The Contribution of Entrepreneurship Education: An Analysis of the Berger Program

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Abstract. Analysis of the surveys of 406 non-entrepreneurship and 105 entrepreneurship business school alumni from the Eller College of Business and Public Administration, University of Arizona, indicates conclusively that entrepreneurship education makes a difference. Entrepreneurship education is found to contributes significantly to risk-taking, the formation of new ventures, and the propensity to be self-employed. In addition, entrepreneurship graduates have higher incomes, higher assets, and indirectly, higher job satisfaction compared to other business graduates. Entrepreneurship education contributes to the growth of small firms that employ entrepreneurship graduates and firms owned by entrepreneurship graduates tend to be larger and have more sales than those owned by non-entrepreneurship graduates. Entrepreneurship education also promotes the transfer of technology from the university to the private sector and promotes technology-based firms and products. An analysis of business plans written in the entrepreneurship program since 1985 indicates a growing trend toward more technical products and services. Survey responses of University of Arizona administrators indicate a strong belief that entrepreneurship education has provided pedagogical innovations worth adopting in other programs and courses.

Keywords: entrepreneur, entrepreneurship, education

1. Introduction

In the past 15 years entrepreneurship education has grown dramatically throughout the United States and other parts of the world.[1] This growth is reflected in the inauguration of numerous international intercollegiate business plans competitions, new entrepreneurship curricula and programs, and endowed professorships in entrepreneurship. Approaches to entrepreneurship education have varied across colleges and universities from offering single

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1. The enormous growth of entrepreneurship programs in the 1980s is well documented in Robinson and Haynes, 1991.

courses in new business development or business plans preparation to integrated curricula that include marketing, finance, competitive analysis, and business plan development. In some institutions, majors in entrepreneurship have been adopted and specialized programs for undergraduates, MBA students, as well as for students from engineering, medicine and other technical colleges, have been implemented. Intercollegiate business plans competitions have been established at Arizona, Texas, Nebraska, San Diego, Oregon, Colorado State University, and elsewhere to compare the quality and viability of the plans developed on college campuses.

Entrepreneurship education has become popular for several reasons. First, the development of business plans allows students to integrate accounting, economics, finance, marketing, and other business disciplines. As such, it can be an enriching, integrative educational experience. Second, entrepreneurship education may promote the founding of new businesses by graduates or enhance their employment prospects and the success of graduates in the job market. Third, entrepreneurship education may promote technology transfer from the university to the market through the development of technology-based business plans. Fourth, entrepreneurship education forges links between the business and academic communities. Entrepreneurship education is viewed by business leaders as a useful, applied approach to the study of business and the economy, and they have been willing to fund entrepreneurship programs and endow professorships within them. Finally, because there is no set approach to entrepreneurship education and because entrepreneurship generally is outside traditional discipline boundaries, it has been possible to experiment with curriculums. The learning from these experiments, in turn, has been used to enhance other business school courses. Each of these activities is addressed in the study reported here. Assessment of the impact of entrepreneurship education can determine if there are positive spillover effects from entrepreneurship education on other, more traditional business school activities and how such education affects the careers of alumni.

There has been relatively little research conducted on the impacts of entrepreneurship education. The earliest studies were evaluations of Small Business Development Centers (e.g., Chrisman, et. al., 1985, Elstrott, 1987, and Chrisman and Katrishen, 1994). McMullan, Long and Graham (1986) assessed the economic value added by a university-based venture outreach program at the University of Calgary, and in 1995 Chrisman, Hynes and Fraser examined the impact of the entrepreneurial activities of the faculty of the University of Calgary. More recently, McMullan and Griffin (1998) evaluated the MEI Entrepreneurship Degree Programme at Swinburne, in Australia by comparing the start-up rate of its graduates with the graduates from an unnamed MBA program in Australia, an MBA Concentration in Entrepreneurship at the University of Calgary, and an MBA Hybrid Entrepreneurship Programme at the University of Calgary. They recognized

the need to partition out the relative impacts of independent variables such as education level obtained, years developing businesses beyond graduation, pre-program education, and experience and type of venture format chosen (e.g., independent or corporate) upon independent variables at both the individual and economic level but limited data prohibited them from examining these potentially important effects.

Zeitaml and Rice (1987) identified high-quality research on a variety of issues relating to the performance of entrepreneurs, small business and entrepreneurial large businesses as a 'pressing need.' Ten years later, Gorman, Hanlan, and King (1997) conclude that empirical research on education for entrepreneurship is still in the exploratory state and that very few studies to date have utilized preconceived hypotheses in a formal testing framework.

In this study, we attempt to partition out the relative impacts of independent variables as suggested by McMullan and Griffin (1998) through the use of multivariate analysis. We also formulate and test preconceived hypotheses regarding the influence of entrepreneurship training and other individual characteristics. Some of the individual characteristics we test, such as pre-program education and years since degree, are suggested by McMullan and Griffin (1998). We also control for experience (Mokry, 1988), gender, age, and ethnic group (the latter suggested by Greenfield and Stricton, 1981). We cannot measure or directly quantify 'self-efficacy' and 'intentionality,' two traits that have been identified as being associated with entrepreneurial behavior (Bird, 1988 and 1992, and Boyd and Vozikis, 1994). However, we do attempt to control for past job experience, which was cited by Boyd and Vozikis as an important key to the development of self-efficacy beliefs.

This study evaluates the effect of the Berger Entrepreneurship Program at the University of Arizona on graduates by comparing them to non-entrepreneurship University of Arizona business graduates from 1985 through 1998.[2] Our survey of non-entrepreneurship and entrepreneurship graduates included questions about a variety of individual-specific characteristics, such as year of birth, gender, ethnicity, high school graduation year, and educational and employment history. Controlling for these and other characteristics described in the survey allows us to analyze the *marginal* effects of entrepreneurship education. In doing so this study goes beyond other analyses of entrepreneurship education that have compared the average performances of entrepreneurship-trained groups with the average performances of control groups. The study combines survey responses with Berger Entrepreneurship Program business plan data to evaluate the effect of the Berger Entrepreneurship Program on technology transfer from the university to the private sector. Pedagogical effects of the entrepreneurship curriculum on other

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2. A larger version of this paper is Charney and Libecap (2000).

disciplines in the college are evaluated through a separate survey of College Deans and administrators.

2. Overview of the Berger Entrepreneurship Program

The Berger program is ideally situated for such an analysis. It has been underway for 17 years, providing long-term data on the performance and success of its graduates, technology transfer, and pedagogical innovations. The Berger Entrepreneurship Program in the Karl Eller Center, Eller College of Business and Public Administration, at the University of Arizona is one of the oldest programs in the country.[3] Between 1985 and 1999, 539 students graduated from the program, 339 undergraduates and 200 MBA students or graduate students from the colleges of engineering, medicine, science, and agriculture. 289 business plans were written, and at least 81 businesses were started from the business plans. Of the 539 graduates, 262 were employed by established firms, 106 graduates had their own businesses, 31 were in non-profit or government activities, 40 went to law, medicine or other post graduate studies, and 100 were in other categories (including 50 from the class of 1999 who were just starting their careers at the time of the survey). Entrepreneurship graduates participate in a variety of activities, including judging business plans competitions, giving class lectures, mentoring student teams, hiring graduates, and investing in the business plans.

The curriculum includes core courses in competitive advantage, venture finance, market research and business plans development. Additional courses in MIS, management, finance, and marketing are recommended. A combination of regular and business-adjunct faculty staffs the courses. Regular faculty includes those from finance, economics, marketing, and management. Adjunct faculty members have expertise in law, operations, engineering, marketing, and finance. Undergraduates are eligible for a major in entre-preneurship and MBA students can select entrepreneurship as an area of concentration. Most students select joint majors and areas of concentration, such as Entrepreneurship/MIS, Entrepreneurship/Marketing, and Entre-preneurship/Finance. Many students receive scholarships, and most are placed in internships with newly started firms or venture capital organizations during the summer prior to their formal entrepreneurship study.

