

DOES OVERCONFIDENCE AFFECT ENTREPRENEURIAL INVESTMENT?

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ABSTRACT

This research examines the affect of overconfidence on the entrepreneurial investment choices of individuals. We argue that individual overconfidence is associated with more aggressive entrepreneurial investment decisions. We show that the propensity of an individual to begin startup activities is positively associated with the individual's level of overconfidence. Furthermore, overconfidence increases the likelihood of a nascent entrepreneur creating an operating business from her startup activity. These results are significant even when controlling for other known characteristics associated with the tendency to undertake entrepreneurial venturing. We investigated decisions related to venture funding and human capital investment in the venture, and investment risk but did not find that overconfidence was significantly related to these choices.

Keywords: expectations, investment, cognitive bias, nascent entrepreneur, overconfidence, venturing.

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I. INTRODUCTION

This research examines the affect of overconfidence on the entrepreneurial investment choices of individuals. Entrepreneurial investment is the allocation of personal or external resources by a founder to his new firm. We study several aspects of entrepreneurial investment choices, including entry decision, financial and human capital commitment, the use of external capital, and investment risk. The entrepreneurial setting is powerful for studying overconfidence for two reasons. First, founders' decisions are reflected in the venture's actions more strongly in new firms than in established firms. Second, the entrepreneurial environment is characterized by high uncertainty, which leads to greater overconfidence.

Overconfidence is a cognitive bias that manifests through excessively positive self-perceptions. An individual can be overconfident with respect to his abilities, knowledge, and accuracy of predictions (Hawyard et al., 2006). Overconfident individuals hold unjustifiably high views of their personal beliefs and abilities (Grinblatt and Keloharju, 2006), which can lead to excessively positive expectations about their endeavors.

Studies have shown overconfidence to be related to several economic choices. Overconfidence has been shown to be associated with greater riskiness of product introductions by managers (Simon and Houghton, 2003a), greater cash-flow sensitivity of corporate investment by CEOs (Malmendier and Tate, 2005a), and more frequent trading activity by individuals (Grinblatt and Keloharju, 2006). In an experimental setting, Camerer and Lovallo (1999) found that overconfident business school students were more likely to enter into skill-based competition.

We utilize the Panel Study of Entrepreneurial Dynamics (PSED), a longitudinal survey of entrepreneurs, to study the affect of overconfidence on entrepreneurial investment. The PSED provides data on entrepreneurial investment and self-reported psychology-based items that we use to measure overconfidence. Accurate measurement of perceptual biases is one of the major issues of applied research on these biases (Puri and Robinson, 2007). The PSED provides more direct measurement than

has been used in previous research focused on perceptual biases and investment, which have generally operationalized overconfidence from external observations, such as personal portfolio decisions of CEOs (Malmendier and Tate 2005a), media perception of CEOs (Malmendier and Tate 2005b), or by simply assuming that entrepreneurs were overconfident (Lowe and Ziedonis, 2006). The PSED sampling allows for the comparison of entrepreneurs to a control group of non-entrepreneurs. Furthermore, the PSED provides measures that allow this study to go beyond the question of how entrepreneurs are different from non-entrepreneurs and investigate how cross-sectional variation amongst entrepreneurs leads to variation in decision-making.

We found that overconfidence does affect entrepreneurial investment decisions. Overconfidence increases the likelihood that an individual will begin pursuing startup activities. Furthermore, overconfident entrepreneurs who are currently pursuing startup activity are more likely to create an operational business from their startup activity. Outside of entry decisions, we did not find overconfidence to be significant to the amount of financial and human capital the entrepreneur invests in the startup or the risk of the entrepreneurial investment.

This study contributes to two areas of research. First, it contributes to the literature that investigates the relationship between psychology and economic choices (Simon and Houghton, 2003; Simon et al., 2003; Puri and Robinson, 2007; Malmendier and Tate 2005a and 2005b). Our findings indicate that entry decisions are affected by overconfidence. Many studies have noted the prevalence of overconfidence amongst existing entrepreneurs, compared to managers (Busenitz and Barney, 1997; Lowe and Ziedonis, 2006). This study suggests that the prevalence of overconfidence in existing entrepreneurs is caused by overconfident individuals self-selecting both to investigate entrepreneurial opportunities through startup activity and then to exploit opportunities by creating operational businesses.

Second, this study contributes to the entrepreneurial literature by investigating several aspects of entrepreneurial investment. Extant empirical research on entrepreneurial investment decisions has focused on the intention to become an entrepreneur (Chen, Greene and Crick, 1998), the decision to start a new

business (Puri and Robinson, 2007; Hurst and Lusardi, 2004; Gentry and Hubbard, 2000; Holtz-Eakin, Joulfaian and Rosen, 1994; Evans and Jovanovic, 1989), and the amount of initial capital investment (Bates, 1997; McCarthy, Schoorman, and Cooper, 1993; Burderl, Preisendorfer and Ziegler, 1992; Cooper, Woo and Dunkelberg 1989). Yet, these are only a few of the many investment choices entrepreneurs face. For example, entrepreneurs can choose their investment of effort and the source of startup funds and the type or risk of the entrepreneurial endeavor. This paper expands on extant research by investigating an extensive scope of investment choices. This study, while finding overconfidence to affect only the entry decisions, is the first to provide evidence on several entrepreneurial investment decisions not found in previous literature.

The following section describes overconfidence. Hypotheses are developed in section three. Section four details the sample, variables used to represent overconfidence and the dependent variables. The findings are provided in section five. A discussion of the implications and limitations of the study is presented in section six. Section seven concludes the study.

