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Impact of entrepreneurship education in colleges and universities on entrepreneurial entry and performance

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ABSTRACT

This study aims to investigate the impact of three established approaches to entrepreneurship education, Theory, Competition and Incubation, on entrepreneurial entry and performance. Propensity score matching is used to compare three cohorts from the alumni of a business college in China who completed entrepreneurship courses with their respective matched sample of similar individuals who did not. The findings suggest that Incubation significantly increases the probability of new venture creation. Theory, and participation in entrepreneurial business plan Competition(s) positively affect only those students that are non-management majors. Analysis including multiple linear regression indicates that Incubation has a positive impact on new venture sales revenue, profit before tax and the number of employees. The effect of Theory and Competition on new venture performance is not significant. This study extends the current knowledge of entrepreneurship education by providing new empirical evidence for the proposition that entrepreneurship can be learned, and the relative impact of these three types of education. The findings have direct implications for policymakers, educational executives, researchers, and others interested in encouraging entrepreneurial activity.

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1. Introduction

The Business Plan Competition initiated by Tsinghua University in 1998 is credited as being the start of entrepreneurship education (EE) in colleges and universities in China (Yongchuan, 2013; Zhou & Xu, 2012). Over the past two decades, innovation

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and entrepreneurship education has been promoted by the national Ministry of Education in China, and as a result, entrepreneurial education and training programs in colleges and universities have expanded at a rapid pace. According to the most recent data available, at the end of 2018, over 28,000 courses had been offered, with an additional 4,100 online courses offered. Over 27,000 full-time teachers of innovation and entrepreneurship courses have been employed, and 13,000 on-campus innovation and entrepreneurship practice platforms have been built at public colleges and universities across China. Additionally, more than 93,000 Subject Matter Experts (SMEs), known in China as Outstanding Talents from various industries, have been employed by colleges and universities to serve as part-time mentors in innovation and entrepreneurship education programs.[1]

China may have the same motivation for encouraging entrepreneurial activity through the dramatic expansion of EE as western nations (Matlay et al., 2013; Rae, 2014; Smith & Chimucheka, 2014). It is widely accepted by public policy and education decision-makers that EE in schools at all levels will boost entrepreneurship intention, cultivate entrepreneurship competency, lead to entrepreneurial activity among students who attend such courses, and improve their financial performance as entrepreneurs, and in doing so, increase employment and facilitate economic growth (Fairlie et al., 2015; Inci, 2013; Leibenstein, 1987; Sang & Lin, 2019; Weitzel et al., 2010). There is consensus among economists reporting that entrepreneurship can play an important or even a critical role in economic growth and employment (Acs & Szerb, 2007; Išoraitė & Gulevičiūtė, 2021; Mueller, 2006; Si et al., 2015; Stephens et al., 2013; Wennekers & Thurik, 1999). However, there is not sufficient evidence so far to support the claim that EE will always play a vital role in creating more and better entrepreneurs. Further research is necessary to test Drucker's (2006) assertion that entrepreneurship is a discipline that can be learned (Marram et al., 2014; Rideout & Gray, 2013).

Based on the data collected from three cohorts of graduates from an undergraduate level college in SE China, this study investigates the impact of EE on the alumni's probability of starting a firm and the firm's financial performance if started by employing a quasi-experimental method. The purpose of the research is to provide some new empirical evidence from China for the proposition above. Specifically, this study focuses on three questions: to what extent does EE lead to an individual's entrepreneurial activity, is it a meaningful proposition for China to advocate the integration of EE with professional education? And whether EE has improved the performance of a new venture or not?

The results indicate that Incubation significantly increases the entrepreneurial probability and the nascent firm's performance, and the study of Theory and engagement in Competitions only have significant positive impact on the entrepreneurial probability of non-management graduates.

This research confirms the positive implications of EE and integration of EE with professional education, which partially supports Drucker's claim that entrepreneurship is a discipline that can be learned. The findings provide public policymakers and EE investors with reliable empirical evidence for continuing to invest in EE. The results also present the difference of outcome effect between different entrepreneurial

courses and of the same entrepreneurial courses between different majors. This highlights the significance of 'live-fire drill' in EE, which has direct implications for educational leaders in the optimization of resource allocation and the design of entrepreneurship curriculum. This research also demonstrates the importance of minimizing self-selection bias, and the importance of utilizing case studies at the university level to investigate the EE outcome effect due to the possible heterogeneity between different types of learning institutions.

The remainder of this paper is outlined as follows. In section 2, a review of the existing literature regarding the evaluation of the EE outcome effect is provided. In section 3, a brief description of the sample institution's entrepreneurship curriculum is provided, as well as a description of the methodology, including conducting the survey, defining the variables, and the approach used to match alumni using PSM to correct for self-selection for the three types of entrepreneurship courses. Section 4 shows the survey analysis results and the effect of entrepreneurship course participation on entrepreneurial outcomes. Finally, Section 5 provides the summary and discussion.

2. Literature review

Despite a dramatic increase of literature on EE in recent years, there is still a chronic shortage of evaluations of EE outcome effects, especially those empirical studies based on rigorous research design (Marram et al., 2014; Rideout & Gray, 2013.). Chronologically, the research themes of EE appear in the following order: how colleges and universities conduct EE, why EE could lead to entrepreneurial action, and to what extent EE leads to entrepreneurial action. The first theme is categorized into theoretical studies on teaching systems, pedagogy, instructor training and EE ecosystem, and the last two are classified respectively as empirical studies on the mechanism and effect of EE.

