



Do Entrepreneurship Courses Change an Individual's Attitude Toward New Venture Creation? Results of a Quantitative Assessment of the Cornell Entrepreneurship Program

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Abstract. Does enrollment in entrepreneurship classes actually impact venture creation? Our findings indicate that entrepreneurship classes have not only had a statistically significant impact on new venture creation, but are also significant in changing a student's mindset to favor entrepreneurship. Using an Instrumental Variable Probit model and data collected from a large sample (1,520) of Cornell University graduates, this paper finds that entrepreneurship classes have positively impacted venture creation, with venture creation being positively correlated with being "rich." The impact of the entrepreneurship program was observed campus-wide and across majors. Quantifying the impact of entrepreneurship classes justifies the existence of entrepreneurship education, and provides evidence for the continuation of such curricula at U.S. colleges and universities. Additionally, the paper highlights some of the issues facing academia as entrepreneurship education becomes more popular.

Keywords: entrepreneurship education, program assessment, class impact.

1. Introduction

Over the past decade, entrepreneurship education has been on the rise across universities. In 2008, the Kauffman Foundation, the largest foundation in the U.S. with a focus on entrepreneurship, noted that more than 5,000 entrepreneurship programs are offered on two- and four-year campuses, up from just 250 courses in 1985. There were more than 500 majors, minors, or certificates in entrepreneurship in 2006, up from 104 in 1975.¹ Since 2003, the Kauffman Foundation has given nearly \$50 million to 19 colleges and universities to build "Kauffman Campuses," designed to implement university-wide programs and/or courses to teach entrepreneurship. At Cornell University, over 35 entrepreneurship courses are offered every academic year and in 2007, approximately 5,000 students passed through these classes.² University donors

1. <http://www.kauffman.org/Section.aspx?id=Education>

believe that entrepreneurship education can have a positive impact on students, which has further led to the growth of entrepreneurship education over the past decade. A 2002 study by Solomon et al. supports this trend. Using results reported by participants in the 1999-2000 National Survey of Entrepreneurship Education, it found “evidence that institutions are receiving major endowments for entrepreneurship education in the form of chairs, professorships and centers.”³

Despite the proliferation of entrepreneurship education, some entrepreneurs and researchers still question the value of such courses and their impact. Many successful entrepreneurs themselves believe that “entrepreneurs are born, not made.”⁴ Blackford et al. (2008) found contradictory evidence when they surveyed 127 students who had taken entrepreneurship classes at a public university. They found that “entrepreneurship education does have an impact on the start-up of new firms...improving the self-efficacy of those taking such courses and identifying those individuals willing to accept the risks may also lead to additional firm start-ups.” Henry et al. (2005) found that while there was great variability in the way entrepreneurship training and education was imparted, there was consensus that some aspects of entrepreneurship could be taught successfully.

Overall, quantitative work linking the impact of education to actual venture creation has been limited. Most past research has explored the intentionality of venture creation but has not followed up to determine if venture creation actually took place. This paper reports on results of a general survey conducted on alumni, both entrepreneurs and non-entrepreneurs who took entrepreneurship classes and those who did not take any entrepreneurship classes. The study builds upon previous research by examining (i) the impact entrepreneurship classes have had on venture creation and (ii) attitudinal changes regarding entrepreneurship that may have occurred as a result of taking such classes. The following section reviews the relevant literature in entrepreneurship education. The paper then discusses the data and methods approach, hypothesis formulation, empirical model and results. Conclusions and potential implications and their limitations are discussed at the end.

1.1. Previous Research

Most previous research in this subject examines the correlation of entrepreneurship education with one of three primary outcomes for students: i)

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2. Entrepreneurship@Cornell statistic derived from class rosters
 3. Solomon, G.T., Duffy, S. and Tarabishy, A. (2002) “The State of Entrepreneurship Education in the United States: A Nationwide Survey and Analysis”, *International Journal of Entrepreneurship Education*, 1(1): 65-86
 4. Expert entrepreneur interviews; eclips.cornell.edu

intent to create new ventures, ii) success in entrepreneurial ventures and iii) acquisition of specific skill sets.

1.1.1. Research Correlating the Intent to Create a New Venture to Entrepreneurship Education

Peterman and Kennedy (2003) provide empirical evidence for including exposure to entrepreneurship education on secondary school students as an additional exposure variable in entrepreneurial intentions models. Their research examined the effects of participation in an enterprise education program on perceptions of the desirability and feasibility of starting a business. They found that students who were immersed in the Young Achievement Australia (YAA) enterprise program reported “significantly higher perceptions of both desirability and feasibility” towards starting a new venture. The degree of change in perceptions was related to prior experiences and a positive experience in the enterprise education program.

Delmar & Davidsson (2000) studied characteristics of Swedish entrepreneurs prior to commercial launch and compared them to similar characteristics of Norwegian and U.S. startup entrepreneurs. They found that age, education, experience and gender had an effect on an entrepreneur’s decision to start a new business. While the education was not entrepreneurship specific, overall education positively impacted venture creation. Similarly, Clark et al. (1984) found that taking entrepreneurship classes had a significant effect on an individual’s motivation to start a venture. They contacted 1855 students who had taken entrepreneurship classes and of these, 67% of the respondents that actually opened their own venture indicated that the entrepreneurship course was a significant factor in their decision-making process.

These results resonated with a later study by Autio et al. (1997), who looked at an international element when they studied university education in the United States, Finland, and Thailand. Using a combined sample size of 1956 students, they found that a supportive university environment positively affected the respondents’ attitudes towards entrepreneurship. This attitudinal impact of entrepreneurship was also positively correlated to the intent of a student starting his own venture within one year of graduation.

While these studies establish the link between entrepreneurship education and the motivation to create a new venture, they fall short by focusing only on students who participated in these classes, with no comparison group, thus leading to severely biased results. Many past studies also rely on summary statistics or weak econometric models to show this linkage. To accurately gauge the impact of classes on entrepreneurial intentions, a control group of students who did not participate in classes but did pursue venture creation, is needed. In addition, by surveying students only about their attitudes and intentions after

taking classes, these studies fail to account for each student's prior disposition towards entrepreneurship and his propensity to seek out such classes.