Upper division undergraduates and MBA students apply for entry into the program during their junior year and first year respectively. Study takes place during undergraduate senior year and MBA second year. Application materials include academic transcripts, letters of recommendation, and an essay

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3. The curriculum was approved by the Arizona Board of Regents in 1983 and the initial class of 30 students graduated in 1985.

describing a proposed business plan idea. These materials are examined and the applicants are interviewed. Selection is based on grades, recommendations, and an assessment of the student's entrepreneurship potential. Additionally, undergraduate and graduate students from technical disciplines, such as engineering, science, agriculture, and medicine, participate in the program as associate students. These students are paired with business students in the development of a business plan. Approximately 70 students are accepted annually, 40 undergraduates and 30 graduates. The number of graduates has grown over the years from 30 in 1985 to 59 in 1999. Students, typically working in two-person teams, begin in the spring and summer with a feasibility study that is evaluated by the faculty in the fall. They develop the plan within the context of their courses during the fall and spring semesters. An internal business plans competition, where students must present and defend their plans, is the capstone for the program. Winning plans receive $10,000 in prizes. Undergraduates and graduates compete in separate divisions. Students also compete in intercollegiate business plan competitions.

3. Research Procedure

Entrepreneurship and non-entrepreneurship alumni were surveyed for their work/business/income information and the Dean, Department heads and other college administrators were surveyed for their assessment of the entrepreneurship program's pedagogical contribution.[4]

Design of the alumni survey instrument took place in May and June, 1999 and involved several rounds of questionnaire development to insure that questions essential for the study were included and that the survey read clearly. Samples were faxed to local businesses for reaction regarding clarity and comprehensiveness. We surveyed all graduates of the Berger Entrepreneurship Program and a random sample of non-entrepreneurship graduates of the Eller College of Business and Public Administration. During the period 1985 to 1998, the Eller College had 16,095 graduates. The non-entrepreneurship sample was drawn from the alumni records of the University of Arizona Foundation, which includes name, year of graduation, colleges, degrees, major, sex, current address, and contribution history. We were uncertain about the response rate from non-entrepreneurship graduates so we requested a large sample of 2,700 from the University of Arizona Foundation data. The 2,700 figure includes 150 Eller college graduates each year from 1985-1989, 200 graduates from 1990-1995, and 250 from 1996-1998. The growth in the college sample approximated the corresponding growth of the entrepreneur-

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4. A copy of both the alumni questionnaire and the questionnaire distributed to administrators can be obtained from the authors.

ship program. Only 2,024 of the 2,700 were ultimately surveyed due to missing addresses and overlap with the entrepreneurship program's database. 480 students graduated from the entrepreneurship program during that period and questionnaires were sent to the 460 for whom we had current addresses. All told, the questionnaire was sent to 2,484 alumni who graduated between 1985 and 1998 (Table 1 below). The survey was sent the last week of July 1999; the first reminder was sent September 1, and the second reminder went out September 15, 1999.

The questionnaire was accompanied by a cover letter that was signed by the Dean of the Eller College of Business and Public Administration at the University of Arizona. The cover letter was general and revealed only that we were collecting information on Eller College business graduates. We provided an incentive for graduates to return their surveys promptly by offering to enter their names into a drawing for pairs of tickets to the then upcoming University of Arizona and Arizona State University football game.

Approximately 21 percent of the survey questionnaires were returned (Table 1). The response rate was generally uniform across levels of degrees

Table 1: Analysis of Response Rate - By Degree and Type of Program

	Bachelor's Degree	Advanced Degree	TOTALS
Graduates Receiving Questionnaires			
Non-Entrepreneurship Graduates	1,730	294	2,024
Entrepreneurship Graduates	301	159	460
TOTAL	2,031	453	2,484
Graduates Who Responded to Questionnaire			
Non-Entrepreneurship Graduates	348	58	406
Entrepreneurship Graduates	68	37	105
TOTAL	416	95	511
Response Rate			
Non-Entrepreneurship Graduates	20.1%	19.7%	20.1%
Entrepreneurship Graduates	21.6%	23.3%	22.8%
OVERALL	20.5%	21.0%	20.6%

and types of programs. We also compared three characteristics of respondents with those who were sent the questionnaire, e.g., the percent that was male, by program, percent living in Arizona, by program, and average year of graduation. We were limited in this comparison by the data maintained in the Foundation's database. We found no major biases in this comparison. Furthermore, in the multivariate analysis we control for characteristics of

respondents, so small differences in response rates of various have less of a consequence. Questionnaires were filled out in different levels of detail so throughout the analysis, the number of respondents to each question is reported.

4. Analysis of Results

In each section, we initially compare entrepreneurship graduate responses with non-entrepreneurship graduate responses. Then for some measures, we compute the marginal effects of the entrepreneurship program by using regression analysis to control for individual characteristics. By estimating equations designed to explain the variation across surveyed individuals for different variables, we examine (a) whether or not entrepreneurship training explains why those variables differ across individuals and, if so, (b) how important entrepreneurship training is in explaining those differences, and (c) what other characteristics of the individual might affect those variables. By using multivariate methods, we separate the effects of the entrepreneurship training on each of the variables from the effects of other characteristics. Ordinary Least Squares (OLS) is used to estimate continuous variables, such as income and job satisfaction. Probit analysis is used to estimate dependent variables that take on values of 0 and 1, such as whether or not an individual was instrumental in a new business venture or start-up. Probit analysis estimates the probability that a person 'has been instrumental in a new business venture or start-up', conditional upon various characteristics of that individual, and determines which individual characteristics best predict the probability of being involved in a new business venture/start-up. It also predicts the change in the probability of being involved in a new business venture/start-up associated with each characteristic.[5]

Marginal effects are reported in tables containing Probit regression results. The number of observations varies across each equation presented, according to which observations have missing values in the variables contained in each specification. Table 2 (page 392) contains a list of variables used in the multivariate analysis. Where indicated, we report results only for those graduates who were working at the time of the survey. Of the 511 respondents from both non-entrepreneurship and entrepreneurship alumni, 39 were not employed at the time of the survey.[6]

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5. The statistical package LIMDEP (Version 7.0) was used to estimate both the Probit analysis equations and OLS regressions. LIMDEP is particularly useful for limited dependent variables; not only does it compute the equation coefficients for limited dependent variable methods it computes the marginal effects of each independent variable. LIMDEP commands were used to eliminate observations for which there are missing data.

Table 2:   Variable List

Variable Name	Variable Definition
ACCOUNTING	=1 if an individual received a degree in accounting (undergraduate or graduate), 0 otherwise
AGE	Individual's age in years
ANNUAL INCOME	An individual's annual income in dollars
ENTREPRENEUR	=1 if an individual is a graduate of the Berger Entrepreneurship Program, 0 otherwise
FINANCE	=1 if an individual received a degree in finance (undergraduate or graduate), 0 otherwise
GOVERNMENT	=1 if the individual works for a government entity, 0 otherwise
HIGH-TECH	=1 if individual is with a high technology firm, 0 otherwise
MIS	=1 if the individual received a degree (undergraduate or graduate) in Management Information Systems, 0 otherwise
NEW PRODUCT	=1 if an individual has been instrumental in developing new products, 0 otherwise
OWNED BUSINESS	=1 if the individual owned a business prior to coming to the Eller College, 0 otherwise
PERCENT TIME WORKING	Percent of time working, e.g., 100, 90
% SALES CHANGE	Percent change in sales at an individual's firm since hire/start/ obtain date
SATISFACTION	Satisfaction with current position (1 through 10)
SELF EMPLOY	=1 if an individual is self-employed, 0 otherwise
SEX	=1 if an individual is a Male, 0 otherwise
STARTUP	=1 if an individual was instrumental in starting a new business venture/start-up, o otherwise
YEARS	Number of years since an individual's Eller College Business Degree
YEARS-ON-JOB	Number of years the inividual has been at his/her current position

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6.   Analysis of all respondents revealed results very similar to those reported for those currently working.