II. OVERCONFIDENCE

In extant research, overconfidence has been defined as occurring when individuals overestimate the accuracy of their predictions (Simon and Houghton, 2003), over-value their ability to learn about a project (Gervais, Heaton and Odean, 2005), or have positive optimistic biases about their future prospects (Malmendier and Tate, 2005a; Hayward et al., 2006). Overconfidence has been used to explain why over 50% of the population consider themselves above average, known as the ‘better than average’ effect (Larwood and Whittaker, 1977). Psychological literature has robustly found that individuals generally exhibit overconfidence, in that they overestimate their ability to do well (DeBondt and Thaler, 1995). We define overconfidence as excessive confidence in relation to abilities, knowledge, and beliefs, as in Grinblatt and Keloharju (2006) and Hayward et al. (2006). This is a broader definition than has been used

in other research that focuses on specific aspects of overconfidence (Forbes, 2005; Busenitz and Barney, 1997; Simon, Houghton, and Aquino, 2000; Russo and Schoemaker, 1992).

Measurement of overconfidence has varied between studies. Malmendier and Tate (2005a) infer overconfidence from personal portfolio decisions of CEOs, whereby overconfident CEOs have greater personal exposure to company-specific risk through holding options longer than required or by buying additional company stock. Malmendier and Tate (2005b) operationalize CEO overconfidence from press media portrayals of CEOs, where CEO's are described as confident if more periodical articles refer to the CEO as "confident" or "optimistic" than as "reliable, cautious, conservative, practical, frugal, or steady." Simon and Houghton (2003) measured overconfidence of executives as the difference between the ex-ante certainty of achieving success for product introduction related tasks and the ex-post success in achieving each of these tasks. Lowe and Ziedonis (2006) operationalized differences in overconfidence exhibited in managers through the dichotomy of businesses that were entrepreneurial startups versus established firms, essentially assuming that founders in entrepreneurial startups were more overconfident than those in established firms. Other studies have looked at overconfidence of prediction accuracy. Overconfidence in prediction has been measured by comparing the accuracy of answers to difficult general-knowledge questions to reported confidence levels (Forbes, 2005; Busenitz and Barney, 1997), and by comparing the self-reported confidence interval around numerical answers to the accuracy of the answers (Simon, Houghton, and Aquino, 2000; Russo and Schoemaker, 1992). Overconfidence in prediction occurs when the respondent's confidence in her answers exceeds the accuracy of her answers.

Studies have found that overconfidence is manifested more strongly in some types of decision environments. Uncertain environments tend to exacerbate overconfidence (Hayward et al., 2006), and biased decision-making is exacerbated by uncertainty (Nisbett and Ross, 1980; Chen, Greene and Crick, 1998). The entrepreneurial setting is characterized by many of the environmental factors that increase overconfidence and biased decision-making, especially uncertainty (Shane and Venkataraman, 2000; Knight, 1921; Hambrick and Crozier, 1985; Covin and Slevin, 1989). Consistent with this, research has

found that overconfidence manifests strongly in the entrepreneurial environment. Cooper et al. (1988) found that entrepreneurs display high perceptual bias, placing their odds of success much higher than for similar businesses. Busenitz and Barney (1997) found that entrepreneurs exhibit higher overconfidence in their predictive abilities than managers.

Overconfidence, manifested through biased perceptions, will likely affect the founder's decisions. There is a strong nexus between founder decisions and the new venture's actions. This relationship is stronger in new ventures than in large firms. In new, small ventures, the founder's preferences are directly reflected in decisions. In large firms the impact of an individual's preferences is reduced by the presence of many managers and shareholders in the decision-making process. Furthermore, entrepreneurial ventures often lack formal processes that mediate the influence of managerial bias over firm action (Simon et al., 2003). The combination of high uncertainty and the close relationship between the founder's beliefs and the venture's actions make the entrepreneurial setting powerful for the study of the affect of overconfidence on investment.

Individuals who are overconfident will tend to overestimate the likelihood of achieving success and the extent of success. This effect of overconfidence will be greater in relation to pursuits where success is perceived to be based on factors about which the individual is overconfident, such as his personal abilities, beliefs, and knowledge, than in pursuits where success is perceived to be more exogenous. In entrepreneurship, success is likely to depend more on the abilities and knowledge of one individual (the founder) than in established firms, where many individuals can contribute to the firm's success. Overall, we expect overconfident individuals involved in entrepreneurship to estimate higher expected returns to their entrepreneurial investments than other individuals, and to estimate returns to entrepreneurship higher than returns to other investment options.

III. HYPOTHESES

Shane and Venkataraman (2000) decompose the process of entrepreneurship into two sub-processes: discovery and exploitation. A nascent entrepreneur is an individual who has decided to enter the discovery process by pursuing startup activities in order to investigate an entrepreneurial opportunity. When the nascent entrepreneur creates an operating business from the startup activity, he has begun the exploitation process and can be characterized as an operational entrepreneur.

The existence of overconfidence amongst entrepreneurs could result from self-selection from traditional employment to nascent entrepreneurship, self-selection from nascent to operating entrepreneurship, or both. Cognitive biases that entrepreneurs hold can be at least partly explained by biases that individuals hold beforehand and bring into entrepreneurship (Forbes, 2005). Schumpeter (1934) suggests that entrepreneurs must perceive the values of resources differently from others. It is their perception of a value difference that leads them to believe an entrepreneurial opportunity exists in the first place. Overconfident individuals will tend to perceive themselves as able to extract greater value from entrepreneurial opportunities.