1.1.2. Correlating entrepreneurial success and education.

Another approach in the literature correlates entrepreneurial success with having taken a course in entrepreneurship. For example, a University of Arizona study (Charney and Libecap, 2002) of 511 entrepreneurship and non-entrepreneurship alumni found that students who took entrepreneurship classes "have annual incomes that are 27 percent higher and own 62 percent more assets." Using wealth as a proxy for success, the authors concluded that entrepreneurship education increased the income of graduates by \$12,654, and these students were more likely to start a business, when compared to other alumni. Their conclusion was that entrepreneurship education led to more wealthy, and thus successful alumni.

Recent findings by Dr. Chad Moutray, Office of Advocacy of the U.S. Small Business Administration, indicate that education choices by graduates are correlated with self-employment.⁵ The author tracked a group of university graduates from 1993 through 2003 and determined that "although the self-employed closely resemble the larger population in many ways, for graduates of 1993 their choice of majors and their stated values while in college are linked to their occupational choices a decade later." Moutray found that race, gender and ethnicity were not significant predictors of entrepreneurship. Instead, general education was one of the significant predictors in determining self-employment. For example, business and management majors were less likely to be self-employed. These graduates instead, were more likely to work in for-profit businesses. Correspondingly, graduates from social sciences were more likely to be self-employed.

The results are mixed on whether entrepreneurship education has an impact on success rates. Robinson and Sexton (1994) used earnings as a measure of success and self-employment as a proxy for entrepreneurship and wealth as a measure of success; their results showed a positive correlation between years of education and earnings. Additional years of general education were also found to increase the likelihood of people starting their own ventures. Conversely, a 2004 study on Norwegian and Indonesian students by Kristiansen & Indarti (2004) found no correlation between general education and a student's intention of becoming an entrepreneur.

Many of the studies that correlate education and entrepreneurial success deal with small sample sizes and recent graduates who took entrepreneurship classes. Thus, they miss out on both the long-term impact of entrepreneurship education

5. Moutray (2007)

and phenomenon such as the “mid-life” entrepreneurs who pursue entrepreneurship after pursuing an alternative career. Additionally, using wealth as a proxy for success is limited in scope and does not truly encapsulate the broad reach of entrepreneurship education, especially given the current trend for entrepreneurship to be a university-wide approach.

1.1.3. Research Correlating Entrepreneurship Education and Specific Skill Sets

While some search for connections between entrepreneurship education and specific career outcomes, such as starting a business venture, others seek to show whether or not such courses can be used to teach students specific skills useful to entrepreneurial life, thus challenging the idea that entrepreneurs are “born, not made.” DeTienne and Chandler (2004) studied 130 undergraduates and focused on business opportunity identification and idea generation. They concluded that students could be taught to identify business opportunities and more importantly, that the predisposition towards innovation did not significantly alter the learning process.

Krueger and Carsrud (1993) tested the intentionality of becoming an entrepreneur by asking respondents in a dichotomous yes/no response choice, “Do you think you’ll ever start a business?”. They found that pedagogy impacted an individual’s intentions of becoming an entrepreneur. Osterbeek et. al (2008) found contrary results in their study linking entrepreneurial education to venture creation intentions. Using a diff-in-diff approach within an IV framework, they found a negative correlation between self-assessed skills and the intention of becoming an entrepreneur.

A ten-year entrepreneurship literature and education review by Gorman et al. (1997) found that “....most of the empirical studies surveyed indicated that entrepreneurship can be taught, or at least encouraged, by entrepreneurship education.” Similarly, Edelman et al. (2008) researched entrepreneurship courses and their teachings and compared it to activities practiced by nascent entrepreneurs. They found some overlap between start-up activities as practiced by nascent entrepreneurs and those covered in textbooks. Although Ucbasaran et al. (2003) found no significant differences between habitual and novice entrepreneurs with respect to information search, they argued that an entrepreneur’s cognitive mindset might be influenced not only by their experience and knowledge but also other cognitive processes.

Delmar and Shane (2003) found that business planning decreased the likelihood of ventures failing and accelerated organizing and product development activities. They examined 223 Swedish firms and argued that “planning helps firm founders to make decisions more quickly than with trial-and-error learning; to manage resource supply and demand in ways that minimize time-consuming bottlenecks; and to turn abstract goals into concrete operational

activities more efficiently.” Binks et al. (2006) examined entrepreneurship education in MBA programs and determined that “entrepreneurship education offers an innovative new paradigm for business school education” and helps develop entrepreneurial skills and aptitudes.

Research results support the view that teaching courses such as business planning to students can help bridge the gap between opportunity identification and venture creation. Nevertheless, while studies show that entrepreneurship education can augment the learning process and mindset, one obvious limitation of such research is that there is a non-trivial leap between a respondent’s intentionality of starting a venture and the respondent actually starting a venture. As Edelman et al. (2008) found, entrepreneurship texts do not have enough of an emphasis on activities that enhance the probability of actually starting a new venture.

To summarize, while previous studies weakly link entrepreneurship education to venture creation, they make incremental gains and do not establish a strong link between entrepreneurship education and venture creation. Additionally, they suffer from one or more of these limitations:

- No pre-testing or control measures for prior disposition towards entrepreneurship. Many past studies also rely on summary statistics or weak econometric models to show this linkage.
- Lack of a baseline or reference group of students that did not take classes. By only dealing with respondents who took classes, past studies ignore endogeneity biases in estimates.
- Lack of follow-up on whether intention to start a business is followed by actual startups. Indicating an intention to start a business is not a good proxy for actually starting a venture.
- By utilizing short time horizons that focus only on student or young entrepreneurs, past studies ignore serial, mid-life or second life entrepreneurs.
- Small sample sizes generally ranging in the one hundreds that force econometric corrections for selection bias.

Recognizing these limitations, this paper incorporates some of the variables used in previous studies but controls for the limitations highlighted above. Additionally, the study is unique because it accounts for a student’s career choices both pre- and post- graduation from University and surveys graduates from the past six decades.