4.1. Role in Starting New Businesses and Prior Business Ownership

The survey responses reported in Table 3 below, address the important question of whether graduates have been involved in starting a new business venture and whether or not they owned a business or were starting a business prior to entering their educational program. Graduates were asked whether or not they had ever been "instrumentally involvedin a new business venture." A positive response did not require that the venture had been successful, nor did it require that the graduate be currently involved with the venture. As indicated, 54 percent of entrepreneurship graduates report that they have been

Table 3: Survey Results: Role in Starting New Ventures and Previous Business Activity – Affirmative Responses of Working Respondents as a Percent of Those Who Responded to the Question, by Level of Degree

	TOTAL WORK RESPONDENTS			
	Non-Entrepreneurship Graduates		*Entrepreneurship Graduates*	
	Percent of Respondents	*Number of Respondents*	*Percent of Respondents*	*Number of Respondents*
Were you ever instrumental in starting a business venture?	17.4%	322	54.0%	87
Were you starting a business when you came to the University of Arizona?	0.6%	333	17.2%	93
Did you own a business before coming to the University of Arizona?	2.5%	361	17.2%	93

instrumental in starting a business venture, compared with only approximately 17 percent of non-entrepreneurship respondents. The average propensity for entrepreneurship graduates to be instrumental in starting a business venture is three times that for non-entrepreneurship graduates. Approximately 17 percent of entrepreneurship graduates either owned a business or were starting a business before coming to the Eller College. In comparison, less than one percent of non-entrepreneurship respondents were starting a business and only 2.5 percent owned a business before entering the business school. Further analysis is necessary to determine whether the observed 18 percent difference in business venturing between the two groups is due to the entrepreneurship program or due to the fact that entrepreneurship graduates were much more likely to be starting or owning a business before coming to the University of Arizona. Analyzing only group data makes it extremely difficult to isolate the

effects of the entrepreneurship training.[7]

Table 4: Estimated Equation for STARTUP
Whether or not an individual was instrumental in a new business venture or start-up

Estimation Method: Probit Analysis					
Dependent Variable: STARTUP		Mean = .249382716		St. Dev. = .4331908598	
Model Size: 405 Observations		Parameters = 6		Degrees of Freedom = 399	
OLS Start Equation Fit:		R-squared = .241346		Adjusted R-squared = .23184	
Probit Model Fit:		Chi-squared (5 d.f.) = 95.88996		Significance level = .0000000	
Estimates of Marginal Effects: Partial Derivates of E[Y] with respect to the vector of characteristics, computed at the mean of the Xs.					
Variable X	Coefficient b	Standard Error	b/Stan. Error	P[|Z| > z]	Mean of X
Constant	−.7009060667	.98486973E-01	-7.117	.0000	
ENTREPRENEUR	.2540164327	.52512546E-01	4.837	.0000	.20740741
OWNED BUSINESS	.5072723326	.12666838	4.005	.0001	.51851852E-01
YEARS	.1495979004E-01	.63131782E-02	2.370	.0178	6.6888889
SEX	.6646060786E-01	.45719561E-01	1.454	.1460	.55802469
AGE	.7963288313E-02	.34899954E-02	2.282	.0225	32.125926

Assessing the marginal effect of entrepreneurship training requires estimating a multivariate relationship. A variety of variables would likely affect whether an individual was involved in a new business start up, such as entrepreneurship training, prior business ownership, the time since receiving a degree from the Eller College, other education (either before or after receiving an Eller College degree), and whether or not the graduate received an advanced degree. Personal characteristics, such as gender, ethnicity, or age, could also influence new business venturing, but no prior expectations were formed regarding the signs or magnitudes of these variables. Preliminary analysis indicated which variables appeared to have a significant effect, and we eliminated those that did not influence the results of the estimation. The final estimated relationship is in Table 4.

Entrepreneurship training increased the estimated probability of a graduate being involved in a business venture by 25 percent, holding prior business ownership, years since receiving their degree, their sex, and age constant. The significance level of the coefficient of ENTREPRENEUR is almost zero,

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7. For each question, chi-squared tests were performed to see if level of degree affected the responses of entrepreneurship graduates and non-entrepreneurship graduates. None were significant, meaning level of degree had no influence on the answers to these questions.

which indicates that the chance of entrepreneurship training *not* being an important determinant of business ventures/start-ups is essentially zero.

Whether or not a graduate had owned a business prior to entering the Eller College is also very significant and has a substantial magnitude in this equation. Prior business ownership increases the estimated probability of having been instrumental in a business venture by 51 percent. While only 5 percent of the individuals examined in this estimation owned a business prior to entering business school, that experience substantially affects their willingness to attempt a business venture. Since graduates with prior business ownership were more likely have entered the entrepreneurship program, according to the group data analysis, failure to control for prior business ownership would have substantially biased the estimated marginal effects of entrepreneurship training. When this variable is eliminated from the regression, the marginal effect of entrepreneurship training increases by approximately 5 percentage points.

Each year a graduate is out of school increases the probability of being involved in a business venture by 1.5 percent. Since all individuals in this study received business degrees during or after 1985, it is probable that more graduates will get involved in a business venture in years to come. Gender was not found to be a significant determinant of business venturing, while the age of graduates positively affects their business venturing. For each year of age, an individual's probability of attempting a new business start up increases by 0.8 percent.

4.2. Type of Employment and the Determinants of Self-Employment

Table 5 (page 396) reports respondents' type of employment for both entrepreneurship and non-entrepreneurship graduates, broken down by level of degree. As indicated, over 27 percent of entrepreneurship graduates are self-employed as either business owners or consultants, compared to 9.0 percent of non-entre-preneurship graduates. Therefore, the average propensity for entrepreneurship graduates to own their own business is *three* times that for non-entrepreneurship graduates. A Chi-squared test for independence between "type of employment" and "type of program" was found to be very significant $(\chi^2_{3d.f.} = 24.1$, which has a pvalue <0.005). Thus, there is a very strong relationship between the type of business program and the type of employment selected by graduates.[8]

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8.   A Chi-square test on whether the level of degree (bachelor or advanced) affected the responses of entrepreneurship graduates on these questions was not significant even at the 10% level of significance $(\chi^2_{3d.f.} = 3.39)$. A similar test on whether level of degree affected non-entrepreneurship graduate responses was also insignificant $(\chi^2_{3d.f.} = 4.37)$.

Table 5: Survey Results: Type of Employment by Type of Program, by Level of Degree

	TOTAL EMPLOYED RESPONDENTS			
	Non-Entrepreneurship Graduates		*Entrepreneurship Graduates*	
	Number Reporting	*Percent of Total*	*Number Reporting*	*Percent of Total*
Self-employed	29	9.0%	25	27.2%
Employed by a Business	228	71.3%	59	64.1%
Employed in Government, including educational institutions	44	13.8%	7	7.6%
Employed in a non-profit institution	19	5.9%	1	1.1%
TOTAL EMPLOYED RESPONDENTS	320	100.0%	92	100.0%

Although the analysis in Table 5 indicates that a greater portion of entrepreneurship graduates have their own businesses, it is difficult to tell whether or not that result is due to the entrepreneurship program or to other characteristics of the entrepreneurship graduates. Again, a multivariate approach is required.

We hypothesized that self-employment would be positively affected by a graduate's business experience prior to attending the university, their participation in the entrepreneurship program, and the length of time since they received their last degree from the Eller College. It takes time for graduates to organize a business or to obtain sufficient capital to obtain an existing firm. We also examined the effects of whether a graduate received an advanced degree and personal characteristics, such as age and sex, on the probability of self-employment.

Graduating from the entrepreneurship program increases the probability of being self-employed by 11 percent, holding all else constant (Table 6 opposite). In the analysis of group data, it was shown that entrepreneurship program graduates are more likely to own and operate their own business, but

Table 6: Estimated Equation for SELF EMPLOY:
Whether or not an individual is self-employed

Estimation Method: Probit Analysis		
Dependent Variable: SELF	Mean = .130982	St. Dev. = .3378068
EMPLOY Model Size: 397 Observations	Parameters = 5	Degrees of Freedom = 392
OLS Start Equation Fit:	R-squared = .092185	Adjusted R-squared = .08292
Probit Model Fit:	Chi-squared (4 d.f.) = 35.02727	Significance level = .0000000
Estimates of Marginal Effects: Partial Derivates of E[Y] with respect to the vector of characteristics, computed at the mean of the Xs.		

Variable X	Coefficient b	Standard Error	b/Stan. Error	P[|Z| > z]	Mean of X
Constant	−.4892526253	.65903365E-01	-7.424	.0000	
ENTREPRENEUR	.1109704617	.34178765E-01	3.247	.0012	.21914358
YEARS	.7880643108E-02	.42644374E-02	1.848	.0646	6.7455919
OWNED BUSINESS	.6042641312E-01	.55268625E-02	1.093	.2743	.57934509E-01
AGE	.5544876483E-02	.22409126E-02	2.474	.0133	32.455919

Table 3 suggested that the higher incidence of prior business ownership among entrepreneurship program graduates might explain a major portion of the propensity to be self-employed. However, whether or not an individual owned a business prior to entering the business school is insignificant in the multivariate analysis.

