data we often empirically capture are ventures ready for funding, where at least some of the initial uncertainty during the idea stages may have already been eliminated. Second, in most of the empirical contexts that require evaluation of ventures, such as entrepreneurial financing, the evaluators' (e.g., the investors) initial assessment of a venture directly influences the financial and professional resources devoted to it. Previous studies have highlighted the different mechanisms through which investors professionalize ventures, such as active mentorship, network access, and control rights (Gorman and Sahlman, 1989; Sahlman, 1990; Lerner, 1995; Hellmann and Puri, 2002; Baum and Silverman, 2004; Hsu, 2004; Bottazzi et al., 2008), and the subsequent improvement in venture outcomes. Third, selection on the entrepreneurs-side (Hsu, 2004) and pre-existing social capital ties between entrepreneurs and investors (Shane and Stuart, 2002) make it difficult to generalize findings on venture evaluation across organizations.

In this paper, we collect detailed data on a large sample of very early stage venture ideas and leverage a unique empirical context to identify the evaluation of venture ideas without any confounding matching or "treatment" effects. We collaborate with Massachusetts Institute of Technology's Venture Mentoring Service (MIT VMS), an educational program that connects ventures started by MIT affiliated entrepreneurs to mentors from the larger New England entrepreneurship and technology community. Ventures typically join VMS at a very early stage – before there is a business plan, a strategy, a revenue model, or a source of funding. These ventures receive advice from VMS mentors, a set of highly skilled practitioners with expertise in business formation and operations. VMS provides the service at no cost to the entrepreneurs nor in exchange for any equity in the venture. Given the educational tenets of the program, there is minimal initial screening of venture ideas, allowing us to observe ideas with a wide range of quality and uncertainty. When a new venture joins VMS, all active mentors have an opportunity to independently express their interest in mentoring the venture, based solely on a short, objective description provided by VMS staff. Expressing interest in a venture is a non-trivial decision that reflects a mentor's willingness to commit their time – one of their most valuable and limited resources – to a venture. Our field research suggests that mentors often base their decisions on the perceived attractiveness of the underlying technology and business idea of the ventures.

The aggregate mentor interest measures the mentors' evaluation of the venture and is unlikely to drive the degree of mentoring a venture receives for several institutional reasons. First, only few of the mentors expressing interest become deeply involved in the venture. Since the size of a typical mentor team is limited, only a subset of the mentors who express interest in a venture have the opportunity to mentor the venture. Even then, many mentors only meet with their paired ventures few times. VMS decides the mentor-venture pairing based on schedule availability and load balancing. The venture is unaware of the aggregate mentor interest and has little to no role in choosing its mentors.[5] Second, the ventures are solely responsible for how much mentoring they receive from VMS. The ventures would contact VMS to set up an appointment with the mentors when they need help and VMS would almost always accommodate the requests. Since a venture does not observe the aggregate mentor interest and does not select its mentors, the aggregate mentor interest is unlikely to affect a venture's decisions to meet with VMS in the future. Furthermore, mentors do not express interest based on the expected frequency of future meetings, which is also impossible to predict.

We construct detailed data on the characteristics and outcomes of 655 venture ideas that came to VMS between 2005 and 2012. Contrary to the existing literature and popular belief, we provide systematic evidence that it is possible to assess venture uncertainty. We show that ventures that attract more aggregate mentor interest when they join VMS at the idea stages are also more likely to receive subsequent validation from the market as a company. An increase in initial mentor interest is tied to an economically meaningful and statistically significant increase in the likelihood of raising funding from outside investors, generating economic activities (e.g. hiring employees and renting office space), or recurring revenue and expenses in the future. These relationships are present after controlling for a rich set of venture characteristics at the time of entry into VMS as well as the number of meetings that a venture has had with VMS, which serves as an approximation for the degree of mentoring.

Furthermore, we find that the feasibility of evaluation is entirely driven by technology-based ventures. Leveraging the richness of our data, we use three different classifications of technology-

[5] After VMS pairs a venture to its mentors, the venture may choose not to work with a particular mentor, but this almost never happens.

based ventures: having intellectual property protection, originating from academic research, or competing in sectors that have a high research and development (R&D) intensity. All three classifications yield consistent results that the relationships between mentor interest and subsequent market validations are strongly positive and statistically significant for technology-based ventures only. In contrast, the relationships are weak in magnitude with no statistical significance for ventures that are not based on technology. Since over half of our mentor sample do not have graduate degrees and the mentors are evaluating ventures outside of their industry expertise most of the time, these results suggest that the uncertainty of technology-based ventures can be evaluated in very early stages by people without in-depth knowledge of the specific technology.

The rest of the paper is organized as follows. We explain the empirical setting and data in detail in Section 2. Section 3 describes our empirical strategy, and Section 4 discusses the empirical results. We conclude in Section 5.

2 Empirical Setting and Data

2.1 MIT Venture Mentoring Service

To fill the gap in the university's support of emerging entrepreneurial ventures, MIT Professor David Staelin from the Department of Electrical Engineering and Computer Science and MIT alumnus Alexander Dingee, both highly successful entrepreneurs, founded VMS under the support of Provost Robert Brown. While informal mentoring programs have always been in the fabric of university entrepreneurship, the founding of MIT VMS in 2000 marked an important first step towards entrepreneurship mentoring finally becoming a standalone component to the university entrepreneurial ecosystem. Key to its development was a belief that support of entrepreneurial activities was central to MIT's mission to educate MIT students and alumni and its role as a world leader in innovation. Through the program, entrepreneurs from the larger MIT community - students, staff, faculty, and alumni - come to VMS with an idea, often at a very early stage, and receive hands-on mentoring from a team of elite volunteer mentors. This service is confidential and provided free of charge. As of July 1, 2014, MIT VMS has worked with over 2,900 entrepreneurs on

nearly 1,700 venture ideas. Of these, 188 ideas have launched as ventures raising over $1.6 billion in funding, including grants and investments. Twenty-eight ventures have reached a successful liquidity event (e.g., initial public offering or acquisition) producing over $1 billion market capital. As of the summer of 2014, MIT VMS has nearly 200 ideas working towards a launch, enrolling over 20 new venture ideas per month, and engaging around 150 active volunteer mentors.