2. Hypothesis

The central hypothesis of this paper is that entrepreneurship classes increase the probability of venture creation. Additionally, the paper intends to determine if classes impacted a student's mindset to favor entrepreneurship.

As discussed in section two, numerous studies positively correlate entrepreneurship education and venture creation by looking at current and recent students who participated in entrepreneurship classes. The limitation of this approach is that it does not account for a student's predisposition towards entrepreneurship classes. We address this endogeneity problem and, unlike prior research, control for a student's intentions pre-graduation. Additionally, by surveying respondents who graduated as far back as 1950, we capture the diverse experiences of respondents and bridge the gap between the intentionality of starting a venture and the respondent actually starting a venture.

3. Data and Methods

Prior to 1990, Cornell offered a small handful of entrepreneurship classes; however, these classes were primarily in the business school and there was no campus-wide involvement. These limited class offerings to the campus community provide some natural exogenous variation that we exploit in identifying the impact of entrepreneurship classes on students. In 1990, Cornell began formalizing the entrepreneurship program, and in 1992, the Entrepreneurship and Personal Enterprise (EPE) was born. Today, Entrepreneurship at Cornell (E@C, previously EPE), advertises over 35 courses offered across multiple academic disciplines every semester. These courses range from entrepreneurship speaker series at an introductory level to business planning and startup financing at the upper levels. Masters/MBA level courses offer more advanced business and engineering training modules that focus on startup issues.

With the assistance of the Alumni Association, an exclusive email list was assembled and surveys were emailed to over 15,000 alumni of Cornell University. The survey was not targeted to alumni from any specific majors or employment status; rather, the sample was a random group of Cornell alumni and can thus be considered representative of all alumni. Two versions of the survey were designed to partition respondents into pre-1990 and post-1990 graduates. A total of 37 questions were asked and respondents were informed that the goal of the survey was to assess the overall impact of the entrepreneurship program. The specific objective of measuring the impact of entrepreneurship classes was not disclosed to prevent response bias.

In our model, the pre-1990 group served as the baseline reference group because of the handful of entrepreneurship classes available prior to 1990. Entrepreneurship classes did not exist in the 50's, 60's and 70's, and in the 80's,

only a few classes existed in the business and agriculture schools. The majority of pre-1990 graduates never had the opportunity to take entrepreneurship classes. For the post-1990 respondents, graduation years were grouped into even, two-year increments, to better gauge the longitudinal impact of classes; thus, the survey was slightly modified for each group, keeping the research goal in perspective. Questions were designed to capture the attitudes of students entering Cornell, the types of entrepreneurship activities they may have participated in, and any attitude changes that may have resulted from their participation in these activities. The survey was field tested with approximately 45 alumni before implementation, and their feedback was incorporated into the final instrument.

4. Data Summary

Overall, 1520 responses were collected with a near fifty-fifty split between pre-1990 and post-1990 graduates. This close distribution between the two groups of respondents was inadvertent but made analysis and comparisons to the control group easier to craft. Table 1 summarizes the graduation years of all the respondents. Additionally, 82.7% of the entire sample received a Bachelor's degree, 12% received an MBA, 13.9% received a non-business Masters degree and 3.9% received a PhD. (Note: percentages do not total 100% as many respondents received multiple degrees from Cornell).

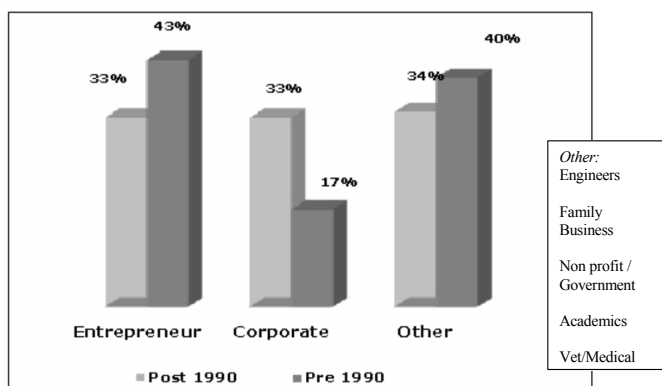
Table 1: What year did you receive your highest degree from Cornell? Response choices for the entire sample

Answer Options	Response Percent
before 1990 (the inception of the Entrepreneurship program)	50.1%
1990-1992	6.8%
1993-1995	5.9%
1996-1998	6.8%
1999-2001	8.5%
2002-2004	10.0%
2005-2007	10.1%
Currently at Cornell	1.7%

Figure 1 summarizes the current (at time of survey, summer 2008) career choices for all respondents. In the pre-1990 group, 43% of the respondents identified themselves as entrepreneurs, 17% as corporate employees, and 40% as other. In the post-1990 group, 33% of the respondents identified themselves as entrepreneurs, 33% corporate employees and 34% as other. For both groups, the "Other" category included career choices of engineering, family business, non-

profit and/or government employment, academia and veterinary or medical fields. The career choice of “entrepreneur” was narrowly defined to someone who was currently working in a self-founded business (for-profit or non-profit). It can be argued that this definition of “entrepreneur” is limiting and there exist many family businesses and corporate positions that can be entrepreneurial in nature. While we agree that the concept of entrepreneurship should be all-inclusive, it was intentionally limited to eliminate response confusion. Moreover, the goal was to identify the impact of classes on venture creation and including family businesses and corporate positions would have diminished our ability to achieve this goal. A conservative approach in defining an entrepreneurial career helps establish a baseline.

