2012

Four essays on risk preferences, entrepreneurship, earnings, occupations, and gender

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Four essays on risk preferences, entrepreneurship, earnings, occupations, and gender

by

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A dissertation submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Economics

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2012

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CHAPTER 1. GENERAL INTRODUCTION

The theory of economic decision under uncertainty implies that individual risk aversion plays a role in a variety of contexts that are critical for understanding individual behavior. According to theory, an individual's risk aversion will influence any economic decision that involve uncertain outcomes such as occupational choice, time allocation between work and leisure, borrowing and lending, portfolio allocation, human capital investments, and business investments. The first two chapters of this dissertation explore the role of measured risk aversion in a variety of labor market settings. Because the theory typically presumes that individuals have time-invariant risk attitudes, the third chapter discusses the stability of measured risk preferences over time. The fourth chapter focuses on the role of entrepreneurial ability in the decision to become a nonprofit entrepreneur.

On average, women are less likely to become self-employed, earn less, and work fewer hours than men. It is also widely reported that women are more risk averse than men. While a vast literature has investigated the extent to which these gaps can be explained by differences in human capital or noncognitive skills, the link between gender differences in risk aversion and gender gaps in labor market outcomes has not been established empirically. The first chapter examines whether gender differences in risk aversion explain the observed gender gaps in entrepreneurship, earnings, and hours worked

Pratt (1964) defines a risk premium as the difference between the expected return and the certain equivalent return. The higher required risk premium makes it less likely that more risk averse agents will become an entrepreneur. However, more risk averse individuals who nevertheless choose entrepreneurship should invest in venture with greater expected return. Standard theoretical models of occupational choice under uncertainty imply a positive correlation between an individual's degree of risk aversion and the expected return from an entrepreneurial venture at the time of entry. Because the expected return is the risk neutral equivalent value, a higher expected return implies a higher survival probability. Therefore, conditional on having entered entrepreneurship, more risk averse entrepreneurs should survive more frequently than their less risk averse counterparts. Accordingly, the second chapter examines how measured risk aversion affects the success of entrepreneurial ventures.

The theory of economic decision under uncertainty typically presumes that individuals have time-invariant risk preferences. However, a series of empirical studies have raised doubts about the validity of the presumed stable risk preferences. While those empirical studies show apparent instability of measured risk preferences, they could not establish a systematic pattern for the extent to which risk preferences change over time due partly to the relatively short time spans and few observations. The third chapter uses a large longitudinal data set to explore the long-term stability of measured risk preferences over time. It also identifies regularities on how risk attitudes change in response to individual circumstances.

The fourth chapter focuses on nonprofit entrepreneurship. Incentives for starting a for-profit venture involve maximizing profits, while incentives for nonprofit startups are less clear because the objective is not tied to maximizing profits. Accordingly, little attention has been paid to the role of entrepreneurial ability in the decision to become a nonprofit entrepreneur. In Lazear (2005)'s model of entrepreneurship, individuals with more diverse academic and occupational training are more likely to become entrepreneurs whereas more narrowly trained individuals become employees. Extending Lazear's model, this chapter shows in theory that diverse skills should have a positive effect on the choice of both nonprofit and for-profit start-ups over the alternative of working for someone else. Accordingly, the fourth chapter examines whether Lazear's model can also explain which individuals become nonprofit entrepreneurs.

CHAPTER 2. DO GENDER DIFFERENCES IN RISK AVERSION EXPLAIN GENDER DIFFERENCES IN LABOR SUPPLY, EARNINGS, OR OCCUPATIONAL CHOICE?

1. Introduction

On average, women are less likely to become self-employed, earn less, and work fewer hours than men. While a vast literature has investigated the extent to which these gaps can be explained by differences in human capital, a more recent effort has found that noncognitive skills such as emotional stability, conscientiousness and aggression, or antagonism can explain some of the pay differences between men and women (Mueller and Plug 2006).

Numerous studies have found that women are more risk averse than men (e.g., Barsky, Juster, Kimball, and Shapiro 1997; Hartog, Ferrer-i-Carbonell, and Jonker 2002; Eckel and Grossman 2002; Borghans, Golsteyn, Heckman, and Meijers 2009; Croson and Gneezy 2009). Recent experimental studies discovered that women do not perform as well as men in competitive environments (Gneezy, Niederle, and Rustichini 2003; Niederle and Vesterlund 2007; Croson and Gneezy 2009). One might presume that gender differences in labor market outcomes would be partially explained by such differences as well.

In fact, risk preferences are commonly found to have a significant role in determining entry into self-employment for men (Van Praag and Cramer 2001; Hartog et al. 2002; Cramer, Hartog, Jonker, and Van Praag 2002; Ekelud, Johansson, Jarvelin, and Lichtermann 2005; Kan and Tsai 2006; Ahn 2009). Bonin, Dohmen, Falk, Huffman, and Sunde (2007) find that less risk-averse individuals select occupations with higher wages and higher variation in wages. Hence, it is tempting to presume that women's greater aversion to risk and competition explains women's lower wages and lower rate of entrepreneurship, as suggested by Croson and Gneezy (2009). However, that link has not yet been established empirically. To date, most studies of labor market outcomes tied to risk preferences have relied either on cross sectional data sets of men only or of pooled samples that do not estimate separate effects of risk preferences across genders.

The exception is a study of the gender wage gap in Australia by Le, Miller, Slutske, and Martin (2010) which found that favorable attitudes toward financial risk raise earnings for both men and women, but gender differences in risk attitudes explain only a small part of the gender pay gap. To our knowledge, no previous study has investigated the extent to which risk attitudes explain gender gaps in occupational choice or labor supply. We attempt to fill the hole in the literature. Therefore, we examine the role of risk aversion in explaining observed gender gaps in entrepreneurship, earnings, and hours worked in the National Longitudinal Surveys of Youth 1979.

Consistent with the earlier studies, we find that less risk averse men are more likely to enter self-employment. However, we find no significant effect of risk attitudes on women's entrepreneurship decision. The role of risk attitudes in earnings also differs by gender across employment type. In self-employment, less risk aversion is associated with lower male earnings, but risk aversion has no effect on female earnings. In paid-employment, less risk aversion lowers male wage as it does in self-employment. On the contrary, decreasing rates of risk aversion raise female wage, consistent with theoretical effects of risk attitudes on labor earnings, but the effects are of modest magnitude. Finally, we find no relationship between risk aversion and hours of labor for both men and women. Consequently, a standard decomposition shows that gender differences in risk attitudes explain only a small fraction of the gender gap in self-employment. Similarly, those differences in risk aversion between men and women account for only a trivial portion of the gender gap in earnings and hours worked.

2. Conceptual Framework*: Choosing an Occupation, Earnings, and Hours of Labor*

This section shows that in theory, risk attitudes should affect individual decisions regarding labor force entry, occupation and earnings conditional on entry, and hours of work. Consequently, differences in risk attitudes between men and women potentially could explain some of the gender differences in these choices.

Individuals are assumed to choose one of three employment types: self-employment, paid employment, or being out of labor force so as to maximize expected utility. Utility depends on expected pecuniary returns from market work and utility from nonmarket work or leisure. Utility is concave in earnings so that it can reflect an individual's risk aversion. Individuals form their beliefs of future earnings based on their human capital which contributes to his or her productivity at home or on the job. The reduced form utility function from an individual *i* choosing an employment type *j* is given by

$$U_{ij} = F(e_{ij}, y_{ij}, \mu_{iL}, \theta_i) \tag{1}$$

$$y_{ij} = f(X_{mi}) \tag{2}$$

$$\mu_{iL} = f(X_{mi}, X_{hi}) \tag{3}$$

where e_{ij} is work effort in *j* occupation (i.e., fraction of time spent in *j*); y_{ij} denotes expected future earnings in *j* which is a function of X_{mi} : the human capital that affects ability in the market; μ_{iL} is known utility from nonmarket work which is determined by both X_{mi} and factors that influence productivity in home production, X_{hi} ; and θ_i denotes a measure of *i*'s risk aversion.

Following Barsky et al. (1997) and Kimball, Sahm, and Shapiro (2008), we assume that individuals have constant relative risk aversion (CRRA). The associated utility function from employment type *j* is given by

$$U_{ij} = e_{ij}\frac{(y_{ij})^{1-\theta_i}}{1-\theta_i} + (1-e_{ij})\mu_{iL} + \varepsilon_{ij}\,,\ \theta \neq 1 \qquad (4)$$

where $\theta_i = \frac{-y_{ij}U''(y_{ij})}{U'(y_{ij})} > 0$ is the Arrow-Pratt measure of the coefficient of individual *i*'s relative risk aversion; (1-e_{ij}) denotes fraction of time spent in the home; ε_i is an error term which captures unobservable factors such as motivation and preferences for job attributes.

In order to derive expected utility with respect to future earnings, we take a second order Taylor series expansion around the mean of future earnings (μ_y). For simplicity, the subscripts *i* and *j* are suppressed:

$$E\big(U(y)\big) \approx U\big(\mu_y\big) + U'\big(\mu_y\big)E\big(y-\mu_y\big) + \tfrac{1}{2}U''E((y-\mu_y)^2) + \omega$$

$$= U\big(\mu_y\big) + \tfrac{1}{2}U''(\mu_y)\sigma_y^2 + \omega \qquad (5)$$

where $\mu_y = E(y)$, $\sigma_y^2 = Var(y)$, and ω is a random error due to approximation.

The first and second order partial derivatives of the equation (4) with respect to *y* are respectively:

$$U'(y) = e(y)^{-\theta}$$

$$U''(y) = -e\theta(y)^{-\theta-1} \qquad (6)$$

Plugging equations (4) and (6) into equation (5) yields

$$E(U) \approx e\left(\frac{\mu_y^{1-\theta}}{1-\theta} - \frac{1}{2}\theta\mu_y^{-\theta-1}\sigma_y^2\right) + (1-e)\mu_L + \omega + \varepsilon \qquad (7)$$

An individual optimally allocates time between market work and nonmarket work by maximizing his expected utility with respect to work effort, *e*. The first order conditions are given by equation (8).

$$\frac{\partial EU}{\partial e} \gtreqless 0 \leftrightarrow \mu_y^{1-\theta}\left(\frac{1}{1-\theta}-\frac{\theta}{2}\left(\frac{\sigma_y}{\mu_y}\right)^2\right)-\mu_L \gtreqless 0 \quad (8)$$

$$e^* > 0 \; if \; \mu_y^{1-\theta}\left(\frac{1}{1-\theta}-\frac{\theta}{2}\left(\frac{\sigma_y}{\mu_y}\right)^2\right)=\mu_L \quad (9)$$

$$e^* = 0 \; if \; \mu_y^{1-\theta}\left(\frac{1}{1-\theta}-\frac{\theta}{2}\left(\frac{\sigma_y}{\mu_y}\right)^2\right)<\mu_L \quad (10)$$

$$e^* = 1 \; if \; \mu_y^{1-\theta}\left(\frac{1}{1-\theta}-\frac{\theta}{2}\left(\frac{\sigma_y}{\mu_y}\right)^2\right)>\mu_L \quad (11)$$

Equations (9), (10), and (11) show that if expected utility from earnings in the market at any positive *e* equals utility from nonmarket work or leisure, an agent allocates his available time between market work and nonmarket work ($e^* > 0$); otherwise he will specialize in home production (e^*=0) or market production (e^*=1). Clearly, a decision on whether to enter the labor market depends on risk aversion, human capital, and household characteristics so that $e^* = e(\theta, X_m, X_h)$.

In addition, if we presume that the utility from time out of the labor force is positive ($\mu_L > 0$) then an interior solution where 0<*e*<1 requires that $\mu_y^{1-\theta}\left(\frac{1}{1-\theta}-\frac{\theta}{2}\left(\frac{\sigma_y}{\mu_y}\right)^2\right)$>0. That in turn requires that the risk aversion parameter

$\theta \in (0,1)$ and $\frac{\theta}{2}\left(\frac{\sigma_y}{\mu_y}\right)^2 < \frac{1}{1-\theta}$. For the rest of our analysis, we will presume that for individuals in the labor market, $0 < \theta < 1$.[1]

Assuming *e*>0, an individual chooses self-employment if expected utility from selecting self-employment exceeds that from paid-employment: $EU_s\big|_{e_s>0} > EU_w\big|_{e_w>0}$

Manipulating the expected utility in (7) yields the following condition for entering self-employment:

$$e_s \mu_{y_s}^{1-\theta}\left[\frac{1}{1-\theta} - \frac{\theta}{2}\left(\frac{\sigma_{y_s}}{\mu_{y_s}}\right)^2\right] + (1-e_s)\mu_L > e_w \mu_{y_w}^{1-\theta}\left[\frac{1}{1-\theta} - \frac{\theta}{2}\left(\frac{\sigma_{y_w}}{\mu_{y_w}}\right)^2\right] + (1-e_w)\mu_L \qquad (12)$$

where subscripts *s* and *w* denote self-employment and paid-employment, respectively.

We presume that self-employment is a riskier occupation than paid-employment. That means that the coefficient of variation (CV) for self-employed earnings is larger than the CV for salaries in paid-employment: $CV_s = \frac{\sigma_{y_s}}{\mu_{y_s}} > \frac{\sigma_{y_w}}{\mu_{y_w}} = CV_w$.

The condition $CV_s > CV_w$ implies that the bracket in the first term on the left hand side of (12) is smaller than the bracketed term on the right hand side. Hence, other things equal, expected return from self-employment needs to be higher than that from

[1] The theoretical models of Kihlstrom and Laffont (1979) and Newbery and Stiglitz (1982) assumed relative risk aversion is less than one. However, empirical estimates of the relative risk aversion coefficient are often larger than one. For examples, Hansen and Singleton (1983) find relative risk aversion in the range from 0 to 2 whereas Pålsson (1996) finds it in the range between 2 and 4.

paid-employment in order for any risk averse individual to enter self-employment: $\mu_{y_s} > \mu_{y_w}$.[2]

We are interested in assessing how increases in risk aversion affect the expected return from occupational choice at a fixed level of work effort. We first simulate the effect of risk aversion on expected utility from market work in equation (12). Figure 1 illustrates how expected utility from market work in each occupation changes as risk aversion increases. Graphs display various conditions on μ_{y_s}, μ_{y_w}, CV_s, and CV_w.

As shown in Figure 1, as θ increases, expected utility from market work decreases in both self-employment and paid-employment. However, expected utility declines faster in self-employment than paid-employment and so paid employment becomes more attractive as θ increases. This evidence suggests that more risk averse agents who nevertheless choose self-employment will require a higher expected return from self-employment, and so μ_{y_s} must increase in θ. The reverse is true for the effect of θ on expected earnings in paid employment. A more risk averse individual requires lower expected return than their less risk averse counterparts when they choose paid-employment. See the Appendix 1 for the proofs.

Risk aversion has an ambiguous effect on work effort, whether in self-employment (e_s) or wage work (e_w). The reason is that effort depends on the utility from

[2] Note that expected utility is increasing in expected return.

nonmarket work. Assuming $0 < e < 1$, more risk averse individuals who receive high utility from nonmarket work or leisure will reduce work effort in the market production because increases in θ decrease utility from market work at any level of expected earnings. The reverse is true for those who have low utility from nonmarket work: more risk aversion increases market work effort in order to scale up the decreased utility from market work. See the Appendix 2 for the derivation.

We have shown that in reduced form, individual decisions on labor force participation, occupational choice, earnings, and work effort will depend on the individual's degree of risk aversion as well as on predetermined skills in market and nonmarket production.[3] Given the frequently reported finding that women are more risk averse than men, it is natural to presume that gender differences in risk attitudes would play a role in explaining widely observed gender gaps in these labor market outcomes. Accordingly, we will examine the extent to which differences in measured risk aversion between men and women can explain differences between the sexes in labor force participation, entrepreneurial entry, earnings, and hours worked.

3. Methods

[3] Assuming constant absolute risk aversion generates the same predictions. See the appendix 3.

To examine the influence of risk aversion on occupational choice, we employ a multinomial logit model using a random utility model approach. We run separate estimations for men and women for an appropriate comparison of the two groups.

The predicted probability that an individual *i* chooses employment mode *j* is given by

$$Pr(C_{ij}=1\mid\theta_i,X_i)=exp(\delta_j^I\theta_i+\beta_j'X_i)\Big/\sum_{k=1}^{3}exp(\delta_k^I\theta_i+\beta_k'X_i),\ j=1,2,3 \qquad (13)$$

where j=1 for self-employment, 2 for paid-employment and 3 for out of labor force; the superscript I indicates an estimate of a categorical risk attitude index; and θ_i is a categorical variable indicating attitudes toward risk with higher levels indicating greater acceptance of risk. Our primary interest is in establishing the sign and significance of the coefficient on risk attitudes, δ_j^I. We also include a vector X_i that contains controls for heterogeneity in tastes and skills including wealth, total number of children, presence of preschool or school age child (age 0~6, 7~12), marital status, education, previous labor market experience, health condition, parental education and occupational background, and other demographic variables such as age and four regions.

It may be possible that measures of risk aversion are non-linear. As an alternative specification, we replace θ_i by three dummy variables D_{li}, l =2, 3, 4; indicating progressively lower levels of risk aversion with unwillingness to take on any risk as the reference category ($l = 1$). The associated predicted probability that individual *i* chooses employment mode *j* is given by

$$\Pr\left(C_{ij} = 1 \middle| D, X\right) = exp\left(\sum_{l=2}^{4} \delta_{lj}^{D} D_{li} + \beta'_{j} X_i\right) \Big/ \sum_{k=1}^{3} exp\left(\sum_{l=2}^{4} \delta_{lk}^{D} D_{li} + \beta'_{k} X_i\right) \quad (14)$$

Next, we want to explore the relationship between degree of risk aversion and earnings and hours worked by gender. As men and women will be selecting hours and wages at the same time they are selecting occupation, those decisions will be subject to the same human capital and socio-demographic factors.

$$\ln Y_{ik}^{g} = \delta_k^{I} \theta_i + \alpha'_k Z_i + \gamma_k \lambda_i + \varepsilon_{ik} \equiv \tilde{X}_i \alpha_k + \varepsilon_{ik} \quad (15)$$

$$\ln h_{ik}^{g} = \tilde{\delta}_k^{I} \theta_i + \tilde{\alpha}'_k Z_i + \tilde{\gamma}_k \lambda_i + \tilde{\varepsilon}_{ik} \equiv \tilde{X}_i \psi_k + \tilde{\varepsilon}_{ik}, \ k{=}s,\ w; \quad g{=}m,\ f \quad (16)$$

where k=s for self-employment, *w* for paid-employment; g=m for male and g=f for female; vector Z_i contains the same variables as those in X_i except wealth and parental occupational background. We only observe earnings and hours of work conditional on labor market entry, and so the earnings and labor supply equations also include a correction $\lambda_{ik} = \frac{\phi(z_i \eta_k)}{\Phi(z_i \eta_k)}$ for sample selection bias based on the procedure by Heckman (1976; 1979). The z_i augments vector X_i with risk aversion θ_i.

4. Data and Sample

The data source for the analysis is drawn from the National Longitudinal Survey of Youth 79 (NLSY79) for the period between 1993 and 2002. The NLSY79 includes 12,686 individuals who were 14-22 years old in the initial survey year. 6,933 individuals aged between 28 and 45 were interviewed during the observation periods. Employment type is identified by using "class of worker" category, which indicates whether a respondent was employed by a private sector or government or was self-employed. We classify those who ever started a business in the period between 1994 and 2002 as self-employed. Hence, self-employment is identified using a 9-year longitudinal horizon to reflect long-term planning horizon that we presume applies to occupational choice. As a consequence, in our data, the decision to become self-employed is made between ages 29 and 45. Schiller and Crewson (1997) also suggested that a longer life-cycle view for entrepreneurs would be preferred in the sense that new entrepreneurs may emerge in later years.

Those who never have a spell of self-employment but did work for pay were placed in the wage worker category over the 9-year time window. Respondents that did not report at least one employment spell over the period are considered out of the labor force.

Earnings are measured by the hourly pay rate. Although total annual earnings from wage and/or business in the previous calendar year can be identified in the NLSY79, there are many missing values for self-employment earnings. Roughly 50 percent of the self-employed reported zero business earnings and about 11 percent of the self-employed with positive total annual earnings report zero income.[4] This may be due to self-employed reporting their income as wage or salary income (Fairlie 2005). Because of the low response rate for the total annual business earnings, we incorporate earnings measured by hourly pay rate. For example, if a respondent identified himself as self-employed and reported hourly pay rate, we treat the self-reported hourly pay rate as self-employment hourly earnings. Because the observation time is between 1994 and 2002, we average their earnings over the years. Earnings are inflated by the CPI-U in 2002 dollars. Hours worked per week are also averaged over the years.

We drop those who were in military service or in school. We also drop individuals for whom critical information is missing. Finally, we exclude individuals who were already self-employed in 1993 to avoid reverse causal effects of experience of business ownership on risk attitudes. Therefore, the risk preference is measured before the spell of self-employment is initiated.[5] The final sample includes 5,443 individuals; 2,662 males and 2,781 females.

The distributions of employment type by gender over the period between 1994 and 2002 are summarized in Table 1.

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4 NLSY79 asked respondents a question of “Did you receive earnings from business or farm in the past year?” In the following question, they were asked “what are total annual earnings from business or farm in the past calendar year?” In our data, 11% of respondents who answered ‘yes’ to the question over the observation years actually reported zero earnings.

5 Individuals’ risk attitudes in this study are elicited in 1993.

The longer time period eliminates most of the differences in labor force participation between men and women. Only 6 % of women and 3% of men were never employed over the 9 years. As shown, self-employment entry rate for women (13%) is lower than that for men (16%). Likewise, the proportion of male wage workers (82%) is slightly larger than that for females (80%). Table 2 reports a summary of self-employment rates, log hourly earnings, and log hours worked across employment types by gender.

Women earn less than men and they also work fewer hours than men regardless of employment type. These differences in self-employment, earnings and labor supply between men and women are statistically significant, consistent with what has been found in the previous literature. Definitions and descriptive statistics of the variables used in the analysis are reported separately by gender in Table 3.

4.1 Measures of risk attitudes

The willingness to take financial risk is measured by a categorical variable with four levels. In the 1993 NLSY79, respondents were asked the following questions:

(Q1) Suppose that you are the only income earner in the family, and you have a good job guaranteed to give you your current (family) income every year for life. You are given the opportunity to take a new and equally good job, with a 50-50 chance that it will double your (family) income and a 50-50 chance that it will cut your (family) income by a third. Would you take the new job?

The individuals who answered ‘yes’ to this question were then asked:

(Q2) suppose the changes were 50-50 that it would double your (family) income and 50-50 that it would cut it in half. Would you still take the new job? Those who answered 'no' to the first question (Q1) then were asked: (Q3) suppose the changes were 50-50 that it would double your (family) income and 50-50 that it would cut it by 20 percent. Would you take the new job?

We use the responses to the series of questions in order to place each respondent into one of four risk categories (1-4). The four risk index categories, ranging from the most risk averse (category1) to the least risk averse (category4), are as followed:

$$riskindex = \begin{cases} 1 \ \ if \ \ Q1 = No \ \& \ Q3 = No \ ; reject \ \ 1/3 cut \ \& \ reject \ \ 1/5 cut \\ 2 \ \ if \ \ Q1 = No \ \& \ Q3 = Yes \ ; reject \ \ 1/3 cut \ \& \ accept \ 1/5 cut \\ 3 \ \ if \ \ Q1 = Yes \ \& \ Q2 = No \ ; accept \ 1/3 cut \ \& \ reject \ \ 1/2 cut \\ 4 \ \ if \ \ Q1 = Yes \ \& \ Q2 = Yes \ ; accept \ 1/3 cut \ \& \ accept \ 1/2 cut \end{cases}$$

Because of the possibility of non-linear measures of risk attitudes, we replace the risk attitude index with four dummy variables to distinguish between levels of risk aversion: willingness to take 1) No risk; 2) Average risk; 3) Above average risk; 4) Substantial risk. The distribution of risk aversion across types of employment by gender is presented in Table 4.

The first two columns show risk aversion for male and female entrepreneurs. Surprisingly, both self-employed men and women are most commonly found in the most risk averse group: 36% of male and 44% of female entrepreneurs. However, the proportion of paid employees in the most risk averse category is even larger, consistent with the presumption that more risk averse individuals are more likely to select paid-employment over self-employment. Consistent with that supposition, 55% of male entrepreneurs are in the two least risk averse categories compared to only 43% of paid employees. Differences in risk aversion between female self-employed and paid-employed are less pronounced: 43% of female entrepreneurs and 37% of female paid employees are in the two least risk averse groups. On the surface, it appears that risk aversion has a smaller effect on female entrepreneurial entry than it does on male entrepreneurship.

Columns (3) and (6) in Table 4 present two-sample *t* tests between men and women within occupation. Women are significantly more risk averse than men regardless of occupation. Columns (7) and (8) test for differences in risk aversion between the self-employed and the paid-employed. Entrepreneurs are less risk averse than are paid employees for both genders, but the differences are only marginally significant for women. Nor is the more modest gap in risk aversion between women self- and paid-employees due to less variation in risk attitudes among women. Variation in risk attitudes across women is comparable to the variation in risk attitudes for men as shown in the final row of Table 4.

5. Empirical results

5.1 Effect of risk aversion on occupational choice by gender

In order to examine the influence of risk attitudes on occupational choice by gender, separate equations (13) and (14) were estimated for samples of men and women using a multinomial logit model. The estimated marginal effects are reported in Table 5 in two panels.

In Panel A, degree of risk aversion is measured by the four point risk attitude index that goes from most (1) to least (4) risk averse. In order to allow for a possible non- monotonic relationship between the probability of entry into self-employment and the degree of risk aversion, we replace the risk attitude index with three dummy variables that indicate degree of willingness to take risk, considering willingness to take "no risk" as the reference category. Those estimates are reported in Panel B.

Turning first to the control measures, wealth increases the probability of moving into self-employment rather than being paid-employed for both men and women, consistent with the findings of previous studies (Evans and Leighton 1989; Evans and Jovanovic 1989; Blanchflower and Oswald 1998; Fairlie 2002). In line with Schiller and Crewson (1997), more employment experiences induce women to stay in paid employment and discourage them from transitioning into self-employment. Conversely, men with more work experience are more likely to enter self-employment instead of paid-employment. Health limitations encourage men to work in their own business. For women, those who reported health limitations tend to exit the labor force rather than enter the labor market.