The number of years since graduating and the individual's age were found to be statistically significant. For each year a graduate is out of school, the probability of becoming self-employed increases by almost 0.8 percent. In addition, as graduates get older, their propensity to become self-employed increases by 0.6 percent. Thus, a graduate who has been out of school for 10 years is 14 percent (combining the effects of age and years since graduation) more likely to be self-employed than a new graduate, holding other characteristics constant.

Sometimes, what is not significant in an estimated relationship is as interesting as what is significant. The dummy for an individual's gender was not significant in any of the specifications that were tried. Therefore, being a female does not reduce the estimated probability that a graduate is self-employed. Similarly, having an advanced degree had no effect on the probability to be self-employed.

Table 7 (page 398) summarizes data regarding firm size for establishments owned by Eller College graduates who responded to the questionnaire. Firms owned by entrepreneurship graduates have an average employment of 199.9,

sales of $50 million, and assets of $4.0 million. These are roughly 10 times the

Table 7: Summary of Data for Firms Owned by Those Who are Self-employed

	Non-Entrepreneurship Graduates		Entrepreneurship Graduates	
	Average Response	*Number Reporting*	*Average Response*	*Number Reporting*
All Self-employed-owned Firms Employment	9.9	27	199.9	23
Sales	$4.8M	24	$50.0M	21
Assets	$0.6M	22	$4.0M	19
Start-ups Employment	10.0	21	229	18
Sales	$5.9M	18	$56.5M	18
Assets	$0.4M	17	$3.0M	16

corresponding figures for firms owned by non-entrepreneurship graduates. Statistics for start-ups are also substantially larger for firms owned by entrepreneurship graduates than for non-entrepreneurship graduates.

4.3.   Annual Income, Job Satisfaction, and Assets

Table 8 below describes annual income and job satisfaction reported by working individuals. Overall, entrepreneurship graduates have an average annual income that is 27 percent higher than that non-entrepreneurship graduates ($71,573 vs. $56,453). The survey instrument asked for both average annual income and the percent of time each individual worked. FTE annual income was then computed for each respondent by dividing their reported annual income by the percent of time they worked (/ 100). When FTE

average annual incomes are compared, entrepreneurship graduates earn almost

Table 8: Survey Results: Income and Job Satisfaction for Working Respondents - by Type of Program and by Level of Degree

	Non-Entrepreneurship Graduates		*Entrepreneurship Graduates*	
	Average Response	*Number of Respondents*	*Average Response*	*Number of Respondents*
Average Annual Income: Bach. and Adv. Degrees Combined	$56,543	334	$71,573	85
Bachelors Degrees	$55,610	286	$73,549	55
Advanced Degrees	$62,104	48	$67,869	30
Average Annual FTE Income: Bach. and Adv. Degrees Combined	$58,337	330	$74,393	83
Bachelors Degrees	$57,435	282	$77,058	53
Advanced Degrees	$63,632	48	$69,684	30
Job Satisfaction (1 = least satisfied, 10 = most satisfied): Bach. and Adv. Degrees Combined	7.7	343	7.8	89
Bachelors Degrees	7.7	295	7.8	58
Advanced Degrees	7.7	48	8.0	31

30 percent more than do other graduates. The job satisfaction rating is similar for graduates from both types of programs, although entrepreneurship program graduates receiving advanced degrees show the highest job satisfaction.

Table 9: Estimated Equation for ANNUAL INCOME: Annual Income of Graduates

Estimation Method:	Ordinary Least Squares				
Dependent Variable: ANNUAL INCOME	Mean = 60410.106		St. Dev. = 39358.169		
Model Size: 366 Observations	Parameters = 7		Degrees of Freedom = 359		
Model Fit:	R-squared = .270868		Adjusted R-squared = .25868		
Model Test:	F[6, 359] = 22.23		Prob. value = 0.00000		
Variable X	Coefficient b	Standard Error	b/Stan. Error	P[|Z| > z]	Mean of X
Constant	–47254.80449	16144.402	–2.927	.0036	
SELF EMPLOY	11507.48228	5744.3384	2.003	.0459	.11748634
SEX	12569.51639	3695.4413	3.401	.0007	.59016393

Variable X	Coefficient b	Standard Error	b/Stan. Error	P[|Z| > z]	Mean of X
Constant	–47254.80449	16144.402	–2.927	.0036	
SELF EMPLOY	11507.48228	5744.3384	2.003	.0459	.11748634
GOVERNMENT	–19534.67283	5473.7441	–3.569	.0004	.12021858
PERCENT TIME WORKING	769.6706117	162.45148	4.738	.0000	97.489071
ENTREPRENEUR	12505.18703	4467.6622	2.799	.0054	.20765027
YEARS	3574.042374	430.14908	8.309	.0000	6.6065574

The incomes in Table 8 are averages for graduates of different programs. In order to assess the marginal effect of the entrepreneurship program on a graduate's income, a multivariate approach is used. The income of a graduate is not only a measure of the graduate's well being (among other measures), it also represents the value of the marginal product of that graduate, if labor markets are efficient. We hypothesized that a graduate's annual income would be dependent on: whether or not a graduate participated in the entrepreneurship program; whether or not a graduate earned an advanced degree; other education that the graduate may have received before entering or after leaving the University of Arizona; the type of work selected by the graduate, such as whether they choose to work in the public or the private sector; their work effort; and personal characteristics such as age, gender and the number of years since the graduate received their last Eller College degree.

According to the regression results in Table 9 (page 399), entrepreneurship education increases individuals' incomes by $12,505 per year, holding other variables constant. Whether or not a person is self-employed increases their annual income by $11,507 per year. This self-employed variable implicitly incorporates an indirect effect of entrepreneurship education on annual income. Recall from Table 6 that entrepreneurship training increases the probability of being self-employed by 11 percent. If the mean of SELF EMPLOY in Table 9 is increased by 11 percent (i.e., an increase of .01292), then estimated annual increases by approximately $149 (0.01292 times the coefficient of SELF EMPLOY in Table 6). The combined effect of entrepreneurship training on a graduate's income is then $12,654, which is the sum of the entrepreneurship program's direct effect ($12,505) and its indirect effect through its influence on the propensity to be self-employed ($149).

The number of years since receiving their last degree from the Eller College is very significant. On average, graduates' incomes increase $3,574 each year after leaving the Eller College. In addition, work effort is also significant in explaining their income. Individuals increase their income $770 for each additional percent of full time they choose to work. An individual who chooses to work 90 percent of full time foregoes $7,700 in annual income.[9]

Whether a graduate chooses to work in the public sector has a substantial negative impact on their annual income. Graduates working for a government

agency, including educational institutions, earn $19,535 less than other graduates, *ceteris paribus*.

Gender also plays a significant role in explaining earnings. Males earn $12,570 more than females, holding other characteristics constant. Why the differential between male and female income is so large is unclear. The regression was estimated only over working individuals, so the choice to work in the home rather than in the workplace is not an issue here. [10]

In analyzing the determinants of job satisfaction, we hypothesized earnings and self-employment (being one's own boss) would have positive effects. In addition, the type of business education was predicted to contribute to a graduate's job satisfaction in the work place because one type of business training may prepare them for the business world better than did others. Years since graduation was hypothesized to have a positive effect on job satisfaction because additional time would allow graduates to start new businesses or advance within an existing firm. Whether or not a graduate received an advanced degree and firm size were also considered as possible determinants of job satisfaction.

Table 10: Estimated Equation for SATISFACTION: Job Satisfaction

Estimation Method:	Ordinary Least Squares	
Dependent Variable: SATISFACTION	Mean = 7.65712	St. Dev. = 1.99368
Model Size: 393 Observations	Parameters = 3	Degrees of Freedom = 390
Model Fit:	R-squared = .035450	Adjusted R-squared = .0305
Model Test:	F[2, 390] = 7.17	Prob. value = 0.00088

Job satisfaction is a difficult variable explain, in part, because it has a small variation. The regression (Table 10 above) was able to explain only 3

9. In addition to the effect of the entrepreneurship program on annual income, other programs within the college, including accounting, management information systems, and finance, were entered into the equation. None were found to have a significant effect. A dummy representing whether or not the individual received an advanced degree was also insignificant. Attempts to control for college degrees earned either before or after their Eller College experience also failed to show any significance in explaining graduates' annual income. Several variables were entered to control for training received other than their Eller College education, including whether the graduate received another bachelors' degree elsewhere, whether they received an advanced degree elsewhere, or whether they received another business degree elsewhere. Again, none were significant.