2.2 Venture Sample

Our sample for analysis includes all ventures ideas that came to VMS between 2005 and 2012. We exclude for the purposes of this study seven ventures that were already funded upon joining VMS, leaving 655 ventures. When MIT VMS first started in 2000, there were only a small number of ventures and mentors, both of which may have been selected through their connections with the founders of VMS and as such are excluded from our sample. By late 2004, VMS had grown substantially, undertaken considerable effort to increase awareness of their services in the larger MIT community, and introduced systematic electronic record keeping. Figure 1 plots the number of new ventures joining VMS during our sample period.

Table 1 presents the definitions and summary statistics of the observed venture characteristics and outcomes in our data. Given the connections to MIT, a fair proportion of the ventures are technology-based. We use three alternatives to define technology-based ventures: whether it has intellectual property protection when joining VMS, whether it is based on academic research, and whether it is in a sector with high R&D intensity. Around 24% of the ventures have intellectual property protection (e.g., patents or patent pending) at the time of entry while 16% are based on academic research.[6] Following the definition used by the National Science Foundation,[7] sectors with high research and development intensities include life sciences and medical devices, hardware, and energy, and together they reflect 35% of the sample. Table 2 shows that all three definitions are positively correlated, as there should be overlaps among them. However, the correlations are not high enough such that the definitions are repetitive.

[6]The correlation between being a research based venture and having intellectual property protection at the time of entry is 0.67.

[7](http://www.nsf.gov/statistics/seind06/c8/c8.cfm?opt=9)

Only 17% of the venture ideas are incorporated when they join VMS. Venture ideas are most often brought to VMS by MIT students (38%) and alumni (36%), with only two percent coming from MIT faculty. The rest are from post-docs, research associates, and staff (24%).

2.3 VMS Mentors

Our sample of mentors includes all VMS mentors who have been active between 2005 and 2012. We exclude full-time VMS staff as they meet with all interested, prospective entrepreneurs prior to evaluation to discuss the VMS program and summarize the venture's idea for disclosure to the volunteer mentors, leaving 244 mentors. The number of active mentors increases during our sample period from around 81 in 2005 to nearly 172 in 2012, with generally over 120 mentors active at any one time. VMS Mentors fall into several basic categories:

- Entrepreneurs – people who have either founded companies or joined a startup as a very early employee. A fair number are serial entrepreneurs, whereas others stayed at the startup as it grew and became senior executives in a large company.

- Executives – people who joined established firms and spent most of their careers in them. Often, they were charged with leading new initiatives (e.g. new lines of business, new divisions, new markets) and encountered many of the same issues an entrepreneur does in their own startup.

- Functional – Less than 15% of the mentors have expertise in particular functional areas such as the legal field. While they may not have direct startup experience as either of the two previous categories, in most cases they frequently interacted with startups.

VMS estimates that their approximately 120 mentors commit over 12,000 hours of volunteer time annually. The mentors report that they devote this time for a variety of reasons, the most common being enjoying the intellectual appeal of the work, a desire to give back, wanting to stay engaged in the greater Boston entrepreneurship scene, seeing new ideas / technologies, and working with a collegial team. Most prospective mentors approach VMS as referrals from existing mentors, providing an initial filter for the program. These prospective mentors are then carefully screened

by VMS staff, including completing an in-depth personal interview where they must demonstrate a compelling focus and interest in helping entrepreneurs. Prospective mentors that indicate any personal or business agenda, who may be looking for investment or employment opportunities, are not accepted. Prospects must also agree to the demanding requirements and expectations for participation. For example, MIT VMS expects mentors to provide one to two days per month of participation in mentoring and other program activities. Furthermore, every mentor must agree and sign an agreement that specifies rigorous guidelines and a code of ethics that ensures transparency and prevents conflicts of interest. VMS also monitors mentor activity and takes swift action to remove mentors that violate these practices.

2.4 Initial Mentor Interest

Given the educational nature of the program, VMS imposes only minimal requirements on the quality of ideas or the backgrounds of entrepreneurs. The only venture criteria are that the entrepreneurs exhibit seriousness about learning entrepreneurship and that the idea provides the context and focus for practical education on the venture creation process. Upon initial consultation and verifying the affiliation with MIT, VMS works with all entrepreneurs to distill their venture idea into a brief written description. The description primarily focuses on the content of venture ideas, with only basic information on the entrepreneurs. VMS sends the descriptions of new ventures to all active VMS mentors over email and also verbalize them at the monthly mentor meetings. Based on the description, mentors indicate whether they are interested in working with the venture. Since the mentors receive the descriptions and express their interests mostly through email, the evaluation is performed independently and only VMS can see whether a venture receives considerable interest.