Figure 1: Current career choices of all respondents



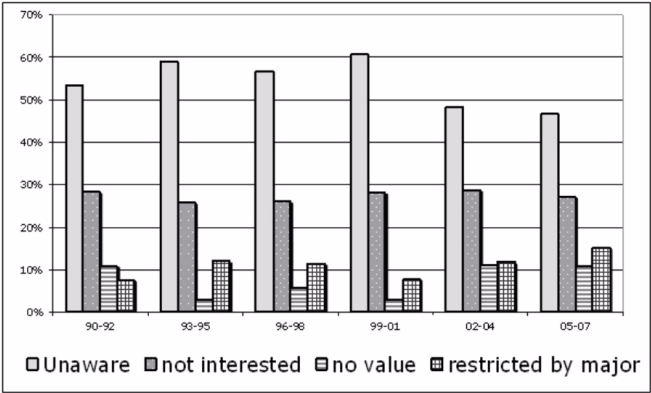
4.1. Class Metrics

The post-1990 group was also asked to indicate how many entrepreneurship classes they had taken while at Cornell. Of this post-1990 group, 53.8% of the respondents did not take any entrepreneurship classes. 41.3% of the respondents took between 1-3 classes, and 4.9% of the respondents took more than 4 classes. The primary reason provided by the post-1990 group for not taking a class was lack of awareness - 73.5% of the respondents were unaware of course offerings, 39.7% were not interested, 11.4% did not see value in taking entrepreneurship classes, and 16.9% of the respondents indicated that they were restricted by their major from taking entrepreneurship classes (respondents were asked to select all applicable options and thus, percentages do not add up to 100%).

Figure 2 summarizes categorical responses as a percentage of total responses, since 1990. As evident by the timeline trends, many students are unaware of entrepreneurship offerings on campus. This suggests that the E@C program has

marketing and awareness opportunities at Cornell. Of particular interest was the group that selected “restricted by major” as the reason not to take an entrepreneurship class. Many of the respondents who selected this choice were either Engineering or Liberal Arts majors. Even though some entrepreneurship courses exist in the Engineering major, some of the recent graduates commented that they would have liked more exposure to business and entrepreneurship to complement their technical skills.

Figure 2: Over the years - why did you not take an entrepreneurship class?



4.2. Prior Attitudes

Because a student’s propensity to take an entrepreneurship class is endogenous to prior attitudes and experiences, questions were asked to determine what career options the student was focused on prior to entering Cornell. Additional questions were asked to determine what attitudinal changes towards career choices, if any, occurred upon graduation. Table 2 summarizes the attitudes of all respondents prior to entering Cornell and changes in career preferences during their undergraduate years at Cornell. The combined majority of the respondents entered Cornell intending to pursue careers in professional practice and corporate life.

Table 2: Career preferences prior to entering Cornell, during their education while at Cornell and career path at the time of the survey (summer 2008). Summary for the entire sample.

Career Preferences	Prior to entering Cornell	Changes during undergraduate years	Career path at time of survey (2008)
Not thinking much about career yet / No change	21.8%	34.0%	-
Oriented toward entrepreneurial path.	13.0%	19.0%	37%
Oriented toward family business.	2.2%	1.6%	2.0%
Oriented toward professional practice (engineering, vet, medicine, law, architecture, design)	29.0%	11.2%	20%
Oriented toward corporate life.	21.0%	19.0%	25%
Oriented toward government, military or nonprofit career.	7.0%	8.0%	8%
Oriented toward academics (teaching/research)	6.0%	7.2%	7%

As the table also indicates, 34% of the respondents did not experience any changes in career orientation. Interestingly, while only 13% of the respondents entered Cornell with an entrepreneurial mindset, 19% of the surveyed alumni changed their career orientations to favor entrepreneurship. It is this change towards an entrepreneurial career preference (a proxy for venture creation) that the statistical model is designed to explain. We must acknowledge here that it is possible that our dataset suffers from some recollection bias especially since we question respondents about their coursework and career attitudes prior to attending Cornell. This limitation is discussed further in section 9.0.

5. Empirical Model and Justification

A simple method to determine the impact of entrepreneurship classes on venture creation would be by OLS where the coefficient β_1 estimates the class impact.

$$(1) Y = \beta_0 + \beta_1 \text{ class participation} + \varepsilon$$

However, since the decision to take an entrepreneurship class may depend of existing propensity towards entrepreneurship and influence the outcome of

interest, the coefficient γ in the above equation will be biased. Here, the OLS estimator is not preferable and variable specifications need to be implemented to adjust for this endogeneity – the existing propensity towards entrepreneurship. One solution to this problem is to use instrumental variable (IV) regression where we find instrumental variables that are uncorrelated with the error term impact the ability to take an entrepreneurship class but have no impact on the outcome which is the decision of an individual to become an entrepreneur. This method permits a consistent estimation of the γ coefficient.

In most cases, the Heckman model is appropriate to adjust for selection bias as it addresses issues arising from small samples. Not only does our paper have a large and diverse sample that adjusts for sampling biases, we also adjust for endogeneity issues that will not be addressed by utilizing the Heckman model. The IVProbit procedure fits models with dichotomous dependent variables and endogenous regressors, and jointly estimates two equations via maximum likelihood. The major difference between the IVProbit estimator and other estimators such as the traditional IV estimator or the Heckman estimator is that the IVProbit estimates are maximum likelihood estimations of Amemiya's generalized least square estimator (Amemiya, 1978; Newey, 1987). Here, the endogenous variable is treated as a linear function of the instruments as well as other exogenous variables. This procedure allows us to predict outcomes between 0 and 1, unlike other linear probability models.

For IV regressions to work, instruments must be relevant and exogenous. If an instrument is relevant, then the variation in the instrument is related to the variation in the instrumented variable. It should also be uncorrelated with the outcome variable. The instrument must also be exogenous and not belong to the explanatory equation. Our paper utilizes a single endogenous regressor and the IVProbit model can be formally written as:

$$(2) Y = A + B + u$$

$$(3) A = B_1 + Z_2 + v$$

Here, “Y” represents the dependent variable, “A” represents the endogenous variables, “B” are the exogenous variables, “Z” are the exogeneous and relevant instruments, and are structural parameters. Equation (3) is in reduced form, where β_1 and β_2 are reduced form parameters. The model is jointly estimated using maximum likelihood estimator and is derived under the assumption that the error terms u and v are independently and identically distributed multivariate normal for all observations.

For the model to be identified similar to two-stage least squares regression, the number of instruments should be greater than or equal to the number of endogenous variables. Unlike the linear regression model, the IVProbit uses a maximum likelihood estimator to give consistent results. Since we are interested

in estimating the impact of entrepreneurship classes on the probability of an individual becoming an entrepreneur, and we are using the pre-1990 group as the baseline reference group, we need to account for two primary issues.