10. Similarly, we controlled for percent of time worked, which should have controlled for the possibility of women choosing to work part-time. Of course, there are many remaining factors that could affect this income differential. For example, we did not collect a complete history of how graduates spent their time since graduation. Although all women included in this regression were working at the time of the survey, some may have been out of the labor market for a period of time prior to the survey. This experience factor, if it exists, cannot be controlled for with the data drawn from the survey.

Variable X	Coefficient b	Standard Error	b/Stan. Error	P[|Z| > z]	Mean of X
Constant	6.939776485	.21383863	32.453	.0000	
ANNUAL INCOME	.5871273094E-05	.27258506E-05	2.154	.0319	60526.809
YEARS	.5446311519E-01	.25540907E-01	2.132	.0336	6.6463104

percent of the variation in job satisfaction, which is low, even for cross-section analysis. The F-statistic, however, is easily significant at the 1- percent level of significance. According to the regression results, the satisfaction rating increases 0.00587 for each $1,000 of income. The regression predicts that a graduate earning $50,000 would report a job satisfaction of 7.23 (the constant of 6.939 plus 0.00587 x 50) while a graduate earning $100,000 would report a job satisfaction of 7.53 (6.939 plus 0.00587 x 100), holding the other variables constant. The only other variable found significant in explaining job satisfaction was the number of years since graduates received their last Eller College degree. Their job satisfaction rating increases by .0545 for each year out of school. This suggests that, overtime, graduates advance and earn their way into work situations that give them higher satisfaction levels.

Entrepreneurship training enters into the equation for job satisfaction only indirectly through its effects on annual income, and its effect is quite small. Recall from the discussion of Table 9 that entrepreneurship training increases annual income by $12,654 (both directly and indirectly). By increasing annual income in Table 10 by $12,654, the estimated job satisfaction rating increases by 0.074. Thus, entrepreneurship education is estimated to increase job satisfaction by approximately 1 percent.

Table 11: Survey Results for Working Respondents – Reported Personal Assets

	Non-Entrepreneurship Graduates		Entrepreneurship Graduates	
	Number Reporting	*Percent of Total*	*Number Reporting*	*Percent of Total*
$0-$10,000	51	14.4	11	12.4
$10,001-$50,000	121	34.2	25	28.1
$50,001-$100,000	79	22.3	17	19.1
$100,001-$250,000	47	13.3	19	21.3
$250,001-$500,000	43	12.0	9	10.0
$500,001-$1,000,000	6	1.7	5	5.6
$1,000,001-$5,000,000	6	1.7	2	2.2
Over $5,000,000	1	0.3	1	1.1
TOTALS	354	100	89	100

Table 11 shows the distribution of reported assets of non-entrepreneurship and entrepreneurship graduates. The survey question regarding assets asked individuals to report only assets that were associated with their work effort; they were asked to exclude non-work related assets such as inheritance, lottery winnings, and so forth. As shown in the table, approximately 71 percent of non-entrepreneurship graduates fall in the lowest three asset categories of $0 through $100,000 compared to less than 60 percent of the entrepreneurship graduates. Four percent of the non-entrepreneurship graduates have assets of over $500,000 compared to nearly 9 percent of the entrepreneurship graduates. If weighted average assets are computed for each group by using the midpoint of each asset category and $7.5 million as the midpoint of the highest category, the entrepreneurship graduates' weighted average assets are $278,000, compared to the non-entrepreneurship graduates' weighted average assets of $172,000. These results suggest that entrepreneurship graduates have been more successful in accumulating assets since graduation.

4.4.   The Relative Effects of Entrepreneurship and Non-entrepreneurship Graduates on Firm Growth and the Annual Income of Graduates, by Firm Size

Because entrepreneurship education emphasizes risk taking and the identification of new products, services, markets, and other opportunities, we hypothesize that entrepreneurship graduates contribute significantly to the growth of firms in which they are employed. We anticipate that the effect of entrepreneurship training will be observable for small firms. However, we expect that it will not be possible to isolate the employment or sales effects associated with an entrepreneurship graduate working for a large firm; the effect of any one employee becomes subsumed within overall operations of a large firm. For graduates working for larger firms, their contribution to the economy would be measured by their salary differential. If labor markets are efficient, and entrepreneurship training contributes to the value of marginal product of its graduates, then we should observe a salary differential for entrepreneurship graduates working for large firms.

Table 12 (page 404) presents various growth statistics for firms employing Eller College graduates. There is evidence that the growth of small firms (<100 employees) is greater for those employing entrepreneurship graduates than non-entrepreneurship graduates. Change in employment, percent change in employment, and the percent change in employment divided by the number of years the graduate has been employed are all greater for firms employing entrepreneurship graduates than for non-entrepreneurship graduates. For small firms, the percent change in sales and the percent change in sales divided by the number of years the graduate has been employed also is greater for firms

employing entrepreneurship graduates than for those employing non-entrepreneurship graduates.

If differential income represents the incremental value of the marginal product of entrepreneurship graduates to large firms, then that value is substantial.[11] Income differences between entrepreneurship graduates and non-entrepreneurship graduates range from $9,000 per year (for firms with

Table 12: Analysis of Changes in Employment, Sales, and Income, by Firm Size
(number reporting is in parentheses in each cell)

	Current Firm Size Distribution of Employed Persons					
	< = 25	*< = 100*	*< = 500*	*< = 1000*	*> 1000*	*Total*
Change in Employment: Non-Entrepreneurship	3(35)	9(25)	45 (28)	154 (6)	3,846 (78)	1,759 (172)
Entrepreneurship	5(7)	28(9)	41 (6)	104 (5)	3,716 (16)	1,476 (43)
% Change in Employment: Non-Entrepreneurship	68% (34)	33% (25)	98% (28)	49% (6)	168% (79)	113% (172)
Entrepreneurship	85% (7)	290% (9)	24% (6)	39% (5)	35% (16)	100% (43)
% Change in Employment/ Years Employed: Non-Entrepreneurship	30% (31)	15% (25)	31% (28)	19% (6)	33% (77)	29% (167)
Entrepreneurship	30% (7)	86% (9)	4% (6)	11% (5)	10% (16)	30% (43)
% Change in Sales: Non-Entrepreneurship	114%(20)	52% (16)	65% (19)	161% (4)	327% (51)	197% (110)
Entrepreneurship	685% (4)	1051% (6)	64% (5)	133% (4)	35% (14)	335% (33)
% Change in Sales/ Years Employed: Non-Entrepreneurship	40% (19)	17% (16)	36% (19)	70% (4)	62% (50)	47% (108)
Entrepreneurship	230% (4)	211% (6)	12% (5)	17% (4)	5% (14)	77% (33)
Income: Non-Entrepreneurship	$47,868 (32)	$63,140 (24)	$50,679 (28)	$67,500 (8)	$63,962 (79)	$56,468 (171)
Entrepreneurship	$46,250 (6)	$94,250 (8)	$59,000 (6)	$102,000 (4)	$85,224 (17)	$79,580 (41)
FTE Income: Non-Entrepreneurship	$51,604 (32)	$69,037 (23)	$50,333 (27)	$67,500 (8)	$63,962 (79)	$78,171 (169)
Entrepreneurship	$50,324 (6)	$94,250 (8)	$70,800 (5)	$102,000 (4)	$85,225 (17)	$81,647 (40)

>100 but <500 employees) to $34,500 (for firms with >500 but <1000 employees). Incomes for entrepreneurship graduates are also substantially higher for the 25-100 employee firm size.[12]

Now we report on attempts to estimate equations on the various measures in Table 12 in order to control for individual characteristics and isolate the

11.   According to the data in Table 12, large firms that employ entrepreneurship graduates tend to grow more slowly than those that employ non-entrepreneurship graduates. We expected that there would be no measurable effect of entrepreneurship training on large firms; however, why large firms that employ entrepreneurship graduates appear to grow more slowly than do larger firms employing other graduates is unclear.

incremental effects of the entrepreneurship program. For both small firms and large firms, we experimented with various specifications for the large firm data set. In these experiments we attempted to explain (a) employment change, (b) percent change in employment, (c) percent change in employment per year of employment, (d) change in sales, (e) percent change in sales, and (f) percent change in sales per year of employment. Each measure was specified as a function of: (1) entrepreneurship training of the individual, (2) whether or not the individual had previously owned a business prior to coming to the Eller College, (3) other majors the individual may have had, (4) other degrees the individual may have earned, (5) age of the individual, (6) years since receiving their last degree from the Eller College, and (7) whether or not the firm they were working for was a high-technology firm.