Individuals will pursue startup activity if they perceive the value of the entrepreneurial opportunity as above a threshold. This threshold depends on opportunity costs; with individuals who can earn higher wages from their labor having higher thresholds (Gimeno et al., 1997). In general, an overconfident individual will perceive a given opportunity as more valuable than an individual who is not overconfident. Overconfidence will increase the likelihood that an individual's valuation of an opportunity is above the critical threshold, making an overconfident individual more likely to invest in that opportunity.

We expect overconfident individuals to overvalue returns from activity generally. In uncertain environments, the overconfidence will cause higher overvaluation, due to the greater manifestation of overconfidence caused by uncertainty. This will lead overconfident individuals to overvalue returns from

entrepreneurial opportunities more than they overvalue returns from traditional employment, that are more certain in their payoffs. The difference in overvaluation caused by overconfidence would increase the desirability and likelihood of exploring the entrepreneurial opportunity as a nascent entrepreneur involved in startup activity.

Hypothesis 1: Overconfident individuals are more likely to be nascent entrepreneurs.

While pursuing startup activities, nascent entrepreneurs can learn about their ventures and decide whether to exploit the entrepreneurial opportunity by creating an operating business based on the startup activity. The decision to exploit the opportunity through operation requires that the nascent entrepreneur expects the entrepreneurial profit to be enough to compensate him for the uncertainty premium, the opportunity cost of alternatives, and the lack of liquidity of his financial and human capital investment (Shane and Venkataraman, 2000; Kirzner, 1973; Cassar, 2006).

Nascent entrepreneurs enter the startup phase believing that the value of the entrepreneurial opportunity exceeds the threshold value; otherwise, they would not have decided to initiate nascent venture activity. During the startup phase, the nascent entrepreneur is likely to receive noisy signals about the quality of the opportunity. Overconfident nascent entrepreneurs will tend to rely more on their prior-held beliefs, in which they are confident, than on new, noisy information (Bernardo and Welch, 2001). Further, they believe that they can overcome problems associated with entry, such as the level of competition (Camerer and Lovallo, 1999), and will continue to have positive beliefs even when faced with negative signals (Kahneman and Lovallo, 1993; Bar-Hillel, 1983). Overconfidence causes nascent entrepreneurs to sustain the belief that they can overcome the risks and challenges of entrepreneurship, even as they learn about new risks and challenges during the startup phase. Nascent entrepreneurs who are overconfident will be more likely to maintain the belief that the opportunity is worth acting upon,

making them more likely to begin operating the new venture and exploiting the entrepreneurial opportunity.

Hypothesis 2: Nascent entrepreneurs who are overconfident will be more likely create an operational business from their startup activity.

Financial Capital Investment

We expect overconfident nascent entrepreneurs to believe that they will achieve greater returns to investment opportunities, when evaluating similar opportunities. They may expect that they can extract greater rents from resources than others, causing them to invest more in such resources (Hayward et al., 2006; Bazerman and Samuelson, 1983). Further, overconfident nascent entrepreneurs may perceive lower risk on financial investment in their ventures. This would lead to the perception of excess returns for a given risk level. The expectation of high returns given risk will cause overconfident entrepreneurs to invest more of their personal financial capital in their entrepreneurial ventures. We expect overconfidence to affect both the total value of financial capital and the share of household wealth that the entrepreneur invests in the venture.

Extant research on financial investment in new ventures tends to focus on venture scale (Cooper, Wu and Dunkelberg, 1989) and liquidity constraints of the entrepreneur (Holtz-Eakin, Joulfaian and Rosen, 1994; Hurst and Lusardi, 2004; Evans and Jovanovic, 1989). McCarthy, Schoorman and Cooper (1993) studied the relationship between overconfidence and the level of investment in new firms, finding that overconfidence was a strong predictor of additional capital investment. Others have shown that managers of established firms who have positive expectation biases believe that outsiders undervalue their firms' securities (Forbes, 2004; Malmendier and Tate, 2005a; Hayward et al., 2006; Heaton, 2002). Overconfident investors tend to put more validity on their personal valuations and rely less on market valuations (Grinblatt and Keloharju, 2006).

Entrepreneurs who are overconfident will tend to display similar behavior. They perceive their ventures' success as more of a sure thing than outsiders, who perceive it as more risky and less certain. The difference in risk perception will lead to variation in venture valuation between overconfident entrepreneurs and outsiders. Overconfident entrepreneurs will be unwilling to dilute ownership of their ventures at the prices offered by potential financiers. They will tend to believe that potential outside investors undervalue their ventures, making overconfident entrepreneurs less likely to use outside sources of money to fund investments. Furthermore, dilution of ownership may imply dilution of decision-making power away from the entrepreneur. Because overconfidence manifests with respect to personal decisions, dilution of decision-making power will be anathema to an overconfident entrepreneur. Overconfidence causes entrepreneurs to overvalue their personal decisions, in effect underestimating the value of having others involved in the decision-making process. This effect will lead the entrepreneur to further concentrate personal ownership of the venture and seek less financing from outsiders.

Hypothesis 3: Overconfident entrepreneurs will invest more of their personal financial capital in their ventures.

Hypothesis 4: Overconfident entrepreneurs will use less external financial capital.