The first issue is the justification of using the pre-1990 group as the reference group. Unlike the post-1990 group, the majority of pre-1990 graduates never had the opportunity to take entrepreneurship classes and this fact helped designate the pre-1990 and the post-1990 groups as the reference and impacted groups respectively. The underlying assumption that the pre-1990 group is by and large similar to the post-1990 group arises from the theory of regression discontinuity. Regression discontinuity methods (see Lee and Lemieux, 2009) are used to estimate how a treatment (entrepreneurship classes in this case) affects individual outcomes in the absence of a randomized controlled trial. The random assignment of individuals to different groups allows outcomes to be compared between the control and treated groups. This method is especially beneficial in situations where there is no feasible experiment possible. Simply put, we claim that there is no significant educational difference between a student that graduated in 1989 and a student that graduated in 1991. The significant educational difference is the availability of entrepreneurship classes.

The second issue that we need to address is the endogeneity issue that could impact the individual's decision to take a class. We assert that the decision to take an entrepreneurship class is influenced by an individual's prior attitude towards their career goals, and towards entrepreneurship in general. Prior affinity towards entrepreneurship is reflected in the number of classes taken by an individual. Accounting for the prior attitudes towards entrepreneurship and subsequent career choices is the primary challenge since prior plans to become an entrepreneur can lead an individual to take entrepreneurship classes and later on, to possibly pursuing an entrepreneurial career path. To discern the impact of entrepreneurship classes on an individual's decision to pursue an entrepreneurial path, we must control for this endogeneity problem.

To adjust for these two issues, we implement IVProbit estimation (see Wooldridge, 2002 for details) in a discrete choice model. The model accounts for the issue where the decision to take an entrepreneurship class can be influenced by career goals and pre-conceived attitudes towards entrepreneurship. A single equation Probit estimation will not work here as it will cause inconsistent regression parameter estimates. In particular, it will confound prior entrepreneurial tendencies with the impact of entrepreneurship classes. As a reference, regular Probit results are still provided and compared to the IVProbit results.

Krueger and Angrist (2001) showed that "instrumental variables methods estimate causal effects for respondents whose behavior would be changed by the instrument, if it were randomly assigned."⁶ Since we cannot see the effect of

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entrepreneurship classes on the probability of becoming an entrepreneur, we have to estimate its impact using known variables. Instrumental Variable estimates are consistent but not unbiased and therefore, large samples work best for this estimation method. We contend that our sample size of 1520 responses is large enough to estimate our dependent variable consistently and minimum of bias.

5.1. Estimation Equation

Two exogenous factors helped determine who would take entrepreneurship classes. As detailed previously, entrepreneurship classes did not exist for the majority of the pre-1990 group. Additionally, some respondents from the post-1990 group were restricted from taking entrepreneurship classes by their major and they automatically selected the “zero” option, for number of classes taken. Since 1990, this percentage ranged between 8%-14% of our sample. We use both the degree restrictions and major restrictions prior to 1990 as instruments assuming that these constitute random assignments. More formally, we assert that these two variables are uncorrelated with entrepreneurial interest.

Ideally, we would like to randomly assign individuals to entrepreneurship classes, track them over time and then assess the impact of classes on their career choices. This, of course, is not possible. The pre-1990 group thus serves as a pseudo-control group since it comprises respondents that graduated prior to the formal implementation of the E@C program. The post-1990 group serves as the treatment group with variation in responses. In the data set, the IV method also allows us to estimate consistent coefficients, simulating the random assignment of respondents to entrepreneurship classes.

Base Equation:

$$\text{Prob}(Y=1) = \beta_0 + \beta_1 \text{ class participation} + \beta_2 \text{ degree type} + \delta_1 \text{ prior attitudes} + \varepsilon$$

In the empirical model, the dependent variable is defined as a dichotomous indicator of whether or not an individual is currently an entrepreneur, a proxy for venture creation. A dummy variable for “entrepreneur” was created by combining respondents from both pre-1990 and post-1990 groups, with “1” representing individuals that have started a business. This dummy variable serves as a proxy for venture creation as only individuals who had started ventures were defined as entrepreneurs. The *degree type* variable divided the variable into two groups – “1” for those respondents that received a Bachelor’s degree and “0” for respondents that graduated with Masters and PhD degrees. This variable was included to determine if there was a difference in venture creation impact between undergraduate and graduate classes. The *class participation* variable was created as a dichotomous variable to divide the respondents into two groups – those that

took an entrepreneurship class (one or more) were assigned a “1” and the rest of the group was assigned “0”. The *prior attitudes* variable is represented by δ_1 and it accounts for a student’s attitude towards their career before entering Cornell. These six attitudes are outlined in table 2.

The base equation is estimated using three different models. First, standard Probit estimation is employed; however, because class participation is endogenous, this procedure will provide inconsistent estimates. In order to correct this bias, *class participation* can be written as a function of the exogenous variables, including the instruments. Age, gender and ethnicity were used as control variables in all equations. Here, graduation year and class restrictions are instruments used in the IVProbit equations.

Class participation = f (degree type, prior attitudes, age, gender, ethnicity, graduation year, class restrictions)

IVProbit estimation is then used as a second method and includes the variable *graduation year* as an instrument for class participation. Graduation year serves as an instrument because it divides the respondents into two groups – those that graduated prior to 1990 and those that graduated after 1990. Since belonging to this group is an exogenous random event, it helps us by replicating the random assignment of students to entrepreneurship classes.

The third model again uses IVProbit but includes both graduation year and other college major imposed restrictions, as instruments. This additional *class restriction* variable combines two restrictions; (i) restrictions imposed by an individual’s academic program and (ii) lack of awareness of entrepreneurship classes by an individual. These three models are summarized in table 3.