For individuals employed by small firms, we estimated equations for (b), (c), (e) and (f). Each of the equations had a significant F-statistic. In the two equations related to percent change in employment (b) and (c), entrepreneurship training had a positive coefficient but was not significant. Entrepreneurship training was found to be significant in the estimation of the equations related to percent change in sales, (e) and (f). In the equation for (e), shown in Table 13 below, small firms employing entrepreneurship graduates are estimated to have sales growth that is higher by 542% than other firms, over an average three-year time period (the mean of the variable YEARS-ON-JOB). And if that firm is a high-technology firm, it's sales are expected to grow by 732% more than non-high technology small firms. These incremental effects appear to be very large, but they must be placed into context. The average growth rate for all firms over the three years is 224% (mean of % SALES CHANGE), thus firms employing entrepreneurship graduates had 318% higher sales increases than the average (542%-224%). Equation results for (f) are consistent with those reported for (e), so the regression is not reported here. That equation estimates that percent change in sales is 126% higher per year for firms employing entrepreneurship graduates than for other

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12. Note that while Table 12 is suggestive, the evidence on employment and sales growth is extremely limited because of small sample sizes. By the time the data are bifurcated into two types of programs (entrepreneurship and non-entrepreneurship) and divided into five firm size groupings, the samples falls to as low as 4 observations per cell for some cells. Thus, while observations can be drawn from this table, conclusions should be tempered due to the small sample sizes.

firms. Similarly, small high technology firms have 194% higher sales each year the graduate was employed than non-high technology small firms.

Table 13: Estimated Equation for % SALES CHANGE: Percent Change in Sales, Estimated across Individuals Employed by Small Firms ($<= 100$ employees)

Estimation Method:	Ordinary Least Squares				
Dependent Variable: % SALES CHANGE	Mean = 224.4703690		St. Dev. = 878.2430199		
Model Size: 53 Observations	Parameters = 4		Degrees of Freedom = 49		
Model Fit:	R-squared = .254242		Adjusted R-squared = .20858		
Model Test:	F[3, 49] = 5.57		Prob. value = 0.00228		
Variable X	Coefficient b	Standard Error	b/Stan. Error	P[|Z| > z]	Mean of X
Constant	−189.3865187	178.27845	−1.062	.2933	
ENTREPRENEUR	542.4038190	261.75580	2.072	..0435	.22641509
HIGH-TECH	732.6602025	261.54511	2.801	.0073	.22641509
YEARS-ON-JOB	42.78391997	46.774640	.915	.3648	2.9254717

As expected, it was difficult to isolate the incremental effects of an entrepreneurship graduate on employment and sales changes for large firms (>100 employees). None of the equations for (a) through (f), resulted in a significant model. Although disappointing, these results confirmed our expectation that the characteristics of a single employee cannot explain the growth of a large firm.

We had more success in examining the determinants of the incomes of individuals working in large firms. We investigated various independent variables including all of those discussed above. The only statistically significant variables were entrepreneurship education and whether or not the establishment was a high-technology firm (Table 14 below). Entrepreneurship graduates working for large firms earn approximately $23,500 more per year than do other graduates working for such establishments. Similarly, high technology firms tend to pay over $17,000 per year more than do non-high technology firms, *ceteris par ibus*.

In summary, the empirical results from examining the effect of entrepreneurship education on firm growth as indicated by employment change and change in sales are mixed. As predicted, large firms pay entrepreneurship graduates more than they do other graduates, and we interpret that income differential as the incremental marginal value of entrepreneurship graduates. For small firms, we found that entrepreneurship training was significant in explaining the percent change in sales and the percent change in

sales per year the graduate was employed, but not in explaining any of the measures of employment growth.

Table 14: Estimated Equation for ANNUAL INCOME: Annual Income for Individuals Employed by Firms > 100 Employees

Estimation Method:		Ordinary Least Squares			
Dependent Variable: ANNUAL INCOME		Mean = 65805.30303		St. Dev. = 33942.6083	
Model Size: 132 Observations		Parameters = 3		Degrees of Freedom = 129	
Model Fit:		R-squared = .152292		Adjusted R-squared = .13915	
Model Test:		F[2, 129] = 11.59		Prob. value = 0.00002	
Variable X	Coefficient b	Standard Error	b/Stan. Error	P[|Z| > z]	Mean of X
Constant	52182.74420	3915.8154	13.326	.0000	
ENTREPRENEURSHIP	23543.76349	6912.0822	3.406	.0009	.19696970
HIGH-TECH	17279.34287	5513.8432	3.134	.0021	.46212121

4.5.   The Effect of the Entrepreneurship Program on Technology Transfer from the University to the Private Sector

Table 15 below summarizes survey results from all working respondents and self-employed respondents to basic questions regarding technology. Entrepreneurship graduates are more likely to be with firms that use licensed technologies, and importantly, they are more likely to be with firms that license technologies to others. Also according to the survey results, entrepreneurship graduates are more likely to be involved with a high technology firm. Similarly, self-employed, entrepreneurship program graduates are more likely to both use licensed technologies and to license technologies to others. Among the self-employed respondents, nearly 23 percent of the entrepreneurship graduates own a high technology firm compared to less than 15 percent of non-entrepreneurship graduates.

Table 15: Survey Responses to a Select Set of Questions Related to Licensed Technology – Affirmative Responses as a Percent of Those who Responded

	Non-Entrepreneurship Graduates		Entrepreneurship Graduates	
All Working Respondents	*Percent of Respondents*	*Number Reporting*	*Percent of Respondents*	*Number Reporting*
Do you use licensed technologies?	22.7	313	26.0	81
Do you license technologies to others?	17.8	275	23.8	80
Is your firm considered to be a high technology industry?	27.0	318	33.7	89
Have you ever been instrumental in developing new products?	7.2	276	21.1	76
Self-Employed Respondents	*Percent of Respondents*	*Number Reporting*	*Percent of Respondents*	*Number Reporting*
Do you use licensed technologies?	16.0	25	21.0	19
Do you license technologies to others?	4.2	24	10.0	20
Is your firm considered to be a high technology industry?	14.8	27	22.7	22
Have you ever been instrumental in developing new products?	21.7	23	28.6	21

The fourth question in Table 15 relates to whether they have ever been instrumental in developing new products. Over 21 percent of all responding entrepreneurship program graduates were instrumental in developing new

products compared with just over 7 percent of all responding non-entrepreneurship graduates. Among the self-employed respondents, almost 29 percent of entrepreneurship program graduates stated they had been instrumental in developing new products, compared to 22 percent of non-entrepreneurship program graduates. It is not surprising that the difference between the responses for 'self-employed' entrepreneurship graduates and non-entrepreneurship graduates is smaller than for 'working respondents.' The fact that they are self-employed makes this group of non-entrepreneurship graduates similar to this group of entrepreneurship graduates. In interpreting these results, however, recall that the entrepreneurship graduates are three times more likely to self-employed than non-entrepreneurship graduates.

Table 16 below relates indirectly to technology. High technology industries tend to be characterized by relatively high research and development effort and short life-span of their products. According to the survey results, entrepreneur-ship graduates spend more of their time on R&D than other graduates. Similarly, the average life-span of the products of firms employing entre-preneurship graduates is shorter than the life-span of products of firms that employ non-entrepreneurship graduates.