Mentor selection criteria is, of course, as varied as there are mentors. Conversations with mentors suggest that they tend to evaluate prospective ventures on the basis of several factors: (a) interest in the business idea, (b) interest in the underlying technology, (c) interest in the entrepreneurs, and (d) the relevance of the mentors experience and knowledge in the venture. Expressing interest represents a mentor's serious willingness to commit to a venture, since time is their most precious

resource. To measure the level of interest expressed by mentors for each venture at the time of its entry while accounting of the size of the active mentor pool, we use the percent of active mentors who express interest in a venture shortly after it signs up. Since mentors may take their time to respond to the descriptions, and their responses may not immediately get recorded in the system, we include all indications of interests expressed within two months after a venture becomes eligible for mentoring.[8] However, it is not uncommon that a mentor who is not interested in a venture at the time of its entry may become interested later in the venture's development. We exclude these cases when calculating the initial interest, since they may be driven by a venture's positive progress and/or information provided by other mentors. On average, a new venture interests around 4.6% of the active mentors when it first joins VMS, with variance in percent interested from less than 0.6% to more than 12% (Table 1). Table A.1 lists the frequency of the initial mentor interest by the count of mentors. The majority of the ventures attract interest from between three and ten mentors. Table 3 shows that technology-based ventures attract much more interests than other ventures, and the differences are statistically significant at the 1% level in all three classifications of technology-based ventures.

2.5 Venture Outcomes

We use three outcomes to capture the progress of a venture and measure the responses of investors and customers. They are: raising funding from professional investors (i.e., angel investors and venture capitalists), generating meaningful economic activities (e.g., hiring employees and renting office space), and recurring revenue and expenses. Following Arora and Nandkumar (2011), these measures seem more indicative of venture performance than survival measures, particularly given the focus here on the entrepreneurial characteristics of the ventures that may be endogenous to survival length. These outcomes measures are operationalized as follows:

- $INVESTOR$ is an indicator that equals one if the venture received funding from angel investors and/or venture capitalists. We exclude crowd funding, grants from government, and investments from friends and family in this definition, since the criteria and purposes of those

[8] Our empirical results are also robust to using 1.5 months or three months as the cutoff.

funding channels vary widely.

- *ACTIVITY* is an indicator that equals one if the venture ever generated meaningful economic activities. These include hiring employees, renting space, investing in physical assets, consuming services, paying taxes and fees and more. During this period, the venture may use funding from various sources (primarily grants and investment capital) to provide for the resources needed to operate.

- *REVENUE* is an indicator that equals one if the venture successfully reached the stage of commercialization, with recurring revenue and expenses associated with the sales of products and/or services that are the business objective of the company. In other words, there is a reasonable expectation of repeated business and new customers. This would not include revenue from one-off "consulting services" or "pilot test fees," which are often employed as bootstrap financing vehicles but do not establish the business objective.

We consider *ACTIVITY* and *REVENUE* as two separate outcomes since a venture may operate for a long period of time prior to commercialization. Since we are interested in the furthest progress a venture has ever made to date, our outcomes do not necessarily describe the current status of a venture. Rather, our outcomes intend to capture the potential economic impact that a venture has ever created. A venture that commercialized but later failed is likely to have had more impact on the economy than a venture that never took off.

In our sample, approximately 19% of the ventures raised funding from investors, 38% generated meaningful economic activities, and 22% recurred revenue (Table 1). Not surprisingly, these three variables are positively correlated with each other (Table 2). Among the 122 ventures raising funding from investors, only 4 never generated economic activities, and 47 never reached commercialization. Conversely, 132 ventures that generated economic activities and 72 ventures that reached commercialization never received funding from investors.[9]

We also observe additional outcomes that we do not include in the main analysis. For instance, we observe liquidity events such as acquisitions and Initial Public Offerings. These events are

[9]Some ventures avoid diluting equity by boot strapping, relying on personal finances, help from friends and family, small grants, one-off consulting services, crowd funding, and/or winnings from business plan competitions.

rare and happen to only 2.1% of the sample, and thus we do not have enough statistical power for analysis.

3 Empirical Strategy

We use the following specification to examine the relationship between the expression of initial mentor interest and the subsequent responses of investors and customers of the venture:

$$Pr(Y_i) = \alpha + \beta INTEREST_PERCENT_i + \gamma D_i^{START} + \delta(Controls)_i + \varepsilon_i \quad (1)$$

where i denotes a venture, Y_i is one of our three main outcome measures discussed in Section 2.5, *and INTEREST_PERCENT* is as described in Section 2.4.

The key coefficient of interest is β, which measures whether a venture that attracts more mentor interest in its very early form is more likely to achieve positive outcomes in the future. Ideally, we would like to perform the analysis in a panel setting where we can control for calendar year fixed effects as well as start-up age effects. However, since we do not observe the outcomes over time, we instead control for the starting year fixed effects with D_i^{START}. Some of the newer ventures may still be working towards raising funding, generating economic activities, or commercialization as of the summer of 2014, when we collected the outcomes data. Because of this truncation, our data may underestimate the likelihood that the ventures in our sample would eventually achieve a positive outcome. This should bias against finding a positive relationship between *INTEREST_PERCENT* and *Y*.

We also include a rich set of venture characteristics observed when the ventures join VMS, since these characteristics could drive both mentor interest and validation from the market in the future. For instance, Table 3 shows that technology-based ventures (i.e., have intellectual property protection, are based on academic research, or come from sectors with a high R&D intensity) receive more interest from mentors and are more likely to be validated in the market. Since each of the three measures may capture a different dimension of the role of technology in the venture, we control for all three measures in addition to the venture's incorporation status at the time of joining

VMS, dummies for the primary entrepreneur's MIT affiliation, and dummies for the venture's primary industry sector.