Age, education and race have no significant effect on an employment choice regardless of gender. Lack of explanatory power of age might be because there are not enough variations in age in our sample. Having entrepreneurial or professional parents has no significant effect on the probability of becoming self-employment for both men and women.[6]

As shown in Panel A of Table 5, more favorable attitudes toward risk raise the probability of being self-employed by 2.4 % and reduce the incidence of selecting paid-employment by 2.4% among men. The finding is as predicted in the theory and is also consistent with the previous literature on risk preferences (Kanbur 1979; Kihlstrom and Laffont 1979, Parker 1997; Van Praag and Cramer 2001; Hartog et al. 2002; Cramer et al. 2002; Ekelund et al. 2005; Kan and Tsai 2006; Ahn, T. 2009).[7] However, there is no statistically significant effect of risk aversion on the probability that women enter either self-employment or paid-employment. Although the signs of the coefficients are the same as those for men, the magnitudes of the marginal effects for women are less than one-tenth those for men. Measured risk aversion does not affect the labor force participation decision for either men or women.

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[6] Manager, official and proprietor are in the same occupational category for parental occupational background in the NLSY79.

[7] These studies have relied either on data sets of men only or of pooled samples of men and women.

As the alternative specification shows in Panel B, for men, the marginal effects of the three risk attitude dummy variables on entry decision into self-employment are all positive and the size of the marginal effect gets progressively larger as willingness to take risk increases. For example, an individual who is willing to take above average risk (substantial risk) has a 5.8% (7.6%) higher probability of being self-employed relative to the individual who is unwilling to take any risk. For women, on the other hand, the signs and magnitudes of the marginal effect of risk attitudes on self-employment do not follow a systematic pattern and are never statistically significant. While risk attitudes play a key role in choosing entrepreneurship for men, they have no significant effect on women's occupational choices.[8]

This finding suggests that men and women place different weights on future earnings in self-employment. Limited evidence on the motivations for entering self-employment may support this conjecture. For example, Georgellis and Wall (2005) found that larger expected earnings premia for self-employment versus paid-employment increases entrepreneurial entry for men but not women. Clain (2000) showed that full-time self-employed women have characteristics that are less valued in the market compared to full-time paid-employed women. For men, the reverse is true, suggesting

[8] This study avoids a problem that the risk preferences is measure after the spell of self-employment is initiated by dropping those who were already self-employed when their risk attitudes were measured in 1993. Hartog et al. (2002) argue that ideally risk aversion should be measured before individuals make self-employment decision. Consequently, 402 observations were omitted from the sample. The results are, however, robust to including these individuals in the sample (See the Appendix 4).

that women may place a higher value on non-pecuniary aspects of self-employment than do men.

5.2 Effect of risk aversion on hours and earnings by gender across employment type

In this subsection, we examine the potential role of risk aversion on earnings and work hours by gender. As shown in section 2, a more risk averse agent requires higher expected earnings from self-employment whereas the more risk averse accepts lower expected earnings from paid-employment. The estimates of earnings model are reported in Panel A of Table 6.

Consistent with the theory, greater risk aversion increases male returns to self-employment. However, there is no significant effect of measured risk aversion on the earnings of the female self-employed. The coefficient on risk aversion for women is less than 98% of the size for men. This is consistent with our earlier finding that risk aversion does not affect women's entry decision on self-employment.

For men engaged in wage work, willingness to accept risk is associated with lower male wage which is inconsistent with theory. The most risk averse are paid almost 12% more than the least risk averse. The least risk averse women are paid more in wage work consistent with the theory, although the differences are small. Going from the least to the most risk averse lowers pay by 6%.[9]

[9] Estimates of log annual earnings are reported in Appendix 5. The signs on risk preferences are

Risk aversion can also affect hours of labor supplied although the direction of the effect is ambiguous. We estimated equation (16) and report the estimated risk aversion effect by gender and employment type in Panel B of Table 6. The complete results from the labor supply estimation are presented in Appendix 6. As with our labor force participation results, there is no significant relationship between risk attitudes and hours of work for either men or women.

5.3 Do gender differences in risk aversion explain the observed gender gaps in the labor market outcomes?

Given our behavioral estimates of the entrepreneurial choice, earnings, and hours of labor supply decisions, we can now assess the extent to which gender differences in risk aversion explain the gender gaps in these labor market outcomes.

To measure how much differences in risk aversion between men and women explain the gender gap in entrepreneurial choice, we apply Fairlie's (1999) nonlinear variant of the Blinder-Oaxaca decomposition. The difference in probability of self-employment across genders is given by

$$\bar{P}_s^m - \bar{P}_s^f = \left[\sum_{i=1}^{N^m} \frac{F(\delta^f \theta^m + X_i^m \beta^f)}{N^m} - \sum_{i=1}^{N^f} \frac{F(\delta^f \theta^f + X_i^f \beta^f)}{N^f} \right]$$

$$+ \left[\sum_{i=1}^{N^m} \frac{F(\delta^m \theta^m + X_i^m \beta^m)}{N^m} - \sum_{i=1}^{N^f} \frac{F(\delta^f \theta^m + X_i^m \beta^f)}{N^m} \right] \quad (17)$$

---

consistent with those from log hourly earnings although the estimates lose precision.

where N^j is the sample size for gender j; P_s is the probability of choosing self-employment; X^g for g=m, f are identical to the X^g in (13).

The standard linear decomposition introduced by Blinder (1973) and Oaxaca (1973) is applied for earnings and labor supply differences:

$$\ln \overline{Y}_{ik}^{m} - \ln \overline{Y}_{ik}^{f} = (\bar{\tilde{X}}_{k}^{m} - \bar{\tilde{X}}_{k}^{f})\hat{\alpha}_{k}^{f} + \bar{\tilde{X}}_{k}^{m}(\hat{\alpha}_{k}^{m} - \hat{\alpha}_{k}^{f}) \tag{18}$$

$$\ln \overline{h}_{ik}^{m} - \ln \overline{h}_{ik}^{f} = (\bar{\tilde{X}}_{k}^{m} - \bar{\tilde{X}}_{k}^{f})\hat{\psi}_{k}^{f} + \bar{\tilde{X}}_{k}^{m}(\hat{\psi}_{k}^{m} - \hat{\psi}_{k}^{f}) \tag{19}$$

where $\tilde{X}^g$ for g=m, f are the same as those in (15).

We only report the first component of the decomposition that captures contributions from differences in observed risk aversion between men and women. The weighted female coefficients in (17), (18), and (19) can be replaced by male's estimates or pooled estimates.

Table 7 reports percentage contribution of risk attitudes to the gender gaps in three outcomes by employment type.

The percentage contribution is calculated as estimated coefficient from decomposition dividing by mean difference in outcome (i.e., entrepreneurial choice, earnings, or hours of work) and then multiplying by 100. The female coefficients from Table 6 are used in specification 1 and the male coefficients are applied in specification 2. Estimates for a pooled sample of men and women are incorporated in specification 3.

Conclusions based on the decomposition analysis are sensitive to the choice of coefficient on self-employment.[10] For instance, gender differences in risk aversion explain 2% of the entrepreneurial choice gap between men and women in the female-weighted decomposition, but 12 % of the gap in the male-weighted decomposition. Similarly, if women had risk aversion equal to those of men, their entrepreneurial earnings would be only about 1% less if we take women's coefficients as weights, but would be 19% lower using men's coefficients. Regardless of choice of coefficients applied, risk aversion explains little of the difference in hours worked or earnings from wage work between men and women.

Most commonly, researchers use the male coefficients in decompositions because of a presumption that the male coefficients are not subject to discrimination. However, this application reflects behavioral decisions regarding occupation, earnings, and hours worked. Therefore, it is appropriate to see how a woman with risk aversion equivalent to those of a male would have affected her behavioral decisions regarding choice of occupation and associated occupational earnings and hours of work. That argument suggests that we should use the female-weighted decomposition to analyze how much risk aversion would affect female labor market outcomes.[11]

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[10] This is a common problem so called "index number problem" in the standard decomposition. See Oaxaca (1973) for more detail.

[11] For a linear case, $(\bar{\theta}_m - \bar{\theta}_f)\hat{\delta}_f = \bar{\theta}_m\hat{\delta}_f - \bar{\theta}_f\hat{\delta}_f$. The first term is counterfactual earnings that women would have if women had men's risk aversion level. The second term is actual earnings. Expected change in

Using that criterion, risk aversion explains only 1.9% of the gap in entrepreneurial choice between men and women. Equalizing risk aversion across the genders would alter relative women's pay by only about 1% in either self-employment or paid-employment.[12] Likewise, equalizing risk aversion would change relative women's hours of work by less than1% in both occupations.

5.4 Sensitivity Analysis

The aim of this subsection is to show the extent to which conclusions regarding the impact of risk aversion on labor market choices are robust to changes in specification. The first change is to replace all individual attributes that were averaged over the 9 year estimation window with their start-of-period (i.e., 1993) values. Second, different time spans for observing labor market outcomes are used: 1994-1996, 1994-1998 and 1994-2000. Finally, potentially endogenous variables such as number of children, presence of young children and wealth are excluded as control variables from the estimation. The estimated marginal effects of risk attitudes are presented in Table 8.

The main estimation results are reported in the first row for reference. In all instances, we find that increasing willingness to accept risk raises the probability of self-

women's entrepreneurial choice can be measured as the same way.

[12] The trivial role of risk aversion in explaining gender gaps in entrepreneurship and the associated earnings in self-employment is also consistent with the finding that risk aversion matters for men's entrepreneurial choice and earnings but not for women's cases, which gives us the validity of focusing on the female-weighted decomposition.

employment and lowers the probability of wage work only for men. However, degree of risk aversion does not affect women's occupational choices in all specifications.

We use the same modifications to our specifications to evaluate the robustness of our results for earnings and labor supply. The results reported in Table 9 show that the signs on risk aversion are stable in most cases. When signs are not consistent with the main estimates the significance level falls below 10%.

Table 10 reports contributions of risk aversion to the gender gap in entrepreneurial choice, earnings, and hours of labor supply. We only focus on the specification 1 (female-weighted decomposition) and so we are assessing how women's estimated behavioral choices would have been different if they had the risk aversion of an average male in the population.

Depending on the specification, differences in risk aversion explain only 0.1% to 4.5% of the gap in entrepreneurial choice between men and women. With one exception, the entrepreneurial earnings gap would be even larger if women had the same level of risk acceptance as men. The gender pay gap for wage work and for hours worked are also largely unaffected by differences in risk aversion between men and women with the explained gap rarely exceeding 1% in absolute value. In short, the commonly observed differences in risk aversion across genders explain little of the observed gaps in labor market outcomes between men and women.

6. Conclusion

This study examines the extent to which gender differences in risk aversion can explain male-female gaps in self-employment rate, earnings, and labor supply. Exploiting a 9-year longitudinal sample of men and women in the NLSY79, we confirm the standardized gender gap reported in the previous literature: on average, women are less likely to become self-employed, earn less and work fewer hours than men. Furthermore, NLSY79 shows that considerable differences in measured risk aversion between men and women exist: women are more risk averse than men.

We find that risk aversion is an important factor that affects occupational choice for men—less risk averse men tend to become self-employed and more risk averse men become wage workers. However, there is no relationship between degree of risk aversion and occupational choice for women. A different role of risk aversion in earnings by gender across employment type is also found. Less risk aversion is associated with lower male earnings in self-employment. On the other hand, there is no significant effect of measured risk aversion on female entrepreneurial earnings. In paid-employment, less risk aversion lowers the male wage whereas it raises female wages. Finally, we find no relationship between risk aversion and hours of labor for both men and women across employment type.

The Blinder-Oaxaca decomposition shows that gender differences in risk aversion explain only small part of gender gap in self-employment rate. Similarly, those differences in risk aversion account for only a trivial portion of the gender gap in hours worked or earnings. The results hold up well against a variety of sensitivity checks. These findings suggest that widely reported differences in risk aversion across genders do not play a role in explaining differences in labor market outcomes between men and women.

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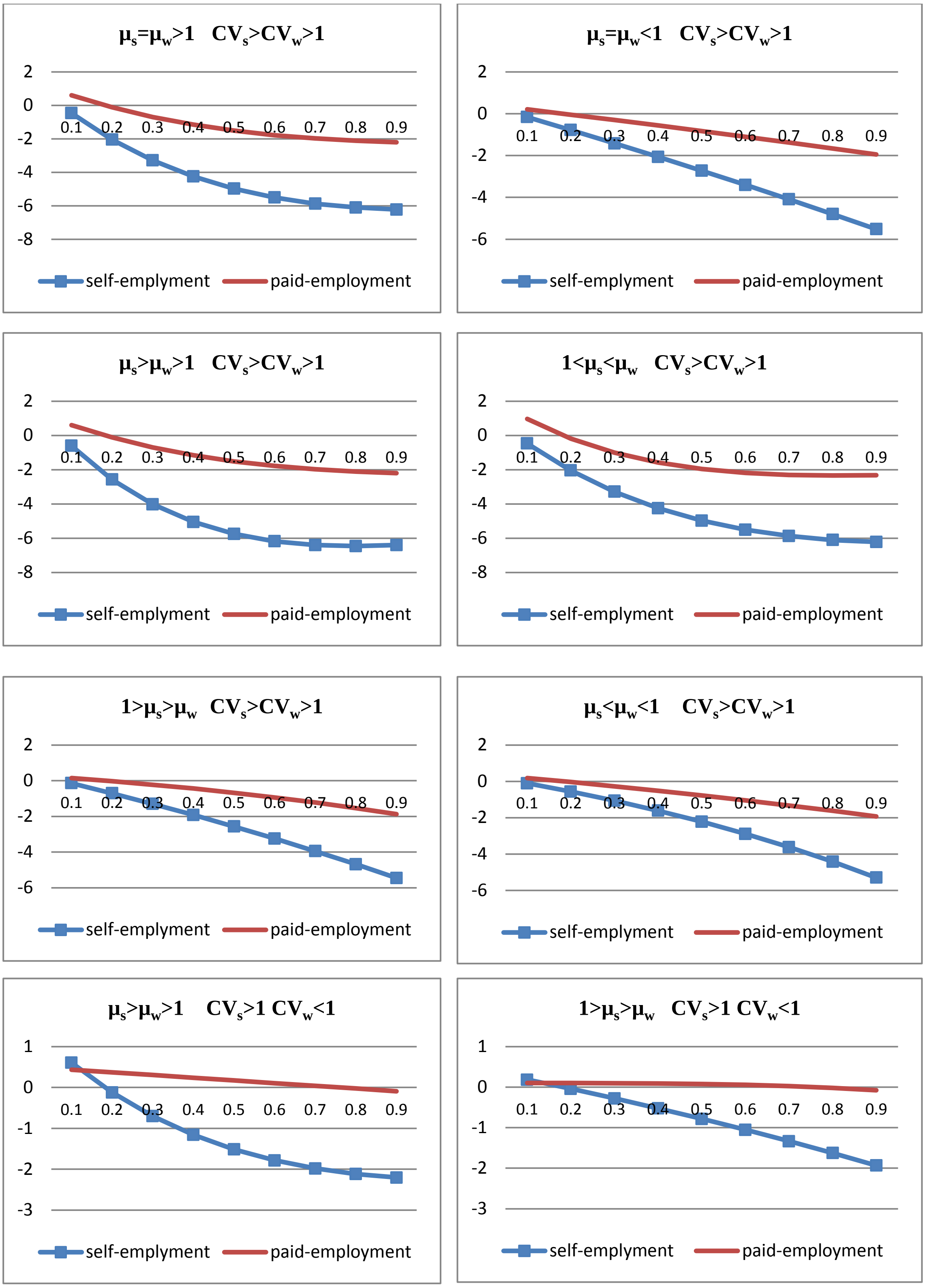
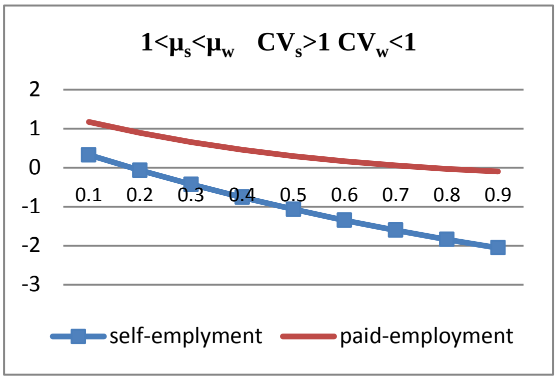
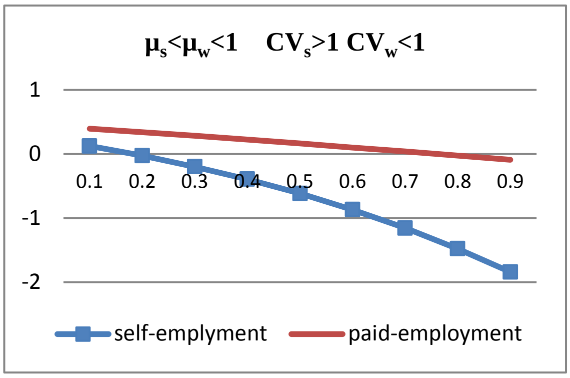
Figure 1. Change in expected utility from market work associated with various expected return and coefficient variation as risk aversion (θ) increases.







Note: CV_s and CV_w denote coefficient variation in self-employment and paid-employment, respectively. The case of $CV_w<CV_s<1$ is not considered because if both CV_s and CV_w are less than 1, there is little difference in risk between *s* and *w*.

Table 1. Distribution of employment status (1994~2002) by gender aged 29~45

Employment status	Men	Women	Total
Self-employed	423 (15.9%)	367 (13.2%)	790
Paid- employed	2,172 (81.6%)	2,236 (80.4%)	4,408
Out of labor force	67 (2.5%)	178 (6.4%)	245
Total	2,662	2,781	5,443

Table 2. Self-employment rate, hourly earnings and labor supply by gender

		Mean (std)		
		(1) Men	(2) Women	(3) Mean Differences
Self-employment	Self-employment rate	0.16	0.13	0.03***
		(0.01)	(0.01)	(2.82)
	Log hourly earnings	7.20	6.80	0.39***
		(0.93)	(1.05)	(0.07)
	Obs.	397	328	
	Log hours worked	3.88	3.51	0.36***
		(0.38)	(0.68)	(0.04)
	Obs.	364	307	
Paid-employment	Log hourly earnings	7.53	7.22	0.31***
		(0.59)	(0.59)	(0.02)
	Obs.	2,159	2,216	
	Log hours worked	3.80	3.60	0.20***
		(0.00)	(0.01)	(0.01)
	Obs.	2,148	2,171	

Note: Column (3) is two-sample *t*-test between men and women

Table 3. Definitions and descriptive statistics of variables

	Definition	Men Mean (Std)	Women Mean (Std)
Risk acceptance index (1-4)	Four point risk attitude index: increasing in willingness to take financial risk	2.29 (1.28)	2.09(1.22)
Willingness to take:			
No risk	=1 if risk index=1	0.44 (0.50)	0.50 (0.50)
Average risk	=1 if risk index=2	0.11 (0.31)	0.13 (0.33)
Above average risk	=1 if risk index=3	0.17 (0.38)	0.17 (0.38)
Substantial risk	=1 if risk index=4	0.28 (0.45)	0.21 (0.41)
log(net-asset)	Difference between all asset values and all debts	14.23 (0.33)	14.21 (0.45)
Education	Years of schooling completed	12.81 (2.41)	12.84 (2.36)
Work experience (in year)	Years of employment experience	14.67 (4.09)	11.97(5.38)
Number of kids	Number of bio/step/adopted children in HH	1.17 (1.15)	1.67(1.17)
Presence of pre-school kid	=1 if pre-school age child (age<6) is present	0.32 (0.33)	0.35 (0.34)
Presence of school kid	=1 if a child aged 7 to 12 is present	0.16 (0.21)	0.26 (0.22)
Age	Age in years	35.69 (2.28)	35.81(2.23)
Married, spouse present	=1 if married and spouse present	0.56 (0.43)	0.55 (0.44)
Health limitation	=1 if health problem limits ability to work	0.08 (0.21)	0.12(0.24)
White	=1 if white	0.64 (0.48)	0.63(0.48)
Father education	Years of schooling his/her father completed	10.70 (4.22)	10.48 (4.15)
Father professional/proprietor	=1 if father has/had professional/proprietor	0.10 (0.29)	0.09 (0.29)
Mother education	Years of schooling his/her mother completed	10.81 (3.27)	10.63 (3.13)
Mother professional/proprietor	=1 if mother has/had professional/proprietor	0.03 (0.16)	0.02(0.14)
Urban	=1 if reside in urban area	0.76 (0.34)	0.76 (0.34)
Northeast	=1 if reside in northeast	0.34 (0.36)	0.16 (0.36)
North central	=1 if reside in north central	0.24 (0.42)	0.23 (0.42)
South	=1 if reside in south	0.41 (0.48)	0.42(0.48)
West	=1 if reside in west	0.18 (0.37)	0.17 (0.37)

Table 4. Measured risk preferences by occupational choice and gender

Risk index	Self-employment (1) men	(2) women	(3) Mean diff.	Paid-employment (4) men	(5) women	(6) Mean diff.	Mean(Self)-Mean(paid) (7) Men	(8) Women
1: unwilling to take financial risk (most risk averse category)								
Observation	151 (36%)	162 (44%)		992 (45%)	1,125 (50%)			
Mean	0.359 (0.02)	0.444 (0.03)	-0.085 [2.44]***	0.455 (0.01)	0.502 (0.01)	-0.047*** [3.10]	-0.097*** [3.67]	-0.058** [2.07]
2: willing to take average risk								
Observation	38 (9%)	48 (13%)		252 (12%)	278 (12%)			
Mean	0.090 (0.01)	0.132 (0.02)	-0.041* [1.85]	0.115 (0.01)	0.123 (0.01)	-0.008 [0.82]	-0.025 [1.50]	0.008 [0.43]
3: willing to take above average risk								
Observation	88 (21%)	78 (21%)		355 (16%)	379 (17%)			
Mean	0.209 (0.02)	0.214 (0.02)	-0.005 [0.16]	0.163 (0.01)	0.170 (0.01)	-0.007 [0.62]	0.046** [2.30]	0.044** [2.04]
4:willing to take substantial risk (least risk averse category)								
Observation	144 (34%)	77 (21%)		582 (27%)	456 (20%)			
Mean	0.342 (0.02)	0.211 (0.02)	0.131*** [4.12]	0.267 (0.01)	0.205 (0.01)	0.062*** [4.84]	0.076*** [3.18]	0.006 [0.28]
Total Obs.	421 (100%)	365 (100%)		2,181 (100%)	2,238 (100%)			
Risk acceptance index	2.53 (1.29)	2.19 (1.21)	0.343*** [3.83]	2.24 (1.28)	2.076 (1.22)	0.163*** [4.34]	0.294*** [4.33]	0.115* [1.68]
Coefficient of Variation	0.510	0.553		0.571	0.588			

Note: Column (3), (6) are two-sample t test between men and women within self-employment and paid-employment, respectively. Column (7), (8) are two-sample t test between self- and paid-employment within gender and risk aversion. ***/**/* indicates significance at the 1%/5%/10% level. Standard errors are in parenthesis. t-statistics are in bracket.

Table 5. Multinomial Logit Marginal Effects of Determinants of Occupational Choice for Men and Women (1994~2002)

	Men			Women		
	Self-Employment	Paid-Employment	Not working	Self-Employment	Paid-Employment	Not working
Panel A						
Risk acceptance index(1-4)	**0.024*** **	**-0.024*** **	**1.91e-07**	**0.002**	**-0.001**	**-0.001**
	(3.86)	**(3.86)**	**(0.87)**	**(0.17)**	**(0.10)**	**(0.81)**
Education	-0.002	0.002	-3.66e-07	0.001	-0.001	0.000
	(0.41)	(0.41)	(1.31)	(0.15)	(0.19)	(0.53)
Age	-0.106	0.106	5.90e-06	-0.043	0.047	-0.004
	(1.04)	(1.04)	(1.07)	(0.39)	(0.43)	(0.48)
Age squared	0.002	-0.002	-9.27e-08	0.001	-0.001	0.000
	(0.95)	(0.95)	(0.97)	(0.44)	(0.48)	(0.58)
Work experience	0.005*	-0.005*	-3.28e-07	-0.005**	0.007***	-0.002***
	(1.74)	(1.74)	(1.30)	(2.35)	(3.37)	(3.85)
log(net asset)	0.072***	-0.072***	3.16e-07	0.057**	-0.063**	0.007**
	(2.98)	(2.98)	(0.37)	(2.30)	(2.55)	(2.62)
White	0.022	-0.022	1.15e-08	0.022	-0.023	0.000
	(1.12)	(1.12)	(0.02)	(1.09)	(1.10)	(0.23)
Married, spouse present	0.023	-0.023	3.24e-07	0.017	-0.021	0.004*
	(0.79)	(0.79)	(0.34)	(0.75)	(0.93)	(1.94)
Number of Kids	-0.012	0.012	6.62e-08	-0.002	0.003	-0.001
	(0.87)	(0.87)	(0.17)	(0.22)	(0.28)	(1.01)
Presence of young kids (0~6)	-0.032	0.032	-2.97e-07	0.042	-0.054	0.012***
	(0.80)	(0.80)	(0.23)	(1.24)	(1.58)	(2.99)
Presence of young kids (7~12)	-0.120*	0.120*	2.82e-07	-0.043	0.049	-0.006
	(1.88)	(1.88)	(0.16)	(0.93)	(1.05)	(1.47)
Health limitation to work	0.094*	-0.094*	4.27e-06	0.043	-0.054	0.011***
	(1.92)	(1.92)	(1.27)	(1.13)	(1.41)	(2.99)
Mother's education	0.006	-0.006	3.41e-08	-0.001	0.001	-0.000
	(1.58)	(1.58)	(0.37)	(0.14)	(0.18)	(0.45)
Father's education	0.000	-0.000	-1.44e-08	0.003	-0.004	0.000*
	(0.03)	(0.03)	(0.22)	(1.11)	(1.25)	(1.72)
Mother-professional/proprietor	-0.005	0.005	-2.96e-06	0.000	0.002	-0.002
	(0.11)	(0.11)	(1.16)	(0.00)	(0.04)	(0.56)
Father-professional/proprietor	-0.030	0.030	-0.0001	0.045	-0.046	0.002
	(1.30)	(1.30)	(1.10)	(1.48)	(1.52)	(0.51)
Urban	-0.023	0.023	1.33e-06	-0.020	0.017	0.003
	(0.94)	(0.94)	(1.14)	(0.79)	(0.67)	(1.39)
Panel B						
Willingness to take:						
Average risk	**0.006**	**-0.006**	-1.84e-06	-0.001	0.000	0.001
	(0.00)	**(0.00)**	(0.00)	(0.05)	(0.00)	(0.57)
Above average risk	**0.058** **	**-0.058** **	1.91e-08	0.033	-0.030	-0.003*
	(2.18)	**(2.18)**	(0.00)	(1.34)	(1.23)	(1.74)
Substantial risk	**0.076*** **	**-0.076*** **	1.19e-08	-0.011	0.011	-0.001
	(3.32)	**(3.32)**	(0.00)	(0.48)	(0.50)	(0.34)

Note: 1) The reference category in Panel B is willingness to take "no risk". 2) Same control variables as Panel A are included in Panel B and C. 3) 4 regions are also included in all Panels) 4) Standard errors can be provided on request 4)***/**/* indicates significance at the 1%/5%/10% level.