Human Capital Investment

Entrepreneurial investment is not limited to financial capital. Entrepreneurs must also decide how much of their personal human capital to devote to the venture. Investment of human capital is the exertion of effort by the entrepreneur on the venture. The opportunity costs of investing human capital in the venture include lost wages and leisure. For an individual to invest human capital in a new venture, she must perceive the returns to outweigh the value of time spent in traditional employment or leisure. We predict overconfident entrepreneurs to invest more time in their ventures for two reasons. First, entrepreneurs must expect the venture to eventually achieve success, so that the hours invested in startup

activity will not be in vain. Overconfident individuals overestimate the likelihood that their ventures will achieve success (Cooper et al., 1988), and thus will be more inclined to invest time in their ventures. Second, the value of time spent earning wages in traditional employment is less uncertain than the value of time spent pursuing entrepreneurial opportunities. Thus the increase in value perception caused by overconfidence will be greater for human capital investment in entrepreneurial opportunities than for human capital investment in traditional employment. This will tend to cause overconfident individuals to perceive a greater difference between the return from human capital investment in entrepreneurship and the return from traditional employment. Thus, we expect that overconfidence will lead to greater investment of human capital in entrepreneurial ventures.

Hypothesis 5: Overconfident entrepreneurs will invest more of their human capital in their ventures.

Investment Risk

Overconfident individuals, because they perceive their abilities and knowledge more highly, will have a higher expectation of reaching successful outcomes that are perceived to depend on their abilities and knowledge. Overconfident individuals may believe that their abilities and knowledge will allow them to overcome the odds of failure, which may lead to a preference for riskier behavior (Camerer and Lovallo, 1999). Simon and Houghton (2003) suggest that overconfident managers are more likely to pursue risky behavior. The entrepreneurial environment may exacerbate the overconfidence-risk relationship, as new ventures lack formal procedures that mediate the relationship between potentially biased managerial perceptions and venture action (Simon et al., 2003).

We expect that overconfidence will lead to a lower perception of investment risk. This will lead overconfident nascent entrepreneurs to involve themselves in riskier ventures.

Hypothesis 7: Overconfident nascent entrepreneurs will enter more risky industries.

IV. METHOD

Sample

The Panel Study of Entrepreneurial Dynamics (PSED) was utilized to investigate how overconfidence affects entrepreneurial investment decisions. The dataset is unique in that it obtains responses from nascent entrepreneurs who are concurrently in the startup phase of a new venture (Gartner et al., 2004). This dataset allows research based on it to overcome issues associated with survivorship biases, which can be problematic when only entrepreneurs who have already established businesses are analyzed.

The PSED sample was identified through a random digit dialing methodology, with over 64,000 households surveyed. A sample of nascent entrepreneurs selected from this process was subsequently phone interviewed, and a further sub-sample sent a mail questionnaire. To be identified as a nascent entrepreneur and included in this study a respondent had to answer “yes” and then “no” to the following two questions: “1) Are you, along or with others, now trying to start a new business?; 2) Are you, along or with others, now starting a new business or new venture for your employer? An effort that is a part of your job assignment?” These criteria ensure that the respondent rather than an employer makes the entrepreneurial decisions. In addition, the respondent had to: 1) expect to have at least some ownership in the new firm; 2) be actively trying to start the new firm in the past 12 months; and 3) be currently involved in the startup phase of the venture. 830 respondents qualified as nascent entrepreneurs in the first round of the PSED. To allow for comparison between the nascent entrepreneurs and individuals not involved in startup activity, a control sample of 431 individuals were also interviewed by telephone and sent questionnaires.

The PSED followed up with subsequent phases, interviewing the entrepreneurs approximately 12, 24, and 36 months after the initial interview by phone and with written questionnaires. Many of the respondents did not answer some or all questions in every round of the PSED. Entrepreneurs who did not respond in subsequent phases of the PSED were more likely to be younger, male, married, more educated, and have a higher household income, household wealth, and risk preference. The number of respondents for different questions varies substantially, as not every respondent answered every question.

Overconfidence Variable

For this study the measure of overconfidence is obtained from self-reported questions derived from psychology. To construct a measure of overconfidence, we first developed a measure of confidence by taking the average of responses to three statements anchored on five-point likert scales. The statements were: “In your work, how do you feel about the following activities? 1) That you will be successful in completing new tasks; 2) That you can reach goals you set for yourself; 3) That you will be successful when confronting obstacles.” Responses ranged from (1) “Not at all confident” to (5) “Very confident”. Of the 1261 respondents (nascent entrepreneurs and control group), 887 answered all three confidence questions. The mean (median) of the confidence responses was 4.15 (4.33), with over 25% of the respondents being “Very confident” on all confidence statements. This is consistent with previous research that individuals generally have high confidence (Simon and Houghton, 2003). Factor analysis was conducted on the three confidence items. The three responses loaded onto one factor that explained 80.8% of the variance, with factor loadings above 0.80 on each variable. The Cronbach Alpha of these responses was 0.88.

As in Grinblatt and Keloharju (2006), we regressed our confidence measure on objective variables that control for knowledge and ability. These variables were: respondent age, household wealth, household income, a series of education dummies, years of work experience in the startup’s industry (years of work experience for individuals in the control group) and years of managerial experience. The

residuals of this regression were used as the overconfidence variable, whereby a positive residual corresponded to the subject being overconfident.