Table 3: Three estimation models and variables used in each model to determine the impact on classes on venture creation

Model #	Method	Variables	Instrument(s)
One	Probit	class participation + degree type + prior attitudes + age + gender + ethnicity	none
Two	IVProbit	class participation + degree type + prior attitudes + age + gender + ethnicity	graduation year
Three	IVProbit	class participation + degree type + prior attitudes + age + gender + ethnicity	graduation year + class restrictions

6. Primary Empirical Results

6.1 . Probit Estimates – Model 1

Table 4 displays results for the three models, including results from the simple Probit regression. The marginal effects column displays the impact of the explanatory variable on the probability of pursuing an entrepreneurial career path and consequently, venture creation. Overall, classes increased the probability of an individual starting a venture 10.3% and this value is significant. One limitation of the Probit model is that it does not adjust for sample selection issues and thus will offer inconsistent estimates.

6.2. IVProbit Estimates using one restriction – Model 2

Results outlined in table 4 indicate that entrepreneurship classes have had a positive impact on venture creation. Overall, taking one or more entrepreneurship classes increases the probability of an individual becoming an entrepreneur 66%. In comparison to the Probit estimates, this model accounts for the lack of availability of classes prior to 1990; however, graduation year may be a rather rough instrument potentially leading to the overestimation of the impact of entrepreneurship classes.

6.3. IVProbit using two restrictions – Model 3

As with previous results, the data demonstrates that classes positively impact the probability of an individual becoming an entrepreneur. These results are shown in table 4. In this more restricted model, taking one or more classes increases the probability of an individual starting a venture 16%, compared to 66% in the base IVProbit model from model 2. Note that the probability for someone entering Cornell with an entrepreneurial focus practically doubles from 12% to 23% in the more restricted model. This is an indication that students entering Cornell with an entrepreneurial mindset actively sought out entrepreneurship classes, further validating the use of the IVProbit model.

This IVProbit model with two instruments uses a more robust instrumentation scheme. 16.9% of our post-1990 group was restricted from taking classes by their major. Additionally, the majority of the respondent group (73.5%) was unaware of entrepreneurship course offerings. Therefore, it is more realistic to predict that taking one or more classes increases the probability of an individual starting a venture 16%, compared to 66% in the base IVProbit model from the previous equation.⁷

Table 4: Results of all three estimation models outlined in table 3. (std. errors in brackets, 95% significance used).

Notes: (i) Family business serves as the reference group. (ii) Age, gender and ethnicity variables are not significant and hence not reported.

Variables	Marginal Effects of Model 1 (Probit)	P-values Model 1	Marginal Effects of Model 2 (IVProbit)	P-values Model 2	Marginal Effects of Model 3 (IVProbit)	P-values Model 3
# of classes > 0	10.3% (0.03)	0.005*	66% (0.01)	0.000*	16% (0.07)	0.025*
Degree type	-10% (0.04)	0.028*	5.2% (0.04)	0.27	-9.6% (0.04)	0.037*
Unsure of career	5.8% (0.10)	0.60	12.2% (0.08)	0.08	6.6% (0.11)	0.53
Entrepreneur	21.8% (0.12)	0.07*	12% (0.12)	0.45	22% (0.12)	0.05*
Professional practice	- 3.4% (0.09)	0.73	- 5.1% (0.10)	0.14	- 2.8% (0.10)	0.78
Corporate	0% (0.09)	0.99	- 1.4% (0.09)	0.91	0% (0.10)	1.0
Govt / Non profit	9% (0.11)	0.48	14.5% (0.11)	0.20	9.6% (0.13)	0.45
Academia	- 1.5% (0.10)	0.89	9% (0.10)	0.17	-0.8% (0.11)	0.93

Note: Marginal effects produced by IV models are higher than the Probit model as informal surveys reveal that the majority of students that take entrepreneurship courses are curious about it and do not have a strong interest in it prior to taking a class.

6.4. Model Robustness Tests

Two tests were performed to assess the robustness of the IVProbit estimates in model 3. We contend that including all restrictions, as in model 3, provides more

7. In our sample, 160 of the total post 1990 entrepreneurs (when classes existed) did NOT take a class and 79 took an entrepreneurship class. Additionally, many engineering students (and current entrepreneurs) complained in the comments section that they could not take a class due to major restrictions or small class sizes that filled up quickly. For the entire sample of entrepreneurs, 388 did not take a class. A large reason for this is due to classes not being offered prior to 1990.

consistent estimates of the impact of entrepreneurship classes on entrepreneurship. Model 3 included two restrictions and one instrumented variable. First, we used a Wald test to determine the strength of our instrument. This test is mentioned in Wooldridge (2002) and the test simply asks whether the error terms in the structural equation and the reduced-form equation for the endogenous variable are correlated. The Wald test did not provide a significant χ^2 result thus indicating that the instruments have successfully mitigated the correlation between the instrumented variables and the error term.

Second, a two-stage IV regression was run to test for instrument identification. The two-stage regression is used to test for selection bias between the pre-1990 and post-1990 groups. We do this to reject the hypothesis that self-selection or other forms of selection into the two groups account for differences in venture creation by respondents. The two-stage results indicate that all estimates are efficient and consistent. The Sargan statistic indicated that the equation was exactly identified and that the instruments used were proper with a χ^2 score less than 1%. These tests, along with the Probit model limitations, are an indicator that the standard Probit is not the appropriate model and that the IVProbit is a better fit for the data.

6.5. Attitudinal Changes

The survey also asked respondents to indicate any change in attitude towards career preferences during their undergraduate years (table 2). This variable was called *attitude change*. Respondents that stated that their career attitudes changed to favor entrepreneurship were assigned a value of “1” and all others were assigned a value of “0.” Additionally, respondents who came into Cornell with an entrepreneurial mindset but changed their preferences to favor an alternate career path were assigned a value of “-1” (minus one) to account for any negative impacts. These cases did not occur much in the data but are included for completeness. For respondents who came in with an entrepreneurial mindset and stated that their attitude did not change towards any other career type were also assigned a value of “0”. The IVProbit estimation equation for *attitude change* is as follows:

$$P(\text{attitude change}) = \beta_0 + \beta_1 \text{ class participation} + \delta_1 \text{ prior attitudes} + \varepsilon$$

As defined on the previous section, the *class participation* variable was created as a dichotomous variable to divide the respondents into two groups – those who took an entrepreneurship class (one or more) were assigned a “1” and the rest of the group was assigned “0.” The *prior attitudes* variable is represented by δ_1 and it accounts for a student’s attitude towards their career before entering

Cornell. In this model, *prior attitudes* and *degree type* serve as instruments for *class participation*.