Table 6. Estimates of Earnings and labor supply for self-employed, paid-employed by gender

	Self-employment		Paid-employment	
	Male	Female	Male	Female
Panel A *log hourly earnings*				
Risk acceptance index	**-0.192*** (3.54)**	**-0.004 (0.08)**	**-0.039*** (3.20)**	**0.020** (2.12)**
Education	0.081*** (3.48)	0.021 (0.59)	0.085*** (14.75)	0.080*** (13.28)
Age	0.889 (1.27)	-0.632 (0.74)	-0.238 (1.61)	-0.123 (0.78)
Age squared	-0.013 (1.16)	0.009 (0.68)	0.004* (1.66)	0.001 (0.60)
Work experience	-0.031 (1.47)	0.043** (2.54)	0.031*** (7.83)	0.049*** (9.49)
White	-0.014 (0.11)	-0.189 (0.99)	0.053* (1.79)	-0.013 (0.43)
Married	0.051 (0.30)	-0.501** (2.61)	0.000 (0.01)	-0.074** (2.28)
Number of kids	-0.010 (0.12)	-0.038 (0.44)	0.028 (1.58)	0.013 (0.80)
Presence of a kid aged under 6	0.152 (0.61)	-0.497* (1.68)	0.140** (2.45)	-0.111** (2.14)
Presence of a kid aged 7-12	1.120*** (2.99)	0.077 (0.21)	0.251*** (2.96)	0.049 (0.71)
Health problem	-0.788** (2.52)	-0.620* (1.85)	-1.091*** (7.92)	-0.283*** (4.12)
Mother education	-0.066*** (3.19)	-0.016 (0.57)	0.002 (0.39)	0.001 (0.22)
Father education	0.027* (1.68)	0.005 (0.25)	0.004 (1.04)	0.001 (0.34)
Urban	0.207 (1.29)	0.268 (1.23)	0.107*** (2.98)	0.131*** (3.63)
Years in business	0.121*** (3.19)	0.159** (2.53)	-	-
Heckman's selection	-9.032*** (3.94)	-13.100*** (3.07)	4.731*** (6.06)	1.097* (1.85)
R^2	0.2327	0.2025	0.3403	0.3611
N	309	242	1651	1530
Panel B *log hours of labor*				
Risk acceptance index	-0.030 (1.36)	-0.003 (0.08)	-0.004 (0.90)	-0.002 (0.36)
R^2	0.153	0.201	0.059	0.223
N	277	221	1629	1488

Note: Risk acceptance index is measured by a categorical variable from the most (1) to the least risk averse. In Panel A, average hourly earnings are dependent variable. In Panel B, average hours worked per week are dependent variable. Same controls in Panel A are used in Panel B. Four regions are controlled in both Panels. t-statistics are in parentheses. */**/*** refer significance levels of 10%, 5%, and 1%. The complete results from the labor supply estimation are presented in Appendix 5.

Table 7. Decomposition for occupational choice, earnings and labor supply models: estimates of percentage of gender gap due to Male/Female differences in Risk preferences

		(1)	(2)	(3)
		Female coefficient	Male coefficient	Pooled coefficient
Entrepreneurial choice				
	Coefficient	0.0004	0.0024	0.0018
	Difference	0.0202	0.0202	0.02022
	Percentage	**1.9%**	11.8%	8.8%
Log Earnings				
Self-employed	Coefficient	-0.0022	-0.0835	-0.0120
	Difference	0.4366	0.4366	0.4366
	Percentage	**-0.5%**	-19.1%	-2.7%
Paid-employed	Coefficient	0.0028	-0.0052	0.0021
	Difference	0.3121	0.3121	0.3121
	Percentage	**0.9%**	-1.7%	0.7%
Log hours worked				
Self-employed	Coefficient	-0.0012	-0.0130	0.0031
	Difference	0.4162	0.4162	0.4162
	Percentage	**-0.3%**	-3.1%	0.8%
Paid-employed	Coefficient	-0.0003	-0.0006	0.0014
	Difference	0.2037	0.2037	0.2037
	Percentage	**-0.1%**	-0.3%	0.7%

Note) Difference indicates mean differences in outcomes such as entrepreneurial choice, earnings, and hours of labor. Percentage is calculated as (coefficient/difference)*100.

Table 8. Robustness of risk preferences in occupational choice

	Men (four point risk index)			Women (four point risk index)		
	Self-Employment	Paid-Employment	Not working	Self Employment	Paid-Employment	Not working
Main estimation	0.024***	-0.024***	1.91e-07	0.0016	-0.0007	-0.0005
(1994~2002)	(3.86)	(3.86)	(0.87)	(0.17)	(0.10)	(0.81)
1993 Control variables	0.025***	-0.025***	0.000	0.007	-0.004	-0.002
	(4.13)	(4.13)	(0.00)	(1.08)	(0.69)	(1.23)
1994-1996	0.012***	-0.012***	-0.000	-0.000	0.002	-0.002
	(3.01)	(2.99)	(0.11)	(0.09)	(0.40)	(0.66)
1994-1998	0.017***	-0.017***	-0.000	0.004	-0.003	-0.001
	(3.58)	(3.56)	(0.54)	(0.77)	(0.57)	(0.71)
1994-2000	0.020***	-0.020***	-0.000	0.004	-0.003	-0.001
	(3.79)	(3.79)	(0.04)	(0.60)	(0.48)	(0.74)
Exclude number of kids, presence of young children, wealth	0.028***	-0.028***	0.000	0.007	-0.006	-0.002
	(4.59)	(4.50)	(0.00)	(1.17)	(0.90)	(1.62)

Note: 1) t-statistics are reported in parenthesis. 2) ***/**/* indicates significance at the 1%/5%/10% level.

Table 9. Robustness of risk aversion in earnings and labor supply

	Self-employment		Paid-employment	
	Male	Female	Male	Female
Panel A *log hourly earnings*				
Main estimate (1994-2002)	**-0.192***** **(3.54)**	**-0.004** **(0.08)**	**-0.039***** **(3.20)**	**0.020**** **(2.12)**
1993 Control variables	-0.143** (2.42)	0.033 (0.54)	-0.041*** (2.67)	0.020** (2.16)
1994-1996	-0.103 (1.26)	-0.095 (1.21)	0.021 (1.46)	-0.011 (0.62)
1994-1998	-0.176* (1.90)	-0.103 (1.03)	0.021 (1.07)	0.007 (0.30)
1994-2000	-0.196 (1.28)	-0.100 (0.73)	0.036 (1.36)	0.048 (1.52)
Exclude number of kids, presence of young children, wealth	-0.140*** (2.73)	-0.004 (0.08)	-0.014 (1.25)	0.019** (2.01)
Panel B *log hours worked*				
Main estimate (1994-2002)	-0.030 (1.36)	-0.003 (0.08)	-0.004 (0.90)	-0.002 (0.36)
1993 Control variables	-0.056** (2.25)	-0.011 (0.26)	-0.005 (1.19)	0.001 (0.20)
1994-1996	-0.146* (1.76)	-0.031 (0.25)	-0.014 (1.01)	-0.018 (0.90)
1994-1998	-0.074 (0.52)	0.030 (0.21)	-0.019 (0.94)	-0.021 (0.80)
1994-2000	0.160 (0.76)	-0.160 (0.88)	-0.023 (0.78)	-0.056* (1.68)
Exclude number of kids, presence of young children, wealth	-0.010 (0.48)	0.004 (0.10)	0.000 (0.09)	-0.002 (0.27)

Note: Averaging time-varying characteristics are controlled in the main regression based 9 years of time window. t-statistics are in parentheses. */**/*** refer significance levels of 10%, 5%, and 1%.

Table 10. Robustness of decomposition of entrepreneurial choice, earnings, and hours worked with respect to risk aversion

		Entrepreneurial choice	Earnings		Hours worked	
			Self-employment	Paid-employment	Self-employment	Paid-employment
Main estimation:1994-2002	Coefficient	0.0004	-0.0022	0.0028	-0.0012	-0.0003
	Difference	0.0202	0.4366	0.3121	0.4162	0.2037
	Percentage	**1.9%**	**-0.5%**	**0.9%**	**-0.3%**	**-0.1%**
1993 Control variables	Coefficient	0.0010	0.0152	0.0029	-0.0043	0.0004
	Difference	0.0259	0.3995	0.3133	0.4035	0.2051
	Percentage	**4.0%**	**3.4%**	**0.9%**	**-1.1%**	**0.2%**
1994-1996	Coefficient	2.09E-05	-0.0428	-0.0018	-0.0046	-0.0073
	Difference	0.0196	0.6087	0.4190	0.6044	0.3859
	Percentage	**0.1%**	**-7.0%**	**-0.4%**	**-0.8%**	**-1.9%**
1994-1998	Coefficient	0.0005	-0.0376	0.0012	0.0249	-0.0033
	Difference	0.0239	0.7048	0.5581	0.6890	0.5835
	Percentage	**1.9%**	**-5.3%**	**0.2%**	**3.6%**	**-0.6%**
1994-2000	Coefficient	0.0006	-0.0404	0.0083	-0.0082	-0.0088
	Difference	0.0203	0.9143	0.6958	1.0880	0.6914
	Percentage	**2.9%**	**-4.4%**	**1.2%**	**-0.7%**	**-1.3%**
Exclude number of kids,	Coefficient	0.0012	-0.0019	0.0026	0.0017	-0.0002
presence of young	Difference	0.0259	0.4366	0.3121	0.4162	0.2037
children, wealth	Percentage	**4.5%**	**-0.4%**	**0.8%**	**0.4%**	**-0.1%**

Appendix 1. Proofs of $\frac{\partial \mu_w}{\partial \theta} < 0$ and $\frac{\partial \mu_s}{\partial \theta} > 0$

1) Proof of $\frac{\partial \mu_w}{\partial \theta} < 0$

For simplicity, subscript y is dropped.

$$EU^s = e_s \mu_s^{1-\theta}\left[\frac{1}{1-\theta} - \frac{\theta}{2}\left(\frac{\sigma_s}{\mu_s}\right)^2\right] + (1-e_s)\mu_L \equiv f^s(\theta; \mu_s, \sigma_s) \qquad (1)$$

$$EU^w = e_w \mu_w^{1-\theta}\left[\frac{1}{1-\theta} - \frac{\theta}{2}\left(\frac{\sigma_w}{\mu_w}\right)^2\right] + (1-e_w)\mu_L \equiv f^w(\theta; \mu_w, \sigma_w) \qquad (2)$$

Let's assume that there exists expected return from paid-employment, $\hat{\mu}_w$, that keeps an individual *i* indifferent between self-employment and paid-employment:

$$f^s(\theta; \mu_s, \sigma_s) = f^w(\theta; \hat{\mu}_w, \sigma_w) \qquad (3)$$

We are interested in assessing how increases in risk aversion affect the required wage in order to choose paid-employment, holding other things constant. Taking total derivative of (3) with respect to θ and $\hat{\mu}_w$ yields

$$\frac{\partial f^s}{\partial \theta} d\theta = \frac{\partial f^w}{\partial \theta} d\theta + \frac{\partial f^w}{\partial \hat{\mu}_w} d\hat{\mu}_w \qquad (4)$$

$$\Leftrightarrow \frac{d\hat{\mu}_w}{d\theta} = \frac{\left(\frac{\partial f^s}{\partial \theta} - \frac{\partial f^w}{\partial \theta}\right)}{\frac{\partial f^w}{\partial \hat{\mu}_w}} < 0 \qquad (5)$$

where $\frac{\partial f^w}{\partial \hat{\mu}_w} = e_w(1-\theta)\hat{\mu}_w^{-\theta}\left[\frac{1}{1-\theta} - \frac{\theta}{2}\left(\frac{\sigma_w}{\hat{\mu}_w}\right)^2\right] + e_w \hat{\mu}_w^{1-\theta}\left[\frac{\theta}{\hat{\mu}_w}\left(\frac{\sigma_w}{\hat{\mu}_w}\right)^2\right] > 0$

Numerator of (5) is negative because $\frac{\partial f^s}{\partial \theta}$ is more negative than $\frac{\partial f^w}{\partial \theta}$ as shown in Figure 1, and denominator of (5) is positive based on the presumption that $0 < \theta < 1$.

Therefore, the equation (5) is negative, which implies that a more risk averse individual requires lower wage from paid-employment than their less risk averse counterparts when they decide to enter wage work, holding other things fixed.

2) Proof of $\frac{\partial \mu_s}{\partial \theta} > 0$ is analogous to 1).

$$\frac{\partial f^s}{\partial \theta} d\theta + \frac{\partial f^s}{\partial \hat{\mu}_s} d\hat{\mu}_s = \frac{\partial f^w}{\partial \theta} d\theta \tag{6}$$

$$\Leftrightarrow \frac{d\hat{\mu}_s}{d\theta} = \frac{\left(\frac{\partial f^w}{\partial \theta} - \frac{\partial f^s}{\partial \theta}\right)}{\frac{\partial f^s}{\partial \hat{\mu}_s}} > 0 \tag{7}$$

Numerator of (7) is positive because $\frac{\partial f^s}{\partial \theta}$ is more negative than $\frac{\partial f^w}{\partial \theta}$ as shown in Figure 1.

Appendix 2. The effect of risk aversion on work effort in hours.

Assume that an individual *i* chooses *j* occupation and so selects e_j for $j=s$, w at a fixed level of utility $\bar{u}_j$.

Let $$e_j \mu_j^{1-\theta}\left[\frac{1}{1-\theta}-\frac{\theta}{2}\left(\frac{\sigma_j}{\mu_j}\right)^2\right]+(1-e_j)\mu_L \equiv e_j g(\theta;\mu_j,\sigma_j)+(1-e_j)\mu_L=\bar{u}_j \qquad (1)$$

Taking total derivative of (1) with respect with θ and e_j yields

$$g(\theta;\mu_j,\sigma_j)de_j + e_j\frac{\partial g}{\partial \theta}d\theta - \mu_L de_j = 0$$

$$\Leftrightarrow \frac{de_j}{d\theta}=\frac{-e_j\frac{\partial g}{\partial \theta}}{g(\theta;\mu_j,\sigma_j)-\mu_L} \gtreqless 0 \qquad (2)$$

Numerator of (2) is positive because $\frac{\partial g}{\partial \theta}<0$ from Figure 1 and $e_j>0$. But, sign of denominator of (2) is ambiguous depending on the relative sizes of utility from market work, $g(\theta;\mu_j,\sigma_j)$ and utility from nonmarket work, μ_L.

Appendix 3. Constant absolute risk aversion

We specify the utility function as

$$U = e[1 - \exp(-\theta y)] + (1 - e)\mu_L$$

where y is monetary return from the market work and μ_L is utility from nonmarket work or leisure; $y = y(X_m)$ and $\mu_L = \mu(X_m, X_h)$.

Taking the MacLaurin series expansion about $-\theta y$ and assuming the distribution of y has second moments, the expected utility is approximated as

$$EU = e\left[1 - \left\{1 - \theta E(y) + \frac{1}{2}\theta^2 E(y^2)\right\}\right] + (1 - e)\mu_L$$
$$= e\left[\theta\mu_y - \frac{1}{2}\theta^2\left({\sigma_y}^2 + {\mu_y}^2\right)\right] + (1 - e)\mu_L$$

where μ_y is expected earnings from market work and ${\sigma_y}^2$ is variance of earnings in the market.

The first order conditions are as given

$$e^* > 0 \; if \; \left[\theta\mu_y - \frac{1}{2}\theta^2\left({\sigma_y}^2 + {\mu_y}^2\right)\right] = \mu_L$$

$$e^* = 0 \; if \; \left[\theta\mu_y - \frac{1}{2}\theta^2\left({\sigma_y}^2 + {\mu_y}^2\right)\right] < \mu_L$$

$$e^* = 1 \; if \; \left[\theta\mu_y - \frac{1}{2}\theta^2\left({\sigma_y}^2 + {\mu_y}^2\right)\right] > \mu_L$$

$$e^* = e(\theta, X_{m,} X_h)$$

Assuming e>0, an individual will enter self-employment if

$$e_s\left[\theta\mu_{y_s} - \frac{1}{2}\theta^2\left({\sigma_{y_s}}^2 + {\mu_{y_s}}^2\right)\right] + (1 - e_s)\mu_L > e_w\left[\theta\mu_{y_w} - \frac{1}{2}\theta^2\left({\sigma_{y_w}}^2 + {\mu_{y_w}}^2\right)\right] + (1 - e_w)\mu_L$$

$$\Leftrightarrow e_s\mu_{y_s}^2\left[\frac{\theta}{\mu_{y_s}}-\frac{1}{2}\theta^2\left(\left(\frac{\sigma_{y_s}}{\mu_{y_s}}\right)^2+1\right)\right]+(1-e_s)\mu_L > e_w\mu_{y_w}^2\left[\frac{\theta}{\mu_{y_w}}-\frac{1}{2}\theta^2\left(\left(\frac{\sigma_{y_w}}{\mu_{y_w}}\right)^2+1\right)\right]+(1-e_w)\mu_L$$

$CV_s > CV_w$ implies that the second term in the bracket on the left hand side is smaller than that on the right hand side. This suggests that μ_{y_s} should be higher than μ_{y_w} to choose self-employment for any given risk aversion, other things equal.

In addition, as risk aversion increases, the expected utility from market work declines faster in self-employment than in paid-employment at a fixed level of work effort because $CV_s > CV_w$. Hence, the predictions from CARA are virtually the same as those from CRRA.

Appendix 4. Multinomial Logit Marginal Effects of Determinants of Occupational Choice for Men and Women (1994~2002): Including those who were self-employed in 1993

	Men			Women		
	Self-Employment	Paid-Employment	Not working	Self-Employment	Paid-Employment	Not working
Panel A						
Risk acceptance index(1-4)	**0.021*** (2.95)**	**-0.021*** (2.91)**	**0.000 (0.01)**	**0.002 (0.20)**	**-0.001 (0.14)**	**-0.000 (0.87)**
Education	-0.011** (2.30)	0.011** (2.09)	-0.000 (0.01)	-0.000 (0.03)	0.000 (0.00)	0.000 (0.43)
Age	-0.077 (0.67)	0.076 (0.62)	0.000 (0.01)	0.012 (0.10)	-0.007 (0.06)	-0.005 (0.62)
Age squared	0.001 (0.61)	-0.001 (0.57)	-0.000 (0.01)	-0.000 (0.05)	0.000 (0.00)	0.000 (0.70)
Work experience	0.006* (1.93)	-0.006 (1.62)	-0.000 (0.01)	-0.005** (2.23)	0.007*** (3.11)	-0.002*** (3.82)
log(net asset)	0.173*** (6.69)	-0.173*** (6.70)	0.000 (0.01)	0.105*** (4.00)	-0.111*** (4.20)	0.006*** (2.69)
White	0.040* (1.82)	-0.040* (1.82)	0.000 (0.01)	0.037* (1.66)	-0.038* (1.68)	0.001 (0.42)
Married, spouse present	-0.030 (0.95)	0.030 (0.95)	0.000 (0.01)	0.040 (1.58)	-0.043* (1.71)	0.003* (1.78)
Number of Kids	-0.008 (0.59)	0.008 (0.58)	0.000 (0.01)	0.015 (1.20)	-0.014 (1.14)	-0.001 (0.91)
Presence of young kids (0~6)	-0.022 (0.49)	0.022 (0.49)	-0.000 (0.01)	0.006 (0.16)	-0.016 (0.43)	0.010*** (2.92)
Presence of young kids (7~12)	-0.113* (1.80)	0.113* (1.80)	-0.000 (0.01)	-0.095* (1.89)	0.101** (2.00)	-0.006 (1.62)
Health limitation to work	0.102* (1.82)	-0.102* (1.64)	0.000 (0.01)	0.064 (1.53)	-0.074* (1.75)	0.009*** (2.96)
Mother’s education	0.005 (1.30)	-0.005 (1.30)	0.000 (0.01)	0.002 (0.42)	-0.002 (0.39)	-0.000 (0.55)
Father’s education	0.001 (0.45)	-0.001 (0.45)	-0.000 (0.01)	0.002 (0.67)	-0.002 (0.79)	0.000* (1.76)
Mother-professional/proprietor	-0.016 (0.34)	0.016 (0.34)	-0.000 (0.01)	0.009 (0.16)	-0.007 (0.13)	-0.002 (0.43)
Father-professional/proprietor	-0.017 (0.64)	0.018 (0.60)	-0.000 (0.02)	0.078** (2.41)	-0.080** (2.44)	0.001 (0.57)
Urban	-0.023 (0.83)	0.023 (0.80)	0.000 (0.01)	-0.015 (0.55)	0.013 (0.46)	0.003 (1.32)

Appendix 5. Estimates of log annual earnings across employment type by gender

	Self-employment		Paid-employment	
	Male	Female	Male	Female
Risk acceptance index(1-4)	**-0.070** **(0.64)**	**-0.073** **(0.52)**	**-0.105***** **(6.86)**	**0.009** **(0.62)**
Education	-0.007 (0.14)	0.102 (1.21)	0.116*** (15.99)	0.097*** (10.29)
Age	1.716 (1.21)	1.307 (0.64)	-0.038 (0.20)	-0.777*** (3.16)
Age squared	-0.024 (1.10)	-0.022 (0.69)	0.001 (0.19)	0.012*** (2.98)
Work experience	-0.105** (2.23)	0.016 (0.43)	0.095*** (19.08)	0.106*** (12.74)
White	0.215 (0.78)	-0.494 (1.11)	0.062* (1.67)	-0.008 (0.18)
Married	-0.113 (0.33)	-0.164 (0.36)	0.058 (1.06)	-0.106** (2.09)
Number of kids	-0.020 (0.12)	-0.044 (0.23)	0.036 (1.63)	0.028 (1.10)
Presence of a kid aged under 6	0.414 (0.85)	-1.097* (1.80)	0.301*** (4.24)	-0.212*** (2.58)
Presence of a kid aged 7-12	0.512 (0.65)	-0.311 (0.37)	0.644*** (6.11)	-0.111 (1.02)
Health problem	-1.362** (2.08)	0.007 (0.01)	-2.358*** (13.73)	-0.503*** (4.47)
Mother education	-0.064 (1.46)	-0.024 (0.40)	-0.0154*** (2.37)	-0.014* (1.74)
Father education	0.003 (0.08)	-0.029 (0.57)	0.000 (0.05)	0.008 (1.24)
Urban	0.265 (0.80)	1.325*** (2.57)	0.126*** (2.79)	0.042 (0.73)
Years in business	0.269*** (3.71)	0.213* (1.68)	-	-
Heckman's selection	-10.291** (2.36)	-19.410** (2.30)	10.337*** (10.53)	-0.982 (1.03)
R^2	0.229	0.261	0.517	0.470
N	172	103	1642	1510

Note: Risk attitudes are measured by a categorical variable from the most (1) to the least risk aversion. Four regions are controlled in both Panels. t-statistics are in parentheses. */**/*** refer significance levels of 10%, 5%, and 1%.

Appendix 6**.** Estimates of labor supply across employment type by gender

	Self-employment		Paid-employment		All working	
	Male	Female	Male	Female	Male	Female
Risk acceptance index(1-4)	-0.030	-0.003	-0.004	-0.002	-0.000	-0.001
	(1.36)	(0.08)	(0.90)	(0.36)	(0.04)	(0.20)
Education	0.007	-0.029	0.005**	0.005	0.006**	-0.003
	(0.71)	(1.22)	(2.12)	(1.43)	(2.27)	(0.69)
Age	0.274	-0.444	0.011	-0.243**	0.023	-0.194*
	(0.93)	(0.81)	(0.18)	(2.48)	(0.35)	(1.73)
Age squared	-0.004	0.007	-0.000	0.004**	-0.000	0.003
	(0.88)	(0.82)	(0.23)	(2.49)	(0.37)	(1.63)
Work experience	0.009	0.028**	0.006***	0.001	0.006***	0.020***
	(0.98)	(2.52)	(3.59	(0.40)	(3.23)	(7.69)
White	-0.108*	-0.113	0.020	-0.013	0.007	-0.069***
	(1.99)	(0.91)	(1.63)	(0.70)	(0.52)	(3.39)
Married	0.015	-0.182	-0.003	-0.085***	0.011	-0.140***
	(0.21)	(1.45)	(0.14)	(4.20)	(0.60)	(6.28)
Number of kids	0.020	-0.094*	0.011	-0.011	0.009	-0.025**
	(0.60)	(1.67)	(1.47)	(1.09)	(1.10)	(2.08)
Presence of a kid aged under 6	0.157	-0.113	0.039*	-0.045	0.049**	-0.147***
	(1.55)	(0.59)	(1.66)	(1.34)	(2.02)	(4.19)
Presence of a kid aged 7-12	0.205	0.465*	0.007	-0.073*	0.003	0.103**
	(1.31)	(1.89)	(0.21)	(1.70)	(0.09)	(2.20)
Health problem	-0.154	0.246	-0.168***	0.194***	-0.093**	0.069
	(1.09)	(1.18)	(2.96)	(4.23)	(2.39)	(1.50)
Mother education	0.013	-0.002	-0.001	-0.003	0.003	-0.003
	(1.34)	(0.13)	(0.48)	(0.90)	(1.23)	(0.96)
Father education	0.000	-0.000	-0.001	0.002	-0.000	-0.005*
	(0.04)	(0.00)	(0.46)	(0.74)	(0.26)	(1.74)
Urban	-0.048	0.026	-0.005	-0.040*	-0.021	-0.019
	(0.71)	(0.19)	(0.34)	(1.75)	(1.34)	(0.73)
Heckman’s selection	-1.396	1.514	0.199	-2.830***	-0.825***	-0.491
	(1.46)	(0.53)	(0.62)	(7.12)	(2.75)	(1.50)
R^2	0.153	0.201	0.059	0.223	0.063	0.175
N	277	221	1629	1488	1906	1709

Note: Four regions are controlled. t-statistics are in parentheses. */**/*** refer significance levels of 10%, 5%, and 1%.