Controls

Previous research has documented several variables that should be controlled for when investigating various entrepreneurial investment choices. For example, the decision to be an entrepreneur may be associated with human capital (education, work experience, previous startup experience, household income), wealth (including receipt of inheritance), demographics (age, race, marital status and gender), and risk preference (Davidsson and Honig, 2003; Parker and Belghitar 2006; Hurst and Lusardi, 2004; Holtz-Eakin, Joulfaian and Rosen, 1994; Zhao, Siebert and Hills 2005). Consequently, we control for human capital, wealth, risk preference, and other demographic characteristics of the entrepreneur.

Specifically, control variables used in this study are: respondent age, gender, industry experience, managerial experience, entrepreneurial experience, the respondent's risk preference, household wealth, household income, and the stage of development of the product or service. Industry experience is given as the log of the number of years the respondent has worked full-time in the same industry as the startup (or in the industry of primary employment for individuals in the control group). Managerial experience is given as log of the number of years the respondent has worked as a manager. Entrepreneurial experience is given as the number of businesses the respondent has helped to start. Household income is a continuous variable self-reported by respondents. We use the household wealth measure developed by Kim et al. (2004) and used previously in Cassar (2006). We censor the household wealth variable at zero to avoid negative values. Logs of household wealth and household income are used in order to reduce skewness. Risk preference is operationalized by the average of three questions whose answers are scaled to the interval [0,1]: 1) "Consider two types of new businesses. Assuming you are the sole owner, which situation would you prefer?: (0) - A business that would provide a good living, but with little risk of failure, and little likelihood of making you a millionaire. (1) - A business that was much more likely to

make you a millionaire but had a much higher chance of going bankrupt.”; 2) “If you could obtain more information to make a choice between businesses (0) and (1), how important would the following be? The chances of going bankrupt for both (0) and (1)”; 3) “The following statements can be used to describe most people. How accurately would they describe you? I enjoy the challenge of situations that many consider ‘risky’”. The stage of development is given by, “At what stage of development is the product or service this (start-up/new firm) will be selling: 5) Completed and ready for sale or delivery; 4) A prototype or procedure has been tested with customers; 3) A model or procedure is being developed; or 2) still in the idea stage? [1) No work has been done on a product or service]”

Model

The dependent variables were modeled using logistic regressions for binary dependent variables and ordinary least squares (OLS) regressions for continuous variables. Logistic models follow the form:

$$\text{Log}[p/(1-p)] = a + b \cdot \text{overconfidence} + c \cdot X + e,$$

where p is the probability of the dependent variable being equal to one. The OLS regressions take the form,

$$y = a + b \cdot \text{overconfidence} + c \cdot X + e,$$

where y is the dependent variable. In both logistic and OLS regressions, a is the intercept, b is the coefficient on the overconfidence variable, c is a vector of coefficients on X , a vector of control variables, and e is an error term.

Dependent Variables

The PSED gathered data from a control group and a group identified in the screening interview as nascent entrepreneurs. *NE* takes a value of 1 for nascent entrepreneurs and 0 for those in the control group. Entrepreneurs who had founded operating businesses were identified by the question, “How would you describe the current status of this start-up effort? Is it now an operating business, still in an

active start-up phase, still a start-up but currently inactive, no longer being worked on by anyone, or something else?” This question was asked in each subsequent round of the PSED. *OE* takes a value of 1 for nascent entrepreneurs who reported having an operating business in any subsequent phase of the PSED, and 0 otherwise. For respondents who responded only during the first phase of the PSED, *OE* was coded missing.

We use the log of the response to “How much of your own money, in total dollars, have you now put into the business?” at the time of initial questionnaire to obtain a measure of the personal financial commitment (*Personal Funds*). We also developed a measure of the share of wealth a respondent has invested in the venture from the total amount of money invested by the individual divided by the individual’s household wealth (*Wealth Share*).

In the second phase of PSED phone interviews, respondents reported how much money their ventures had received from various sources. *External Funds* was measured as the log of the total amount of funds provided to the venture from banks, private investors, government agencies, suppliers and subcontractors.

We measured the rate of human capital investment by dividing the difference in the total hours worked on the venture as of the first PSED phase by the number of months between the first PSED phase and the month when the respondent began thinking about the venture (*Hours Per Month*).

To measure the riskiness of entrepreneurial investment, we used measures of industry riskiness developed by Bitler et al. (2005) and Li et al. (2003). The Bitler et al. (2005) measure, *Risk A*, takes riskiness as the absolute value of the residuals of a regression of the profit-to-equity ratios of small businesses on their observable characteristics. We took the median of these values across 2-digit SIC codes to obtain an industry riskiness measure. The Li et al. (2003) measure, *Risk B*, is the median variance for each 3-digit industry of a market model regression of firm returns. A higher value of *Risk B* indicates that individual firm returns in this industry move less synchronously.

All variables were measured during the first phase of the PSED unless otherwise noted. All responses were elicited during phone interviews, except overconfidence and risk preference, which were taken from mail questionnaires.

V. RESULTS

Table 1 presents the descriptive statistics and correlations of the study variables. Pearson correlation coefficients are given, as well as the number of responses for each pair of questions. Not all respondents answered every question in the PSED, which leads to variation in the number of responses for each variable. Correlations were not calculated between *NE* and several variables because these were answered only by individuals in the nascent entrepreneur group and not asked to the control group.

Overconfidence is significantly correlated with several of the decision variables in the direction hypothesized. It has a positive correlation with *NE*, *OE*, and *Wealth Share*, and a negative correlation with *External Funds*. Overconfidence is not significantly correlated with *Personal Funds* or *Hours per Month*. This suggests preliminarily that overconfidence affects decisions related to the four former variables, as predicted, but does not affect the latter two variables. More overconfident individuals are more likely to have a higher risk preference ($p < 0.01$). 44% of nascent entrepreneurs in our sample eventually found operating businesses based on their startup activity. This is consistent with the values of 33%-48% reported by Parker and Belghitar (2006).