Table 5: Results estimating the impact of classes on attitude changes to favor entrepreneurship (std. errors in brackets, 95% significance used)

Variables	Marginal Effects	P-values
# of classes > 0	31.7% (0.05)	0.000*
Unsure of career	1.8% (0.03)	0.538
Entrepreneur	18.7% (0.04)	0.000*
Family business	6.8% (0.05)	0.216
Professional practice	0.8% (0.02)	0.728
Corporate	6.9% (0.02)	0.007*
Govt / Non profit	- 6.0% (0.03)	0.094
Academia	- 4.0% (0.03)	0.193

As evident from table 5, results indicate that classes have had a statistically significant impact in changing a student's mindset to favor entrepreneurship. For respondents who had taken more than one entrepreneurship class, there is a 31.7% probability that the attitude change was a direct result of taking a class. Since our model cannot separate out the impact of taking exactly one class, we cannot control for any attitudinal changes that may have occurred after taking exactly one class; hence, the results account for the impact of taking one or more classes. As a reminder, 53.8% of our respondents did not take any entrepreneurship classes and 41.3% of the respondents took between 1-3 classes.

This finding does underscore the importance of the existence of a university-wide entrepreneurship curriculum that focuses on education, versus a sole focus on venture creation. While this idea is discussed more in section 10, we need to acknowledge the challenge of separating the impact of one class on a change in mindset versus the collective impact of taking more than one class. It can be argued that only highly motivated students seeking an entrepreneurial path would take multiple classes and it is this factor that leads to an attitudinal change. This point is indirectly explored in section 8.4.

7. Other Empirical Results

7.1. Do It Now Or Wait?

The survey asked respondents to indicate their career choices within 5 years of graduation and their career path today. The motive behind this question was to determine if the amount of time spent in the “real world” impacted an individual’s decision to start a venture. At Cornell, we find two primary schools of thought relating to venture creation – donors to the entrepreneurship programs want to see students starting their ventures immediately upon graduation while many students prefer gaining work experience before launching a business venture. An informal poll of business and engineering faculty reveals that in their discussions with students, more students prefer to gain experience before starting a venture versus delving right in upon graduation.

Our data indicates that entrepreneurs who started an entrepreneurial venture within 5 years of graduation had a higher probability of staying on that same career path. This statistic was calculated by looking at career choices within 5 years of graduation and what individuals indicated their career choice was at the time of the survey. Only the entrepreneurial career choice was compared across groups. Career choices today for both groups were regressed on their career choice within 5 years of graduation. In the pre-1990 group, individuals who started a venture within 5 years of graduation had a 22% probability of staying on that same career path. The probability falls to 16.5% when we look at all entrepreneurs that started their ventures outside of 5 years.

It can be reasonably argued that the length of existence of the Cornell program and the various entrepreneur networks are a factor in the higher probability rates for staying entrepreneurial. The entrepreneurship program at Cornell has existed in some form since the 80’s and formally, since 1990. The University also has a variety of on-campus and alumni networks that can provide support and advice to burgeoning entrepreneurs. Despite these factors, the key takeaway from these results is that there is evidence for supporting entrepreneurial ventures at the collegiate level. Pursuing venture creation within 5 years of graduation is statistically significant in predicting a current entrepreneurial career path.

7.2. Helpfulness of Classes

The survey also asked all post-1990 respondents how they felt about any entrepreneurship classes they may have taken and if they found the classes to be helpful when starting a business. Not surprisingly, 52.6% of the respondents did not take a class and stated that they had no opinion. 24.8% of the respondents though stated that they found the classes to be useful and/or helpful. A small

percentage (2.4%) responded that they did not find the classes helpful while 20.2% stated that they took classes but did not start a business.

The survey also asked all non-entrepreneurs in the post-1990 group if they felt their participation in entrepreneurship classes and events was of value to their careers. 19.5% of this group found value in classes but 6.7% disagreed and stated that their entrepreneurship classes and events were not of value to them.

7.3. Wealth Creation

We find a direct correlation between venture creation and being “rich.” Our survey asked respondents to indicate if they were “rich” and to indicate the primary source of their wealth. The SEC definition for “rich” was provided to all respondents. It states “families are rich if they have investible assets of at least \$2.5 million, excluding equity in any homes or business.” Analogous to existing research, our data indicates that entrepreneurs tend to be richer than their non-entrepreneur counterparts, with the entrepreneurial venture accounting as the primary source of wealth. For the pre-1990 group, 54.1% of the entrepreneurs indicated they were rich, versus 31.3% of non-entrepreneurs. A majority of these rich entrepreneurs were serial entrepreneurs and indicated that they had started more than one business.

In the post-1990 sample, 10.4% of the entrepreneurs indicated they were rich, compared to 6.5% of non-entrepreneurs. We include this statistic because many entrepreneurship programs have a strong emphasis on venture formation and use wealth creation as a yardstick for success. At Cornell, the educational emphasis is on the formation of an overall entrepreneurial mindset, although several agencies support student entrepreneurial ventures.

7.4. Impact on Fostering the Entrepreneurial Spirit

To get at the impacts of the benefits of a university-wide program, we also asked all respondents to indicate whether they felt their entrepreneurial spirit was fostered while they were at Cornell. In the pre-1990 group, 19.7% of the group agreed and 36.8% of the group disagreed with the statement that their entrepreneurial spirit was fostered while they were at Cornell. Conversely, 34.4% of the post 1990 group agreed and 26.6% of the group disagreed with the same statement. A Kruskal-Wallis one-way analysis of variance test was conducted on the sample to test whether the samples originated from the same distribution. Results show that both the agree and disagree responses are statistically significant at the 99% level indicating that the implementation of classes and other activities at the university wide level has had an impact on fostering the entrepreneurial spirit and not just on venture creation.