The main empirical concern is that *INTEREST_PERCENT* may affect the intensity of mentoring that a venture receives from VMS, which in turn may influence its future outcomes. As discussed in the introduction, there are several institutional reasons why mentor interest does not drive the degree of mentoring. First, there is little variation in the size of a mentor team, with a typical mentor team having two to four volunteer mentors excluding the VMS staff. As seen in Table A.1, the number of mentors indicating interest is usually greater than the size of a typical mentor team. Thus, only a subset of the mentors who express interest in a venture actually have an opportunity to interact with the venture. VMS determines the assignment almost entirely based on scheduling constraints and load balancing, with ventures having no role in the selection of their paired mentors. Even within a mentor team for a venture, there is variation in how much a mentor interacts with the venture. Many mentors who express initial interest have only met with their paired ventures once. Over time, the actual active mentor group may change as different knowledge, skills and experiences become more useful as the venture proceeds along its path. Second, the ventures are solely responsible for how much mentoring they receive from VMS. The ventures would contact VMS to set up an appointment with the mentors when they need help, and VMS would almost always accommodate the requests. Since a venture does not observe the overall level of initial interest from all of the mentors and does not select its mentors, mentor initial interest is unlikely to affect a venture's decision to meet with VMS in the future. Furthermore, as described in Section 2.4, mentor interest is primarily driven by the merits of the venture idea and entrepreneurs and not by the expected frequency of future meetings, which is also hard to predict.

Econometrically, we take two approaches to address the potential omitted variable bias. First, we include the number of meetings that a venture has had with VMS mentors as a control for the relative degree of mentoring that a venture receives. While we do not observe all of the interactions between VMS mentors and ventures[10] or their causal impact on a venture's future success, we expect that ventures that have met with VMS more should have received more mentoring on average. We use the total number of meetings as opposed to the frequency of meetings to capture the total

[10]For instance, we do not track email exchanges between them.

impact that VMS may have had on a venture.[11] Table 1 shows that on average, a venture only meets with VMS mentors around three times. After signing up to be mentored and being assigned a set of mentors, around 36% of the ventures never meet with the VMS mentors or meet only once. Table 2 shows that the correlation between mentor initial interest and number of meetings is 0.19. Our second approach calculates two distinct mentor interest measures for robustness checks, one for mentors who expressed interest and met with the venture more than once, and the other for mentors who expressed interest but never met with the venture or met with the venture only once.

Next, we study whether the relationship between mentor interest and future outcomes varies by whether a venture is technology-based and estimate:

$$\begin{aligned} Pr(Y_i) &= \alpha + \beta_1 INTEREST_PERCENT_i * (X_i = 1) + \beta_2 INTEREST_PERCENT_i * (X_i = 0) \\ &\quad + \beta_0 X_i + \gamma(Controls)_i + \varepsilon_i \end{aligned} \tag{2}$$

where X_i is one of three ways to classify whether a venture is technology-based: whether it has intellectual property protection when joining VMS (*ENTRY_IP*), whether it is based on academic research (*RESEARCH_BASED*), and whether it is in a sector with high R&D intensity (*RD_SECTOR*). Thus, β_1 measures the relationship between mentors' initial interest and venture outcomes for technology-based ventures, and β_2 measures the relationship for other ventures. Controls are similar to those in Equation (4) and include the starting year fixed effects, incorporation status at the time of joining VMS, dummies for the primary entrepreneur's MIT affiliation, and dummies for the venture's primary industry sector, and the number of meetings a venture has had with VMS.

[11] Also, it is difficult to measure frequency without errors, especially for venture ideas that have failed, since it is hard to know the precise timing of a failure.

4 Empirical Results

4.1 Initial Mentor Interest and Future Outcomes

Table 4 presents the OLS estimates of Equation (1). The Logit estimates are nearly identical (see Table A.2 in the Appendix). Overall, without controlling for venture characteristics and number of meetings with VMS, Columns (1), (4), and (7) show that a venture that receives more interest from mentors when it first joins VMS is also more likely to receive investment, have economic activities, and successfully commercialize later. The magnitudes of the coefficient estimates are economically meaningful, and all of the estimates are statistically significant at the 5% level. A one standard deviation increase in the mentor interest percent, which is 2.57 percentage points, implies on average a 4.11 percentage point increase in the probability of receiving angel or venture capital funding (a 21.6% increase from the baseline probability of 19%), a 7.45 percentage point increase in the probability of generating economic activities (a 19.6% increase from the baseline probability of 38%), and a 5.14 percentage point increase in the probability of recurring revenue and expenses (a 23.4% increase from the baseline probability of 22%).

After controlling for venture characteristics at entry, Columns (2), (5), and (8) suggest that mentor interest is still positively correlated with future outcomes, but the magnitudes of the coefficients are reduced. The coefficients still remain economically meaningful, and they are statistically significant at the 5% level for ACTIVITY and REVENUE. This shows that mentors are not expressing their interest randomly. Rather, they base at least some of their evaluation on venture characteristics that positively predict future outcomes. This suggests that they take expressing interest seriously even though there are no financial investment or professional relationships involved.

The final set of specifications Table 4 estimated in Columns (3), (6), and (9) include the number of meetings between a venture and VMS as an additional control. Not surprisingly, the number of meetings is positively correlated with future outcomes, especially generating economic activities. For the purpose of this study, we do not need to distinguish between whether the meetings have a causal impact on a venture's future outcomes or whether ventures that progress further have more needs for mentoring. Importantly, the coefficients on mentor interest percent remain positive and economically meaningful. The coefficients on *INTEREST_PERCENT* and the adjusted *R*-

squares for *INVESTOR* and *REVENUE* change only marginally after controlling for the number of meetings. The coefficient on *INTEREST_PERCENT* for *ACTIVITY* decreases from 0.016 in Column (5) to 0.011 in Column (6) but is still statistically significant at the 10% level. Even after controlling for key objected characteristics of the venture and its degree of interaction with VMS, a one standard deviation increase in the mentor interest percent still implies, on average, a 11% increase in the likelihood of receiving funding from angel investors and venture capitalists (although not statistically significant), a 7% increase in the likelihood of generating economic activities, and a 15% increase in the likelihood of commercializing successfully.