CHAPTER 3. RISK AVERSION OR RISK MANAGEMENT?: HOW MEASURES OF RISK AVERSION AFFECT FIRM ENTRY AND FIRM SURVIVAL

1. Introduction

Numerous studies have shown that measured risk aversion affects occupational and human capital investment decisions. Less risk averse individuals are more likely to pick private sector jobs (Pfeifer, 2008). Less risk averse individuals are also more likely to become entrepreneurs (Van Praag and Cramer, 2001; Hartog et al., 2002; Cramer et al., 2002; Ekelund et al., 2005; Kan and Tsai, 2006; Ahn, 2009). Similarly, less risk averse individuals are more likely to enter occupations and educational investments characterized by higher earnings variances (Orazem and Mattila, 1991; Shaw, 1996; Bonin et al., 2007; Isphording, 2010).

A missing element in these empirical analyses of the effects of risk aversion on occupational or educational decisions is whether those risk aversion also affect the outcomes of those decisions.[13] For example, if risk attitudes affect the decision to become an entrepreneur, they should also affect the choice of riskiness of the venture at the time of decision making. That is, more risk averse entrepreneurs should select safer ventures while less risk averse entrepreneurs should opt for riskier firms. As a consequence, holding constant observable skills, more risk averse entrepreneurs should

[13] Exceptions include Rauch and Frese (2007) and Caliendo et al. (2010) which will be discussed below.

survive more frequently than their less risk averse counterparts. This chapter shows in theory that there is a positive correlation between an individual's degree of risk aversion and the expected return from an entrepreneurial venture at the time of entry and that greater risk aversion increases expected duration in business. Because the expected return is the risk neutral equivalent value, higher expected return implies a higher survival probability. From that proposition, we posit a hypothesis that more risk averse entrepreneurs have higher survival probability than their less risk averse counterparts. We test the hypothesis using successive entry cohorts of young entrepreneurs in the National Longitudinal Survey of Youth 1979 (NLSY79). We show that the prediction is soundly rejected: the most successful entrepreneurs are the least risk averse.

This surprising finding calls into question the interpretation of common measures of risk aversion such as those used in the NLSY as measures of taste for risk. Instead, these measures perform as if they are indicators of entrepreneurial skill – the least risk averse are apparently those who can best assess and manage risks. Indeed, this interpretation ties well with recent experimental evidence presented by Frederick (2005), Benjamin et al. (2006), Burks et al. (2009), and Dohmen et al. (2010) who find that the least risk averse have superior cognitive ability measured by IQ. In the NLSY79 sample, cognitive ability measured by the score on the AFQT is also significantly positively correlated with willingness to accept risk. It seems that agents with the lowest measured risk aversion have unusually high endowments of unmeasured ability, and it is this human capital advantage that leads them to become entrepreneurs, private sector employees, and entrants into occupations and education choices with greater earnings variance.

The next section derives the theorized positive relationship between risk aversion and probability of business success conditional on entrepreneurial entry. Section 3 presents an empirical methodology that will test the role of measured risk aversion on entrepreneurial survival. Section 4 reviews data. In the following subsection, the relation between business income and failure/closure and the measure of risk aversion are discussed. Empirical results that soundly reject the hypothesized relationship between measured risk aversion and entrepreneurial success are presented in section 5. Section 6 concludes.

2. Theory

Pratt (1964) defined a risk premium as the difference between the expected return and the certainty equivalent return. The higher required risk premia make it less likely that more risk averse agents will choose to become entrepreneurs. However, the more risk averse individuals who nevertheless enter self-employment should invest in ventures with greater expected return and less risk compared to entrepreneurs who are less risk averse. This section demonstrates that these predictions follow from a standard theoretical model of occupational choice under uncertainty.

Agents engage in choosing one of several alternative occupations. The individual's utility depends on the monetary and hedonic returns to occupational entry, $U(y_j, \alpha_j)$, where y_j is the present value of future earnings and α_j is a positive or negative hedonic return from an occupation *j*. The utility function is concave and strictly increasing in earnings so that it can reflect an individual's risk aversion. Assuming additive separability, the utility can be described as

$$U_j = u(y_j) + \alpha_j \tag{1}$$

where *u* is an increasing and strictly concave function in y_j, $u' > 0$ and $u'' < 0$.

For simplicity, suppose that there are two occupations, entrepreneurship (*e*) and wage work (*w*). We assume that the present value of income from wage work is known but that the return from entrepreneurship is uncertain.[14] However, the distribution of entrepreneurial earnings is assumed to have known mean and variance.[15] We also assume that the hedonic return from all occupations is known with certainty.

The expected utility of choosing entrepreneurship can be approximated by the second order Taylor series expansion of (1) around mean of earnings, μ_e:

[14] The theory is for a point in time occupational decision subject to expected earnings in the occupation at that time. We do not consider occupational reswitching, although any planned reswitching could be incorporated into the expected earnings stream at that point in time.

[15] We get similar implications if the returns to wage work are uncertain but have lower variance than returns to entrepreneurship, but the derivation is more complicated. Our derivation is consistent with using the variance in wage work as a baseline variation. Hamilton (2000) found that the standard deviation of earnings from self-employment 2-4 times larger than the standard deviation of earnings from wage work. In the NLSY, the coefficient of variation of log hourly earnings from self-employment is 67% to 89% larger for self-employment than wage work.

$$EU_e = u(\mu_e) + u'(\mu_e)E(y_e - \mu_e) + \frac{1}{2}u''(\mu_e)E((y_e - \mu_e)^2) + \alpha_e$$

$$= u(\mu_e) + \frac{1}{2}u''(\mu_e)\sigma_e^2 + \alpha_e \quad (2)$$

where $\mu_e = E(y_e)$ and $\sigma_e^2 = Var(y_e)$.

An individual will enter the risky occupation *e* if his expected utility in the risky job (*e*) is greater than that in the safe job (*w*): $EU_e > EU_w$. The agent is indifferent between the two alternatives when $EU_e = EU_w$,[16]

$$u(\mu_e) + \frac{1}{2}u''(\mu_e)\sigma_e^2 + \alpha_e = u(y_w) + \alpha_w \quad (3)$$

Dividing both sides of (3) by $-u'(\mu_e)$ and rearranging yields

$$\frac{1}{2}\gamma\sigma_e^2 = \frac{u(\mu_e) - u(y_w) + \alpha_e - \alpha_w}{u'(\mu_e)} > 0 \quad (4)$$

where $\gamma = -\frac{u''(\mu_e)}{u'(\mu_e)} > 0$ is the Arrow-Pratt coefficient of absolute risk aversion (ARA).[17]

We need to establish how an increase in risk aversion affects the required return in the risky job in order to keep an individual indifferent between *e* and *w* for any given risk, σ_e. The answer depends on the expected return from *e* at the time individuals are choosing an occupation. Taking the partial derivative of μ_e with respect to γ in (4) yields

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[16] Recall that we have imposed $\sigma_w^2 = 0$ and $\mu_w = y_w$.

[17] Notice that as the known hedonic return from entrepreneurship increases relative to the hedonic return from wage work, the required gap in expected income, $u(\mu_e) - u(y_w)$ necessary to leave the individual indifferent between *e* and *w* gets smaller. This is consistent with Hamilton's (2000) conclusion that entrepreneurs accept lower pay in order to have their own businesses.

$$\frac{\partial \mu_e}{\partial \gamma} = \frac{\frac{1}{2}\sigma_e^2[u'(\mu_e)]^2}{[u'(\mu_e)]^2 - u''(\mu_e)[u(\mu_e) - u(y_w) + \alpha_e - \alpha_w]}$$

$$= \frac{\frac{1}{2}\sigma_e^2 u'(\mu_e)}{u'(\mu_e) - u''(\mu_e)\frac{[u(\mu_e) - u(y_w) + \alpha_e - \alpha_w]}{u'(\mu_e)}}$$

$$= \frac{\frac{1}{2}\sigma_e^2 u'(\mu_e)}{u'(\mu_e) + \gamma[u(\mu_e) - u(y_w) + \alpha_e - \alpha_w]} > 0 \qquad (5)$$

$\frac{\partial \mu_e}{\partial \gamma} > 0$ because $u' > 0$ due to the concavity of u, $\gamma > 0$, and $u(\mu_e) - u(y_w) + \alpha_e - \alpha_w > 0$ from equation (4).[18] The positive sign indicates that as an individual becomes more risk averse, he requires a higher expected return from *e* to be as well off in the risky occupation *e* as in the safe occupation *w*.

If risk aversion affects the required expected return from entrepreneurship at the time of entry, it should also affect the probability of entrepreneurial survival. The expected return is the risk neutral equivalent present value of entering entrepreneurship, and so requiring an even higher expected return implies a higher survival probability.

To formalize this proposition, let $T_i \geq 0$ denote the duration of the firm's existence so that if an entrepreneur *i* exits a business t_i years after start-up: $T_i = t_i$. T_i has a cumulative distribution function, $F(t_i) = \Pr(T_i \leq t_i)$, which is the probability of firm failure by time t_i. The associated probability density function is $f(t_i)$.

An entrepreneur decides to shut down his business if the realized present value of

[18] Alternatively, we could assume relative risk aversion, which generates the same result as ARA does. See Appendix1 for the derivation.

the monetary and hedonic returns from operating the business is less than the operating cost of time which equals the present value of the stream of pecuniary and hedonic returns from wage work at t_i.

$$\pi^R_{i,e,t} + \alpha_e < y_{w,t}(x_i) + \alpha_w \tag{6}$$

The realized return from the entrepreneurial venture at time *t* ($\pi^R_{i,e,t}$) is decomposed into expected return and unexpected return:

$$\pi^R_{i,e,t} = \mu_e(\gamma_i) + \xi_{i,e,t} \tag{7}$$

where μ_e represents the return expected at the time of start-up which is a function of *i*'s degree of risk aversion and $\xi_{i,e,t}$ denotes a random negative or positive shock to the expected stream of returns to entrepreneurship that is realized as of time *t*. The random shock $\xi_{i,e,t}$ is drawn from the distribution, $g(\xi_{i,e,t})$.

The i^{th} entrepreneur will survive in business unless he receives a sufficiently bad draw on $\xi_{i,e,t}$ that the expected present value of pecuniary and hedonic returns to the venture fall below the entrepreneur's opportunity costs of time. In (6), the opportunity costs are represented from the present value of pecuniary and nonpecuniary returns from wage work. That would include $y_{w,t}(x_i)$ which is the present value of anticipated wages which are based on *i*'s human capital and socioeconomic background designated by the vector x_i; plus the hedonic return from wage work, α_w.

The cumulative distribution function of T_i can be specified by the probability of failure at time t_i:

$$\begin{aligned} F(t_i) &= \Pr(T_i \le t_i) \\ &= \Pr(\pi^R_{i,e,t} + \alpha_e \le y_{w,t}(x_i) + \alpha_w) \\ &= \Pr(\mu_e(\gamma_i) + \xi_{i,e,t} + \alpha_e \le y_{w,t}(x_i) + \alpha_w) \\ &= \Pr(\xi_{i,e,t} \le y_{w,t}(x_i) - \mu_e(\gamma_i) + \alpha_w - \alpha_e) \\ &= \Pr(\xi_{i,e,t} \le a_i^*) = G(a_i^*) \end{aligned} \quad (8)$$

where $a_i^* = y_{w,t}(x_i) - \mu_e(\gamma_i) + \alpha_w - \alpha_e$ denotes the reservation profit level at which the entrepreneur is indifferent between shutting down and staying in business; and G is cumulative distribution function of $\xi_{i,e,t}$.

The reservation profit is decreasing in risk aversion because of (5), which means that more risk averse entrepreneurs have a lower reservation profit: $\frac{\partial a_i^*}{\partial \gamma_i} = -\frac{\partial \mu_e}{\partial \gamma_i} < 0$. Therefore, the probability that more risk averse entrepreneurs stay in business is higher than less risk averse entrepreneurs.

The probability that an entrepreneur exits is given by

$$\eta = \int_{-\infty}^{a*} g(\xi_{iet}) d\xi = G(a_i^*) \quad (9)$$

Assuming the profit shocks $\xi_{i,e,t}$ are *iid* random expectation errors, the expected duration in business before receiving a bad draw is:

$$\frac{1}{\eta} = \frac{1}{G(a_i^*)} = S(t_i) = 1 - F(t_i) \quad (10)$$

where $S(t_i)$ is the probability that the firm survive until time t_i.

Equation (10) indicates that because $G(a_i^*)$ is decreasing in γ_i, the expected length of time in business is increasing in γ_i. As a result, conditional on having entered entrepreneurship, the most risk averse agents have to have the lowest probability of exit because they required the highest expected returns from the venture at the time of entry.

Our theoretical predictions contrast with a theory advanced in psychology that the most successful entrepreneurs have medium levels of risk aversion. Atkinson and Birch (1978) argue that entrepreneurs are motivated by conflicting motivations to achieve success and to avoid failure. In effect, their model assumes utility is the product of probability of success, *P*, and probability of failure, *1-P*. Utility is maximized at *P*= 0.5 which they interpret as entrepreneurs with intermediate risk preferences. Meredith et al. (1982) present a similar theory that successful entrepreneurs are moderate risk-takers. They argue that entrepreneurs like to challenge themselves with difficult tasks because they get satisfaction by accomplishing difficult tasks. On the other hand, entrepreneurs want to avoid disutility from failure. As a consequence, successful entrepreneurs pick projects of intermediate risk that offer reasonable probability of success and at least some moderate challenge. These theories fail to incorporate expected returns into their models which lead them to confuse the riskiness of the projects undertaken with the risk preferences of the entrepreneurs. By emphasizing project survival rather than anticipated or realized return on investment, they devalue high risk and high reward ventures. Nevertheless, their prediction that intermediate risk preferences are most successful can be tested against the data as we examine our prediction that success is highest among the most risk averse.

3. Empirical methodology

In order to investigate the extent to which risk aversion affects firm failure, we incorporate a hazard regression variant of the exit probability $F(t_i) = \Pr(\xi_{i,e,t} \le a_i^*) = G(a_i^*)$ in (8). The hazard rate at which spells are completed at duration t_i conditional on surviving up to t_i is defined as

$$h(t_i) = \frac{f(t_i)}{1 - F(t_i)} = \frac{f(t_i)}{S(t_i)} \quad , \tag{11}$$

where $S(t_i)$, $f(t_i)$, and $F(t_i)$ are as defined in equation (10). Assuming the survival time t_i has a Weibull distribution, the hazard function and survival function at time t_i for individual *i* are given by

$$h(t_i, \beta, \delta \mid \gamma_i, a_i^*) = \exp(a_i^* \beta + \delta \gamma_i)\, p t_i^{p-1} \tag{12}$$

$$S(t_i, \beta, \delta \mid \gamma_i, a_i^*) = \exp\{-\exp(a_i^* \beta + \delta \gamma_i) t_i^p\} \tag{13}$$

where p is an ancillary shape parameter to be estimated from the data, γ_i is an ordered categorical variable indicating attitudes toward risk with higher levels representing greater acceptance of risk, and a_i^* is composed of human capital and other socioeconomic variables that set the entrepreneur's pecuniary ($y_{w,t}(x_i)$) and nonpecuniary (α_e and α_w) costs of time. We include education, previous labor market experience, age, and parental self-employment/management experience in the x_i. For our measures of the relative hedonic returns from self-employment and wage work, α_e and α_w, we include marital status and number of children. Such family variables may affect the relative enjoyment in the two occupations. Additional controls include regional and industry dummies to account for sectoral and regional macroeconomic conditions. Definitions and descriptive statistics of the variables employed in our econometric analysis are presented in Table 1.

The sign on δ reveals whether decreasing levels of risk aversion (i.e., increasing levels of willingness to take risk) increase the hazard of firm failure, consistent with the theoretical requirement that more risk averse entrepreneurs must have higher expected returns from selecting *e* at the time of entry. This test implicitly assumes that expectation errors are not systematic, meaning that entrepreneurs' forecasts are rationale given information at the time of entry. Then, taking expectations across multiple entry cohorts, expected and realized returns to entrepreneurship converge to the same mean value.

Although we control for entrepreneurs' observed characteristics, there may be unobserved factors that affect the entrepreneurial survival or failure in addition to the observed regressors. Hence, a frailty model is used to account for the presence of unobserved heterogeneity among individuals. Because frailty (λ) is not directly estimated from the data, we assume that it has unit mean and finite variance (θ) where θ is estimated from the data. Assuming λ is drawn from an inverse Gaussian distribution, the survival function conditional on the frailty is defined as

$$S_\theta(t_i,\beta,\delta,\theta\,|\,\lambda)=\int_0^\infty\{S(t_i,\beta,\delta)^\lambda g(\lambda)d\lambda$$
$$=\exp\left\{\frac{1}{\theta}(1-[1-2\theta\ln\{S(t_i,\beta,\delta)\}]^{1/2})\right\} \qquad (14)$$

where $g(\lambda)$ is probability density function of λ and the subscript θ indicates the dependence of $S(t_i)$ on θ.[19]

The log-likelihood function can be written as

$$L(\beta,\delta,\theta\,|\,a_i^*,\gamma_i)=\sum_{i=1}^n\{d_i\ln f_\theta(t_i,\beta,\delta,\theta)+(1-d_i)\ln S_\theta(t_i,\beta,\delta,\theta)\} \qquad (15)$$

where d is a binary indicator defined such that $d=1$ if the entrepreneur exited from his business and 0 otherwise; $f_\theta(t_i,\beta,\delta,\theta)=-\frac{d}{dt}S_\theta(t_i,\beta,\delta,\theta)$ is probability density function of survival duration *t*.

In order to construct the log-likelihood function in (15), we need to define business survival and failure. We require a common window of time over which to judge a venture's survival. Two-thirds of U.S. firms close within 6 years of entry, and so firms that survive at least 6 years have performed well above average (Dunne et al., 1988;

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[19] Exploiting the relationship between cumulative hazard function and survival function, the survival function conditional on the frailty is given as follows:

$$S(t\,|\,\lambda)=\exp\{-\int_0^t h(u\,|\,\lambda)du\}=\exp\{-\lambda\int\frac{f(u)}{S(u)}du\}=\{S(t)\}^\lambda$$

Knaup and Piazza, 2007).[20] In this vein, we define entrepreneurial survival as remaining in business at least 6 years after startup and business failure as closing the business within the first 6 years.

If we select an inappropriate baseline hazard function, unreliable estimates can result (Heckman and Singer, 1984). As an alternative, we use a semiparametric Cox proportional hazard model which requires no assumption about the baseline hazard function in order to examine the robustness of our findings to alternative assumptions about the error process.

4. Data

The data for the analysis is drawn from the National Longitudinal Survey of Youth 1979 (NLSY79). The NLSY79 includes 12,686 individuals who were 14-22 years old in the initial survey year. Our first step is to create successive cohorts by entry year. The first year the respondent reported self-employment is assumed to be their startup year. We pick a sample of first-time entrepreneurs who entered business in the same year. Hence, those who started their business in 1992, 1994, 1996, 1998, and 2002 are collected for each entry cohort.[21] By analyzing entrepreneurial survival from startup, we avoid

[20] Dunne et al. (1988) found that 62% of manufacturing firms exited within five years following startup. Knaup and Piazza's (2007) examination of the 1998 cohort of new firm entrants found that about two-thirds of firms exited by the sixth year in each of the 10 industries examined.

[21] The NLSY79 conducted survey annually from 1979 through 1994 and biennially thereafter. Due to the biennial survey over the period we are interested in, we assume that the startup is in an even year.

left-censored entrepreneurial spells that have already selected out the most prone to failure. Setting a common starting point also insures that all ventures in the cohort are subject to the same macroeconomic environment. The exit year is measured as the middle year between the last reported self-employment year and the year of new employment status. For example, if the respondent reported self-employment in 1994 but paid-employment in 1996, then we use 1995 as the self-employment exit year. Those who remain self-employed as of the wave of the survey conducted 6 years after entry are treated as survivors. All others in the cohort are treated as failures.

We can stack these 6 cohorts into a series of overlapping sample windows of 6 years each. Figure 1 shows cohorts differentiated by entry years and their related six year window with individual cases labeled as success or failure. Dummy variables for year of entry control for the common macroeconomic environment shaping the expectations of each entry cohort.

Focusing on our entrepreneurship entry cohorts between 1992 and 2002, our sample of self-employed individuals will be initiating their ventures between ages 27 and 37, and deciding to continue the venture or shut down between the ages of 28 and 45. The self-employed are identified by using the “class of worker” category in the NLSY79. We consider respondents to be self-employed if at least one job is reported as self-employment among five possible jobs listed. Unfortunately, not all the respondents were interviewed in each survey year. For the missing case of "class of worker" we tracked down their employment status by looking at job tenures before and after the missing year. For instance, if a respondent's job tenures on self-employment increased by four years over two consecutive surveys (i.e., 1994, 1998), we consider him as self-employed in the year when he was not interviewed (i.e., 1996). When multiple spells of entry and exit are reported, only the first entry and exit are included. We drop entrepreneurs from the sample if they enrolled in school at the time of startup. We also drop individuals with incomplete information on individual attributes at the time of start-up as we need to keep our vector of covariate controls exogenous to the progress of the business over the next six years. The final sample includes 588 entrepreneurs.

The survival and exit rates by entry cohort are summarized in Table 2. Average exit rate varies from 49% to 71% across entry cohorts. The 2000 entry cohort has the lowest exit rate while the 1992 entry cohort has the highest exit rate. Overall, 59 % of the self-employed exited their business within six years of startup, close to the 65% exit rate reported in national analyses of firm survival.

4.1. Relation between income and failure/closure

It is possible that the closure of a business is not due to business failure or bankruptcy but to the sale of a profitable business. While our business exit rate corresponds well to the stylized facts regarding business exits, it is useful to examine the income distribution of our entrepreneurs prior to business closure to insure that exits are due mainly to failure and not to sales of viable enterprises. Business income after expenses (i.e., profit) in the past calendar year was self-reported during each round of the NLSY79. Our measure of entrepreneurial income prior to business exit is net business income reported in the most recently reported wave of the NLSY79 prior to the exit/closure of the business. We can compare that to the distribution of net business income reported by the firms in the same cohort that survived at least 6 years. Figure 2 shows the net profit distribution for both groups. The surviving group net business income distribution lies well to the right with fatter tails than the distribution for those who exited before 6 years elapsed. Appendix 2 provides more precise statistical summary of net profit distribution for both groups. Seventy-two percent of the exiting entrepreneurs reported zero profit shortly before business closure.[22] The percentage rises to 95% at the time of exit. On the other hand, only 22% of surviving entrepreneurs reported zero profit after 5 years from entry. The median profit is $11,384 for surviving firms after five years and zero for exiting firms. Therefore, exits in this sample seem driven by true failure compared to surviving firms.

4.2. Measures of risk aversion

Risk aversion in the NLSY is elicited using questions closely related to the

[22] Zero profit was recorded for those who answered ‘no’ to the question of any business income earned. Hence, zero profit might infer negative profit for some cases.

simple occupational choice model presented in section 2. Respondents are presented a series of hypothetical occupations with different expected lifetime income levels and variances. The individual is asked to choose between a ‘safe’ job paying a fixed income and a second ‘risky’ job that will double the ‘safe’ income with 50% probability or else pay only a fraction of the ‘safe’ income with 50% probability. The degree of risk aversion is measured by the degree to which the respondent is willing to accept downside risk, measured by the amount that pay could be reduced in the ‘risky’ job relative to the ‘safe’ job. The lifetime income gamble questions are as follows:

(Q1) Suppose that you are the only income earner in the family, and you have a good job guaranteed to give you your current (family) income every year for life. You are given the opportunity to take a new and equally good job, with a 50-50 chance that it will double your (family) income and a 50-50 chance that it will cut your (family) income by a third. Would you take the new job?

The individuals who answered ‘yes’ to this question were then asked: (Q2) suppose the chances were 50-50 that it would double your (family) income and 50-50 that it would cut it in half. Would you still take the new job? Those who answered ‘no’ to the first question (Q1) then asked: (Q3) suppose the changes were 50-50 that it would double your (family) income and 50-50 that it would cut it by 20 percent. Would you take the new job?

The risk questions are asked in 1993, 2002, 2004, and 2006 in the NLSY79. Because the 2002 entry cohort is the last one considered based on the window of 6 years, we employ the risk aversion measured in 1993 in order to avoid having measures of risk aversion that follow the business entry decision and reflect the success or failure of the enterprise.[23]

Based on their responses to these questions in the 1993 wave of the NLSY, we place our entrepreneurs into one of four risk aversion categories ranging from the most risk averse (category1) to the least risk averse (category4). The risk aversion categories are constructed as follows:

$$Risk\ acceptance\ index = \begin{cases} 1\ if & reject\ 1/3cut\ \&\ reject\ 1/5cut\ ;the\ most\ risk\ averse \\ 2\ if & reject\ 1/3cut\ \&\ accept\ 1/5cut \\ 3\ if & accept\ 1/3cut\ \&\ reject\ 1/2cut \\ 4\ if & accept\ 1/3cut\ \&\ accept\ 1/2cut\ ;the\ least\ risk\ averse \end{cases}$$

The distribution of the measured risk aversion for our entrepreneurial entry cohorts is presented in Table 3. Overall, 40% of the entrepreneurs fall into the most risk averse category and 28 % fall into the least risk averse group. There is no apparent systematic pattern to the distribution of the measured risk aversion across cohorts, with the 2002 and 1992 cohorts having similar variation in risk attitudes. These distributions indicate that there is considerable variation in measured risk attitudes in all the entry cohorts included in our sample.