2.1. Psychological grounding of EE

Most countries that encourage EE in colleges and universities do so in an attempt to solve practical problems in the economy and society, such as to either reduce ongoing or upcoming unemployment (Matlay, 2008) or to meet the needs of economic restructuring and/or changing the dynamics of economic growth (Naudé, 2010; Obaji & Olugu, 2014; Wennekers & Thurik, 1999). For government policymakers and academicians, the idea that entrepreneurship can be learned is rooted in the increasingly refined social psychology theory of the 1970s. Social Cognitive Career Theory holds that career goals are related to outcome expectations and self-efficacy, which has been formally defined as the conviction that one can successfully execute the behaviour required to induce desired outcomes (Bandura, 1977). According to Bandura (1977), self-efficacy develops from four processes: performance accomplishment, vicarious experience, verbal persuasion and emotional arousal. To some extent, EE delivery imparts these four processes and enforces students' entrepreneurship outcome expectations. Theoretically, self-efficacy in entrepreneurship can be enhanced, leading to

entrepreneurial action (Schunk & Zimmerman, 1998). Another well-known theory that supports EE is the Theory of Planned Behaviour (Ajzen, 1991). Ajzen's (1991) theoretical model consists of five elements: attitude, norm, control, intention and behaviour, where attitude describes an individual's feeling about the behaviour in question; norm describes how an individual perceives the social pressures on engaging or not engaging in the required behaviour change; control describes the ability of an individual to perform the behaviour change; intention is a means of establishing if the individual will actually perform the required behaviour and behaviour, the final element which signifies the required behaviour change. The Planned Behaviour Theory postulates that entrepreneurial behaviours are always preceded by entrepreneurial 'intentions' which theoretically can be modified by educational experiences.

2.2. Studies with EE psychological outcomes

Influenced by Social Cognitive Theory and Planned Behaviour Theory, most literature on the effect of EE in the past few decades has been focused on psychological outcomes, including self-efficacy and intentions. The focus of research in these areas may be related to the relative ease with which these indicators can be measured immediately after the entrepreneurial program when compared to objective ones, such as the probability of new venture formation and new venture financial performance. Using standard search engines, Rideout and Gray (2013)explicitly searched all major entrepreneurship journals from 1997 to 2011, and using the typology developed by Storey (2017), categorized the related studies into six progressively more inferentially robust categories. The studies in steps 1-3 were discarded because they were essentially descriptive case studies and provided no basis for causal-effect inference. Only 12 studies remained that met the standards for either step 4, which involved a comparison between participants and a typical non-participant group, or step 5, which employed a comparison between participants and a matched control group. There were no studies that met the standards of step 6, which involved Step 5 with the addition of controls for self-selection bias. Of the 12 studies, 5 (Chen et al., 1998; DeTienne & Chandler, 2004; Lucas & Cooper, 2004; Sánchez, 2013; Zhao et al., 2005) are concerned with the psychological outcomes of EE, and all of them reported support for the causal connection between EE and entrepreneurial self-efficacy and intention, two widely researched psychosocial precursors to entrepreneurship. Given the difference in the samples and methodology between the five studies, Rideout and Gray (2013) concluded that although these five studies do not provide a solid basis for answering the question 'Does EE really work?', they do indeed have the potential to help us begin to answer the more refined question 'if EE works, how does it work?', which lends modest support for the Social Cognitive Theory-based hypothesis that EE can affect entrepreneurial self-efficacy, and the Planned Behaviour Theory-based hypothesis that entrepreneurial intentions lead to entrepreneurial acts. This study included a search for related literature published after 2012[2] and screened them with the same criteria as was used by Rideout and Gray (2013). The findings suggest that the majority of studies support their conclusion that EE to some extent cultivates students' self-efficacy and increases their entrepreneurial intentions (Alharbi et al.,

2018; Cera et al., 2020; Huber et al., 2014; Karimi et al., 2016; Maresch et al., 2016; Mirjana et al., 2018; Ni & Ye, 2018; Omer & Aljaaidi, 2020; Volery et al., 2013). A few studies were exceptions and found no influence, including Vukovi et al. (2016) and Kusumojanto et al. (2020), or even a negative effect on entrepreneurial intentions in some cases (Nabi et al., 2018; Shinnar et al., 2014). Notably, all of these studies employed either comparisons between treatment and control or between pre and post-test of treatment.