For robustness checks, Columns (1), (3), and (5) in Table A.3 in the Appendix uses the count of mentor interest (i.e., how many mentors express interest) instead of the percentage, yielding results that are the same qualitatively and quantitatively.[12] Columns (2), (4), and (6) split the *INTEREST_PERCENT* into the percentage of active mentors who express interest and meet with a venture more than once and the percentage of active mentors who express interest but never do not interact with the venture much (i.e., they never meet or meet only once). The results suggest that the relationships between overall mentor interest and a venture's future outcomes are not driven by the percentage of mentors actively involved with the venture. In particular, the only positive and statistically significant coefficient is on *INTEREST_LESSINVOLVED_PERCENT* for REVENUE.

4.2 Technology-Based Ventures

Next, we consider how the relationship between mentor interest and future outcomes may differ for technology-based ventures. Tables 5 to 7show that the prior relationships between initial mentor interest and the subsequent responses of investors and customers are mainly driven by technology-based ventures, and the results are consistent across all three classifications. For ventures that are not based on technology, the coefficients on mentor interest are primarily near zero and have no statistical significance.

[12]The standard deviation of the count of interest is 3.7.

5 Conclusion

Across the entrepreneurial context, evaluation of early stage ventures is used in the allocation of resources to early stage ventures with high potential for innovation and growth. However, it has remained unclear if these ventures could be effectively evaluated given their inherent uncertainty. Despite considerable literatures discussing the evolution and performance of resources targeted towards early stage ventures, empirical challenges, including data limitations and confounding effects, have constrained research on this critical question.

In this paper, we overcome these challenges by leveraging the unique empirical context and rich archival data presented by Massachusetts Institute of Technology's Venture Mentoring Service, a program whose nearly 1,700 ventures have raised over $1.6 billion in funding and achieved over $1 billion in liquidity events. The program's educational objectives and the institutional structure of its mentor-venture pairing process allowed us to capture the evaluation of all ventures through the expression of interest by mentors to take on individual ventures. We find that ventures that attract more aggregate mentor interest when they join VMS at the idea stages are also more likely to receive subsequent validations from the market as a company. An increase in initial mentor interest is tied to an economically meaningful and statistically significant increase in the likelihood of raising funding from outside investors, generating economic activities, or recurring revenue in the future. These relationships are present after controlling for a rich set of venture characteristics at the time of entry into VMS and not driven by differential degrees of mentoring. Furthermore, we find that this relationship is driven entirely by the screening of technology based ventures and the relationship does not hold for non-technology based ventures.

Our results provide systematic evidence that it is possible to assess venture uncertainty, particularly for technology-based ventures. In addition to the context of resource allocation, the inherent risks of venture ideas and idea uncertainty are also critical considerations for potential entrepreneurs deciding whether to pursue a venture idea full-time as well as early employees. Thus, our findings have considerable implications in a wide range of entrepreneurial contexts.

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Tables and Figures

Table 1: Descriptive Statistics for Venture Characteristics and Outcomes

Variable	Definition	Obs	Mean	Std. Dev.	Min	Max
Characteristics						
START_YEAR	Year the venture joined VMS	655	2009.9	1.96	2005	2012
ENTRY_IP	Whether the venture has intellectual property at the time of entry	655	0.24	0.43	0	1
RESEARCH_BASED	Whether the venture is based on academic research	655	0.16	0.37	0	1
SECTOR_CP	Venture sector: consumer products	655	0.13	0.34	0	1
SECTOR_CWM	Venture sector: consumer web/mobile	655	0.27	0.45	0	1
SECTOR_ENGY	Venture sector: energy	655	0.06	0.23	0	1
SECTOR_HW	Venture sector: hardware	655	0.15	0.36	0	1
SECTOR_SW	Venture sector: B2B software	655	0.18	0.38	0	1
SECTOR_LSMD	Venture sector: life sciences and medical devices	655	0.14	0.35	0	1
SECTOR_OTHER	Venture sector: consulting/life style/finance	655	0.07	0.25	0	1
RD_SECTOR	SECTOR_LSMD + SECTOR_HW + SECTOR_ENERGY	655	0.35	0.48	0	1
ENTRY_INCORP	Whether the venture is incorporated at the time of entry	655	0.17	0.38	0	1
AFFLI_STUDENT	Whether the primary contact person is an MIT student	655	0.38	0.49	0	1
AFFLI_ALUMNI	Whether the primary contact person is an MIT alumni	655	0.36	0.48	0	1
AFFLI_FACULTY	Whether the primary contact person is an MIT faculty	655	0.02	0.12	0	1
Interactions with VMS						
INTEREST_PERCENT	$\frac{\text{Num. mentors expressing interest}}{\text{Num. active mentors}} * 100$	655	4.58	2.57	0.56	12.17
MEETINGS	Num. meetings with VMS mentors	655	3.25	3.11	0	21
Outcomes						
INVESTOR	Ever received funding from investors	655	0.19	0.39	0	1
ACTIVITY	Ever generated meaningful economic activities	655	0.38	0.49	0	1
REVENUE	Ever successfully commercialized	655	0.22	0.42	0	1

Table 2: Correlation Table

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) INVESTOR	–											
(2) ACTIVITY	0.58	–										
(3) REVENUE	0.45	0.68	–									
(4) INTEREST_PERCENT	0.12	0.19	0.15	–								
(5) MEETINGS	0.21	0.36	0.19	0.19	–							
(6) START_YEAR	-0.22	-0.28	-0.29	-0.17	-0.25	–						
(7) ENTRY_IP	0.30	0.34	0.26	0.23	0.21	-0.23	–					
(8) RESEARCH_BASED	0.22	0.23	0.18	0.22	0.26	-0.14	0.67	–				
(9) RD_SECTOR	0.13	0.20	0.10	0.29	0.09	-0.10	0.47	0.42	–			
(10) ENTRY_INCORP	0.25	0.42	0.38	0.09	0.22	-0.28	0.34	0.17	0.17	–		
(11) AFFLI_STUDENT	-0.05	-0.11	-0.07	-0.06	-0.05	0.02	-0.05	-0.03	-0.11	-0.05	–	
(12) AFFLI_ALUMNI	0.06	0.14	0.12	0.08	0.02	-0.18	-0.02	-0.05	0.03	0.11	-0.59	–
(13) AFFLI_FACULTY	-0.03	0.06	-0.04	0.01	0.03	-0.06	0.13	0.18	0.09	0.01	-0.10	-0.09