5. Estimation results

The results of the failure hazard models applied to the 6 stacked entry cohorts of young entrepreneurs in the NLSY79 are reported in Table 4 Panel A. For robustness, we

[23] We focus on how risk aversion measured before occupational choice affects the present value of expected return from entrepreneurship at the time of entry and expected duration in business.

show various specifications implying different assumptions about the nature of the error terms and individual unobserved heterogeneity. The estimate of θ is statistically different from zero and a likelihood ratio test for the presence of heterogeneity is statistically significant, which confirms the existence of unobserved individual traits that affect probability of business failure. The estimated shape parameter p is greater than 1 and statistically significant, which means that the hazard of failure increases with time. The significant estimates of θ and p suggest that the Cox model is misspecified. We will therefore focus our discussion on the frailty model results, although none of our qualitative conclusions is sensitive to the specification choice.

We report our results in terms of implied hazard ratio: i.e. the proportional shift in the failure hazard function due to one unit change of the covariate, holding fixed all other factors including the unobserved frailty. The control measures perform as in earlier studies of firm longevity. In line with Holtz-Eakin et al. (1994), Cressy (1996) and Taylor (1999), entrepreneur’s age has a significant effect on the hazard of failure. The probability of business failure is quadratic in age, decreasing initially and then increasing past a certain age (i.e., 37 in our data). Previous labor market work experience plays an important role in lowering the hazard of firm failure, consistent with Taylor’s (1999) analysis. An additional year of previous experience cuts the hazard of failure by 10%. Education (in years of schooling) has no significant impact on firm hazard rate. This suggests that academic success is a poor indicator of entrepreneurial ability (Taylor, 1999). Apparently, practical intelligence acquired from work experience is more important (Sternberg, 2004). Finally, our results show that gender, race, and marital status have little effect on hazard rate. Having self-employed parents also does not have a significant impact on business failure although it is found to increase probability of becoming self-employed in the previous literature (e.g., Lentz and Laband, 1990; Dunn and Holtz-Eakin, 2000).

Turning to our main concern, the first column reports the effect of risk attitudes on firm exits when risk is the only regressor. Recall that the risk index goes from most (1) to least (4) risk averse. We have the unexpected result that as the entrepreneur becomes less risk averse, as measured by standard measures of risk aversion, the likelihood of failure decreases. This is the exact opposite of the predicted relationship between risk aversion and firm survival.

It is possible that the unexpected result is attributable to a correlation between risk attitudes and individual human capital and demographic variables that are known at the start of the entrepreneurial spell. However, when we add these measures in Column 2 the impact of risk attitudes on entrepreneurial hazard of failure is almost identical to that in the first column. The next column adds controls for industry. Technically these measures are endogenous as the entrepreneur picks the sector at the time of entry, and so these sectoral dummies should be excluded. Nevertheless, they are commonly found to affect firm survival (Taylor, 1999) due to sector specific shocks that may differentially affect profitability for firms in the same cohort. The most risk averse are still the most likely to fail with a similar hazard ratio, although the estimate loses precision.

Overall, the results from the four specifications suggest that less risk aversion results in a lower hazard and therefore a longer survival time. More precisely, a unit increase in risk acceptance index is associated with a 14% decrease in the hazard of failure. As a result, we soundly reject the hypothesis that more risk aversion increases the probability of entrepreneurial survival. Our finding is also inconsistent with the psychological models that argue the most successful entrepreneurs have moderate risk aversion. In order to check the psychological argument, we test for the intermediate risk attitudes against the most and the least risk using risk attitudes dummies. To do so, we generate three risk attitude dummies: willingness to take low, medium, and high risk. We use willingness to take low risk as base category. As shown in Panel B of Table 4, we do not observe the predicted nonlinear relationship between risk aversion and hazard of firm failure.[24] Instead, the hazard ratio drops progressively as willingness to take risk increases. Indeed, the most successful entrepreneurs are the least risk averse as before.

Our findings differ from the few previous studies relating risk aversion and

[24] The results are not sensitive to different classification of risk dummy variables. See the Appendix 3 for the estimation results.

entrepreneurial success. The meta analysis of past studies of risk aversion and entrepreneurial success by Rauch and Frese (2007) reported a positive but relatively small correlation. Hence, they conclude that risk attitudes have little effect on entrepreneurial success. However, differences in risk and success measures across studies make it hard to generalize findings. A more recent study by Caliendo et al. (2010) reported a U-shaped relationship between risk attitudes and entrepreneurial failure which they offered as support for the psychological theories.[25] One difficulty with their study is the reliance on nonstandard measures of risk aversion that do not fit the required context of selecting risky occupations.[26] A further problem is that risk attitudes were measured after startup for most respondents and so their measure of risk attitudes may reflect business success or failure. However, the most important problem common to past studies is the failure to focus on the decisions of an entry cohort but rather on business survival of entrepreneurs who have already managed to survive many years prior to the survey. The longer a firm survives, the more likely it will continue to survive (Knaup and Piazza, 2007), and so the risk attitudes of entrepreneurs that already failed before the survey are not incorporated

[25] It is likely that Caliendo et al. (2010) misinterpret the psychological theory of achievement motivation as an inverse U-shaped relationship between risk-taking propensity and survival. That higher achievement is positively related to propensity to take an intermediate risk does not necessarily mean an inverse U-shaped relationship between risk attitudes and achievement. In their theoretical model, Caliendo et al. (2010) assume that less risk aversion is associated with higher expected payoff in the case of success, which yields the odd implication that the most risk averse picks projects with the lowest return conditional on success, regardless of variance. In addition, they did not model utility explicitly.

[26] Two sets of questions are used to measure respondent's risk aversion. One set of questions asks respondents if they are risk averse. The other asks respondents how they would invest lottery winnings, a context that could elicit very different risk preferences than one where they are allocating earned income, and one that confuses risk preferences with portfolio allocation.

into the analysis. That selection problem biases any interpretation of the relationship between risk aversion and firm survival.

5.1. Sensitivity analysis

We first test sensitivity of the results with respect to the time windows over which business survival and failure are defined. The estimation results are summarized in Table 5 Panel A. For brevity, we report only the estimates of risk attitudes in the four specifications. The baseline estimation results are redisplayed in the first row of Table 5 for reference. The second row represents the results when we define the survival as remaining in business at least 4 years after startup. The third row is the case when we consider firm survival as remaining in business at least 8 years after entry. The regression results remain stable in all the specifications. The negative relationship between risk attitudes and hazard of failure holds for both the windows of 4 and 8 years although the estimates based on 4 years become insignificant.

One concern we raise with past studies is the use of measures of risk aversion that are taken after the respondent has already been in business. We illustrate the potential bias of using endogenous risk preference measures in Panel B of Table 5. We re-estimate the hazard regression with risk attitudes measured in 2002, 2004, and 2006. While the coefficient is still negative, the estimate is never statistically significant. It appears that the bias from using risk aversion elicited after startup is to lessen evidence that the most risk averse are the least successful.

Because our own results rely on the NLSY's 1993 elicitation of risk attitudes, it is possible that we should have excluded the 1992 entrepreneurship cohort. Our findings above suggest that inclusion of the 1992 cohort may have biased our results. We refit the hazard regression without the 1992 entry cohort. The results are summarized in Table 5 Panel C. In all cases, the finding that the most risk averse are most likely to fail strengthens compared to the estimates in the first row of Table 5, consistent with our assessment that endogenously elicited risk aversion bias the estimates toward zero.

Lastly, rather than using entry cohorts, we use a sample of surviving entrepreneurs as of 2002, a sample comparable to the type used in previous studies. Such samples should be biased by the exclusion of the least successful entrepreneurs. We add a control for firm tenure along with the other individual characteristics used before. As shown in Panel D of Table 5, all coefficients on risk attitudes are now positive and insignificant, consistent with the theoretical effect of risk aversion of entrepreneurial success. Selection bias from inappropriately excluding unsuccessful entrepreneurs appears to bias upward coefficients on risk attitudes.

Our conclusion that entrepreneurs with the lowest measured risk aversion are the most successful holds up well. When researchers use selected samples or endogenous measures of risk aversion, these findings are compromised. We believe our results are more reliable than past studies because of our use of risk attitudes elicited before startup and our inclusion of all members of each entrepreneurial entry cohort in the analysis.

5.2. Risk aversion or Risk management?

Our surprising finding that the most risk averse entrepreneurs are the most likely to fail calls into question the interpretation of common measures of risk aversion such as those used in the NLSY as measures of attitudes toward risk. Our measured risk attitudes perform as if they are indicators of entrepreneurial ability: utilizing information and making intelligent decision under uncertainty. In other words, the less risk averse are apparently those who are better able to assess and manage risks.

Although previous studies have found that greater willingness to take risk increases probability of entrepreneurship, it is likely that the least risk averse agents may have unusually high endowments of entrepreneurial talent and it is this human capital advantage that leads them to become entrepreneurs. Indeed, this interpretation is consistent with the recent evidence presented by experimental studies that find that the least risk averse are those who have superior cognitive ability. These experimental studies elicited risk aversion using choices between a lottery and a safe payment.

Frederick (2005) investigates how cognitive ability is related to risk attitudes using U.S. undergraduate students. To do so, he developed intelligence test called “Cognitive Reflection Test (CRT)” that measures respondents’ cognitive ability. He finds that individuals in the high CRT-score group are less risk averse than those in the low CRT-score group. He states that, “the relation is sometimes so strong that the preferences themselves effectively function as expressions of cognitive ability (p.26).” Similarly, Benjamin et al. (2006) investigate whether variation in risk attitudes is related to variation in cognitive ability measured by Scholastic Assessment Test (SAT). They find that students with higher SAT score in Chilean high school show greater willingness to take risk. They suggest that measured risk attitudes may not fully reflect tastes for risk due to cognitive limitations.

More recently, Dohmen et al. (2010) assess the relation between risk attitudes and cognitive ability using representative German data. They discover that less risk averse individuals are those who have higher cognitive ability as measured by tests of word fluency and symbolic logic. They concluded that cognitive ability conveys information about risk aversion.

There is modest support for a link between risk acceptance and cognitive ability in the NLSY sample. The Armed Forces Qualifying Test (AFQT), a widely-used proxy for measures of ability, was administered to all individuals in the NLSY79. The correlation between measured risk acceptance and the AFQT score is 0.04 for those who were self-employed in 1993 and 0.03 for those who ever had start-ups between 1992 and 2002. In contrast, the correlation between AFQT score and risk acceptance is negative in the population of wage workers.

As a simple test of the comparative static relationship between cognitive ability and risk acceptance, we regress measured risk attitudes on AFQT score, controlling for the other individual characteristics we included as measures of opportunity cost of time. Because of the possible nonlinear measures of risk attitude index, we also incorporate ordered probit model. The regression results are reported in Panel A of Appendix 4. In both models, AFQT score has a statistically significant and positive effect on risk acceptance index. We also report marginal and discrete changes in probabilities for each outcome of risk attitudes in Panel B of Appendix 4. The probability change is associated with a standard deviation increase in the corresponding independent variable centered on the mean. The effect of AFQT score is small: a one standard deviation increase in AFQT score increases the probability of being in the most risk accepting category by just 1.4 percentage points. Nevertheless, it is much larger than the statistically insignificant 0.4 percentage point increase in probability of being in the same category from an additional year of schooling. The implied existence of an unlearned or nascent entrepreneurial skill separate from learned skills is similar to the λ in Lazear's (2005) 'jack-of-all-trades' model of entrepreneurship. Along with the experimental evidence of a positive correlation between measured risk acceptance and cognitive ability suggest that measures of risk attitudes are in fact measures of entrepreneurial ability or the ability to manage risk. The more confidence agents have in their own ability, the greater confidence they will have in their decisions under uncertainty and so greater willingness to take risks.

6. Conclusion

This chapter presents a standard theoretical model of occupational choice under uncertainty in order to explain more risk averse agent requires higher expected return at the time of entry into entrepreneurship. Because the expected return is the value adjusted by risk aversion, higher expected return implies a higher survival probability. From that proposition, we hypothesize that more risk averse entrepreneurs have a higher probability of survival than their less risk averse counterparts. This chapter empirically tests the hypothesis applying a frailty hazard model to successive entry cohorts of young entrepreneurs in the NLSY79. Success is judged as surviving at least 6 years which puts the venture in the upper third of the tenure of start-ups.

Surprisingly, the empirical tests soundly refute the hypothesis. We find that the most successful entrepreneurs are the least risk averse. This finding also holds true when controlling for individual human capital and demographic variables. Furthermore, the unexpected result is not sensitive to different time windows over which to judge a venture's success. When incorporating risk aversion dummies in our regression, we still observe a monotonically negative relationship between risk acceptance and entrepreneurial failure. Consequently, our conclusion that the most successful entrepreneurs are the least risk averse holds up well. This finding suggests that commonly used measures of risk aversion are not indicators of taste toward risk. Instead, measured risk aversion signals weak entrepreneurial ability, consistent with recent experimental evidence linking cognitive ability with a greater willingness to accept risk. There is also modest support for a link between measured risk attitudes and cognitive ability in the NLSY 79 sample.

This current study suggests an alternative interpretation; individuals with the lowest measured risk aversion have unusually high endowments of unmeasured ability, and it is this human capital advantage that leads them to become entrepreneurs, private sector employees, and entrants into occupations and education choices with greater earnings variance.

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Table 1. Definitions and descriptive statistics of variables

	Definition	Mean (Std.)	Min	Max
Risk acceptance index (1-4)	Willingness to take risk: the risk index 1 indicates the most risk averse and 4 means the least risk averse	2.35 (1.26)	1	4
Education	Years of schooling completed	12.82 (2.40)	1	20
Work experience	Years of previous labor market employment experience before self-employment	13.59 (5.33)	0.35	24.58
Age	Age in years	35.90 (3.75)	27	45
Married, spouse present	=1 if married and spouse present	0.57 (0.49)	0	1
Number of kids	Number of bio/step/adopted children in household	1.34 (1.31)	0	6
Male	=1 if male	0.51 (0.50)	0	1
White	=1 if white	0.72 (0.45)	0	1
F-proprietor/manager	=1 if father was/is a proprietor or manager	0.10 (0.30)	0	1
M-proprietor/manager	=1 if mother was/is a proprietor or manager	0.02 (0.15)	0	1
Urban	=1 if reside in urban area	0.73 (0.44)	0	1
Northeast	=1 if reside in northeast	0.14 (0.35)	0	1
North central	=1 if reside in north central	0.23 (0.42)	0	1
South	=1 if reside in south	0.41 (0.49)	0	1
West	=1 if reside in west	0.22 (0.41)	0	1
Indus1	=1 if Agriculture, Forestry and Fisheries	0.063 (0.24)	0	1
Indus2	=1 if Construction	0.14 (0.34)	0	1
Indus3	=1 if Manufacturing	0.03 (0.16)	0	1
Indus4	=1 if Wholesale trade, Retail trade	0.16 (0.37)	0	1
Indus5	=1 if Transportation, Communication, Public Utilities	0.05 (0.21)	0	1
Indus6	=1 if Finance, Insurance, and Real Estate	0.03 (0.17)	0	1
Indus7	=1 if Business and Repair Services	0.16 (0.37)	0	1
Indus8	=1 if Personal Services	0.23 (0.42)	0	1
Indus9	=1 if Entertainment and Recreation Services	0.03 (0.17)	0	1
Indus10	=1 if Professional and related services	0.10 (0.30)	0	1
Indus11	=1 if Public administration	0.003 (0.06)	0	1

Table 2. Six year survival and exit rates by entry cohort (NLSY79)

	1992 Age 27-35	1994 Age 29-37	1996 Age 31-39	1998 Age 33-41	2000 Age 35-43	2002 Age 37-45	Total
Survived	16 (29%)	31 (31%)	63 (43%)	44 (42%)	34 (51%)	56 (47%)	243 (41%)
exited	39 (71%)	69 (69%)	84 (57%)	60 (58%)	33 (49%)	63 (53%)	345 (59%)
Total	55 (100%)	100 (100%)	147 (100%)	104 (100%)	67 (100%)	119 (100%)	588 (100%)

Note: Number of observations is reported with percentage in parenthesis. Survival is measured based on 6 year longevity in business.

Table 3. Distribution of risk aversion by entry cohort (%) NLSY79

Risk acceptance index	1992	1994	1996	1998	2000	2002	overall
1: Most risk averse	43 %	52 %	35 %	34 %	39 %	43 %	40 %
2	17 %	9 %	12 %	14 %	7 %	11 %	11 %
3	7 %	13 %	24 %	22 %	24 %	25 %	21 %
4: Least risk averse	33 %	26 %	29 %	30 %	30 %	21 %	28 %
Total Obs.	54	99	147	103	67	118	588

Table 4. Regressions explaining probability of failure from frailty hazard and Cox proportional model

	(1) Frailty Hazard	(2) Frailty Hazard	(3) Cox proportional	(4) Frailty Hazard
Panel A				
Risk acceptance index(1-4)	0.851 (-2.35)[b]	0.863 (-2.08)[b]	0.929 (-1.66)[c]	0.875 (-1.88)[c]
Previous Labor market experience (in years)		0.919(-3.99)[a]	0.958 (-3.33)[a]	0.921 (-3.84)[a]
Education		1.178 (0.75)	1.112 (0.72)	1.161 (0.68)
Education squared		0.996 (-0.53)	0.997 (-0.58)	0.996 (-0.53)
Male		0.730 (-1.53)	0.824 (-1.51)	0.902 (-0.43)
Married, spouse present		1.067 (0.31)	1.032 (0.24)	1.010 (0.05)
Number of Kids		0.930 (-0.94)	0.959 (-0.86)	0.929 (-0.94)
White		1.234 (0.97)	1.092 (0.66)	1.213 (0.89)
Age		0.380 (-2.31)[b]	0.629 (-1.81)[c]	0.381 (-2.31)[b]
Age squared		1.013 (2.26)[b]	1.0066 (1.76)[c]	1.013 (2.25)[b]
Urban		1.267 (1.11)	1.121 (0.86)	1.234 (0.98)
Father-proprietor		0.806 (-0.70)	0.915 (-0.46)	0.815 (-0.66)
Mother-proprietor		0.546 (-0.96)	0.700 (-0.85)	0.548 (-0.95)
Entry cohort dummies	Yes	Yes	Yes	Yes
4 region dummies		Yes	Yes	Yes
Industry dummies				Yes
θ (frailty variance)	5.221 [1.936][a]	5.578[2.344][b]		5.468 [2.300][a]
p (ancillary parameter)	1.818 [0.134][a]	1.878 [0.147][a]		1.881 [0.147][a]
Log likelihood	-723.2	-704.98	-2099.47	-702.04
Likelihood Ratio (LR) test	$\chi^2(6)$=31.55[a]	$\chi^2(22)$=72.49[a]	$\chi^2(22)$=48.93[a]	$\chi^2(33)$=78.64[a]
LR test for $\theta = 0$	$\overline{\chi^2}(1)$=45.1[a]	$\overline{\chi^2}(1)$=38.6[a]		$\overline{\chi^2}(1)$=38.55[a]
Panel B				
Willingness to take medium risk	0.71 (-1.48)	0.75 (-1.23)	0.86 (-1.03)	0.79 (-1.00)
Willingness to take high risk	0.62 (-2.30)[b]	0.65 (-2.01)[b]	0.81 (-1.57)	0.67 (-1.89)[c]

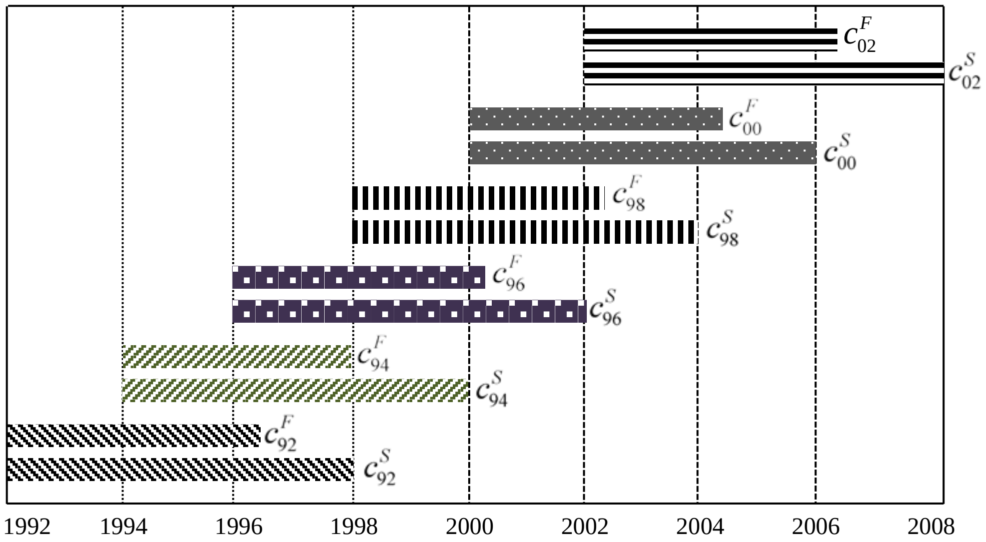
Note: Hazard ratios are exponentiated coefficients. t-statistics are reported in parentheses. Standard errors are in brackets. [a/b/c] significance level at 1%/5%/10%. The null distribution of the LR test statistic is a 50:50 mixture of a χ^2 with zero degree of freedom and a χ^2 with one degree of freedom, denoted as $\overline{\chi}^2(1)$.

Table 5. Sensitivity of risk attitudes: Negative relationship between risk attitudes and hazard

Risk acceptance index	(1) Frailty hazard	(2) Frailty hazard	(3) Cox proportional	(4) Frailty hazard	Sample size
Panel A					
Main estimation: 6 year period	0.851 (-2.35)[b]	0.863 (-2.08)[b]	0.929 (-1.66)[c]	0.875 (-1.88)[c]	588
4 year period	0.919 (-1.20)	0.924 (-1.09)	0.965 (-0.82)	0.930 (-1.01)	679
8 year period	0.849 (-2.33)[b]	0.859 (-2.09)[b]	0.926 (-1.66)[c]	0.864 (-1.97)[b]	470
Panel B					
2002 risk attitudes	0.988 (-0.17)	0.954 (-0.64)	0.977 (-0.52)	0.963 (-0.51)	568
2004 risk attitudes	0.990 (-0.14)	0.995 (-0.06)	0.100 (-0.01)	0.987 (-0.17)	551
2006 risk attitudes	1.006 (0.09)	0.970 (-0.41)	0.982 (-0.38)	0.975 (-0.34)	574
Panel C					
Omitting 1992 cohort with 1993 risk attitudes	0.825 (-2.53)[b]	0.812 (-2.61)[a]	0.901 (-2.18)[b]	0.825 (-2.40)[b]	534
Panel D					
Self-employed in 2002 With 1993 risk attitudes	1.000 (0.01)	1.011 (0.15)	1.011 (0.24)	1.007 (0.10)	639

Note: Top number is the estimated hazard ratio for the risk attitude index where firm success is measured under alternative time windows. The Risk index varies from 1: most risk averse to 4: least risk averse. Columns correspond to the specifications used in the corresponding columns in Table 4. t- statistics reported in parenthesis. [a/b/c] significance level at 1%/5%/10%.

Figure 1. Successive entry cohorts overlapped based on windows of 6 years



Note: Superscript indicates status of survival or failure. Subscript denotes

Figure 2-A. Profit for those who exited business within 6 years after startups

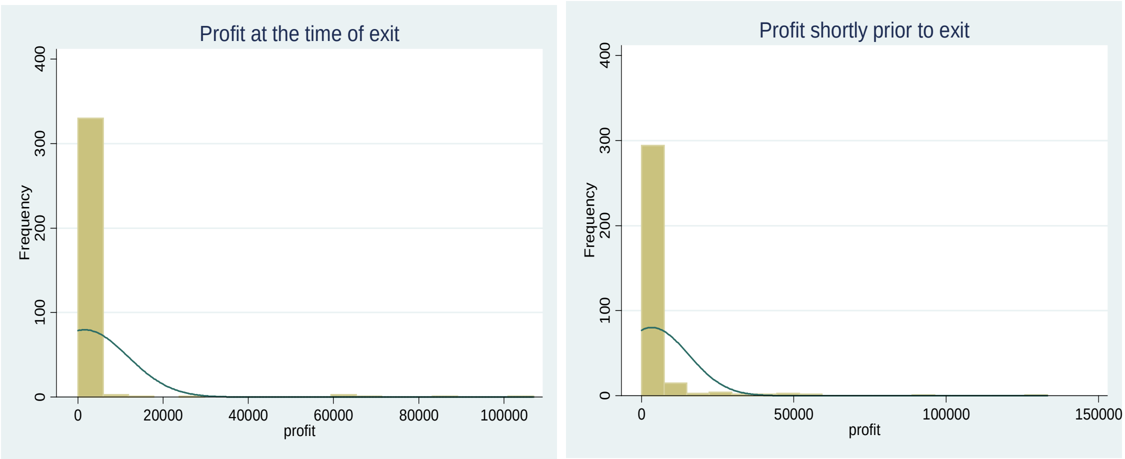
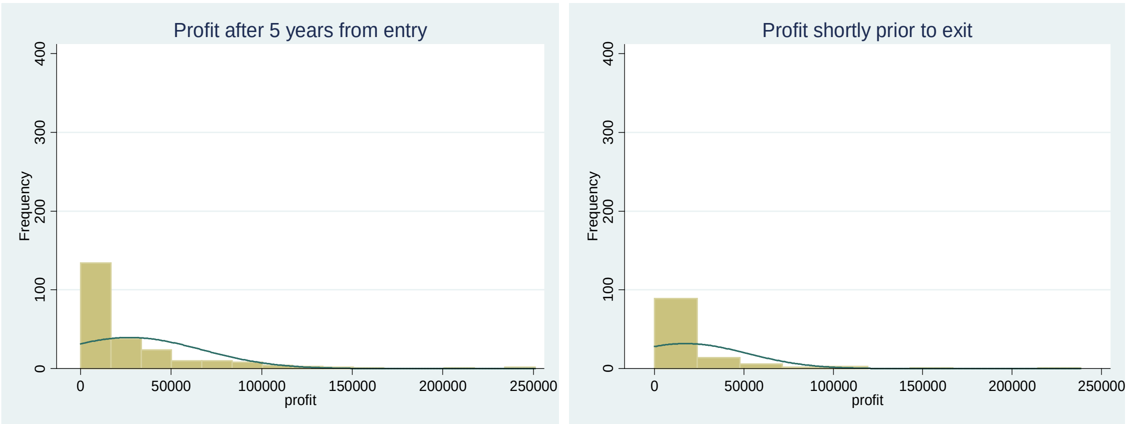


Figure 2-B. Profit for those who survived in business at least 6 years



Appendix 1

An agent is indifferent between the risky job and the safe job when $EU_e = EU_w$,

or

$$u(\mu_e) + \frac{1}{2}u''(\mu_e)\sigma_e^2 + \alpha_e = u(y_w) + \alpha_w \tag{1}$$

Multiplying both sides of (1) by $-\frac{\mu_e}{u'(\mu_e)}$ and rearranging (1) yields

$$\frac{1}{2}\gamma\sigma_e^2 = \frac{\mu_e\{u(\mu_e) - u(y_w) + \alpha_e - \alpha_w\}}{u'(\mu_e)} \equiv \frac{F(\mu_e)}{u'(\mu_e)} \tag{2}$$

where $\gamma = -\mu_e \frac{u''(\mu_e)}{u'(\mu_e)}$ is the Arrow-Pratt coefficient of relative risk aversion.