2.3. Studies with EE objective outcomes

Rideout and Gray (2013) also included five studies with objective outcomes that met the criteria of Storey's (2017) Step 4 and/or Step 5 in their descriptive review[3] (Brown, 1990; Charney & Libecap, 2000; Kolvereid & Moen, 1997; Menzies & Paradi, 2002; Souitaris et al., 2007). Although all five of the studies indicated at different levels of significance that EE participation results in a higher probability of evolving into new venture creation, Rideout and Gray (2013) concluded that these studies leave unanswered the question, 'Does EE work?', because of the methodological blemishes of either an insufficient sample, poor structural validity, or self-selection bias. Martin et al. (2013) undertook a meta-analysis on the outcome effects of EE with forty-two studies during nearly the same time period as Rideout & Gray,(2013). Martin et al. (2013) defined EE as human capital investment. Entrepreneurial capacity, self-efficacy, and entrepreneurial intentions created from EE were defined as human capital assets, while the probability of new venture creation, new venture's financial performance and firm survival as entrepreneurial outcomes. They concluded that EE has a positive correlation with both entrepreneurial human capital assets and entrepreneurial outcomes; however, the relationship between academic-focused EE interventions and entrepreneurial outcomes is more robust than that between training-focused EE interventions and entrepreneurial outcomes. Unlike the studies on psychological outcomes of EE, which increased noticeably after 2012, only three studies on objective outcomes of EE could be located. After screening using Storey's (2017)criteria, only one study remained. In that study, Elert et al. (2015) investigated the long-term impact of EE in high school students on entrepreneurial entry, firm performance, and firm survival. By using PSM, the authors found that while EE program participation increases the long-term probability of starting a firm, as well as entrepreneurial incomes, there is no noticeable effect on firm survival. Taken together, it appears that there is no academic consensus on the issue of the objective outcome effects of EE.

2.4. Brief comments

As discussed earlier, the primary reason for the mismatching of the theoretical logic and practical logic of EE is that public policymakers have no choice but to believe the findings of psychological studies, specifically, of Social Cognitive Theory and Planned Behaviour Theory, when facing problems of unemployment and/or economic growth. However, that does not preclude their need for a 'smoking gun' to support the assertion that EE could actually create employment and propel economic growth.

Although studies on the psychological outcomes of EE have shown a positive association between EE and self-efficacy and entrepreneurial intentions, there remain a variety of elements that could mediate the causation between entrepreneurial intentions and entrepreneurial acts. The question 'does EE work?' remains unanswered. For EE decision-makers, the present form of EE in colleges and universities is considerably different from that of a few decades earlier. EE curriculums show continuous improvement with EE modalities approaching diversification (Jin & Yang, 2017; Xu, 2016), and EE courses are available not only for management majors but also for engineering majors (Barba-Sánchez & Atienza-Sahuquillo, 2018; Maresch et al., 2016). EE decision-makers need to know what kind of EE courses or modalities are more likely to improve outcomes and whether integration of EE with professional education is a prudent decision due to the considerable resources that could be allocated to such initiatives. EE decision-makers are not satisfied with current research (Krisnaresanti et al., 2020). For researchers, the fundamental shortcoming in the existing literature could likely be the lack of rigour in the design of most research. In the absence of an actual random sample, many studies can only offer descriptive analysis on the effect of EE and are unable to compare either between the treatment and control, or pre-posttest values of the treatment. Most do not mention or make a response to the possible endogeneity or reverse endogeneity in treatment groups, which certainly compromises the inferential validity and reliability of the research.

3. Data and method

3.1. Entrepreneurship curriculum

The data was collected from the graduates of a business college with a relatively complete entrepreneurship curriculum, based on four components, theory, training, competition and practice in the starting of a business on campus. Theory includes three courses, Entrepreneurship (EPS) Practice for Small and Middle-Sized Business, which is an introductory course, EPS Foundation, an abridged version, and EPS Strategy Management, an advanced course. The contents of the three theory courses are similar with escalating complexity and are referred to as *entrepreneurial Theory* or just *Theory* in the following analysis. There are two types of training courses: Virtual Business Social Environment (VBSE) and Entrepreneur Sand Table. Although they have different content, both are designed to simulate the business process. These two courses are combined for purposes of this study into one variable, *training*. Competition includes the Challenge Cup and 'Internet+', two national level government-sponsored competitions, and the Creative Marketing Competition and Career Pioneer Competition, two local level competitions initiated by the regional government. The college also encourages and sponsors students to start their own business on campus, which is actually a common practice as part of the EE curriculum in China's colleges and universities. The survey used in this study utilized the criterion of acceptance by the college's incubator to determine whether a student had started a business on campus. For the sake of external validity, Training, Creative Marketing and Career Pioneer were not included in the analysis. At the same time, Challenge Cup and Internet + were combined into one variable, *Competition*.[4] Consequently,

this study focused on the ATTs of three types of courses, *Theory*, *Competition* and *Incubation*.

3.2. Questionnaire and data

The survey instrument used consists of four sections, demographics, education, employment and entrepreneurship. To the extent deemed reasonable, possible items that may exert influence on entrepreneurial intent and activity were included in the questionnaire. Questions such as 'registered resident of Wenzhou' and 'father's occupation' were included to address possible endogeneity. The internal validity test was concluded at the end of August 2019, and the online survey was conducted through Questionnaire Star, an internet platform, between October 10 and November 13, 2019. A total of 1023 surveys were completed, with 971 valid surveys remaining after removing unqualified completed surveys, including those who graduated in 2019, those that have exited the labour market, those pursuing a higher degree, and stay-at-home parents. Table 1 shows the full range of descriptive statistics for each variable by sample.[5]

We see from the variable means that survey participation is fairly reasonably distributed across gender and major. In all, 43.15% men, 56.85% women, 17.2% economics majors, 28.4% accounting majors, 29.1% management majors, 13.9% information engineering majors, and 6.6% art design majors were included. It can also be seen that respondents who were registered residents of Wenzhou city account for 33.4%, and those whose father is an owner-manager of a private enterprise count for 53% of the whole sample, which indicates an unusually high level of proximity to family members engaging directly in commercial activity. Table 1 also shows that the rate of enterprise formation among the sample is 9.4%, much higher than the average rate of 2.9%[6] among college students nationwide in 2018. Given that the average duration since graduation is 3.5 years and the mean age of respondents is 25.9 years old, and if the probability of starting a new firm tends to peak when individuals are in their 30 s and early 40 s (Delmar & Davidsson, 2000), the entrepreneurial rate of this sample will be likely to rise further over the next few years.