Insert Table 1 about here

The remainder of this section reports the results of the tests of our models. All models were tested using 2-tailed t-tests. The tests for entry decisions are reported in Table 2. Column 1 reports the

coefficients for the logistic model of being a nascent entrepreneur (*NE*). The coefficient on overconfidence was positive and significant ($B = 0.22, p < 0.10$). A change in overconfidence from the 25th to the 75th percentile increases the likelihood of being a nascent entrepreneur by 4.5% (when all other variables are at their means). This model gives support to Hypothesis 1, that overconfident individuals are more likely to be nascent entrepreneurs. Several of the controls were also found significant to the decision to become an NE, including industry experience ($p < 0.01$), managerial experience ($p < 0.01$), and risk preference ($p < 0.05$). The overall model was found to be statistically significant ($p < 0.01$), and explains approximately 19% of the variance in the decision to become a nascent entrepreneur.

Column 2 reports the coefficients for the logistic model of becoming an operational entrepreneur (*OE*). The coefficient on overconfidence is positive and significant ($B = 0.26, p < 0.10$). This evidence supports Hypothesis 2, suggesting that overconfident NE's are more likely to found operational businesses based on their startup activity. A change in overconfidence from the 25th to the 75th percentile increases the likelihood of being an operational entrepreneur by 6.5% (when all other variables are at their means). Industry experience ($p < 0.05$), household wealth ($p < 0.01$), and the stage of product development ($p < 0.01$) were also found to be significant in the *OE* model. These results are consistent with research that has found wealth to be significant to the entry decision (Hurst and Lusardi, 2004; Parker and Belghitar, 2006). The overall logistic model is significant ($p < 0.01$) and explains approximately 9.5% of the variance. The explanatory power for the *Nascent Entrepreneur* and *Operating Business* models is consistent with extant empirical research that has investigated entrepreneurial entry (Hurst and Lusardi, 2004; Parker and Belghitar, 2006).

Insert Table 2 about here

Column 3 displays the coefficients from the OLS regression model of *Personal Funds*. Overconfidence was not significant in the model of the amount of money the NE has put into her startup. Therefore, Hypothesis 3 is not supported. Industry experience ($p < 0.01$), and risk preference ($p < 0.05$) were significant in the model and all had positive coefficients on *Personal Funds*. Overall, the model was significant ($p < 0.01$) and explained 14.5% of the variance of this investment decision.

The coefficients from the OLS regression model of *Wealth Share* are reported in column 4. As in the model of *Personal Funds*, the coefficient on overconfidence is not significant, which fails to support Hypothesis 3. Our models of personal financial capital variables suggest that overconfidence does not cause entrepreneurs to invest more of their own money in their ventures, either in absolute terms or as a percentage of their total wealth.

Table 3 presents the tests for financial and human capital investment decisions. Column 1 presents the coefficients from the OLS regression model of *External Funds*. The coefficient on overconfidence is negative and significant ($p < 0.05$). This supports hypothesis 4, that overconfident entrepreneurs utilize less external financial capital. This finding is consistent with results from studies examining how overconfidence affects investment decisions in established firms (Malmendier and Tate, 2005a & 2005b; Heaton, 2002). Overall, the model of *External Funds* was not significant ($p > 0.10$) and explained approximately 5% of the variance in *External Funds*. The insignificance of the model may suggest problems of misspecification.

Column 2, 3 and 4 present the coefficients from the OLS regression models of *Hours per Month*, *Risk A* and *Risk B*, respectively. The coefficient on overconfidence is not significant in any of the three models. Thus, hypotheses 5 and 6 are not supported.

Insert Table 3 about here

Several variables, including a series of dummies representing education levels were considered; however, inclusion of these variables resulted in harmful multicollinearity with condition indexes greater than 100 (Belsey, Kuh, and Welsch 1980), and variance inflation factors (VIFs) greater than 5. Consequently, I report the results without these variables. The remaining variables in the models had VIFs < 1.5.

VI. DISCUSSION

This study observes that overconfidence affects some entrepreneurial investment decisions. Specifically, investment decisions related to entrepreneurial entry and external sources of financial capital are influenced by overconfidence. The entry result is consistent with the literature that has found that entrepreneurs tend to be overconfident and are more overconfident than managers of established firms. We extended the understanding of overconfidence in entrepreneurship by testing two separate decisions involved in the founding of an entrepreneurial business: the decision to begin startup activity and the decision to begin business operations. We found that overconfidence influences both decisions. Overconfident individuals are more likely to undertake nascent activities to investigate entrepreneurial opportunities. Furthermore, amongst nascent entrepreneurs, the more overconfident ones are more likely to begin operating their ventures as businesses. This is consistent with the arguments for hypotheses one and two, that overconfident nascent entrepreneurs are more likely to have and maintain a positive perception of their entrepreneurial opportunities from entering the startup phase to the reaching operational phase.

Overconfidence affects the amount of outside equity financing. In the established firm setting, Malmendier and Tate (2005a) found that overconfidence increased investment sensitivity to cash flows. They argued that this was caused by overconfident CEOs who were averse to issuing equity financing because of a belief that the market undervalued their securities. We expected overconfidence to cause

similar behavior amongst entrepreneurs. We found that an entrepreneur's degree of overconfidence tends to be decrease the amount of external funding her venture utilizes.