Taking partial derivative of μ_e with respect to γ in (2) yields

$$\frac{\partial \mu_e}{\partial \gamma} = \frac{\frac{1}{2}\sigma_e^2[u'(\mu_e)]^2}{F'(\mu_e)u'(\mu_e) - u''(\mu_e)F(\mu_e)} > 0 \tag{3}$$

where $F'(\mu_e) = u(\mu_e) - u(y_e) + \alpha_e - \alpha_w + \mu_e u'(\mu_e)$.

The equation (3) is positive because $F' > 0$, $F > 0$, $u' > 0$, and $u'' < 0$.

Appendix 2. Statistical summary of net profit

	Zero profit (frequency)	Mean ($)	Median ($)	Total (N)
<u>Self-employed who exited their business within the first 6 years after startups</u>				
Shortly prior to exit	237 (72%)	$3,401	$0	327
At the time of exit	324 (95%)	$1,548	$0	341
<u>Self-employed who survived at least 6 years</u>				
Shortly prior to exit	34 (29%)	$17,263	$3,106	116
After 5 years from entry	52 (22%)	$27,043	$11,384	237

Note: All income is inflated by CPI-U in 2009 dollar.

Appendix 3. Different classifications of risk attitude dummy variables

	(1) Frailty Hazard	(2) Frailty Hazard	(3) Cox proportional	(4) Frailty Hazard
Panel A				
Risk2	0.96 (-0.14)	0.98 (-0.08)	0.98 (-0.13)	1.02 (0.08)
Risk3	0.71 (-1.47)	0.75 (-1.21)	0.85 (-1.03)	0.79 (-0.95)
Risk4	0.62 (-2.25)[b]	0.65 (-1.95)[c]	0.81 (-1.54)	0.67 (-1.79)[c]
Panel B				
Willingness to take medium risk (risk2)	0.96 (-0.14)	0.98 (-0.08)	0.98 (-0.13)	1.03 (0.08)
Willingness to take high risk (risk3+risk4)	0.65 (-2.31)[b]	0.69 (-1.97)[b]	0.83 (-1.61)	0.72 (-1.72)[c]
Panel C				
Willingness to take medium risk (risk2+risk3)	0.79 (-1.15)	0.82 (-0.93)	0.90 (-0.82)	0.87 (-0.65)
Willingness to take high risk (risk4)	0.62 (-2.25)[b]	0.65 (-1.95)[c]	0.81 (-1.54)	0.67 (-1.80)[c]
Panel D				
Willingness to take medium risk (risk3)	0.71 (-1.48)	0.75 (-1.23)	0.86 (-1.03)	0.79 (-1.00)
Willingness to take high risk (risk4)	0.62 (-2.30)[b]	0.65 (-2.01)[b]	0.81 (-1.57)	0.67 (-1.89)[c]

Note: In Panel A, the categorical variable of 4-point risk acceptance index is converted to four risk attitudes dummies. Risk1 indicates the most risk aversion and Risk4 the least risk aversion. Willingness to take low risk (Risk 1) is used as base in Panel B and C. The consolidated category of Risk1 and Risk2 is used as base in Panel D. t- statistics reported in parenthesis. [a/b/c] significance level at 1%/5%/10%.

Appendix 4. Effect of AFQT score on risk attitudes

Panel A Effect of AFQT score on risk attitudes			
Risk attitudes	(1) OLS	(2) Ordered Probit	(3) Ordered Probit Marginal effect
AFQT	0.002 (1.87)*	0.002 (2.24)**	0.009
Education	0.006 (0.70)	0.005 (0.67)	0.002
Male	0.206 (6.40)***	0.184 (6.25)***	0.036
Age	-0.222 (1.10)	-0.205 (1.12)	0.091
Age squared	0.003 (1.06)	0.003 (1.08)	0.088
White	0.015 (0.40)	0.010 (0.28)	0.002
log(family income)	-0.051 (2.34)**	-0.047 (2.31)**	0.009
Number of kids	-0.023 (1.64)*	-0.022 (1.68)*	0.005
Married	-0.194 (5.04) ***	-0.169 (4.80)***	0.033
Previous labor market experience	-0.014 (2.88) ***	-0.012 (2.85)***	0.010
Constant	6.208 (1.95)*		
/cut1		-3.782 [2.91]	
/cut2		-3.474 [2.91]	
/cut3		-2.983 [2.91]	

Panel B Marginal and discrete changes in predicted probabilities for each outcome of risk attitudes in Ordered probit					
	Average Change	Risk acceptance index=1	Risk acceptance index=2	Risk acceptance index=3	Risk acceptance index=4
AFQT	0.009	-0.018	0.000	0.004	0.014
Education	0.002	-0.005	0.000	0.001	0.004
Male	0.036	-0.073	0.001	0.014	0.058
Age	0.091	0.182	-0.003	-0.035	-0.144
Age squared	0.088	-0.175	0.003	0.034	0.139
white	0.002	-0.004	0.000	0.001	0.003
Log(family income)	0.009	0.017	-0.000	-0.003	-0.014
Number of Kids	0.005	0.011	-0.000	-0.002	-0.009
Married	0.033	0.067	-0.001	-0.013	-0.053
Previous labor market experience	0.010	0.020	-0.000	-0.004	-0.016

Note: t-statistics are reported in parenthesis. Standard errors are in bracket. ***/**/* significance level at 1%/5%/10%. 4 regions are controlled.

CHAPTER 4. ARE RISK ATTITUDES FIXED FACTORS OR FLEETING FEELINGS?

1. Introduction

Although the theory of economic decision under uncertainty typically presumes that individuals have time-invariant risk preferences, a series of empirical papers have raised doubts about the validity of the presumed stable risk preferences. More than two decades ago, Love and Robison (1984) examined the intertemporal stability of risk preferences using a data set including just 23 American farmers. Individual's risk preferences were elicited through choices between pairs of possible incomes at four different income levels in 1979 and again in 1981. They found that risk preferences were not stable over time, although they could not establish a firm pattern of change in risk preferences over two years. More recently, Andersen et al. (2008), using 97 Danish adults from experiments, found that individual's risk attitudes change over a 17-month time period, but they also could not establish a definable pattern of either positive or negative change in risk preferences across time. While optimistic perceptions of personal financial security tend to reduce risk aversion, no other demographic characteristic was correlated with variation in risk attitudes across time. In both studies, relatively short time spans and few observations per individual made it difficult to draw any conclusions beyond the apparent instability of risk preferences. That leaves open the possibility that instability is due more to random measurement errors in risk measurement than to a behavioral response to changing economic circumstances.

Past studies have tried to establish how various economic or demographic attributes 'cause' attitudes toward risk using cross-sectional data. The evidence is uneven. Donkers et al. (2001) find that more educated and higher income individuals are less risk averse. Hartog et al. (2002) also find that wealthier individuals are less risk averse. However, Barsky et al. (1997) show that risk aversion increases with income and wealth for the lower half of their distributions. Donkers et al. (2001), Barsky et al. (1997), and Riley and Chow (1992) all find that risk aversion varies by age, but they disagree on the direction of the correlation. The most consistent finding is that women are more risk averse than men (Donkers et al., 2001; Hartog et al., 2002). Halek and Eisenhauer (2001) find that the unemployed are less risk averse than job holders.

A more recent strand of the literature has begun to question whether measures of risk aversion depend on the risk elicitation method. Barseghyan et al. (2011) found that households tend to be more risk averse when facing hypothetical deductible decisions involving home insurance compared to auto insurance. Anderson and Mellor (2009) find that risk preferences obtained from experiments using real money prizes are not consistent with those inferred from surveys with hypothetical gambles. Binswanger

(1980) observed that the distribution of measured risk aversion shifts to the right as proposed payoffs increase in a field experiment in India. Holt and Laury (2002) derive the same conclusion in a sample of American students.

Another strand of literature suggests that individual risk attitudes depend on feelings or emotions at the time risk is assessed. Raghunathan and Pham (1999) find that anxiety makes people more risk averse whereas sadness makes people less risk averse. Lerner and Keltner (2000) show that fearful people are more pessimistic and so they are less likely to take on risk. In a similar vein, but focusing on personal experience on stock market returns, Malmendier and Nagel (2011) find that people who experienced higher stock market returns show greater willingness to take risk.

While there appears to be consensus that measured risk preferences vary with elicitation mechanisms at a point in time, there is less evidence that measures of risk preferences using the same elicitation method are subject to change over time. Finding cross-sectional variation in risk preferences across individuals at one point in time does not prove that individual risk preferences are unstable. This chapter explores the log-term stability of measured risk preferences by exploiting a 13-year longitudinal sample of individuals in the National Longitudinal Survey of Youth 79 (NLSY79) over which risk attitudes were elicited on four different waves. The longer time series allows us to evaluate not just whether preferences are stable, but whether variation in preferences is dominated by variation in risk preferences across individuals or by variation in individual risk preferences over time. Furthermore, the large sample size and long time frame allow us to identify some clear regularities in how risk attitudes change due to individual economic circumstances.

We find dramatic evidence that measured risk preferences for individuals are not stable: 57% of the total variance in measured risk aversion is attributable to changing individual risk attitudes over time and only 43% to variation across individuals. Even after controlling for plausible demographic and economic factors that might alter individual attitudes toward risk, the *within* variance due to unexplained changes in individual risk aversion over time dominates the *between* variance across individuals. To the extent that the *within* variation is an indication of measurement error, over half of the variation in measured risk preferences is noise, suggesting that there will be significant bias when such measures are included in regressions explaining economic behavior.

Although many cross-sectional studies found that demographic variables such as age, education, and marriage are correlated with variation in risk aversion, we find that changing personal economic circumstances have a greater impact on individual risk aversion than do changing demographics. Individuals become more risk averse as their incomes rise and as the duration of a current employment spell increases. Risk aversion also increases with duration of time spent out of the labor force and with accumulated work experience. In contrast, risk aversion decreases with length of a current unemployment spell. Because risk preferences respond to current economic circumstances, they cannot be viewed as causal factors in studies of contemporaneous economic decisions such as occupational choice, earnings, or entrepreneurship.

The rest of this chapter is organized as follows. Section 2 reviews data and measures of risk aversion. Section 3 discusses empirical methodologies for testing the intertemporal stability of risk aversion. Empirical results that reject the stability of risk aversion are presented in section 4.

2. Data and Measures of Risk Aversion

The data is drawn from the National Longitudinal Survey of Youth 79 (NLSY79). The NLSY79 offers a consistently designed lifetime income gamble questions to respondents in 1993, 2002, 2004, and 2006.

In the hypothetical gamble questions, the individual is asked to choose between a safe job paying a fixed current income and a risky job that will return a higher expected return but with a chance of income below the safe level. The risk questions are as follows:

(Q1) Suppose that you are the only income earner in the family, and you have a good job guaranteed to give you your current (family) income every year for life. You are given the opportunity to take a new and equally good job, with a 50-50 chance that it will double your (family) income and a 50-50 chance that it will cut your (family) income by a third. Would you take the new job?

The individuals who answered 'yes' to this question were then asked: (Q2) suppose the chances were 50-50 that it would double your (family) income and 50-50 that it would cut it in half. Would you still take the new job? Those who answered 'no' to the first question (Q1) then asked: (Q3) suppose the changes were 50-50 that it would double your (family) income and 50-50 that it would cut it by 20 percent. Would you take the new job?

Responses to the series of gamble questions are used to elicit measures of risk aversion. Degree of risk aversion is measured by the degree to which the respondent is willing to accept downside risk, measured by the amount that could be reduced. We construct an ordered categorical risk aversion index ranging from 1 to 4 and so the risk index goes from the least to the most risk averse.

$$Risk\ aversion\ index = \begin{cases} 1\ \ if\quad accept\ 1/3\, cut\ \&\ accept\ 1/2\, cut\ ; the\ least\ risk\ averse \\ 2\ \ if\quad accept\ 1/3\, cut\ \&\ reject\ 1/2\, cut \\ 3\ \ if\quad reject\ 1/3\, cut\ \&\ accept\ 1/5\, cut \\ 4\ \ if\quad reject\ 1/3\, cut\ \&\ reject\ 1/5\, cut\ ; the\ most\ risk\ averse \end{cases}$$

Our sample includes all respondents who answered the risk questions in at least two years between 1993 and 2006. We drop households that report zero net family income which excludes less than 1% of the sample. We also drop those who have incomplete information on demographics. Our conclusions are not sensitive to these sample inclusion criteria. The final sample is large: 5,197 respondents answered the risk questions in 1993; 5,424 in 2002; 5,387 in 2004; 5,698 in 2006, and 3,805 in all four years. The final analysis sample contains 21,706 person-year observations. Therefore, our study uses a much larger sample than the past longitudinal studies which had at most 300 observations.

Distributions of measured risk aversion in the unbalanced panel sample over time are reported in Panel A of Table 1. Most respondents fall into the most risk averse category and the second largest portion into the least risk averse category. This suggests that there is considerable heterogeneity in risk attitudes across individuals. There is a tendency for increasing risk aversion with age: 46% were in the most risk averse category in 1993 but 57% in 2006. The largest decline is in the least risk averse group which falls from 25% to 17%. However, the progression to greater average risk aversion with age masks considerable variation in the patterns of changing risk aversion across individuals as shown in Panel B of Table 1. Panel B focuses on the balanced panel of 3,805 individuals who answered the risk aversion question all four years. We show the distribution of 2006 risk aversion measures by 1993 measured risk aversion. Only 43% remained in the same risk aversion category over 13 years. Only 2% stayed in the same risk aversion category all four years.

As in Panel B, there is a movement toward greater average risk aversion as age increases: 46% of those in the least risk averse category in 1993 were in the most risk averse category in 2006. However, 33% of those in the most risk averse category in 1993 became less risk averse in 2006. The changes in measured aversion are not of modest size as 35% moved at least 2 risk categories between the two periods. These intertemporal changes cannot be explained as just reflecting an aging cohort of respondents.

3. Testing for the stability of risk aversion over time

In order to test the presumption that risk aversion is stable over time, we first incorporate analysis of variance (ANOVA). We measure the relative stability of risk aversion by assessing how much of the variance in measured risk aversion is attributable to variation across individuals and how much is due to variation in individual risk aversion over time. ANOVA allows us to decompose the total variance in responses to the income gamble question into '*between*' individual and '*within*' individual components. The *between* variance is due to deviations of individual mean risk aversion from the sample mean. The *within* variance is due to changes in measured risk aversion within an individual over time.

With n individuals in the sample and 4 temporally separated measures of risk aversion for each individual i, the total sum of square (TSS) partitioned into sum of squared errors (SSE) and sum of squares of treatments (SST) can be written as:

$$TSS = SSE + SST$$

$$\sum_{i=1}^{n}\sum_{t=1}^{4}(\theta_{it} - \bar{\theta})^2 = \underbrace{\sum_{i=1}^{n}\sum_{t=1}^{4}(\theta_{it} - \bar{\theta}_{i0})^2}_{within} + \underbrace{\sum_{i=1}^{n}4(\bar{\theta}_{i0} - \bar{\theta})^2}_{between} \qquad (1)$$

$$= n \times \sigma_{\theta}^{2} \tag{2}$$

where θ_{it} is individual *i*'s risk aversion measured at time *t*; $\overline{\theta}_{i0} = \frac{1}{4}\sum_{t=1}^{4}\theta_{it}$ represents an individual's average measured risk aversion over 4 years; $\overline{\theta} = \frac{1}{n}\sum_{i=1}^{n}\overline{\theta}_{i0}$ denotes the sample mean of measured risk aversion across individuals in the sample; and σ_{θ}^{2} is variance of measured risk aversion.[27]

The SSE corresponding to the first term of equation (1) measures the 'within' variance due to changes in individuals measured risk aversion, while the second term measures the 'between' variance due to differences in mean risk preferences across individuals. The TSS can be alternatively estimated by the sum of the two variance components or by equation (2).

We report the variance decomposition in Panel A of table 2. Surprisingly, 57% of the total variance comes from the *within* individual component and only 43% is due to the *between* variance. The majority of the variance in risk aversion is due to changing individual risk preferences over time and not to different risk preferences across individuals. Nor is this result due to some regular pattern of evolving risk preferences as individuals age.

Panel B reports the *within* and *between* variation in risk aversion after controlling for a vector X_{it} of demographic attributes that could explain why individual risk

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[27] See Appendix 2 for full derivation of equation (1).

attitudes might change over time: age, marriage, education, and number of kids. If risk preferences change as these demographic attributes change over the sample period, they will reduce the *within* component. However, after removing the variance attributable to these non-economic variables, the *within* variance falls only to 54% from 57%, and so the *within* component is still larger than the variation across individuals.

Since the sizeable *within* component is not due to non-economic factors, it is potentially influenced by changing economic circumstances. We take on that question next.

3.1 What personal economic circumstances affect risk aversion over time?

To explore the transitory economic factors that alter measured risk attitudes, we first must control for any underlying differences in tastes for risk across individuals. That suggests using a fixed-effects regression that will control for unobservable individual tastes and all other time-invariant factors u_i. We also add the time-varying elements of the vector of demographic factors, X_{it}, including age and its square, education, marital status, and number of children. We then add a vector of time-varying labor market factors, M_{it} to a regression explaining changes in measured risk preferences over time. The linear regression model with fixed effects is

$$\theta_{it} = X_{it}\beta_X + M_{it}\beta_M + u_i + \varepsilon_{it}\,, \quad \varepsilon_{it} \sim N(0,\sigma^2) \qquad (3)$$

As before, θ_{it} is an ordered categorical risk aversion index variable ranging from the least risk averse to the most risk averse for an individual *i* at time *t*. The vector M_{it} contains time-varying measures that reflect individual household and local labor market economic status: the net family income and its square, years of previous labor market experience, the duration of recent employment, unemployment, and out of labor force spells, and the local unemployment rate. Gender, race, and other factors that do not change over the sample period are absorbed by the individual fixed effects.

It is possible that measures of degree of risk aversion are nonlinear. Thus, alternatively we estimate an ordered probit model. More specifically, random effect ordered probit model and an ordered probit model clustering the standard errors on the level of the individual are incorporated to show our results are robust to the alternative specifications.

3.2 Measures of Key Independent Variables

Weekly labor force information and interview date are available in the NLSY79. Accordingly, we were able to identify each individual's labor force status—employed, unemployed, or out of labor force—at the time individual risk aversion was measured. Unemployed individuals and those out of labor force differ in that the unemployed are actively looking for a job while those out of labor force are neither working nor looking for work. Hence, the unemployed are constrained from their presumed preferred time allocation (employment) while those out of the labor force are in control of their time allocation. The employed are also nominally meeting their time allocation objectives. Our measure is the length of the current time allocation spell since the last interview and so the maximum length of the current spell is 2 years.

Previous labor market experience is measured by cumulative years spent at work since the first survey year, 1979. Net family income variable is created by NLSY79 at each wave. The descriptive statistics of variables are summarized in Appendix 1.

4. Results

Table 3 reports estimation results using various model specifications. The first four columns are fixed effects estimates of the linear model. In the first column, age and age-squared are the only regressors. Age has a significant effect on changes in measured risk aversion over time. Risk aversion increases until age 52 and then decreases.[28] The R-squared statistic is the ratio of the *between* variance to the total variance and so the *within* and *between* variances can be inferred by the R-squared statistic. As 57% of the total variance was due to the within-individual component without controlling for any cofactors, removing only the variation in age lowers the *within* component to 54%. When we add the other time-varying non-economic variables—education, marriage, and number of kids—the proportion of total variance attributable to the *within* component remains 54%.

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[28] In the study of Barsky et. al (1997) using older cohorts (age between 50 and 70) from Health and Retired Study (HRS), risk aversion starts to decrease at age 60 without controlling for any factors.

When we include only time-varying economic variables in the third column, the *within* component is also 54%. We then let the non-economic and economic variables compete with one another in column 4. The *within* variance remains at 54%. However, we can no longer reject the null hypothesis that the effect of the demographic factors on risk preferences is jointly zero ($F_{5,n-5}$=1.72, p>0.1).[29] On the other hand, the effect of the economic factors are jointly significant ($F_{7,n-7}$=5.49, p=0.00). Hence, economic circumstances rather than demographic variation are the more important observable source of changing risk attitudes over time. Nevertheless, the dominant source of variation in risk preferences remains the *within* component, even after controlling for economic and demographic variables.

When economic variables are added, the relationship between age and risk aversion weakens. Peak risk aversion now occurs at age 43 and decreasing thereafter. The weakening effect of age on risk preferences is due to the correlation between age and risking income and job security, both of which raise risk aversion. This nonlinear effect of age on risk aversion conflicts with findings from single cross-sectional studies that risk aversion rises monotonically with age (Riley and Chow, 1992; Donkers et al., 2001; Dohmen et al., 2006) but is similar to results reported by Barsky et al. (1997). Unlike

[29] Marital status, fertility behavior and education may be a consequence of risk preferences rather than a causal factor. However, none of our results are sensitive to the inclusion or exclusion of these factors, and so we include them for completeness.

earlier conclusions based on studies using a single cross-section, changes in education do not affect measured risk aversion. And changes in marital status have only small effects that are statistically significant only at the 10% level.

Changing economic circumstances do influence risk preferences by statistically significant but numerically small amounts. Risk aversion increases with net family income at a decreasing rate with peak risk aversion at $307 thousand. In other words, household become increasingly risk averse as income rises for virtually the entire range of household income. Because age and income are positively correlated, conclusions regarding the pattern of risk preferences by age in previous studies may have been clouded by the underlying correlation between age and household economic status. Our results that risk preferences rise with income are consistent with Barsky et al. (1997) and Bellemare and Brown (2010).

Previous studies argued that more risk-averse job seekers exit unemployment faster (Stephenson 1976; Feinberg 1977) or that the employed are more risk averse than the unemployed (Halek and Eisenhauer 2001). However, the direction of causality is uncertain when based solely on cross-sectional data. The longitudinal data used in this study allows us to investigate whether the duration of employment, unemployment, or out of labor force spells affect risk preferences. We find that among those who are currently employed, risk aversion increases with the duration of employment spell. Risk aversion also increases with the duration of time spent out of the labor force. To the extent that employment or out of labor force are the desired state, these results suggest that risk aversion increases with persistence in success at time allocation decisions. In contrast, risk aversion decreases with length of current unemployment spell or persistent lack of success in time allocation. A one standard deviation increase in weeks of a current employment spell raises risk aversion by 1.6%, evaluated at sample means. A one standard deviation increase in time out of the labor force increases risk aversion by 1.4%. On the other hand, a one standard deviation increase in unemployment spell lowers risk aversion by 0.5%.

These effects are quite small. It takes a consistent spell of 1-2 years to move measured risk preferences up or down by one point. Nevertheless, individuals are more responsive to current spells than accumulated labor market experience. A 52 week current employment spell raises risk aversion 3 times more than one year of accumulated work experience.

The last two columns remove the fixed effects and allow nonlinearities in the measured risk aversion using an ordered probit specification. These estimates allow us to show that some of the demographic effects are captured by the individual fixed effects as marital status and education do not change for large fractions of the sample. In addition, males are significantly less risk averse than women. However, the signs and significance of the economic variables remain intact.

Regardless of specification, we easily reject the hypothesis that risk preferences do not respond to current and accumulated household economic circumstances.[30] The implication is that risk preferences are endogenous to economic success. One cannot use contemporaneously measured risk preferences to 'explain' labor market decisions regarding search, employment, or labor force participation. With extended periods of unemployment or employment, risk preferences can change substantially. Recent work of Malmendier and Nagel (2011) also suggests that personal economic experiences of macroeconomic shocks explain individual risk preferences. They show that experiences of high stock market returns makes individuals less risk averse and so risk preferences are indeed endogenous to personal economic experiences, which is consistent with our conclusion.

The main story from section 3 remains. Variation in measured risk preferences are dominated by changes in individual risk preferences that are uncorrelated with demographics or changing economic circumstances. These apparent random measurement errors in risk preferences suggest that one should use considerable caution

[30] Expanding the sample to include individuals with on partial information on demographic or economic variables does not change our conclusions. See Appendix 3.

in using measured risk preferences to test theoretical propositions regarding how risk attitudes influence economic choices.

5. Conclusion

Risk aversion plays an important role in economic decision. Economists often use measured risk aversion as fixed attitudes toward risk. This chapter attempts to find the empirical validity of the typical presumption. Utilizing panel structure of the NLSY79 over a 13-year span, we find unstable temporal measured risk aversion. Individuals' risk aversion changes systematically responding to personal economic circumstances over time. Although many cross-sectional studies found that non-economic factors are correlated with variation in risk aversion, we find that personal economic circumstances have more important effects on intertemporal change in individual risk aversion. Length of employment spells or out of labor force increases risk aversion whereas duration of unemployment spells decreases risk aversion. Years of accumulated labor market experience also positively affects to shape risk aversion. Risk aversion has an inverted U-shape relation with household Income and age. Risk aversion decreases at age 43 and at $307 thousand net family income.