The sample of entrepreneurs averaged 3.5 years since the formation of their new venture. They had an average sales revenue in 2018 of RMB 4.339 million, an average profit before tax (PBT) in 2018 of RMB 1.02 million, and averaged 18 employees in 2018. This indicates that the alumni's start-ups are in the infancy or start-up stage. From the perspective of EE participation, the entrepreneurial theory participation rate of 53.8% is higher than that of the full sample, which is 40.3%, and the non-management sample, which is 32.8%, but lower than that of the management sample, which is 58.7%. The entrepreneurial competition participation rate, which is 19.8%, is higher than that of the full sample, which is 10.3%, higher than the management sample, which is 10.6%, and higher than the non-management sample, which is 10.1%. The rate of entrepreneurs who started a firm after incubation on campus was 24.1%, higher than that of the full sample, which is 4.9%, higher than the management sample, which is 5.3%, and higher than the non-management sample, which is 4.8%. Although all of these indicators show a higher rate of participation in the three types

Table 1. Descriptive statistics.

Variables	Full sample	Management	Non-management	Entrepreneur
Gender	0.43	0.47	0.42	0.64
Age	25.91	27.23	25.38	27.82
Marriage status	0.32	0.46	0.26	0.64
Party member	0.25	0.32	0.22	0.24
Siblings	0.68	0.74	0.66	0.82
Wzhukou	0.33	0.39	0.31	0.37
Father's education	9.79	9.46	9.93	10.38
Mother's education	8.72	8.44	8.84	8.81
Father is a business owner	0.53	0.59	0.5	0.66
Bachelor	0.97	0.93	0.98	0.84
Provincial key	0.14	0.14	0.14	0.15
Municipal key	0.24	0.24	0.24	0.3
County key	0.23	0.26	0.22	0.29
East	0.96	0.95	0.96	0.97
Years since graduation	3.51	4.79	2.98	5.44
WZBC degree	0.92	0.87	0.94	0.74
Economics	0.17		0.24	0.15
Accounting	0.28		0.4	0.11
Management	0.29			0.48
Information	0.14		0.2	0.15
Art design	0.07		0.09	0.08
Theory	0.4	0.59	0.33	0.54
Training	0.23	0.31	0.2	0.26
Related course	0.04	0.06	0.03	0.07
Competition	0.1	0.11	0.1	0.2
Career pioneer	0.12	0.17	0.1	0.21
Creative marketing	0.11	0.22	0.07	0.18
Other activities	0.02	0.01	0.02	0.01
Incubation	0.05	0.05	0.05	0.24
Entrepreneur	0.09	0.16	0.07	
Years since foundation				3.46
Sales revenue				433.96
PBT				102.09
Number of employees				18.35
Previous startup experience				0.3
Experience				2.3
Founders' combined years of experience in the same industry				3.59
Number of observations	971	283	688	91

Source: Authors.

of EE courses by alumni who have started a business than those who have not, it would be premature to attribute the higher entrepreneurial rate to the higher rate of EE course participation. Further research is still needed to identify whether EE is the driver and what the net effect of each of the three types of EE courses is.

3.3. Methodology

Given the observational nature of the data, it is not possible to directly obtain the objective outcome effect of EE by subtracting the outcome of non-participants from the outcome of participants. Theoretically, the average treatment effect on the treated (ATT) is the difference between the outcome of the treated, and the outcome of the treated, if they had not been treated.

$$ATT = E(Y^1 \big| D = 1) - E(Y^0 | D = 1) \tag{1}$$

Where Y^1 represents the entrepreneurial probability of the treated, Y^0 represents the entrepreneurial probability of the untreated, D is the variable of participation in an EE course. When treated, $D = 1$, untreated, $D = 0$. However, the second term of the right-hand side of the equation is unable to be observed. What could be observed is the probability of the untreated. Subtracting the probability of the untreated from the probability of the treated yields equation (2):

$$E(Y^1\Big|D=1)-E(Y^0\Big|D=0)=E(Y^1-Y^0\Big|D=1)+\Big\{E(Y^0\Big|D=1)-E(Y^0|D=0)\Big\} \tag{2}$$

The second term of the right-hand side of the equation is self-selection bias. If the item is positive, there is endogeneity. If negative, there is reverse endogeneity. As long as this item is not zero, we cannot have unbiased causal effects. Self-selection does not exist due to the sample's random distribution among the treated and untreated groups in the experimental environment. However, with observational data, different methods must be adopted to overcome self-selection bias according to the difference in the nature of the data. For this study, it is assumed that self-selection bias is entirely derived from observable factors, so Propensity Score Matching (PSM) can be applied in drawing inferences based on the reconstruction of the counterfactual.