Table 3: Descriptive Statistics by Venture Characteristics

Variable	Mean	Std. Dev.	Mean	Std. Dev.	|T-statistic|
PANEL A	ENTRY_IP = 1 (N = 157)		ENTRY_IP = 0 (N = 498)		
INTEREST_PERCENT	5.62	2.79	4.25	2.41	5.96***
INVESTOR	0.39	0.49	0.12	0.33	8.06***
ACTIVITY	0.68	0.47	0.29	0.45	9.21***
REVENUE	0.41	0.49	0.16	0.37	6.74***
PANEL B	RESEARCH_BASED = 1 (N = 107)		RESEARCH_BASED = 0 (N = 548)		
INTEREST_PERCENT	5.87	2.76	4.33	2.46	5.82***
INVESTOR	0.38	0.49	0.15	0.36	5.73***
ACTIVITY	0.64	0.48	0.33	0.47	6.06***
REVENUE	0.39	0.49	0.19	0.39	4.62***
PANEL C	RD_SECTOR = 1 (N = 228)		RD_SECTOR = 0 (N = 427)		
INTEREST_PERCENT	5.59	2.69	4.33	2.34	7.66***
INVESTOR	0.25	0.44	0.15	0.36	3.29***
ACTIVITY	0.52	0.50	0.33	0.46	5.33***
REVENUE	0.28	0.45	0.19	0.40	2.53***

Table 4: Estimated Relationship between INTEREST_PERCENT and Venture Outcomes in OLS

Outcome	INVESTOR			ACTIVITY			REVENUE		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
INTEREST_PERCENT	0.016**	0.010	0.008	0.029***	0.016**	0.011*	0.020***	0.014**	0.013**
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
ENTRY_IP		0.161***	0.166***		0.154***	0.169***		0.064	0.066
		(0.056)	(0.056)		(0.058)	(0.056)		(0.052)	(0.052)
RESEARCH_BASED		0.075	0.051		0.044	-0.034		0.097*	0.087
		(0.064)	(0.065)		(0.060)	(0.059)		(0.057)	(0.057)
ENTRY_INCORP		0.132**	0.118**		0.389***	0.345***		0.308***	0.303***
		(0.052)	(0.052)		(0.049)	(0.049)		(0.055)	(0.055)
MEETINGS			0.011*			0.035***			0.004
			(0.006)			(0.005)			(0.006)
Additional Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Start Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	655	655	655	655	655	655	655	655	655
Adjusted R^2	0.08	0.14	0.14	0.11	0.25	0.29	0.10	0.21	0.21

Notes: Coefficients estimated from Linear Probability Model. Robust standard errors in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$. See Table 1 for variable definitions. "Additional Controls" include AFFLI_STUDENT, AFFLI_ALUMNI, AFFLI_FACULTY, SECTOR_CP, SECTOR_CWM, SECTOR_ENGY, SECTOR_HW, SECTOR_SW, and SECTOR_LSMD. "Start Year Dummies" include indicator variables for the values of START_YEAR.

Table 5: Estimated Relationship between INTEREST_PERCENT and INVESTOR by Venture Characteristics in OLS

Dep. Var. = INVESTOR	(1)	(2)	(3)	(4)
INTEREST_PERCENT	0.008			
	(0.006)			
INTEREST_PERCENT x (ENTRY_IP = 1)		0.023*		
		(0.013)		
INTEREST_PERCENT x (ENTRY_IP = 0)		0.001		
		(0.007)		
INTEREST_PERCENT x (RESEARCH_BASED = 1)			0.050***	
			(0.015)	
INTEREST_PERCENT x (RESEARCH_BASED = 0)			-0.003	
			(0.006)	
INTEREST_PERCENT x (RD_SECTOR = 1)				0.018*
				(0.010)
INTEREST_PERCENT x (RD_SECTOR = 0)				0.000
				(0.008)
F-Statistics	–	2.06	10.56***	1.99
ENTRY_IP	0.166***	0.060	0.154***	0.168***
	(0.056)	(0.094)	(0.056)	(0.056)
RESEARCH_BASED	0.051	0.037	-0.245**	0.048
	(0.065)	(0.066)	(0.105)	(0.064)
N	655	655	655	655
Adjusted R^2	0.14	0.15	0.16	0.14

Notes: Coefficients estimated from Linear Probability Model. Robust standard errors in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$. See Table 1 for variable definitions. All specifications include MEETINGS, ENTRY_INCORP, AFFLI_STUDENT, AFFLI_ALUMNI, AFFLI_FACULTY, SECTOR_CP, SECTOR_CWM, SECTOR_ENGY, SECTOR_HW, SECTOR_SW, SECTOR_LSMD, and indicator variables for the values of START_YEAR.