Individual risk aversion is endogenous to personal economic experiences of labor force status. With extended periods of unemployment or employment, risk aversion can change substantially. Our finding suggests that measured risk aversion is indeed not fixed but changing over time corresponding to personal situation. It seems that in recent literature measured risk aversion is more frequently incorporated into the empirical analysis owing to data availability. But, researchers should remain cautious in using the measured risk aversion. Contemporaneously measured risk aversion cannot be used as an explanatory factor in studies explaining labor market decisions regarding search, employment, or labor force participation.

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Table 1. Distribution of categorical responses to income gamble questions over time

Panel A: Unbalanced panel

Risk aversion index	1993	2002	2004	2006
1: the least risk averse	23.9%	18.0%	16.6%	17.2%
2	17.1%	16.3%	13.9%	14.9%
3	12.9%	10.7%	16.1%	11.2%
4: the most risk averse	46.1%	55.0%	53.4%	56.7%
Total Observation	5,300 (100%)	5,583 (100%)	5,540 (100%)	5,949 (100%)

Panel B: Balanced panel subset

Risk aversion index 1993	Risk aversion index 2006				
	1	2	3	4	Total
1: the least risk averse	6.2% (26.0%)	4.0% (17.0%)	2.8% (12.0%)	10.9% (46.0%)	23.8% (100%)
2	2.9% (16.8%)	3.5% (20.6%)	2.0% (11.8%)	8.7% (50.8%)	17.1% (100%)
3	1.8% (13.8)	1.9% (14.6%)	2.5% (18.9%)	7.0% (52.7%)	13.3% (100%)
4: the most risk averse	5.3% (11.5%)	5.3% (11.5%)	4.7% (10.3%)	30.6% (66.7%)	45.8% (100%)
Total	16.1%	14.7%	12.0%	57.1%	100.0%

Note: Top number is the percentage of all observations. Number in parentheses is the related row proportion.

Table 2. Variance Decomposition of measured risk aversion (θ)

	Within variance (SSE)	Between variance (SST)	Total variance (TSS)
Panel A			
	$\sum_{i=1}^{n}\sum_{t=1}^{T_i}(\theta_{it}-\bar{\theta}_{i0})^2$	$\sum_{i=1}^{n}T_i\,(\bar{\theta}_{i0}-\bar{\theta})^2$	$n \times \sigma_\theta^2$
Variance	17,601	13,448	31,049
(%)	(57%)	(43%)	(100%)
Observations (n)			21,706
Standard error (σ_θ)			1.196

	Within variance (SSE)	Between variance (SST)	Total variance (TSS)
Panel B			
	$\sum_{i=1}^{n}\sum_{t=1}^{T_i}\left\{(\theta_{it}-\bar{\theta}_{i0})-(X_{it}-\bar{X}_{i0})\hat{\beta}_X\right\}^2$	$\sum_{i=1}^{n}T_i\left\{(\bar{\theta}_{i0}-\bar{\theta})-(\bar{X}_{i0}-\bar{X})\hat{\beta}_X\right\}$	$n\times\sigma_\theta^2$
Variance after controlling for individual demographics	16,673 (54%)	14,376 (46%)	31,049 (100%)
Observations (n)			21,706

Note: $\bar{\theta}_{i0}=\frac{1}{T_i}\sum_{t=1}^{T_i}\theta_{it}$, $\bar{X}_{i0}=\frac{1}{T_i}\sum_{t=1}^{T_i}X_{it}$, $\bar{\theta}=\frac{1}{n}\sum_{i=1}^{n}\bar{\theta}_{i0}$, and $\bar{X}=\frac{1}{n}\sum_{i=1}^{n}\bar{X}_{i0}$.

Table 3. Effects of economic factors on change in risk aversion over time

	Linear Regression					Ordered Probit	
	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Beta[a]	Random effects	Clustering
Time-varying economic factors							
Family income/100,000			0.172***	0.135**	0.069	0.117**	0.088**
			(3.34)	(2.46)		(2.46)	(2.06)
(Family income/100,000)^2			-0.029**	-0.022*	-0.043	-0.031***	-0.029***
			(2.52)	(1.86)		(2.91)	(3.04)
Recent weeks employed			0.001***	0.001***	0.045	0.002***	0.002***
			(3.99)	(3.83)		(6.23)	(6.43)
Recent weeks unemployed			-0.001**	-0.001**	-0.015	-0.002***	-0.002***
			(2.12)	(2.03)		(3.46)	(3.71)
Recent weeks out of labor force			0.002***	0.002***	0.037	0.002***	0.002***
			(3.87)	(3.33)		(5.14)	(5.49)
Labor market experience (in years)			0.016***	0.012**	0.069	0.014***	0.012***
			(6.00)	(1.98)		(5.68)	(5.42)
State unemployment rate			0.003	0.0002	0.004	0.0003	0.0003
			(0.54)	(0.38)		(0.56)	(0.65)
Non-economic controls							
Age	0.074***	0.072***		0.042**	0.192	0.035	0.029
	(3.61)	(3.40)		(1.96)		(1.53)	(1.36)
Age^2	-0.001***	-0.001**		-0.000*	-0.171	-0.0004	-0.0003
	(2.60)	(2.39)		(1.74)		(1.33)	(1.16)
Education (in years)		-0.027		-0.026	-0.054	-0.010*	-0.007*
		(1.31)		(1.27)		(1.94)	(1.66)
Number of children		0.004		-0.0001	0.0001	0.011	0.010
		(0.30)		(0.01)		(1.24)	(1.26)
Married		0.084**		0.056*	0.023	0.100***	0.099***
		(2.74)		(1.73)		(3.88)	(4.23)
Male						-0.216***	-0.187***
						(8.88)	(9.12)
White						0.027	0.022
						(1.05)	(0.98)
Constant	0.184	0.522	1.517***	2.043***			
	(0.48)	(1.14)	(24.27)	(4.36)			
R^2	0.46	0.46	0.46	0.46			
1-R^2 (within variance %)	54%	54%	54%	54%			
Total observation (*n*)	21,706	21,706	21,706	21,706		21,706	21,706
Cut1						0.016	0.028
						[0.438]	[0.395]
Cut2						0.603	0.522
						[0.438]	[0.395]
Cut3						1.003	0.858
						[0.438]	[0.395]

Note: [a] Fully standardized coefficients. *t*-statistics are in parentheses. Standard errors are in brackets.

*/**/*** significant at 10%/5%/1%.

Appendix 1. Descriptive statistics

Variables	Definition	Mean (Std) 1993	2002	2004	2006
Risk aversion index	Ordered categorical variable (1-4) 1 = the least risk averse 4 = the most risk averse	2.81 (1.24)	3.03 (1.19)	3.07 (1.15)	3.09 (1.18)
Net Family income		39,251 (31,314)	63,011 (58,545)	68,002 (65,670)	74,707 (75,604)
Recent length of employment	Weeks employed in past 2 years if currently employed	34.17 (21.55)	75.14 (39.42)	74.09 (39.66)	75.97 (38.52)
Recent length of unemployment	Weeks unemployed in past 2 years if currently unemployed	1.61 (10.35)	1.84 (12.69)	5.71 (23.10)	6.01 (23.44)
Recent length of out of labor force	Weeks out of labor force in past 2 years if currently out of labor force	6.54 (17.53)	10.20 (28.74)	14.60 (34.35)	12.07 (31.56)
Work experience	Previously labor market experience (in years)	10.35 (3.92)	17.56 (5.67)	19.08 (6.10)	20.65 (6.37)
Unemployment rate	Local unemployment rate	7.49 (2.57)	6.68 (2.41)	5.71 (1.51)	5.02 (1.49)
Age	Age (in years)	31.58 (2.25)	40.55 (2.25)	42.55 (2.25)	44.55 (2.26)
Education (in year)	Years in schooling	13.16 (2.42)	13.36 (2.48)	13.39 (2.49)	13.42 (2.50)
Number of kids	Number of kids in household	1.37 (1.28)	1.44 (1.29)	1.34 (1.25)	1.25 (1.22)
Married	= 1 if married	0.59 (0.49)	0.59 (0.49)	0.59 (0.49)	0.59 (0.49)
Male	= 1 if male	0.46 (0.50)	0.48 (0.50)	0.48 (0.50)	0.48 (0.50)
White	= 1 if female	0.68 (0.47)	0.67 (0.47)	0.66 (0.47)	0.64 (0.47)
Total observation (*n*)		5,197	5,424	5,387	5,698

Note: Standard deviations are in parentheses.

Appendix 2

With *n* individuals in the sample and 4 temporally separated measures of risk aversion for each individual *i*, the total sum of square (TSS) is given by

$$TSS = \sum_{i=1}^{n}\sum_{t=1}^{4}(\theta_{it} - \overline{\theta})^2$$

$$= \sum_{i=1}^{n}\sum_{t=1}^{4}(\theta_{it} - \overline{\theta}_{i0} + \overline{\theta}_{i0} - \overline{\theta})^2$$

$$= \sum_{i=1}^{n}\sum_{t=1}^{4}\{(\theta_{it} - \overline{\theta}_{i0}) + (\overline{\theta}_{i0} - \overline{\theta})\}^2$$

$$= \sum_{i=1}^{n}\sum_{t=1}^{4}\{(\theta_{it} - \overline{\theta}_{i0})^2 + 2(\theta_{it} - \overline{\theta}_{i0})(\overline{\theta}_{i0} - \overline{\theta}) + (\overline{\theta}_{i0} - \overline{\theta})^2\}$$

where $\overline{\theta} = \frac{1}{n}\sum_{i=1}^{n}\overline{\theta}_{i0}$ and $\overline{\theta}_{i0} = \frac{1}{4}\sum_{t=1}^{4}\theta_{it}$.

Summing over the first *t* yields

$$TSS = \sum_{i=1}^{n}\left\{\sum_{t=1}^{4}(\theta_{it} - \overline{\theta}_{i0})^2 + 2(\overline{\theta}_{i0} - \overline{\theta})\sum_{t=1}^{4}(\theta_{it} - \overline{\theta}_{i0}) + 4(\overline{\theta}_{i0} - \overline{\theta})^2\right\}$$

$$= \sum_{i=1}^{n}\left\{\sum_{t=1}^{4}(\theta_{it} - \overline{\theta}_{i0})^2 + 2(\overline{\theta}_{i0} - \overline{\theta})(4\overline{\theta}_{i0} - 4\overline{\theta}_{i0}) + 4(\overline{\theta}_{i0} - \overline{\theta})^2\right\}$$

$$= \sum_{i=1}^{n}\sum_{t=1}^{4}(\theta_{it} - \overline{\theta}_{i0})^2 + \sum_{i=1}^{n}4(\overline{\theta}_{i0} - \overline{\theta})^2$$

Appendix 3. Effects of economic factors on change in risk aversion over time with different total observations

	Linear Regression					Ordered Probit	
	Fixed effects	Fixed effects	Fixed effects	Fixed effects	Beta[a]	Random effects	Clustering
Time-varying economic factors							
Family income/100,000			0.173***	0.136**	0.072	0.113**	0.093**
			(3.35)	(2.48)		(2.43)	(2.20)
$(\text{Family income}/100{,}000)^2$			-0.029**	-0.022*	-0.044	-0.030***	-0.030***
			(2.53)	(1.87)		(2.84)	(3.15)
Recent weeks employed			0.001***	0.001***	0.052	0.002***	0.002***
			(3.99)	(3.84)		(5.98)	(6.33)
Recent weeks unemployed			-0.001***	-0.001**	-0.008	-0.002	-0.002***
			(2.12)	(2.03)		(3.28)	(3.54)
Recent weeks out of labor force			0.002***	0.002***	0.045	0.002	0.002***
			(3.87)	(3.33))		(5.20)	(5.57)
Labor market experience (in years)			0.016***	0.012**	0.081	0.015***	0.012***
			(6.00)	(1.98)		(6.15)	(5.63)
State unemployment rate			0.0003	0.0002	0.003	0.0002	0.0003
			(0.53)	(0.37)		(0.55)	(0.61)
Non-economic controls							
Age	0.067***	0.064***		0.042*	0.157	0.037	0.030
	(3.65)	(3.37)		(1.93)		(1.61)	(1.45)
Age^2	-0.001***	-0.001**		-0.0004*	-0.149	-0.0004	-0.0003
	(2.51)	(2.24)		(1.73)		(1.43)	(1.25)
Education (in years)		-0.024		-0.026	-0.039	-0.012**	-0.008*
		(1.35)		(1.27)		(2.42)	(1.90)
Number of children		0.007		0.0000	0.001	0.013	0.011
		(0.64)		(0.00)		(1.46)	(1.40)
Married		0.066**		0.056*	.020	0.103***	0.095***
		(2.40)		(1.73)		(4.06)	(4.10)
Male						-0.207***	-0.184
						(8.71)	(9.07)
White						0.029	0.022
						(1.13)	(1.02)
Constant	1.300***	1.631***	2.516***	2.046***			
	(3.79)	(4.02)	(40.33)	(4.37)			
R^2	0.47	0.47	0.47	0.47			
$1-R^2$ (within variance %)	53%	53%	53%	53%			
Observations (*n*)	25,784	25,783	22,042	22,042	22,042	22,042	22,042
Cut1						-0.007	0.048
						[0.428]	[0.390]
Cut2						0.577	0.540
						[0.428]	[0.390]
Cut3						0.972	0.874
						[0.428]	[0.390]

Note: [a] Fully standardized coefficients. Note: *t*-statistics are in parentheses. Standard errors are in brackets.

*/**/*** significant at 10%/5%/1%.

CHAPTER 5. ARE NONPROFIT ENTREPRENEURS ALSO "JACKS-OF-ALL-TRADES"?

1. Introduction

The motivation to enter entrepreneurship involves a potentially unobservable skill for organizing the talents of more specialized employees to produce output (Lazear 2004,2005). By exploiting returns to scale from this entrepreneurial talent, the earnings from the owner's share of firm profits can dominate earnings expected from working for someone else. The main implication of Lazear's "Jacks-of-All-Trades" theory is that the pattern of human capital investment differs across entrepreneurs and those in paid employment—entrepreneurs acquire more varied skills necessary to run a business while those they employ specialize in more occupation-specific and narrowly focused skills. Several studies have provided empirical evidence that for-profit entrepreneurs are generalists with balanced skills while paid workers are specialists (e.g., Wagner, 2006; Backes-Gellner and Moog, 2008; Åstebro and Thompson, 2011; Stuetzer and Kaya, 2011).

Incentives for starting a nonprofit are less clear because the objective is not tied to maximizing expected income or profits. Accordingly, little attention has been paid to the role of entrepreneurial ability in the decision to become a nonprofit entrepreneur. Given the rapid increase in new nonprofit organizations, it is important to identify which skills lead to successful nonprofit entrepreneurship.[31]

One rationalization for the existence of nonprofit organizations (NPOs) is to resolve market failures (Hansmann, 1980; Easley and O'Hara, 1983; Chillemi and Gui, 1991; Holtmann, 1983). Nonprofit firms add supply to a market that would otherwise be characterized by excess demand. A second literature argues that goods produced by NPOs are imperfect substitutes for goods produced by for-profit firms in the same market. Preston (1988) shows that for-profit firms produce goods which generate higher private revenue but nonprofits introduce products with higher social benefits. Focusing on differences in quality of services, Mark (1996) empirically tests whether ownership is correlated with quality of hospital services and shows that nonprofit hospitals provide higher quality than their for-profit counterparts whereas Sloan et al. (2001) find no significant difference in quality of service between nonprofit and for-profit hospitals.

A third difference between NPOs and for-profit firms is that nonprofit entrepreneurs have different motivations than for-profit entrepreneurs (Young, 1986). Hansmann (1980) emphasizes that those who heavily weight nonpecuniary benefits rather than pecuniary returns are more likely to enter nonprofit sector. Supportive of that hypothesis, James (1987) finds that religious groups are the major founders of NPOs in many countries such as the U.S., India, Japan, Holland and Sweden. Gassler (1998)

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[31] The number of nonprofit organizations in the U.S. increased 32% between 1999 and 2009 (http://nccsdataweb.urban.org/PubApps/profile1.php?state=US).

argued that altruistic motives and Kantian ethics are necessary to explain the existence of nonprofit firms on a qualitative analysis basis. However, Glaeser and Shleifer (2001) showed that self-interested entrepreneurs could also choose not-for-profit status if they placed a large weight on product quality because non-profit firms produce higher quality products.

Although previous studies have explained the existence of nonprofit firms, little attention has been paid either theoretically or empirically to the characteristics that cause a nonprofit entrepreneur to succeed. To our best knowledge, this study is the first to explore the human capital investments that lead to successful NPO start-ups.

Data for this analysis were drawn from a random sample of 25,000 Iowa State University (ISU) alumni who graduated between 1982 and 2006 with a Bachelor's degree. This novel data set includes nonprofit business experience, for-profit startup background, family background and socioeconomic characteristics. Information on college major(s), courses taken, credits obtained, and other academic records were matched with each observation in the sample.

Our extension of Lazear's model of entrepreneurship shows that diverse skills should have a positive effect on the choice of both nonprofit and for-profit start-ups over the alternative of working for someone else. We further posit a hypothesis that the same unobservable entrepreneurial skills that are presumed to be important in for-profit ventures are important for nonprofit ventures as well.

Using successive cohorts of ISU graduates, we first confirm that for-profit entrepreneurs are generalists with more occupational diversity while paid-employees are specialists, consistent with Lazear (2005). Furthermore, our empirical finding shows that a more balanced skill set increases the choice of nonprofit start-ups, supporting our hypothesis that nonprofit entrepreneurs are also "Jacks-of-All-Trades". Lastly, we find that unobserved factors that jointly affect for-profit and nonprofit start-ups are positively correlated, consistent with the presence of a common observed entrepreneurial skill that leads to both for-profit and nonprofit entrepreneurial success. In other words, people who are atypically more likely to start a for-profit business given their observable skills are also more likely to start a nonprofit enterprise, and *vice versa*.

In the next section, we extend the Lazear's "Jacks-of-All-Trades" model of entrepreneurship by adding nonprofit entrepreneurship choice in order to show how balanced skills affect nonprofit startups and for-profit startups over the alternative of being employed and set out the respective hypotheses. Section 3 describes data and variables used to test the hypotheses. Empirical methodology is presented in Section 4. We report empirical results in Section 5. Section 6 concludes.

2. Basic model

In Lazear (2005)'s model, more balanced skills increase the probability of becoming an entrepreneur. More diversified skills are required so that entrepreneurs can understand and organize the talents of more specialized workers they employ. Suppose that human capital can be decomposed into two skills, x_1 and x_2.[32] If the individual plans to work for someone, he would specialize in one or the other skill and his earnings would equal $\max[x_1, x_2]$. If instead he becomes an entrepreneur, he must be able to evaluate employees with specializations in either human capital subcomponent, and he can only do that effectively if he has skills in both areas. Consequently, expected earnings for an entrepreneur will depend on the extent of his weakest skill: $\min[x_1, x_2]$. His earnings will also incorporate a multiplicative entrepreneurial skill that will be unobserved in general, λ. The choice to become an entrepreneur will depend on which is the larger of the two expected earnings. The individual will become an entrepreneur if $\lambda \min[x_1, x_2] > \max[x_1, x_2]$.

If H is the amount of time one can invest in skills and time translates directly into a quantity of human capital, a specialists' stock of skill will be either $[H,0]$ or $[0,H]$. Entrepreneurs will try to equalize their holdings of both skills so that their skill stock will be $[\frac{H}{2}, \frac{H}{2}]$. That was the main empirical prediction emphasized by Lazear: that more balanced observed skills will increase the likelihood of a for-profit startup. However, a second implication follows from the condition that entrepreneurial entry will occur when

[32] Lazear shows that the basic predictions of the model still go through when human capital has more than two subcomponents

$\lambda \frac{H}{2} > H$ or $\lambda > 2$. A larger endowment of the unobserved entrepreneurial skill λ increases the probability of becoming a for-profit entrepreneur. To the extent that nonprofit entrepreneurs are also trying to maximize output, that same unobservable skill could be critical in the probability of starting a successful nonprofit venture. To explore that possibility, we need to add nonprofit entrepreneurship as an additional occupational choice in the Lazear's framework.

We assume that an individual *i* is faced with the nonexclusive choices of creating a nonprofit start-up, creating a for-profit start-up, or working for someone else. His objective is to maximize the possible returns from devoting his time to working at one or possibly more than two alternatives under time constraints. The returns include pecuniary benefits from either for-profit start-up or working for someone and non-pecuniary benefits from nonprofit start-up. He possesses two types of skills, x_1 and x_2. Following Lazear (2005), expected market productivity from wage work will involve specializing in his best skill, and so his wage is $w = \max[x_1, x_2]$. His expected returns from a for-profit venture depend on the extent of his weakest skill: $Y_f = \lambda_f \min[x_1, x_2] = \lambda_f \frac{H}{2}$. Similarly, his return from a nonprofit venture depends on his weakest skill, but it is the cash equivalent non-pecuniary return to nonprofit entrepreneurship which we assume is proportional to the output of the nonprofit:

$Y_n = \lambda_n \min[x_1, x_2] = \lambda_n \frac{H}{2}$.

Working time is assumed to be the only input required for production with T_f being time devoted to a for-profit enterprise and T_n being time devoted to a nonprofit venture. We assume that production in the for-profit and nonprofit firms is also influenced by the unobservable entrepreneurial skill λ: $F(\lambda_f T_f)$ and $G(\lambda_n T_n)$, respectively. We also assume diminishing marginal returns to time which opens up the possibility of working more than one occupation at once. Entrepreneurial talent λ increases the marginal product of the time devoted in both for-profit and nonprofit enterprises.

The objective can be written as

$$Max\{\lambda_f \min[x_1, x_2]F(\lambda_f T_f) + \lambda_n \min[x_1, x_2]G(\lambda_n T_n) + \max[x_1, x_2](T_W)\} \quad (1)$$

subject to $T_f + T_n + T_W = \bar{T}$, $T_j \geq 0$ for $j = f, n, W$

where f, n, W indicate for-profit entrepreneurship, nonprofit entrepreneurship, and wage employment, respectively.

The Lagrangian is $L = Y_f F(\lambda_f T_f) + Y_n G(\lambda_n T_n) + wT_W - \theta[T_f + T_n + T_W - \bar{T}]$ (2)

The first order conditions with respect to T_f, T_n *and* T_W are:

$$Y_f \lambda_f F_{T_f} - \theta \leq 0 \quad (=0 \text{ if } T_f^* > 0) \quad (3)$$

$$Y_n \lambda_n G_{T_n} - \theta \leq 0 \quad (=0 \text{ if } T_n^* > 0) \quad (4)$$

$$w - \theta \leq 0 \quad (= 0 \; if \; T_W^* > 0) \quad (5)$$

Optimal allocation of time among the three choices depends on the marginal product of time, entrepreneurial talent, and returns. The individual will start a for-profit enterprise if the first equation holds with equality, he will start a nonprofit enterprise if the second condition holds, and he will engage in wage work if the third equation holds. The individual will devote time to both a for-profit and nonprofit enterprises if

$$\frac{Y_f}{Y_n} = \frac{\lambda_f \frac{H}{2}}{\lambda_n \frac{H}{2}} = \frac{\lambda_n G_{T_n}}{\lambda_f F_{T_f}} \tag{6}$$

which implies that $\lambda_f^2 F_{T_f} = \lambda_n^2 G_{T_n}$. Equation (6) indicates that when the individual starts both for-profit and not-for-profit enterprises, he will allocate time across the two sectors so that the marginal products of the last unit of time expended in each enterprise are equal.

If the individual specializes in wage work only, we have that:

$$Y_f \lambda_f F_{T_f} < w = H$$

$$Y_n \lambda_n G_{T_n} < w = H \tag{7}$$

An individual will never engage in both wage work and entrepreneurship. To see this, note that to get a return from entrepreneurship, he will need to spread his human capital investments across the two skill types, meaning that his human capital will equal $\frac{H}{2}$. At least one of the following conditions must hold to both work for a wage and be an entrepreneur:

$$Y_f \lambda_f F_{T_f} = \lambda_f^2 \frac{H}{2} F_{T_f} = w = \frac{H}{2}$$

$$Y_n \lambda_n G_{T_n} = \lambda_n^2 \frac{H}{2} G_{T_n} = w = \frac{H}{2} \quad (8)$$

But the wage worker could have specialized in human capital, and so the wage will be less than *H* in both cases, and so the individual would not have chosen to become an entrepreneur.

In practice, virtually everyone will engage in wage work at some time over the life cycle. For individuals aspiring to entrepreneurship, wage work is an investment in skills to be used later as an entrepreneur. On the other hand, the theory demonstrates that a higher draw on the unobservable λ gives the decision maker an incentive to become both a for-profit and a nonprofit entrepreneur over the alternative of working for a wage. An important implication is that if λ_f and λ_n are positively correlated, an increase in either λ_f or λ_n will increase the probability of both types of entrepreneurship and decrease the probability of wage work.

Four testable hypotheses emerge from the theory:

Hypothesis 1: An individual with more balanced skills is more likely to become a for-profit entrepreneur.

Hypothesis 2: An individual with more balanced skills is more likely to become a nonprofit entrepreneur.

Hypothesis 3: More balanced skills decrease the probability of entering paid-employment.

Hypothesis 4: Unobserved entrepreneurial talent will raise the probability of both for-profit and nonprofit entrepreneurship, and so there will be a positive correlation in the error terms derived from models of for-profit and nonprofit entry.

3. Data

The empirical analysis is based on Iowa State University (ISU) Bachelor's degree alumni survey data, which is an excellent and novel source of data for conducting research on non-profit entrepreneurship. The 5,416 usable responses are obtained from a random sample of 25,000 ISU alumni who graduated between 1982 and 2006. The data set provides detailed information on respondents' employment histories, for-profit and nonprofit business start-ups, and socioeconomic characteristics. In addition, these data were matched with each student's academic record, so we were able to get information on college major(s), courses taken inside and outside of the major, and even high school rank.