Rosenbaum and Rubin (Rosenbaum & Rubin, 1983, 1984, 1985a, 1985b) developed PSM in a series of articles. A 'propensity score' is defined as the probability of study participants receiving a treatment based on observed characteristics X, which is virtually that the many potentially confounding covariates in an observational study are replaced with a function of these covariates:

$$P(D=1|X)=P(x) \tag{3}$$

So, the effect of participating in EE courses can be estimated by using a propensity score $P(\mathrm{x})$ as in the following:

$$ATT=E(Y^1-Y^0\Big|P(x))=E(Y^1\Big|D=1,P(x))-E(Y^0|D=1,P(x)) \tag{4}$$

Where D is a binary dummy variable representing participation in either entrepreneurial Theory, Competition or Incubation, X is a covariant vector of a potentially influenced entrepreneurial act or participation in an EE course. The purpose of the measurement is to assess the impact of D on the probability of starting a business. Since it is assumed that D is not correlated to the covariates or the error term, the estimate of the coefficient of D is the effect of EE course participation. This study employs a logit model to calculate the propensity score, the economic meaning of the coefficient of D is odds ratio, namely, the ratio of start-up probability between the treated and the control ($\frac{P}{1-P}$).

The basic idea of PSM is that if two individuals, one in the treated group and another in the control group, have the same value of propensity score, then the experiment can be considered as random. Thus, Y^0, as the participating individual's

counterfactual is accurate, and consequently so is the ATT. For PSM to be employed appropriately, two conditions must be met. First, the Conditional Independence Assumption (CIA), meaning that the output is independent of the participation variable when conditional on covariates. CIA requires a substantial amount of variables, the omission of a vital covariate may lead to an incorrect estimate of the propensity score (Criscuolo et al., 2012). Guided by causal theory and prior empirical studies, this study included 28 covariates for the entire sample and 23 covariates for the subsample, which are either background variables or those that are theoretically relevant for selection into entrepreneurship. Thus there is high reliability that the CIA holds. Second, the Common Support Condition, meaning that given$X$, individuals with the same$X$ values have a positive and equal opportunity of being assigned to the treated or control group. This study accounts for this condition by requiring that all variables means do not deviate more than 10% between the treated and control groups and reports the sample size of both the treated and control groups within the common support domain.

Since the sample size of the control is far larger than the treated, nearest-neighbour matching was employed to estimate ATT, the bootstrap method was used to calculate the standard error and statistical significance, kernel matching was used to perform a robust test, and conduct matching quality test, and report the results in the last step.

This study employed multi-linear regression to identify the impact of each of the three types of EE course on a new firm's economic performance after all the analysis on the probability of starting a new firm had been completed.

4. Results

4.1. The probability of starting a new firm

The first step of PSM is to regress the treatment variable on a set of theoretically relevant covariates to estimate the propensity score. In this study, the treatment variables include entrepreneurial Theory, Competition, and Incubation respectively, covariates consist of 28 continuous and discrete variables from 'Gender' to 'Other activities'. The logit model was employed to do the regression.

As can be seen from the estimated propensity score,[7] participation in entrepreneurial Theory is not influenced by an individual's characteristics and household background. Those who graduated from a high school in east China, hold a bachelor's degree, management majors, and those who have been involved in competitions and other entrepreneurial activities are more likely to take the entrepreneurial theory course. The year of graduation significantly negatively correlates to theory course participation, probably because of the insufficient promotion of entrepreneurial courses at an earlier stage. The variables associated with participation in Competition are similar to those associated with participation in the theory course. The variables associated with participation in Incubation are quite different from those associated with Competition and Theory. Those majoring in economics, management, and accounting, are more likely to start a business and get incubated on campus. Those who took the entrepreneurial theory course as an elective or were involved in other

entrepreneurial activities are more likely to start a business and get incubated on campus. Demographic characteristics, such as male gender, and siblings exhibits a significantly positive influence on the probability of starting a business and getting incubated on campus. 'Father is a business owner' also has a positive influence, which is expected since growing up in an entrepreneurial family is commonly deemed to be a salient indicator for entrepreneurial propensity.

Based on the estimated propensity score, the effect of Theory, Competition, and Incubation participation on the probability of starting a firm can be assessed. Table 2 presents the ATTs of the three types of courses by using k-nearest neighbour matching and kernel matching, the standard error and *P*-values calculated by Bootstrap, and also the treated samples and untreated samples in the common support domain as well. It can be seen that both the k-nearest neighbour and kernel matching for ATT of Incubation pass the test at the 1% significance level, meaning that participants' probability of starting new firms is 36.4%－37.7% higher than if they did not. It can also be seen that neither of the two matching for ATT of Theory and Competition passes the test at the 10% significance level, meaning that neither Theory nor Competition significantly influence students' probability of starting new firms after graduation. Although there are slight differences in the matching outcomes, there is robust consistency in ATT estimates for each of the three entrepreneurship courses.