Overconfidence was not found to influence how much financial or human capital the founder invests in the venture. We predicted that overconfident entrepreneurs would overestimate the return to investment in their ventures relative to other investment options. On the other hand, overconfident entrepreneurs may underestimate the resource endowments their ventures require (Hayward et al., 2006). Excessive confidence in personal abilities may lead entrepreneurs to believe they can overcome obstacles and achieve success with less money, which would cause overconfident entrepreneurs to invest less money, *ceteris paribus*. We cannot conclude which effect of overconfidence is dominant from our regression, or if either effect exist.

Overconfidence was not found to be related to the amount of human capital entrepreneurs invest in the startup. The arguments for human capital investment are similar to the arguments for financial capital, focusing on expected returns and investment required to pursue the opportunity. Overall, the findings suggest that overconfidence affects some, but not all entrepreneurial investment decisions.

We did not find overconfidence to be related to the riskiness of entrepreneurial investment. We measured riskiness by industry, whereby industries with greater variance in returns or returns that move less synchronously are riskier. The link between overconfidence and our risk measure is potentially weak because overconfidence may not have a strong effect on industry choice. For example, an individual who is trained as carpenter, should he decide to become an entrepreneur, will probably start a business in the carpentry industry regardless of his level of overconfidence. *Risk Preference* is not significant in the models of investment risk, which further suggests that non-industry measures of risk may be more fruitful avenues to explore because the entrepreneur's industry choice is not strongly affected by the riskiness of industry returns.

VII. CONCLUSION

This study examines how overconfidence affects entrepreneurial investment. We used the PSED to examine several dimensions of entrepreneurial investment, including entry decisions, financial and human capital allocation, the seeking of outside funding, and the risk associated with the venture. By doing so, we have expanded the range of entrepreneurial investment choices that have previously been examined.

This study utilized a measure of overconfidence based on responses to self-perception items grounded in psychology. Measurement of overconfidence has been one of the primary problems in research on the economic effects of overconfidence (Malmendier and Tate, 2005b). Our measure is more direct than measures used by other studies and allows for investigation of cross-sectional variation in overconfidence amongst nascent entrepreneurs.

We found that overconfidence affected entrepreneurial investment decisions related to entrepreneurial entry and utilization of external sources of funding. Overconfident individuals are more likely to initiate startup activity, and overconfident nascent entrepreneurs are more likely to found operational businesses based on their startup activity. Overconfident entrepreneurs tend to use less external funding in their ventures. However, overconfidence was not found to affect the amount of money or time a nascent entrepreneur invested, or the riskiness of entrepreneurial investment.

Our findings contribute by expanding the understanding of how psychological factors affect economic decisions. We also contribute to the understanding of a wide range of investment decisions faced by entrepreneurs. Our findings are useful to individuals who are considering investing in entrepreneurial opportunities, as we show that the entrepreneur's decisions related to venturing activity are affected by overconfidence.

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Table I: Descriptive statistics and correlations

			Pearson Correlation Coefficients (Bold: $p < 0.05$)							
			Number of Observations							
	Mean	S.E.	1	2	3	4	5	6	7	8
1 Overconfidence	0.00	0.80	1.00 679							
2 NE	0.66	0.47	0.07 679	1.00 1261						
3 OE	0.44	0.50	0.10 355		1.00 606					
4 Pers. Funds	7.84	1.58	0.12 198		0.32 252	1.00 343				
5 Wealth Share	0.11	0.20	-0.03 206		0.03 226	0.34 277	1.00 304			
6 Ext. Funds	2.39	4.52	-0.19 103			0.29 59	0.16 51	1.00 162		
7 Hours Per Month	46.57	84.55	0.10 151		0.03 187	0.04 221	0.02 204	0.29 44	1.00 261	
8 Risk A	0.84	0.20	-0.02 396	-0.04 767	0.12 560	-0.04 321	-0.02 284	0.07 152	0.00 246	1.00 777
9 Risk B	0.03	0.01	-0.10 276	-0.12 525	-0.04 380	-0.15 218	-0.10 199	-0.15 101	0.04 168	0.14 513
10 Age	40.00	12.19	0.00 679	-0.03 1221	0.07 587	0.15 340	-0.14 299	-0.13 154	-0.02 259	-0.10 734
11 Female	0.51	0.50	-0.06 679	-0.07 1258	0.00 605	-0.09 343	-0.19 304	-0.10 161	-0.01 261	-0.07 765
12 Married	0.52	0.50	0.03 678	0.07 1243	0.10 599	-0.02 337	-0.15 303	-0.01 160	0.00 253	0.03 750
13 Industry Exp.	1.92	1.15	0.00 679	-0.32 1255	0.15 603	0.26 343	-0.02 303	-0.17 160	-0.16 260	0.04 763
14 Mgr. Exp.	1.72	1.05	0.00 679	0.13 1213	0.08 588	0.21 332	-0.02 299	-0.08 158	0.04 252	0.00 735
15 Bus. Starts	1.12	2.93	0.02 676	-0.02 1252	-0.03 602	0.10 341	0.01 303	-0.18 159	0.12 260	-0.02 762
16 Risk Pref	0.31	0.21	0.14 665	0.07 878	-0.01 445	0.22 248	0.02 224	0.04 126	0.07 185	0.03 507
17 HH Income	10.61	1.04	0.00 679	0.10 1120	0.14 551	0.07 312	-0.16 287	-0.02 149	0.05 235	0.03 686
18 HH Wealth	11.14	1.66	0.00 679	0.07 1056	0.14 528	0.12 292	-0.50 304	-0.05 140	0.07 223	-0.03 647
19 Prod. Dev.	3.88	1.15	0.04 423		0.22 592	0.08 339	0.06 300	-0.04 159	0.14 258	-0.03 748