Nonprofit entrepreneurs are defined as those who ever started a nonprofit organization during their career. Likewise, for-profit entrepreneurs are identified as having ever initiated a for-profit enterprise. Individuals working for salary or wages at the time of the survey are categorized as wage workers. This means that some respondents fall into more than one category. Table 1 shows the distribution of respondents who fall either one or both categories of nonprofit and for-profit start-up. About 45% of nonprofit entrepreneurs (or 63 out of 140 nonprofit entrepreneurs) also become for-profit entrepreneurs. This distribution suggests that entrepreneurial skills that lead to for-profit start-up could also play a role in the decision to start a nonprofit venture.

We place individuals who started as wage workers but became full-time entrepreneurs later in the entrepreneurial category because wage work can serve as a means of acquiring human capital for the venture. On the other hand, if an individual started a for-profit or nonprofit venture that failed and returned to wage work, we include them in both the wage worker and entrepreneurial occupations. That definition seems consistent with the Lazear framework where diversity of occupational experiences may be selected as a means to becoming an entrepreneur later, while individuals who misjudge their entrepreneurial venture and switch to wage work are clearly choosing entrepreneurial and wage work as separate occupations. In the data, 27% of the for-profit entrepreneurs and 20% of the not-for-profit entrepreneurs left their enterprises and returned to wage work.

3.1 Explanatory variables

The theory says that entrepreneurs will invest in balanced skills to manage their employed specialists efficiently. For our analysis, we include three measures of entrepreneurial skills as indicators of a balanced skill set. In the ISU alumni survey, respondents were asked to report the number of different jobs held since obtaining Bachelor's degree.[33] After reporting the total number of different jobs, respondents subsequently answered the question, "what occupations have you had in these jobs? *Check all that apply*". Accordingly, we first measure the balanced skill set by the total number of different occupations associated with those jobs held since graduation, which is denoted by *Occupations*. The second measure is the total number of industries in which the jobs were located, denoted by *Industries*.[34] Higher values of these variables reflect more balanced skills.

Lazear (2005) found that students with a more balanced university curriculum were more likely to enter entrepreneurship while those with general curricula chose to work for someone else. Hence, we include an academic skill set as a third measure of a balanced skill set. We measure an academic skill set by the difference between total number of courses taken in the major and the average number of courses taken in other departments, defined as *Course-specialization*. Lower value of this measure indicates a

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[33] We may measure a balanced skill set by number of different jobs ever held since graduation. The number of different jobs, however, does not necessarily reflect the degree of different work experience because some different jobs may be classified into the same occupation category or they are in the same industry. Because of this possibility, we count the total number of occupations and industries in which the jobs were located. Nevertheless, the results are not sensitive to this alternative measure.

[34] Distributions of each employment type by industries and occupations are reported in the appendix Table A-2 and A-3, respectively.

more diverse academic program.

As additional control variables, we include parental business experience because entrepreneurial ability can be passed from parents to their offspring (Lentz and Laband, 1990). A set of other control variables includes age, age-squared, gender, race, marital status at graduation, parental education, close friends' business experience, and information on academic record such as high school rank, college GPA, and college dummies.

Table 2 shows some descriptive evidence on how the nonprofit and for-profit entrepreneurs are similar and how entrepreneurs in either sector differ from paid-employees. First of all, individuals who became for-profit entrepreneurs have, on average, higher number of occupations than paid-employees. The average number of different occupations held by for-profit entrepreneurs is 37% higher than that for paid-employees. Similarly, the average number of different occupations held by nonprofit entrepreneurs is 27% higher than paid-employees. For-profit and nonprofit entrepreneurs also average more industries of employment compared to wage workers. The pattern is less clear cut with respect to academic diversity. For-profit entrepreneurs took the broadest academic programs, but there were no substantial differences between nonprofit entrepreneurs and wage workers.

On average, nonprofit and for-profit entrepreneurs were from families that owned a business and had less educated parents than did wage workers. Entrepreneurs were weaker students in both high school and college. Entrepreneurs came from all colleges, and so choice of major did not dictate a path to entrepreneurship.

4. Methodology

In order to assess the proposed hypotheses whether entrepreneurial ability plays an important role in determining a nonprofit startup, we employ trivariate probit model which is suitable for allowing correlation among three choices.

The model to be estimated is based on a latent regression:

$$y_j^* = X_j \beta_j + Z_j \gamma_j + \varepsilon_j , \qquad (9)$$

$$y_j = 1(y_j^* > 0) , j=f, n, W \qquad (10)$$

where $j=n$ for nonprofit startup, f for for-profit startup and W for paid employment. The latent variable y_j^* represents the value of an occupation j relative to other alternatives. The vector X contains two occupational diversity measures (*Occupations*, *Industries*) and one academic skill measure (*Course_specialization*). As control variables, Z is a vector of demographic variables that potentially alter the relative return to the three occupations including age, gender, marital status at graduation, parental education, parental business experience, cumulative GPA, ISU college dummies, and high school rank.

The trivariate probit model further assumes that:

$$\begin{pmatrix}\varepsilon_n\\ \varepsilon_f\\ \varepsilon_W\end{pmatrix} \sim N\left[\begin{pmatrix}0\\0\\0\end{pmatrix},\begin{pmatrix}1 & \rho_{nf} & \rho_{nW}\\ \rho_{nf} & 1 & \rho_{fW}\\ \rho_{nW} & \rho_{fW} & 1\end{pmatrix}\right] \quad (11)$$

For identification reasons, the variance of ε_i must equal 1, but we do allow for correlated disturbances. The three correlation coefficients (ρ_{nf}, ρ_{nW}, ρ_{fW}) represent the extent to which unobserved covariates jointly determine the occupations. The trivariate probit allows us to identify β_j, γ_j, ξ_j for $j= f, n, W$ and ρ_{jk}, $j \neq k$

Because entrepreneurial skill is unobservable to the researchers, it will be a source of error. Consequently, the sign of the correlation between ε_n and ε_f will depend on the correlation between the unobserved λ_n and λ_f. We expect a positive correlation (ρ_{nf}) between the incentives to start for-profit and nonprofit start-ups due to the common unobservable entrepreneurial talents that are presumably valued in both sectors.

We expect that the unobserved skills that lead to specialization and wage work are negatively correlated with the unobserved general skills that enhance entrepreneurship and so $\rho_{nW} < 0$ and $\rho_{fW} < 0$.

5. Empirical results

The results from the trivariate probit model accounting for correlation in the occupation-specific error terms are reported in Table 3. The first three columns include no covariate controls. The second three columns add pre-college characteristics. The next three columns include more controls for college records. The last three columns report marginal effects associated with all controls included. Higher value of *Occupations* or *Industries* indicates a more balanced skill set while lower value of *Course_specialization* indicate a more diverse skill set. The main implications of the results for occupational choices are consistent across different specifications.

5.1. Do Nonprofit and For-profit entrepreneurs share common human capital?

Before getting to our main findings, we first investigate whether nonprofit entrepreneurs and for-profit entrepreneurs are more similar to one another than to wage workers. In the second set of results, 5 of 8 covariates have common signs across the for-profit and not-for-profit entrepreneurial choices. In the third set of results, 13 of 16 covariate pairs have common signs across the two choices. Parental education and high school rank are the only covariates that have different signs across the two entrepreneurship groups. The clearest distinction in factors that raise the probability of becoming either entrepreneur type while lowering the probability of wage work are growing up with a family or having friends that owned a business, being a member of a minority group, being married at graduation, having engineering major, and getting older.

We now turn to the main finding on the relationship between balanced skill sets and occupational choice. Having more diverse job experiences across *Occupations* and across *Industries* raises the probability of starting either or both for-profit and nonprofit enterprises compared to wage work. As we add more controls, the effect of *Occupations* and *Industries* gets slightly smaller. However, regardless of specifications, balanced skills from diverse work experience increases the probability of both nonprofit and for-profit start-ups but decreases the chance to work for pay, consistent with the predictions from Lazear's "Jacks-of-All-Trades" theory. More precisely, increasing the number of occupations held since graduation by one raises the probability of nonprofit startups by 0.2% and the probability of initiating a for-profit venture by 2.7%. Meanwhile, it lowers the probability of working for wages by 2.9%. Likewise, working in one more industry increases the probability of nonprofit entrepreneurship by 0.3% and for-profit startups by 1.6%, but it reduces the chance to become a wage worker by 2%. This evidence supports our hypothesis that nonprofit entrepreneurs are also "Jacks-of-All-Trades". In contrast with Lazear's (2005) findings, more specialized coursework did not affect the likelihood of any of the three occupational choices.[35] The marginal effects across occupations are virtually zero.

We investigate the role of the unobservable entrepreneurial skill λ_n and λ_f through the correlations in the errors reported at the bottom of Table 3. Consistent with a presumed common role of an entrepreneurial skill on both for-profit and not-for-profit

[35] An alternative measure of academic skill set is a Herfindahl index of academic credit concentration denoted by $\sum S_{ij}^2$, where S_{ij} is the share of credits earned in major *j* by individual *i*. The results are not sensitive to this alternative measure.

entrepreneurship, $\rho_{nf} > 0$ in all specifications. This positive correlation suggests that there exist common unobservable factors that lead to both for-profit and nonprofit startups. On the other hand, regardless of specification, unobserved skills that raise the probability of either type of entrepreneurship lower the probability of paid-employment ($\rho_{nW} < 0$ and $\rho_{fW} < 0$).

Because our tests of the Jacks-of-all-Trades theory represent three measures: *Occupations, Industries,* and *Course_specialization,* that will be correlated if chosen to raise productivity in wage work or entrepreneurship, the individual coefficients may provide an incorrect inference regarding their joint influence on occupational choice. Table 4 presents joint tests of the joint significance and impact of the three human capital measures. Panel A shows the likelihood ratio (LR) test of the restriction that the three measures have no effect on the probability of selecting each occupation. Panel B provides the test of the hypothesis across the three occupations. Both within and between occupations, the LR test of joint significance soundly rejects the null that the three measures do not jointly affect the occupational choice.

Given that the three measures are jointly important, the overall numerical effect of three measures should be the average effect of three measures on individuals for each occupation.[36] Panel C shows the numerical net effect of three measures for each

[36] The overall numerical effect of three measures is almost identical for each occupation when we use sum

occupation and Panel D reports test of the hypothesis that the sum of each effect equals zero. As shown in Panel C, the net effects of three measures are positive on both nonprofit and for-profit venture, while it is negative on paid-employment. In addition, the LR test of joint significance in Panel D soundly rejects the null hypothesis, suggesting that the numerical impact of the three measures is jointly influencing occupational choice. Accordingly, the observed diversity of academic and occupational skills jointly increases the probability of nonprofit sector entrepreneurship, consistent with previous findings of for-profit entrepreneurs. Those diverse skills jointly lower the chance to work for pay. The numerical impact of three measures is the weakest in wage sector. The overall marginal effects of three measures are positive on both nonprofit and for-profit startups, but it is negative on paid-employment. An increase in one unit of three measures as a balanced skill set raises the probability of nonprofit startups by 0.5% and for-profit startups by 4.2%. On the other hand, it lowers the chance to enter paid-employment by 4.7%.

Our results strongly support the hypothesis that nonprofit and for-profit entrepreneurs share similar skill requirements. Both nonprofit and for-profit entrepreneurs are generalists with more balanced skill sets, while those working for pay are specialists. Furthermore, both for-profit and not-for-profit entrepreneurs share

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of three effects evaluated at sample means. See the Table A-1.

common unobserved human capital, consistent with the hypothesized roles of the entrepreneurial skill λ. These findings are consistent with the observation that in the sample of Iowa State University alumni, nonprofit entrepreneurs atypically had also started a for-profit business and *vice versa*.

6. Conclusion

In Lazear (2005)'s model of entrepreneurship, individuals who are broadly trained are more likely to become entrepreneurs whereas individuals with specialized skills tend to work for someone else. The entrepreneur's more diverse skills are important to organize the specialists they hire. Extending the Lazear's model, we show in theory that diverse skills should have a positive effect on the choice of both nonprofit and for-profit start-ups over the alternative of paid-employment. Accordingly, this chapter examines whether Lazear's model can also explain nonprofit entrepreneurial choice. In particular, this study tests whether observed diversity of skills increase the probability of nonprofit entrepreneurship and whether unobservable talents that lead to nonprofit startup are positively correlated with the unobservable skills that lead to for-profit start-ups.

Using a sample of Iowa State University alumni who graduated between 1982 and 2006, we find that observed diversity of academic and occupational skills increases the probability of both nonprofit and for-profit entrepreneurship, while those skills lower the chance to work for pay. Nonprofit and for-profit entrepreneurs share similar observed skill requirements. Two error terms between for-profit start-up and nonprofit start-up are positively correlated, indicating the existence of common unobservable factors that lead to both for-profit and nonprofit entrepreneurship. Indeed, nonprofit entrepreneurs are also “Jacks-of-All-Trades”.

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Table 1. Number and percent of for-profit and nonprofit entrepreneurs in ISU alumni data

	For-profit entrepreneur?		
Nonprofit entrepreneur?	**No**	**Yes**	**Total**
No	4,467	809	5,276
Row%	(84.7%)	(15.3%)	(100%)
Column%	[98.3%]	[92.8%]	[97.4%]
Yes	77	**63**	140
Row%	(55%)	**(45%)**	(100%)
Column%	[1.7%]	**[7.2%]**	[2.6%]
Total	4,544	872	5,416
Row%	(83.9%)	(16.1%)	(100%)
Column%	[100%]	[100%]	[100%]

Table 2. Summary statistics

	Mean [Std]		
	Nonprofit entrepreneurship	For-profit entrepreneurship	Paid-employment
Balanced skill sets of human capital			
OCCUPATIONS	2.06 [1.59]	2.22 [1.70]	1.62 [1.12]
INDUSTRIES	2.14 [1.36]	2.06 [1.22]	1.70 [1.06]
Course_specialization	13.41 [8.05]	12.83[7.26]	13.51 [7.21]
Other human capital			
Male	0.61 [0.49]	0.67 [0.47]	0.59 [0.49]
Married at graduation	0.14 [0.35]	0.11 [0.31]	0.10 [0.30]
White	0.94 [0.24]	0.94 [0.24]	0.95 [0.22]
Mother education	4.58 [1.59]	4.53 [1.56]	4.72 [1.54]
Father education	4.65 [1.71]	4.83 [1.80]	4.91 [1.72]
Either of parents started business	0.57 [0.50]	0.56 [0.50]	0.47 [0.50]
Close friends started business	0.29 [0.46]	0.28 [0.45]	0.47 [0.50]
High school rank	68.30 [33.14]	62.18 [34.62]	70.59 [31.16]
Cumulative GPA	3.02 [0.57]	2.96 [0.58]	3.05 [0.59]
Age at graduation	23.82 [3.70]	24.10 [4.06]	23.50 [3.04]
Current age	41.01 [7.35]	40.50 [7.94]	36.88 [8.47]
College			
Agriculture and Life Sciences	0.22 [0.42]	0.16 [0.37]	0.18 [0.39]
Business	0.18 [0.38]	0.20 [0.40]	0.16 [0.37]
Design	0.15 [0.36]	0.18 [0.38]	0.17 [0.38]
Engineering	0.13 [0.34]	0.09 [0.29]	0.07 [0.25]
Human Sciences	0.23 [0.42]	0.26 [0.44]	0.29 [0.45]

Note: The number in the square bracket is standard deviation.

Table 3. Results of the estimation of the trivariate probit model

										Marginal Effects		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Nonprofit Startup	For-Profit Startup	Paid Employment	Nonprofit Startup	For-Profit Startup	Paid-Employment	Nonprofit Startup	For-Profit Startup	Paid-Employment	Non-profit startup	For-Profit Startup	Paid-Employment
<u>*Balanced skill sets*</u>												
Occupations	0.062***	0.191***	-0.047***	0.046*	0.157***	-0.074***	0.039	0.150***	-0.074***	0.002	0.027	-0.029
	(2.36)	(11.22)	(2.72)	(1.64)	(8.79)	(4.07)	(1.36)	(8.25)	(4.00)			
Industries	0.105***	0.104***	-0.052***	0.084***	0.093***	-0.014	0.076**	0.089***	-0.006	0.003	0.016	-0.019
	(3.37)	(5.45)	(2.53)	(2.54)	(4.63)	(0.64)	(2.26)	(4.35)	(0.26)			
Course_specialization	0.001	-0.004	0.004	0.006	-0.002	0.003	0.003	-0.003	0.004	0.000	-0.001	0.001
	(0.22)	(1.34)	(1.39)	(1.10)	(0.51)	(0.99)	(0.46)	(0.96)	(1.20)			
<u>*Controls*</u>												
Age				0.119***	0.062***	-0.005	0.112***	0.052***	-0.015	0.005	0.012	-0.017
				(2.65)	(3.04)	(0.27)	(2.46)	(2.38)	(0.69)			
Age^2				-0.001**	-0.001*	-0.000	-0.001**	-0.000	0.000	-0.000	-0.000	0.000
				(2.18)	(1.86)	(0.05)	(1.98)	(1.29)	(0.43)			
Male				0.114	0.169***	0.485***	0.084	0.133***	0.433***	0.001	0.009	-0.010
				(1.41)	(3.67)	(10.36)	(0.96)	(2.65)	(8.54)			
White				-0.065	-0.249***	0.056	-0.055	-0.219**	0.061	-0.001	-0.037	0.038
				(0.37)	(2.60)	(0.54)	(0.31)	(2.26)	(0.58)			
Father education				-0.034	0.031**	-0.059***	-0.036	0.028*	-0.060***	-0.002	0.007	-0.005
				(1.35)	(2.06)	(3.74)	(1.41)	(1.87)	(3.77)			
Mother education				0.017	-0.014	0.028	0.013	-0.015	0.027	0.001	-0.004	0.004
				(0.58)	(0.81)	(1.58)	(0.44)	(0.90)	(1.53)			
Either of parents started business				0.158**	0.190***	-0.150***	0.125	0.155***	-0.127***	0.006	0.030	-0.036
				(2.05)	(4.27)	(3.27)	(1.55)	(3.38)	(2.71)			

High school rank				0.001	-0.003***	0.000	0.002	-0.003***	0.000	0.000	-0.000	0.000
				(0.93)	(4.30)	(0.51)	(1.20)	(3.85)	(0.06)			
Married at graduation							0.208*	0.124*	-0.078	0.011	0.024	-0.035
							(1.81)	(1.74)	(1.09)			
Close friends started business							-0.187**	-0.322***	0.115***	-0.008	-0.059	0.066
							(2.26)	(6.85)	(2.43)			
Cumulative GPA							0.011	0.034	-0.046	0.000	0.004	-0.004
							(0.15)	(0.84)	(1.08)			
<u>College</u>												
Agriculture							0.223	0.015	0.013	0.012	-0.008	-0.004
							(1.50)	(0.18)	(0.17)			
Business							0.171	0.152*	0.022	0.007	0.016	-0.023
							(1.12)	(1.82)	(0.27)			
Design							0.095	0.044	0.143*	0.005	0.004	-0.009
							(0.59)	(0.49)	(1.68)			
Engineering							0.490***	0.321***	0.015	0.033	0.054	-0.086
							(2.83)	(3.09)	(0.15)			
Human Sciences							0.116	0.092	0.217***	0.005	0.004	-0.009
							(0.76)	(1.13)	(2.69)			
Constant	-2.269***	-1.466***	1.234***	-5.011***	-2.910***	1.365***	-4.960***	-2.721***	1.549***			
	(22.02)	(24.19)	(19.83)	(5.71)	(7.11)	(3.46)	(5.25)	(5.88)	(3.41)			
ρ_{nf}		0.294***			0.284***			0.281***				
		(6.81)			(6.35)			(6.09)				
ρ_{nW}		-0.394***			-0.428***			-0.428***				
		(16.09)			(16.72)			(16.66)				
ρ_{fW}		-0.109***			-0.095*			-0.164***				
		(2.38)			(1.90)			(3.24)				

Note: t-statistics are in parenthesis. */**/** significance level at 10%/5%/1%, respectively.

Table 4. Joint effects of three human capital measures (*Occupation*, *Industry*, *Course_specialization*)

Panel A			
	Nonprofit entrepreneurship	For-profit entrepreneurship	Paid-employment
Within occupation ($H_0: \beta_1 = \beta_2 = \beta_3 = 0$)	$\chi^2(3) = 10.09$ *p*=0.018	$\chi^2(3) = 122.26$ *p*=0.000	$\chi^2(3) = 20.50$ *p*=0.000
Panel B			
Across occupations ($H_0: \beta_1 = \beta_2 = \beta_3 = 0$)	Nonprofit entrepreneurship	For-profit entrepreneurship	Paid-employment
Nonprofit entrepreneurship		$\chi^2(6) = 127.44$ *p*=0.000	$\chi^2(6) = 29.60$ *p*=0.000
For-profit entrepreneurship			$\chi^2(6) = 128.48$ *p*=0.000
Panel C			
	Nonprofit entrepreneurship	For-profit entrepreneurship	Paid-employment
The average effect of three measures on individuals : $\overline{(\beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3)}$	0.278	0.472	-0.070
Panel D			
($H_0: \beta_1 + \beta_2 + \beta_3 = 0$)	$\chi^2(1) = 10.20$ *p*=0.0015	$\chi^2(1) = 103.03$ *p*=0.0000	$\chi^2(1) = 9.76$ *p*=0.0018

Table A-1. Joint effects of three human capital measures (*Occupation*, *Industry*, *Course_specialization*)

	Nonprofit entrepreneurship	For-profit entrepreneurship	Paid-employment
Sum of three human capital effects evaluated at sample means: $\beta_1\bar{X}_1 + \beta_2\bar{X}_2 + \beta_3\bar{X}_3$	0.230	0.353	-0.073

Table A-2. Distribution of three employments across industry

Industry	Nonprofit entrepreneurship	For-profit entrepreneurship	Paid-employment
Agriculture	5.00%	6.19%	4.42%
Arts, Entertainment, & Recreation	2.14%	1.83%	1.17%
Construction	5.71%	4.82%	3.17%
Finance/Insurance	4.29%	5.28%	6.16%
Hospitality	0.71%	0.80%	0.77%
Manufacturing	4.29%	6.65%	9.48%
Mining	0.00%	0.00%	0.19%
Real Estate	1.43%	2.06%	0.62%
Social Services	1.43%	0.80%	0.96%
Transportation & Utilities	0.71%	2.64%	3.91%
Accommodation & Food Services	0.00%	0.46%	0.36%
Communications	2.86 %	4.13%	1.93%
Education	11.43%	5.96%	9.03%
Government/Military	10.00%	3.90%	6.12%
Legal	2.14%	1.38%	1.38%
Medicine/Health Care	2.14%	3.21%	4.78%
Non-profit	3.57%	0.80%	1.47%
Retail	0.71%	2.29%	1.85%
Information Technology	7.86%	8.72%	5.91%
Other	7.14%	10.78%	8.63%

Table A-3. Distribution of three employments across occupation

Occupation	Nonprofit entrepreneurship	For-profit entrepreneurship	Paid-employment
Marketing & sales managers	18.57%	23.85%	12.94%
Financial managers	12.14%	12.50%	8.20%
Industrial production managers	4.29%	4.59%	4.53%
Transportation, storage, & distribution managers	2.14%	4.01%	3.19%
Service occupations	10.71%	14.11%	11.60%
Office, clerical, & administrative support occupations	16.43%	14.22%	11.88%
Construction & extraction occupation	7.14%	7.68%	4.27%
Transportation & material moving occupations	1.43%	4.01%	3.08%
Chief executives	22.86%	18.00%	4.23%
Computer & information systems managers	10.00%	10.67%	7.42%
Human resources managers	7.86%	5.73%	3.06%
Purchasing managers	5.00%	6.19%	3.36%
Professional & technical occupations	57.86%	54.93%	59.49%
Sales & related occupations	18.57%	26.95%	17.26%
Farming, fishing, & forestry occupations	7.86%	9.40%	4.21%
Production occupations: Laborers & operatives	3.57%	5.50%	3.36%

CHAPTER 6. GENERAL CONCLUSION

This dissertation consists of four chapters exploring the roles of risk preference and skills in various labor supply settings. The first three chapters focus on the role of measured risk aversion on economic choices and the fourth chapter focuses on the role of observed and unobserved entrepreneurial skills on starting a nonprofit enterprise.

The first three chapters use NLSY79 data to show that commonly used measures of risk preferences do not behave as theory would suggest in many labor market settings. First, while we confirm prominent differences in risk aversion between men and women, those gender differences in risk aversion do not explain gender gaps in entrepreneurship, earnings, and hours of work decision.

Second, the hypothesis that more risk averse entrepreneurs survive longer in business than their less risk averse counterparts is soundly rejected. This surprising finding calls into question the interpretation of common measures of risk aversion as measures of taste for risk. Instead, measured risk attitudes perform as if they are indicators of entrepreneurial ability–the least risk averse are apparently those who can best assess and manage risks. Indeed, our interpretation is consistent with the work of recent experimental studies that find that the less risk averse has higher cognitive ability.

Third, the theoretical presumption of stable risk preferences is soundly rejected.

Individual risk preferences are changing over time in response to personal economic circumstances such as income and employment status. In particular, recent employment spells increases risk aversion whereas recent unemployment spells decrease risk aversion. This finding shows that measured risk aversion cannot be treated as a fixed attitude toward risk. Because risk preferences respond to current economic circumstances, they cannot be viewed as causal factors in studies of contemporaneous economic decisions such as occupational choice, earnings, or entrepreneurship.

The last chapter uses a data set composed of Iowa State University alumni from 1982-2006 to show that observed diverse skills increase the probability of nonprofit entrepreneurship. This is consistent with previous finding regarding how these same skills affect the decision to become a for-profit entrepreneur. In addition, unobservable talents that increase probability of for-profit startups are positively correlated with the unobservable skills that lead to nonprofit start-ups, consistent with a presumed entrepreneurial skill that underlies the Lazear Jack-of-All-Trades model. Apparently, nonprofit sector entrepreneurs and for-profit sector entrepreneurs share common human capital that is crucial for successful entrepreneurship in both sectors. Indeed, those who start a for-profit venture also opt for starting a nonprofit enterprise, and *vice versa*.

This dissertation focused on individual decisions made in isolation. It is plausible that married couples make joint decisions regarding one spouse's entrepreneurial choices. That leads to interesting questions for future research including whether entrepreneurship is tied to the attributes of the spouse, whether one spouse's entrepreneurial entry alters the labor supply or occupational choices of the partner, and whether marriage serves as a risk-management mechanism for entrepreneurs by providing a second, more secure source of income.