8. Limitations and Further Research

While considerable effort was dispensed in collecting the large dataset of 1520 responses, all respondents are Cornell University graduates, which limits the generalization of results across other universities. A larger limitation of this paper is the justification that the changing attitude to favor entrepreneurship by students was due to entrepreneurship classes. Some may argue that the quality of interactions with other students in informal settings or simply student maturity is responsible for the change in attitudes to favor entrepreneurship. This is often referred to as the omitted variable bias in the IVProbit model. As with any empirical model, the paper cannot account for variables that are unobserved. The IVProbit model though does adjust for this omitted variable bias and provides consistent estimates.

Empirically, a matter of discussion can be the use of demarking respondents based on their graduation year to serve as an instrument for participation in entrepreneurship classes, and then using this instrument to predict entrepreneurial outcomes. For example, business creation rates can be affected by the state of the economy and one can even argue that as Cornell began offering entrepreneurship classes in the 1990's, entrepreneurially inclined students chose Cornell over other universities, thus biasing estimates.

We agree that business cycles influence venture creation and unfortunately, do not have details on what economic climate the respondents "thought" they graduated in and if it impacted their venture formation. We did look at the responses to the question "what was your career choice within 5 years of graduation" and for all respondents that selected the "entrepreneur" choice, we looked at their response rates over the years starting at 1990, in 2-year increments. We find that the responses to this question are steady over time and do not display much fluctuation. While admittedly this is not an econometric test, the response window is broad enough to mask fluctuations and multiple career changes. Kher et. al (2011)⁸ investigated if offerings in entrepreneurship courses impact a student's decision to attend a particular university. They find that when analyzing the respondents' university selection decision, entrepreneurship classes are not a statistically significant factor in determining whether a student chooses to attend Cornell University.

This paper dataset does not suffer from a recency problem where only recent graduates responded to the survey. We are able to compare responses between two groups of students; students who took classes versus students who did not. But, it is reasonable to claim that the dataset suffers from some recollection bias especially since we question respondents about their coursework and career attitudes prior to attending Cornell. Many events in an individual's life as well as social changes can impact his or her memory. For example, entrepreneurship has

8. Kher R, Streeter D & Just D; The "Good Job" Trap: Opportunity Cost as a Deterrent to Immediate Venture Creation, *working paper*.

become much more mainstream recently and may be seen as a much more appropriate career choice today versus fifteen years ago. In the case of Cornell, since formal classes were available only to the post-1990 cohort, we do limit the time frame for “remembering” whether or not an individual took an entrepreneurship class to relatively recent graduates. The research group (pre-1990) was not offered the opportunity to take an entrepreneurship class, thus establishing strong baseline comparison.

We attempt to overcome the recollection bias limitation by combining all respondents who stated they took an entrepreneurship class into one group, despite their indications of whether they took one or more entrepreneurship classes. The survey also asked this question in two separate sections, and an inspection of the data shows that the responses were consistent over both questions. A better way to overcome the recollection bias limitation could be to survey students as freshmen, track them through their schooling, and then survey them at some point after graduation. This method could provide a better estimate and understanding of the impact of entrepreneurship classes. We hope that our paper can serve as a foundation for another, more detailed study that can overcome these limitations.

9. Discussion

This study finds positive linkage between entrepreneurship classes and their impact on creating ventures. An increase in the number of students touched via entrepreneurship classes could lead to more ventures created. Additionally, classes encourage students to think and act entrepreneurially, a finding that can serve broader programmatic goals. While these results are exciting and positive for entrepreneurship proponents, two issues come to mind. The first concern is the use of venture creation as a variable in program assessment. A recent study on the rankings system found that only 44% of the top 160 programs, as ranked by *Entrepreneur* magazine, specifically listed venture creation as a goal in their mission statements.⁹ Yet, this variable is widely used in ranking systems and in program validation metrics.

The approach of simply counting new startups is too narrow in its reach. While student startups may bring media attention to a university, the mission of any educational system should be to prepare the most number of students for success. Taking this macro view towards education, we believe that entrepreneurship classes, which at times may lead to venture creation, have a broader purpose to cultivate and foster entrepreneurial thinking, applicable to many settings. It is this “change in attitude” that we attempted to measure and as the results illustrate, entrepreneurship classes have had a positive impact on the

9. Streeter, Kher and Jaquette (2011).

entrepreneurial mindset. Some sample survey comments further support this perspective:

“Cornell entrepreneurship classes taught me ‘how to think’ which is a lot more than most ‘employed physicians’ do” (’90-’92 graduate)

“Entrepreneurship courses have reshaped the manner I approach a problem, conflict or disagreement. It has benefited me by providing an alternative mindset when necessary” (’93-’95 graduate)

“My experience at Cornell definitely fostered an entrepreneurial spirit and has led me to want to work for small, dynamic companies” (’96-’98 graduate)

The second challenge in trying to “touch” more students in entrepreneurship classes is the limited availability of campus resources. As our survey results indicate, over 70% of the respondents were unaware of the availability of entrepreneurship classes. Trying to solve this marketing problem is a double-edged sword as most entrepreneurship classes, at Cornell and elsewhere, quickly reach their maximum enrollment, and students are actually turned away. Without the influx of additional faculty and monetary resources, increasing the awareness of entrepreneurship classes will worsen the over enrollment dilemma. As one survey respondent stated, *“I tried to take classes but could never get in...pre-registration was always maxed out”* (’05-’07 graduate).

With the explosion in entrepreneurship education, we intend for this paper to serve as a starting point for more research into the impact and validity of entrepreneurship education. While we have no doubt that entrepreneurship classes have benefited students, we realize that at many universities, there still exists a need to justify the existence of entrepreneurship education. Many faculty still question the validity of teaching entrepreneurship and subscribe to the theory that “entrepreneurs are born, not made.” We believe that using the Cornell entrepreneurship program as an example, the quantifiable the impact of entrepreneurship education justifies the existence for entrepreneurship programs. Replicating and refining this study can provide stronger evidence for the existence, and continuation of entrepreneurship education.

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