Table 16: Survey Responses to a Select Set of Questions Related to R&D and Life Span of Major Product

	Non-Entrepreneurship Graduates		Entrepreneurship Graduates	
All Working Respondents	*Average Response*	*Number Reporting*	*Average Response*	*Number Reporting*
What percent of your time is spent on R&D?	12.1%	321	14.6%	89
Average life span of major product?	7.7 years	157	5.6 years	60
Percentage Reporting Not Applicable to Life-Span of Product Question	33.2%	235	20.0%	75
Self-Employed Respondents	*Average Response*	*Number Reporting*	Average Response	*Number Reporting*
What percent of your time is spent on R&D?	12.4%	25	13.5%	23
Average life span of major product?	8.9 years	11	5.7 years	14
Percentage Reporting Not Applicable to Life-Span of Product Question	47.6%	21	22.2%	18

There were more respondents to the "average life-span" question that is shown for the second question in Table 16 because many graduates (especially those working in service industries such as law offices, accounting firms, or banks) wrote "Not Applicable (NA)" for their responses. Interpretation of the product life-span questions should include both the second and third lines of Table 16, for both the "All Working Respondents" group and the "Self-employed" group. For example, 235 of the non-entrepreneurship graduates responded to the product life-span question. Of those, 157 reported a life-span for their major product, while the remaining reported NA. For self-employed entrepreneurship program graduates, 18 responded to the product life-span question, 14 provided a life-span estimate for their major product, and the remaining four responded with NA. NA responses are interpreted by us to indicate a product for which it is difficult to estimate a life-span and is probably not a high-tech product. In general then, entrepreneurship graduates on average appear to be more involved in research and development, to work with products with shorter life spans, and to work in high-tech industries.

Multivariate regressions were estimated for two technology variables: whether or not a graduate is with a high-technology firm; and whether or not the graduate has ever been instrumentally involved in developing new products. We examined a variety of possible variables available to us that might affect the likelihood that a graduate would be involved in a high-tech

firm, including entrepreneurship, whether the graduate had a MIS (management information systems) degree, whether the individual owned a business prior to entering the business school, and whether or not they were self employed upon graduation (Table 17).

Table 17: Estimated Equation for HIGH-TECH: Whether or not an individual is with a high technology firm

Estimation Method:	Probit Analysis	
Dependent Variable: HIGH-TECH	Mean = .27170868	St. Dev. = .4454648
Model Size: 357 Observations	Parameters = 5	Degrees of Freedom = 352
OLS Start Equation Fit:	R-squared = .090166	Adjusted R-squared = .07983
Probit Model Fit:	Chi-squared (4 d.f.) = 30.52335	Significance level = .000003829
Estimates of Marginal Effects: Partial Derivates of E[Y] with respect to the vector of characteristics, computed at the mean of the Xs.		

Variable X	Coefficient b	Standard Error	b/Stan. Error	P[|Z| > z]	Mean of X
Constant	−.2460161568	.21494693E-01	−11.445	.0000	
SELF EMPLOY	−.1646991608	.78344956E-01	−2.102	.0355	.13165266
ENTREPRENEURSHIP	.1272788350	.58853966E-01	2.163	.0306	.22969188
MIS	.3404599214	.70636973E-01	4.820	.0000	.12044818
OWNED BUSINESS	−.1996327091	.11865327	−1.682	.0925	.56022409E-01

We expected that graduates who attended the entrepreneurship program would be more likely to be in a high-technology firm than would other Eller College graduates. We were only partly right on that issue. Eller College graduates receiving either an undergraduate or advanced degree in Management Information Systems were the most likely to be with a high technology firm. MIS graduates are 34 percent more likely to be with a high-technology firm than other graduates, *ceteris paribus*. Since a relatively high portion of the reported 'high-technology' firms are related to communications, the Internet, and the development/sale of specialized software, it is not surprising that MIS graduates are likely to be with high-technology firms.

Even so, participation in the entrepreneurship program increases a graduate's estimated probability of being with a high-technology firm by close to 13 percent, holding other effects constant. For those graduates receiving both an entrepreneurship degree and MIS degree, they are approximately 47 percent more likely to be with a high technology firm. About 9 percent of the entrepreneurship graduates who responded to the survey had a combined MIS/ Entrepreneurship major.

The results in Table 17 also indicate that graduates who owned a business prior to entering the Eller College are less likely to be involved with a high-technology business, and that self-employed graduates are about 16 percent less likely to be with a high-technology firm. These results may reflect the

Table 18: Estimated Equation for NEW PRODUCT: Whether or not the graduate was instrumental in developing new products

Estimation Method:	Probit Analysis				
Dependent Variable: NEW PRODUCT	Mean = 0.1014084507		St. Dev. = .302294875		
Model Size: 355 Observations	Parameters = 6		Degrees of Freedom = 349		
OLS Start Equation Fit:	R-squared = .067001		Adjusted R-squared = .05363		
Probit Model Fit:	Chi-squared (5 d.f.) = 25.00942		Significance level = .00013875		
Estimates of Marginal Effects: Partial Derivates of E[Y] with respect to the vector of characteristics, computed at the mean of the Xs.					
Variable X	Coefficient b	Standard Error	b/Stan. Error	P[|Z| > z]	Mean of X
Constant	−.264163128	.37260057E-01	−7.090	.0000	
ENTREPRENEURSHIP	.8956621258E-01	.30702871E-01	2.917	.0035	.21126761
FINANCE	−.8239884386E-01	.39004413E-01	−2.113	.0346	.22816901
ACCOUNTING	−.6417004597E-01	.47837470E-01	−1.341	.1798	.17464789
SEX	.4885233497E-01	.29686119E-01	1.646	.0998	.55211268
YEARS	.6408818285E-02	.33855151E-02	1.893	.0584	6.7070423

costs of entry and risks associated with many types of high-technology businesses. Accordingly, the estimation should be interpreted to mean that a graduate is more likely to be employed by a high technology firm than to own one. Since entrepreneurship education is a significant factor in explaining the propensity to be self-employed, the indirect effect of entrepreneurship on whether a graduate is with a high-technology firm is approximately −1.5 percent.

We anticipated that the determinants of whether an individual is likely to develop new products would include the type of degree program and training received by the graduate; personal characteristics, such as sex, ethnicity, or age; and the amount of time that has passed since the graduate received their last Eller College degree. In terms of degree program, we expected that participation in the entrepreneurship program would increase the propensity to develop new products, whereas we expected that participation in certain other business majors, such as accounting and finance would decrease the probability of developing new products. Students in these two majors tend to

be employed in large accounting and financial firms, where new product development may be more difficult.

As indicated in Table 18 opposite, entrepreneurship graduates are almost 9 percent more likely to have been instrumental in developing new products. Both of the two other business school majors that were entered into the regression are negative, but only the finance major is significant. Finance majors tend to be 8 percent less likely to develop new products than other business majors and 17 percent less likely than entrepreneurship graduates. The MIS major was entered into earlier versions of this equation, but was always very insignificant. Males are almost 5 percent more likely to develop new products than females. The length of time since their Eller College degree is also significant in explaining the propensity to develop new products. For each year out of business school, the probability that a graduate will develop a new product increases by 0.6 percent.

In addition to the survey responses, the Berger Entrepreneurship Program maintains data files on all of the business plans written by students who participate in the curriculum. 289 plans were written between 1985 and 1999. Many of these involved new technology. Some technologies were from the University of Arizona, whereas others were developed elsewhere. Additionally, some of the plans were implemented by graduates, while in other cases, the ideas were developed by different individuals with limited involvement of the graduates. In a few cases, we do not know whether or not the technology was commercialized. It seems likely that even when the technology was not commercialized, the process of business plan development and presentation in the business plans competitions publicized the process of technology transfer to the community and thereby encouraged further transfers. We cannot, however, document this precisely.

4.6. Pedagogical Contributions of the Entrepreneurship Program

Entrepreneurship programs contribute to the training of future business leaders. At the University of Arizona, entrepreneurship education is interdisciplinary and not bound by discipline-based protocols. As such, entrepreneurship programs can have flexibility in developing new teaching methods, coursework and projects that prepare business students to recognize a business opportunity and to know how to build and expand a business. In many instances, the demonstrated successes of these teaching programs are borrowed and incorporated into the general business curriculum. The extent to which changes in the business and MBA curriculum have been changed to reflect the philosophy of the entrepreneurship program was documented and quantified. The MBA curriculum has been revised, an International Business

Table 19: Frequency Distribution of Responses Regarding Academic Achievements/ Pedagogical Contributions

	Strongly Agree	Somewhat Agree	Don't Know/ Have No Opinion	Somewhat Disagree	Strongly Disagree
The Berger Entrepreneurship Program has been a leader in developing new teaching methods to prepare students to identify business opportunity and to build and expand a new venture	7	2	1	0	0
The Berger Entrepreneurship Program has been a leader in developing new coursework to prepare students to identify business opportunity and to build and expand a new venture	7	4	1	0	0
The Berger Entrepreneurship Program has been a leader in developing new projects to prepare students to identify business opportunity and to build and expand a new venture	7	1	1	0	0
Business and MBA course curriculums have benefited by incorporating teaching philosophy practiced in the Berger Entrepreneurship Program	3	2	2	0	0

Program started, and discipline courses restructured borrowing from the innovations of the Berger Entrepreneurship Program. The format of the business plans competition was modified for use in the MBA case analysis competition; business planning consulting was established through the creation of a MBA Consulting Desk; MBA and undergraduate courses were made more integrative and based on real-world applications; and the International Business Program adopted the use of program certificates for graduates as has been done in the entrepreneurship program.