Table I: Descriptive statistics and correlations, continued

	9	10	11	12	13	14	15	16	17	18	19
9 Risk B	1.00 616										
10 Age	-0.10 505	1.00 1221									
11 Female	-0.04 522	0.05 1221	1.00 1258								
12 Married	-0.02 518	0.15 1204	-0.02 1240	1.00 1243							
13 Industry Exp.	0.00 521	0.36 1219	-0.05 1255	0.01 1237	1.00 1255						
14 Mgr. Exp.	-0.06 510	0.45 1176	-0.10 1210	0.19 1209	0.24 1207	1.00 1213					
15 Bus. Starts	-0.02 520	0.10 1216	-0.12 1252	0.00 1234	0.12 1251	0.20 1204	1.00 1252				
16 Risk Pref.	-0.01 342	-0.03 861	-0.22 877	-0.06 876	0.00 877	0.08 853	0.11 873	1.00 878			
17 HH Income	0.07 476	-0.01 1088	-0.08 1118	0.26 1118	0.04 1115	0.14 1096	0.09 1112	0.05 804	1.00 1120		
18 HH Wealth	-0.01 454	0.23 1028	-0.06 1056	0.23 1054	0.12 1053	0.27 1028	0.11 1051	0.03 750	0.42 977	1.00 1056	
19 Prod. Dev.	0.00 504	0.11 777	0.01 811	0.16 796	0.01 809	0.09 781	0.01 808	0.01 542	0.08 729	0.09 690	1.00 813

Table II: Entry and Personal Financial Capital Models

	Nascent Entrepreneur		Operational Business		Personal Funds		Wealth Share	
	<i>Coefficient</i>	<i>S.E.</i>	<i>Coefficient</i>	<i>S.E.</i>	<i>Coefficient</i>	<i>S.E.</i>	<i>Coefficient</i>	<i>S.E.</i>
Intercept	0.159	1.283	-6.834 ***	1.806	4.430 ***	1.181	0.358	0.171
Overconfidence	0.221 *	0.117	0.261 *	0.155	0.131	0.139	-0.012	0.017
Age	0.012	0.010	-0.006	0.013	0.007	0.012	-0.003	0.001
Female	-0.035	0.191	0.174	0.240	-0.142	0.224	-0.047 *	0.028
Married	0.194	0.195	0.067	0.257	-0.242	0.228	-0.055 *	0.029
Industry Exp.	-1.115 ***	0.123	0.242 **	0.095	0.275 ***	0.090	0.007	0.012
Mgr. Exp.	0.435 ***	0.105	0.065	0.132	0.166	0.122	0.017	0.016
Bus. Starts	-0.005	0.043	-0.050	0.059	0.053	0.051	0.002	0.006
Risk Pref.	0.968 **	0.471	-0.335	0.568	1.306 **	0.513	0.001	0.066
HH Income	0.075	0.132	0.213	0.166	0.079	0.091	-0.018	0.014
HH Wealth	0.036	0.069	0.239 ***	0.091	0.058	0.080		
Prod. Dev.			0.375 ***	0.108	0.130	0.099	0.019	0.012
-2LL	706 ***		431 ***		3.92 ***		1.48	
F-stat								
R ²	0.187		0.094		0.144		0.024	
n	661		334		192		200	

* Significant at 0.1; ** Significant at 0.05; *** Significant at 0.01

Table III: External Funding, Human Capital, and Risk Models

	External Funds		Hours/month		Risk A		Risk B	
	<i>Coefficient</i>	<i>S.E.</i>	<i>Coefficient</i>	<i>S.E.</i>	<i>Coefficient</i>	<i>S.E.</i>	<i>Coefficient</i>	<i>S.E.</i>
Intercept	13.058	8.821	-1.583	59.139	0.892 ***	0.109	0.0350 ***	0.0086
Overconfidence	-1.472 **	0.684	6.840	5.559	-0.003	0.010	-0.0014	0.0010
Age	-0.069	0.047	-1.313 **	0.545	-0.003 ***	0.001	-0.0002 ***	0.0001
Female	-0.569	0.923	-1.156	9.747	-0.006	0.017	-0.0025	0.0016
Married	0.009	1.074	0.285	10.349	0.011	0.017	-0.0004	0.0017
Industry Exp.	-0.273	0.392	-2.312	4.121	0.015 **	0.007	0.0007	0.0006
Mgr. Exp.	-0.094	0.494	5.331	5.565	0.009	0.009	0.0003	0.0009
Bus. Starts	-0.600 *	0.321	6.508 ***	2.160	-0.003	0.004	0.0000	0.0004
Risk Pref.	2.262	2.116	4.135	21.860	0.000	0.040	-0.0032	0.0037
HH Income	-0.588	0.862	1.727	4.573	-0.001	0.011	0.0006	0.0007
HH Wealth	0.163	0.380	3.993	3.257	0.003	0.007	0.0001	0.0006
Prod. Dev.	-0.485	0.466	5.441	4.161				
F-stat	1.45		2.12 **		1.52		1.93 **	
R ²	0.048		0.079		0.013		0.033	
n	100		145		390		271	

* Significant at 0.1; ** Significant at 0.05; *** Significant at 0.01