Because PSM is not conditional on all covariates but is conditional on the propensity score, it must be tested whether a matching procedure can balance the distribution of covariates between participants and non-participants to ensure that there is no significant difference between the matched variables. Table 3 presents the quality index of the matching.[8] Comparing the quality indicators before and after matching, it can be seen that all items become smaller after matching, and the joint F-test is significant before, and not after matching, which indicates that the matching procedure employed in this study can balance the distribution of the covariates of the two groups, and also that the logit model specification is appropriate. Comparing the quality indicators between k-nearest and kernel matching, it can be seen that the values of Ps R2, LR chi2, and MeanBias of kernel matching are all smaller than those of neighbour matching. A small MeanBias indicates a small difference of each characteristic between participants and controllers and a small value of Ps R2 with insignificant F test together indicate little systematic difference in the distribution of matched covariates between the treated and untreated group. The insignificant F test indicates that covariates have no predictive ability for participation variable, thus better matching quality. Therefore, the data indicates that the results of kernel matching are closer to the actual values of the EE participation effect. That is, the ATT of Incubation is 36.4%.

4.2. The difference of ATT between different majors

The sample was divided into two sub-samples, management and non-management, to investigate EE's ATT difference between majors. Participation variables were still Theory, Competition, and Incubation, while covariates were reduced to 23 because of professional distinction.[9] The estimation of $P(x)$ by major displays a similar pattern to

Table 2. Average treatment effect on the treated. Probability of starting a new firm after graduation, full sample.

Entrepreneurship Courses	Matching method	ATT	Bootstrap Std. Err.	Bootstrap $P>\|z\|$	Treated on support	Untreated on support
Theory	Neighbor ($K=5$)	0.043	0.029	0.644	391	542
	kernel (bwidth = 0.06)	0.049	0.023	0.670	391	542
Competition	Neighbor ($K=5$)	0.027	0.063	0.672	97	814
	kernel (bwidth = 0.06)	0.029	0.060	0.636	92	814
Incubation	Neighbor ($K=5$)	0.377	0.100	0.000	44	650
	kernel (bwidth = 0.06)	0.364	0.091	0.002	44	650

Source: Authors.

that of the full sample. For both management and non-management majors, participation in the Theory course and entrepreneurial Competition is not related to demographic characteristics and household background, but is related to participation in other entrepreneurial courses. Involvement in business creation and Incubation on campus is not only correlated to individual's taking other entrepreneurship courses, but also to the individual's demographic characteristics and household background variables, such as male gender, party membership, siblings, bachelor's degree, and provincial high school are all significantly positively correlated with entrepreneurship Incubation.

Table 4 shows the matching results for the management sample. It can be seen that neither Theory nor Competition has passed the significance test at 10% level, while all those matching with Incubation have passed the significance test at 1% level, which indicates that the probability of starting a new firm after graduation for management majors who participated in business creation and were incubated on campus is 61.6-65.4%, higher than those who did not.

Table 5 lists the matching quality test results. It can be seen that the adjusted-R^2, F-test, and MeanBias are all significantly reduced after matching, and the joint F-test is significant before and not after matching. This signifies that both of the two matching methods for the three participation variables meet the matching quality requirements and that the results have robust consistency. Comparing the quality indices of the two matching methods, the adjusted-R^2, F-test, and MeanBias of k-nearest matching are all smaller than that of kernel matching, so it can be concluded that the probability of starting a new firm after graduation for management majors who engaged in business creation and were incubated on campus is 61.8%, higher than those who did not.

The matching results for the non-management sample are listed in Table 6. It can be seen that the k-nearest matching of Theory has passed the significance test at the 10% level with kernel matching at 5%, proclaiming that the probability of starting a firm after graduation for students who took the entrepreneurship Theory course are 4.9-5.2% higher than that of who did not. The k-nearest matching of Competition has passed the significance test at 10%, but kernel matching does not, demonstrating that the ATT of Competition for non-management students is 12.3%. The k-nearest matching of Incubation has passed the significance test at the 10% level, the kernel matching does not, meaning that the ATT of Incubation for non-management students is 18.5%.

Table 7 lists the matching quality indices. It shows that the adjusted-R^2, F-test, and MeanBias are significantly reduced after matching, and joint F-test is significant before but not after matching, which signifies that both the two matching methods for the three participation variables meet the matching quality requirements and the

Table 3. Matching quality test, full sample.

		Theory		Competition		Incubation	
		Neighbor ($K=5$)	Kernel (bwidth = 0.06)	Neighbor $K=5$)	Kernel (bwidth = 0.06)	Neighbor ($K=5$)	Kernel (bwidth = 0.06)
Unmatched	Ps R2	0.167	0.167	0.251	0.251	0.303	0.303
	LR chi2 ($p>$chi2)	218.96(0.00)	218.96(0.000)	161.84(0.00)	161.84(0.00)	115.86(0.00)	115.86(0.00)
	MeanBias	16.800	16.800	23.600	23.600	26.500	26.500
Matched	Ps R2	0.014	0.007	0.024	0.020	0.049	0.024
	LR chi2 ($p>$chi2)	14.66(0.98)	7.71(1.00)	6.54(1.00)	5.05(1.000)	6.02(1.00)	2.97(1.00)
	MeanBias	4.300	3.00	6.100	5.800	7.200	6.200

Source: Authors.

Table 4. Average treatment effect on the treated. Probability of starting a new firm after graduation, management sample.