Table 6: Estimated Relationship between INTEREST_PERCENT and ACTIVITY by Venture Characteristics in OLS

Dep. Var. = ACTIVITY	(1)	(2)	(3)	(4)
INTEREST_PERCENT	0.011*			
	(0.007)			
INTEREST_PERCENT x (ENTRY_IP = 1)		0.020*		
		(0.012)		
INTEREST_PERCENT x (ENTRY_IP = 0)		0.007		
		(0.008)		
INTEREST_PERCENT x (RESEARCH_BASED = 1)			0.028**	
			(0.014)	
INTEREST_PERCENT x (RESEARCH_BASED = 0)			0.007	
			(0.008)	
INTEREST_PERCENT x (RD_SECTOR = 1)				0.022**
				(0.011)
INTEREST_PERCENT x (RD_SECTOR = 0)				0.003
				(0.008)
F-Statistics	–	0.83	1.86	2.05
ENTRY_IP	0.169***	0.105	0.164***	0.171***
	(0.056)	(0.091)	(0.056)	(0.056)
RESEARCH_BASED	-0.034	-0.043	-0.155	-0.037
	(0.059)	(0.059)	(0.103)	(0.058)
N	655	655	655	655
Adjusted R^2	0.29	0.29	0.29	0.29

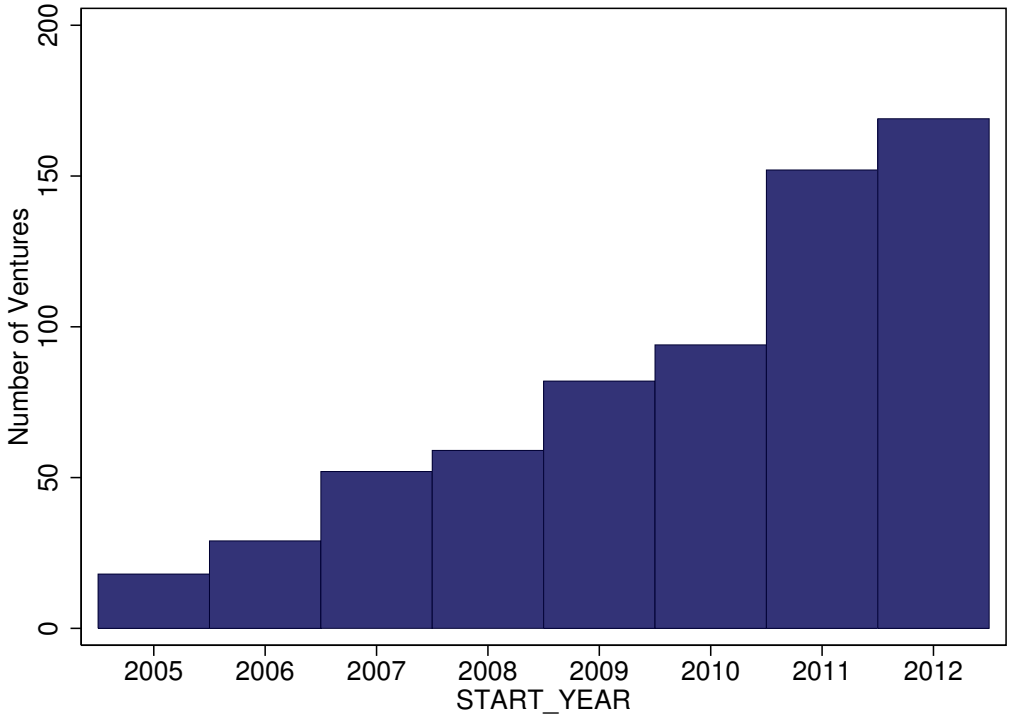
Notes: Coefficients estimated from Linear Probability Model. Robust standard errors in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$. See Table 1 for variable definitions. All specifications include MEETINGS, ENTRY_INCORP, AFFLI_STUDENT, AFFLI_ALUMNI, AFFLI_FACULTY, SECTOR_CP, SECTOR_CWM, SECTOR_ENGY, SECTOR_HW, SECTOR_SW, SECTOR_LSMD, and indicator variables for the values of START_YEAR.

Table 7: Estimated Relationship between INTEREST_PERCENT and REVENUE by Venture Characteristics in OLS

Dep. Var. = REVENUE	(1)	(2)	(3)	(4)
INTEREST_PERCENT	0.013**			
	(0.007)			
INTEREST_PERCENT x (ENTRY_IP = 1)		0.021*		
		(0.013)		
INTEREST_PERCENT x (ENTRY_IP = 0)		0.010		
		(0.008)		
INTEREST_PERCENT x (RESEARCH_BASED = 1)			0.031**	
			(0.014)	
INTEREST_PERCENT x (RESEARCH_BASED = 0)			0.009	
			(0.007)	
INTEREST_PERCENT x (RD_SECTOR = 1)				0.026**
				(0.011)
INTEREST_PERCENT x (RD_SECTOR = 0)				0.004
				(0.007)
F-Statistics	–	0.57	1.97	2.50
ENTRY_IP	0.066	0.011	0.061	0.068
	(0.052)	(0.083)	(0.052)	(0.052)
RESEARCH_BASED	0.087	0.080	-0.037	0.084
	(0.057)	(0.059)	(0.096)	(0.057)
N	655	655	655	655
Adjusted R^2	0.21	0.21	0.21	0.21

Notes: Coefficients estimated from Linear Probability Model. Robust standard errors in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$. See Table 1 for variable definitions. All specifications include MEETINGS, ENTRY_INCORP, AFFLI_STUDENT, AFFLI_ALUMNI, AFFLI_FACULTY, SECTOR_CP, SECTOR_CWM, SECTOR_ENGY, SECTOR_HW, SECTOR_SW, SECTOR_LSMD, and indicator variables for the values of START_YEAR.

Figure 1: Number of Ventures by Start Year at VMS



Notes: See Table 1 for variable definitions.