To assess these effects, questions regarding the academic achievements and pedagogical contributions of the entrepreneurship program were prepared and sent to 27 deans, directors, and department heads within the University of Arizona who were familiar with the entrepreneurship program's curriculum and who had familiarity with changes made in other Eller College programs. The survey, sent in August 1999, asked administrators to agree or disagree with statements about the entrepreneurship program and its impact on business and MBA program curriculums. Administrators were also asked to provide descriptions of the effects they observed. Response rates ranged from 33 to 44

percent for the four agree/disagree questions but fell to under 21 percent when they were asked to list specific innovations and/or coursework introduced by the Berger Entrepreneurship Program that had been incorporated into other business courses.

As shown in Table 19 opposite, none disagreed with the very positive statements contained in the questionnaires. A few responded that they didn't know or didn't have enough information to respond. Among the rest, about 75 percent strongly agreed with the statements and 25 percent somewhat agreed with the statements. Assessing values of +2 for "strongly agree,", +1 for "somewhat agree," 0 for "don't know/have no opinion," –1 for "somewhat agree," and –2 for "strongly disagree," the four questions have mean responses of 1.6, 1.5, 1.5, and 1.14, respectively. The lower mean response value for "Business and MBA course curriculums have benefited…" is understandable in that it is easier to observe the changes adopted by the entrepreneurship program than it is to determine just how those innovations were incorporated into other programs.

Specific contributions that were listed by administrators included: a). introduction of new venture finance classes open to both entrepreneurship and non-entrepreneurship students; b). frequent use of guest speakers from the business community to illustrate how concepts were used in practice; c). expansion of consulting projects for both undergraduate and graduate students; d). the overall emphasis on blending theory and practice that distinguishes the entrepreneurship program; and e). use of capstone presentations similar to the business plans competition.

5. Conclusions and Limitations

We surveyed 2,484 surveyed graduates of the Eller College of Business and Public Administration at the University of Arizona from 1985 through 1998 (2,024 non-entrepreneurship and 460 entrepreneurship graduates). Analysis of the 406 non-entrepreneurship alumni and 105 entrepreneurship alumni who responded, as well as examination of Berger Entrepreneurship Program business plans data indicates strongly conclusively that entrepreneurship education makes a difference. Comparison of entrepreneurship and non-entrepreneurship group averages and statistical examination of the marginal effects of entrepreneurship education both provide similar results. The results indicate that entrepreneurship education clearly contributes to risk-taking and the formation of new ventures. On average, entrepreneurship graduates are three times more likely than non-entrepreneurship graduates to start new business ventures. Controlling for the personal characteristics of graduates and other environmental factors, entrepreneurship education increased the

probability of an individual being instrumentally involved in a new business venture by 25 percent over non-entrepreneurship graduates.

Similarly, there is strong clear evidence that entrepreneurship education increases the propensity of graduates to be self-employed. Once again, entrepreneurship graduates on average are three times more likely to be self-employed than are general business graduates. Controlling for personal characteristics and other factors, entrepreneurship education increases the likelihood that a graduate alumnus owns his or her business by 11 percent relative to non-entrepreneurship graduates. Entrepreneurship education has a significant impact on the income of graduates. On average entrepreneurship graduates have an average annual income that is 27 percent higher than the average annual income of non-entrepreneurship students, and entrepreneurship graduates are more likely to be employed full time. Further, they have 62 percent more assets than do their counterparts. Controlling for personal characteristics, entrepreneurship education increases the income of graduates by $12,654 beyond that of other business graduates. There is weaker evidence that entrepreneurship education increases job satisfaction through greater income. Controlling for other factors, entrepreneurship education increases job satisfaction by approximately 1 percent.

Entrepreneurship education contributes to the growth of firms, especially small firms. On average, small firms employing entrepreneurship graduates have greater sales and employment growth than do those that employ non-entrepreneurship graduates. For larger firms, the growth effects of a graduate are more difficult to detect. Nevertheless, larger firms pay entrepreneurship graduates substantially more than they do non-entrepreneurship graduates. Firms owned by entrepreneurship graduates also appear to be larger and have more sales than do those owned by non-entrepreneurship graduates. Controlling for individual characteristics, entrepreneurship graduates working for large firms earn approximately $23,500 more per year than do other graduates. Small firms employing entrepreneurship graduates have substantially greater growth as measured by percent change in sales than do those employing non-entrepreneurship graduates.

Entrepreneurship education also promotes the transfer of technology from the university to the private sector and promotes technology-based firms and products. On average, entrepreneurship graduates are more likely to be with firms that use licensed technologies and to be with firms that license technologies to others. They also are more likely to be involved with a high-technology firm than are non-entrepreneurship graduates. Among self-employed entrepreneurship graduates, nearly 23 percent own a high-technology firm, compared to less than 15 percent of non-entrepreneurship graduates. Entrepreneurship program graduates also are more apt to be instrumental in developing new products. Further, entrepreneurship graduates spend more time in R&D, work with products that have shorter life spans, and

are more apt to work in high-tech industries. Controlling for other factors, entrepreneurship education increases the graduate's probability of being with a high-tech firm by close to 13 percent and of developing new products by almost 9 percent. Analysis of business plans written in the Berger Entrepreneurship Program since 1985 indicates a growing trend toward more technical products and services, with 50 percent of all 1999 business plans involving innovative technologies.

We also surveyed 27 administrators to assess the pedagogical effects of the entrepreneurship program on the college curriculum. Survey responses indicate a strong belief that entrepreneurship education has provided innovations worth adopting in other programs and courses.

These results suggest that the investment in entrepreneurship education in business schools throughout the U.S. and elsewhere can bring important returns to graduates and to society. At a time when technology is changing rapidly and when university graduates must be adept in seeking and implementing new products and new technologies, entrepreneurship education can be an important instrument for success. Entrepreneurship education also can provide spill over effects to the broader society by making it more responsive to new technology and more supportive of risk taking and technology transfer.

Although we believe that the methods used in this paper represent the most rigorous attempt to assess the marginal effect of entrepreneurship education to date, there are several limitations to this study. First, this is a study of a particular entrepreneurship program, so it is unknown whether the results apply to other entrepreneurship programs or whether these findings are restricted solely graduates of the Berger Entrepreneurship Program. There is a strong need for additional studies using similar or improved methodologies.

Second, the Berger Entrepreneurship Program uses a rigorous screening process to select students. The results of this study are therefore limited to the extent that characteristics used in the screening process were not controlled for in our analysis.

Another limitation of this study is the type of personal characteristic we were able to control for. Traits such as 'self-efficacy' and 'intentionality' cannot be measured directly in the informational type of survey used in this analysis. We controlled for some important determinants of intentionality and self-efficacy, e.g., job experience, previous training, and whether or not the graduate previously owned a business. In addition, we believe that entrepreneurship training itself enhances both self-efficacy and intentionality by providing entrepreneurial role models, by teaching skills that affect a person's belief regarding the feasibility of starting one's own business, and by providing positive feed back and realistic encouragement by persons with credibility, expertise and prestige (each of these are listed as sources of self-efficacy by Boyd and Vozikis,1994). Whether we were completely successful

in separating the effects of the entrepreneurship training from personal entrepreneurial traits of individuals remains uncertain.

Despite these limitations, these results suggest that the investment in entrepreneurship education in business schools throughout the U.S. and elsewhere can bring important returns to graduates and to society. At a time when technology is changing rapidly and when university graduates must be adept in seeking and implementing new products and new technologies, entrepreneurship education can be an important instrument for success. Entrepreneurship education may also provide spillover effects to the broader society of graduates and contribute to making it more responsive to new technology and more supportive of risk taking and technology transfer.

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