Entrepreneurship courses	Matching method	ATT	Bootstrap Std. Err.	Bootstrap $P>\|z\|$	Treated on support	Untreated on support
Theory	Neighbor($K=5$)	0.032	0.060	0.595	145	108
	kernel(bwidth = 0.06)	0.019	0.058	0.740	145	108
Competition	Neighbor($K=5$)	0.008	0.129	0.951	25	221
	kernel(bwidth = 0.06)	0.018	0.142	0.901	25	221
Incubation	Neighbor($K=5$)	0.618	0.171	0.000	23	91
	kernel(bwidth = 0.06)	0.654	0.201	0.001	23	91

Source: Authors.

results have robust consistency. Comparing the quality indices of the two matching methods, the adjusted-R^2, F-test, and MeanBias of kernel matching are smaller, so it can be concluded that the ATT of Theory for non-management majors is 5.2%.

4.3. Nascent firm's operating performance

Multi-regression is employed to analyze the impact of EE on nascent firm's operating performance. The firm's operating performance was measured by sales revenue, profit before tax (PBT) and the number of employees at the end of the year 2018. Given the skewed distribution of the raw data, the logarithms of each of the dependent variables was used in the regression model. In addition to the three main independent variables, Theory, Competition, and Incubation, which are the principal areas of focus, the following variables were added to the model as control variables, work experience, work experience squared, founders' combined experience in same industry, start-up experience, ln (founded years), age, gender, marriage status, father is a business owner or/self-employed. The regression results are shown in Table 8.

Neither Theory nor Competition is statistically significant in either of the three models, while Incubation positively influences sales revenue, PBT, and the number of employees at the 5% significance level in all three models. Work experience is not significant in any of the models, while Founders' combined experience in the same industry positively influences operating performance in all models. Start-up experience is not significant in any models. Ln (years since foundation) is significant in the ln(PBT) model and the ln(number of employees) model, but not in the ln(sales revenue) model. Regarding individual characteristics, male entrepreneurs tend to have

Table 5. Matching quality test, management sample.

		Theory		Competition		Incubation	
		Neighbor ($K=5$)	Kernel (bwidth = 0.06)	Neighbor ($K=5$)	Kernel (bwidth = 0.06)	Neighbor ($K=5$)	Kernel (bwidth = 0.06)
Unmatched	Ps R2	0.149	0.149	0.357	0.357	0.495	0.495
	LR chi2 ($p>$chi2)	57.33(0.000)	57.33(0.000)	68.23(0.000)	68.23(0.000)	58.13(0.000)	58.13(0.000)
	MeanBias	18.800	18.800	29.500	29.500	40.000	40.000
Matched	Ps R2	0.025	0.021	0.049	0.052	0.091	0.327
	LR chi2 ($p>$chi2)	9.89(0.987)	8.31(0.996)	3.35(1.000)	3.59(1.000)	2.672(1.000)	9.68(0.983)
	MeanBias	6.400	5.500	7.000	6.900	10.800	34.000

Source: Authors.

Table 6. Average treatment effect on the treated. Probability of starting a new firm after graduation, non-management sample.

Entrepreneurship courses	Matching method	ATT	Bootstrap Std. Err.	Bootstrap $P>\|z\|$	Treated on support	Untreated on support
Theory	Neighbor($K=5$)	0.049	0.026	0.057	217	427
	kernel(bwidth = 0.06)	0.052	0.024	0.034	217	427
Competition	Neighbor($K=5$)	0.123	0.062	0.051	69	571
	kernel(bwidth = 0.06)	0.068	0.059	0.246	64	571
Incubation	Neighbor($K=5$)	0.185	0.106	0.080	27	347
	kernel(bwidth = 0.06)	0.158	0.131	0.317	27	347

Source: Authors.

Table 7. Matching quality test, non-management sample.

		Theory		Competition		Incubation	
		Neighbor ($K=5$)	Kernel (bwidth = 0.06)	Neighbor ($K=5$)	Kernel (bwidth = 0.06)	Neighbor ($K=5$)	Kernel (bwidth = 0.06)
Unmatched	Ps R2	0.147	0.147	0.276	0.276	0.295	0.295
	LR chi2 ($p>$chi2)	128.04(0.00)	128.04(0.00)	124.89(0.00)	124.89(0.00)	78.04(0.000)	78.04(0.00)
	MeanBias	18.200	18.200	27.600	27.600	29.000	29.000
Matched	Ps R2	0.009	0.004	0.047	0.033	0.041	0.018
	LR chi2 ($p>$chi2)	5.31(1.00)	2.420(1.00)	8.93(0.996)	5.80(1.00)	3.02(1.00)	1.32(1.00)
	MeanBias	3.300	2.200	9.500	7.300	9.000	6.100

Source: Authors.

higher sales revenue and larger firm scale than females. Those who are married tend to have higher PBT and larger firm scale than those who are unmarried. Notably, having a father who is a business owner or self-employed does not affect operating performance. Our findings are consistent with those of Marram et al. (2014), who investigated 913 alumni entrepreneurs of Babson College in the US and Zheng et al. (2018), who studied 201 alumni entrepreneurs of Zhejiang University in China.

5. Discussion and conclusion

This study investigates the impact of the three main types of entrepreneurship courses, Theory, Competition and Incubation, in colleges and universities on alumni's probability of starting a new venture and the subsequent performance of new ventures. Using propensity score matching, this study compared three cohorts from the

Table 8. Regression models for operating performance.