Appendix Tables and Figures

Table A.1: Distribution of Mentor Interest Count

Num. Mentors Interested	Frequency	Percentage	Cumulative Percentage
1-2	95	14.6%	14.6%
3-5	203	31.2%	45.9%
6-10	275	42.3%	88.2%
11-15	68	10.5%	98.6%
16-20	9	1.4%	100%

Table A.2: Estimated Relationship between Initial Interest and Venture Outcomes in Logit

Outcome	INVESTOR			ACTIVITY			REVENUE		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
INTEREST_PERCENT	0.015***	0.009	0.008	0.029***	0.015**	0.011*	0.019***	0.014**	0.014**
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)
ENTRY_IP		0.123***	0.128***		0.144***	0.156***		0.047	0.048
		(0.041)	(0.041)		(0.052)	(0.049)		(0.040)	(0.040)
RESEARCH_BASED		0.050	0.029		0.023	-0.031		0.080*	0.074*
		(0.043)	(0.045)		(0.059)	(0.055)		(0.044)	(0.045)
ENTRY_INCORP		0.090**	0.079**		0.345***	0.295***		0.209***	0.206***
		(0.036)	(0.036)		(0.043)	(0.044)		(0.033)	(0.034)
MEETINGS			0.009*			0.036***			0.003
			(0.005)			(0.005)			(0.005)
Additional Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Start Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	655	655	655	655	655	655	655	655	655
Pseudo R^2	0.08	0.15	0.16	0.09	0.22	0.27	0.10	0.21	0.21

Notes: Coefficients are marginal effects estimated from Logit Model. Robust standard errors in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$. See Table 1 for variable definitions. "Additional Controls" include AFFLI_STUDENT, AFFLI_ALUMNI, AFFLI_FACULTY, SECTOR_CP, SECTOR_CWM, SECTOR_ENGY, SECTOR_HW, SECTOR_SW, and SECTOR_LSMD. "Start Year Dummies" include indicator variables for the values of START_YEAR.

Table A.3: Estimated Relationship between Alternative Constructs of Mentor Initial Interest and Venture Outcomes in OLS

Outcome	INVESTOR		ACTIVITY		REVENUE	
	(1)	(2)	(3)	(4)	(5)	(6)
INTEREST (Count)	0.004		0.009*		0.009**	
	(0.004)		(0.005)		(0.004)	
INTEREST_INVOLVED_PERCENT		0.003		0.019		-0.006
		(0.016)		(0.017)		(0.017)
INTEREST_LESSINVOLVED_PERCENT		0.009		0.010		0.016**
		(0.007)		(0.007)		(0.007)
N	655	655	655	655	655	655
Adjusted R^2	0.14	0.14	0.29	0.29	0.21	0.21

Notes: Coefficients estimated from Linear Probability Model. Robust standard errors in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$. *"INTEREST"*: Number of mentors expressing interest in a venture. *"INTEREST_INVOLVED_PERCENT"*: Number of mentors expressing interest & meeting with the venture more than once divided by number of active mentors. *"INTEREST_LESSINVOLVED_PERCENT"*: Number of mentors expressing interest & meeting with the venture once or less divided by number of active mentors. All specifications include ENTRY_IP, RESEARCH_BASED, MEETINGS, ENTRY_INCORP, AFFLI_STUDENT, AFFLI_ALUMNI, AFFLI_FACULTY, SECTOR_CP, SECTOR_CWM, SECTOR_ENGY, SECTOR_HW, SECTOR_SW, SECTOR_LSMD, and indicator variables for the values of START_YEAR.

Table A.4: Estimated Relationship between INTEREST_PERCENT and Venture Outcomes in OLS.Sample: INVESTOR=0

Outcome	ACTIVITY			REVENUE		
	(1)	(2)	(3)	(4)	(5)	(6)
INTEREST_PERCENT	0.023***	0.013*	0.007	0.017***	0.013**	0.012*
	(0.008)	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)
ENTRY_IP		0.095	0.103*		0.026	0.027
		(0.062)	(0.059)		(0.053)	(0.053)
RESEARCH_BASED		-0.032	-0.097		0.003	-0.009
		(0.068)	(0.064)		(0.058)	(0.058)
ENTRY_INCORP		0.456***	0.404***		0.305***	0.295***
		(0.061)	(0.062)		(0.064)	(0.065)
MEETINGS			0.039***			0.007
			(0.006)			(0.006)
Additional Controls	No	Yes	Yes	No	Yes	Yes
Start Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
N	533	533	533	533	533	533
Adjusted R^2	0.06	0.22	0.27	0.03	0.13	0.13

Notes: Coefficients estimated from Linear Probability Model. Robust standard errors in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$. See Table 1 for variable definitions. "Additional Controls" include AFFLI_STUDENT, AFFLI_ALUMNI, AFFLI_FACULTY, SECTOR_CP, SECTOR_CWM, SECTOR_ENGY, SECTOR_HW, SECTOR_SW, and SECTOR_LSMD. "Start Year Dummies" include indicator variables for the values of START_YEAR.

Table A.5: Estimated Relationship between Initial Interest and Venture Outcomes by Venture Incorporation Status in OLS

Outcome	INVESTOR	ACTIVITY	REVENUE
	(1)	(2)	(3)
INTEREST_PERCENT x (ENTRY_INCORP = 1)	0.012	-0.002	-0.001
	(0.016)	(0.013)	(0.017)
INTEREST_PERCENT x (ENTRY_INCORP = 0)	0.007	0.014*	0.017**
	(0.006)	(0.008)	(0.007)
ENTRY_INCORP	0.095	0.426***	0.392***
	(0.102)	(0.094)	(0.107)
N	655	655	655
Adjusted R^2	0.14	0.29	0.21

Notes: Coefficients estimated from Linear Probability Model. Robust standard errors in parentheses. $*p < 0.10, **p < 0.05, ***p < 0.01$. See Table 1 for variable definitions. All specifications include ENTRY_IP, RESEARCH_BASED, MEETINGS, AFFLI_STUDENT, AFFLI_ALUMNI, AFFLI_FACULTY, SECTOR_CP, SECTOR_CWM, SECTOR_ENGY, SECTOR_HW, SECTOR_SW, SECTOR_LSMD, and indicator variables for the values of START_YEAR.