Variables	Ln(sales revenue)	Ln(PBT)	Ln(number of employees)
Theory	−0.31	−0.314	−0.00929
	[0.409]	[0.335]	[0.265]
Competition	−0.601	−0.398	−0.0851
	[0.530]	[0.434]	[0.353]
Incubation	1.084**	1.058**	0.916**
	[0.535]	[0.438]	[0.351]
Work experience	0.223	0.12	0.112
	[0.266]	[0.218]	[0.171]
Work experience squared	−0.0138	−0.0103	0.0155
	[0.039]	[0.032]	[0.024]
Founders' combined experience in same industry	0.0598**	0.0523**	0.0430**
	[0.028]	[0.023]	[0.019]
Startup experience	−0.3191	−0.1637	−0.2937
	[0.4618]	[0.3725]	[0.3291]
Ln(years since foundation)	0.418	0.478*	0.709***
	[0.325]	[0.267]	[0.212]
Age	−0.0423	−0.13	−0.170**
	[0.102]	[0.083]	[0.066]
Gender	1.102**	0.505	0.746**
	[0.436]	[0.358]	[0.287]
Marriage status	0.756	0.745*	0.662**
	[0.501]	[0.411]	[0.324]
Father is a business owner	0.327	0.432	0.447
	[0.428]	[0.352]	[0.274]
Constant	3.474	5.349***	4.057***
	[2.341]	[1.917]	[1.523]
Number of observations	69	68	73
Adjusted R-square	0.2072	0.1414	0.2516

Standard errors in brackets * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Source: Authors.

alumni of a business college who participated in the courses with their respective matched sample of similar individuals who did not participate in the courses. The findings indicate that Incubation significantly increases the probability of new venture creation with the average treatment effect on the treated for the full sample, management and non-management sample is 0.364, 0.618 and 0.185, respectively. Theory and Competition only affect the non-management sample. The average treatment effect on the treated of the two courses is 0.052 and 0.123. Moreover, the multiple linear regression analysis indicates that Incubation has a positive impact on the new venture's sales revenue, profit before tax and the number of employees, which is the proxy of firm size at 5% significance level. In contrast, the effect of Theory and Competition on new venture performance is not significant.

Contributions of our study are multifold. Firstly, the investigation of objective outcomes of EE in colleges and universities provides new empirical evidence for the proposition that entrepreneurship can be learned. Thus making a positive response to the concerns of policymakers and EE investors. Secondly, the investigation and analysis of the effect of different entrepreneurial courses and the same entrepreneurial course between different majors highlights the significance of 'live-fire drill' in EE. This finding positively responds to the concerns of educational executives regarding the possible result of the commitment of resources to EE. Thirdly, in this study, the potential bias derived from endogeneity is eliminated by employing a post-test design and propensity score matching, which addresses the concern of researchers.

Although the three types of EE courses chosen are also offered in most of China's colleges and universities, care should be given regarding the external validity of this study due to the difference in students' inherent heterogeneity, teaching quality, and the specific context in which alumni start their business among different schools. This study is also constrained by sample size. Due to the small sample size of the entrepreneurs, the employment of PSM to identify the net effect of EE on new ventures' performance cannot be effectively performed, we could only analyze the correlation between the independent and dependent variables by using multi-linear regression.

Despite the deficiency, the conclusions are reliable, and their policy implications are obvious. As was addressed in the Introduction section, this research can provide government and educational investors with new empirical evidence for continuing investment in EE. Further, these findings provide educational executives with a scientific basis for optimizing resource allocation and entrepreneurship curriculum. The findings also highlight the importance of overcoming self-selection bias, the importance of sample size, and the necessity of conducting case studies at the university level to investigate the EE outcome effect, and, provides useful information for further study in this domain.

Notes

1. Department of Higher Education, Ministry of Education of the People's Republic of China, Innovation and Entrepreneurship Education Converges new Impetus in China. http://www.moe.gov.cn/fbh/live/2019/51300/sfcl/201910/t20191010_402406.html
2. Keywords of 'entrepreneurship education', 'financial performance', 'outcomes', 'evaluation', 'impact' and 'effect' were used alone and in combination for searching in both CSSCI indexed Chinese journals and SSCI indexed English journals from 2012. Studies on EE's psychological outcomes have dramatically increased, while studies on objective outcomes are still rare.
3. There are seven studies on the objective outcomes of EE in the review of Rideout and Gray (2013). Two of the seven are actually on students' GPA, finance and sales ability, thus excluded from our research.
4. The two are essentially competitions about a written business plan and a roadshow.
5. Due to space limitations the research instrument is not included.
6. Tencent Education, Employment Report for China's College Students in 2018 https://edu.qq.com/a/20180611/029867.htm
7. Due to space limitations, the estimated value of the propensity score is not included.
8. This study involves two matching methods of one full sample, two sub-samples and three entrepreneurship courses with a total of 18 balance tests. Test results show that after matching, covariate means the differential between the treated and control groups is mostly within 10%, with only a few exceptions that exceed 10%, but less than 15%, which indicates qualified matching. Due to space limitations, the 18 tables of the balance tests are not presented.
9. Accounting is classified as a non-management sample because of its more robust expertise in practice.

Disclosure statement

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Data availability statement

The data that support the findings of this study are available from the corresponding author, [Xianzhou Zhao] or [Chuanyu Peng], upon reasonable request.

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