# Are They All Like Bill, Mark, and Steve? The Education Premium for Entrepreneurs*

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**Abstract**

We rely on the Survey of Consumer Finances to study how the return to education of US entrepreneurs has evolved since the late 80's. We calculate the yearly income that an entrepreneur expects to obtain during his entrepreneurial venture, as resulting from labor income, dividend payments, and realized capital gains upon selling the business. We find that the premium of having a college degree relative to a high school degree has increased, but roughly as much as the analogous premium for workers. Instead, the premium for postgraduate education relative to college education has increased substantially more for entrepreneurs than for workers. Today an entrepreneur with a postgraduate degree earns on average 100,000 dollars per year more than an entrepreneur with a college degree. The difference is larger at higher quantiles of the entrepreneurs' income distribution. In the late 80's, differences were close to zero. The rise in the premium to postgraduate education is mainly due to an increased complementarity between the advanced formal skills provided by higher education and the applied practical expertise acquired through past labor market experience which, combined together, have become increasingly important for running successful businesses.

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## 1 Introduction

There is widespread evidence that the return to skills (defined, for example, as the wage premium attributable to college or post-graduate education) has increased over the last decades in most industrialized countries. The available evidence has focused on employees (see for example Card (1999) for a review), while we know very little—if anything—on the evolution of the skill premium of entrepreneurs. The anecdotal evidence is somewhat mixed. On the one hand, some of the most successful recent US companies, such as Microsoft, Facebook, Apple and Twitter have been founded by college drop-outs like Bill Gates, Mark Zuckerberg, Steve Jobs and Evan Williams respectively. This might indicate that higher education has become less useful for successful entrepreneurship, possibly because of its high opportunity cost in terms of time. On the other hand, successful entrepreneurs who received little or no formal education are common throughout the history of capitalism.[1] And, over the recent years, the US have also experienced a boom in the number of successful high tech firms created by entrepreneurs with postgraduate education, which might rather suggest an increase in the return to higher education for entrepreneurs. Google began as a research project by Sergey Brin and Larry Page during their PhD in computer science at Stanford University, where they eventually obtained their Master of Science degree. Both Michael Bloomberg, founder of the global financial data and media company Blomberg L.P., and Scott McNealy, co-founder of Sun Microsystems, have an MBA – Bloomberg from HBS abd McNealy from Stanford GSB. The three leading companies in the booming US biotechnology industry, Amgen, Gilead Sciences and Celgene, have been founded by entrepreneurs with PhD degrees.[2] And even Peter Thiel, a serial entrepreneur and a leading figure in Silicon valley who has recently funded

[1] Michael Dell, founder of Dell Computers and Ralph Lauren, CEO and Chairman of Ralph Lauren Corp, are examples of well known entrepreneurs who dropped out of college. George Eastman, founder of Kodak, Henry Ford, founder of Ford Motor Company, John D. Rockefeller Senior, founder of Standard Oil, Ray Kroc, founder of McDonald's and Walt Disney, founder of the Walt Disney Company, are all examples of entrepreneurs who did not even attend college and in some cases (Eastman, Kroc, Rockefeller, and Disney) did not even complete high school.

[2] Amgen by George Blatz Rathmannw who holds a PhD in physical chemistry from Princeton university; Gilead by Michael L. Riordan who holds both a Doctor of Medicine degree from Johns Hopkins University and an MBA degree from Harvard University; and Celgene by Sol J. Barer together with David Stirling who both hold a PhD in biochemistry—Barer from Rutgers University and Stirling from the University of Warwick.

a fellowship programm to encourage young people to skip or drop out of college to start businesses, holds a Juris Doctor degree from Stanford Law School.

In this paper we use the Survey of Consumer Finances (SCF) to supply evidence on the evolution of the educational composition and the return to education of US entrepreneurs over the period 1989-2013. We identify entrepreneurs as individuals whose primary job consists of actively managing one or more privately-held businesses, which they own in part or in full. According to this criterion, around 10% of employed individuals in the US are entrepreneurs.[3] To measure the return to entrepreneurship, we take into account that an important part of the income of entrepreneurs comes from capital gains realized upon selling the business. An entrepreneur also immobilizes part of his wealth as well as his human capital in his business. Upon exit (due to failure or because the business is sold), the entrepreneur obtains back some wealth that can be re-invested somewhere else or consumed, while his human capital can be re-employed in the labor market. Based on this insight we construct a simple measure for the *return to entrepreneurship*, which can be implemented using data from the SCF, that consists of repeated cross-sectional surveys with information just on the date of start of the entrepreneurial venture, current income from the entrepreneurial venture (in the form of either labor income or dividend payments), its current market valuation and the initial investment made by the entrepreneur to acquire or to start-up the business. We define the *excess* return from entrepreneurship as the income that the entrepreneur obtains because of running the business in excess of the income that he would have obtained if he had invested his wealth in financial markets and employed his human capital in the labor market. With this definition the duration of the entrepreneurial venture matters for the return, as a quicker exit implies that the entrepreneur can re-employ her wealth and human capital more quickly in alternative uses, which pushes up the return.

Our measure for the return from entrepreneurship can be generalized to account for some possible biases due to the repeated cross-section nature of the SCF. There could be

[3]Notice that "Bill, Mark and Steve" are part of the population sampled by the SCF until before entering the Forbes 400 list that contains the wealthiest 400 people in the US, since these individuals are explicitly excluded from the SCF sampling.

a composition bias, which arises because entrepreneurs with lower failure rates or lower selling opportunities are over-represented in the cross-section. There could be a valuation bias due to firm failure, which arises because the return from entrepreneurship depends on the expected realized capital gains from the entrepreneurial venture, which should account for the fact that capital gains are never realized if the business fails before a profitable selling opportunity materializes. Finally there could be a recycling bias due to the fact that entrepreneurs can re-employ their entrepreneurial skills to start new ventures, which implies that the return from entrepreneurship should be cumulated over the expected future sequence of entrepreneurial ventures that an entrepreneur will start-up and complete.

We group entrepreneurs depending on whether they have (i) a post-graduate degree, (ii) a college degree, (iii) a high school degree, or (iv) they are high school dropouts. In our data the fraction of entrepreneurs with a college degree has increased, while the fraction of entrepreneurs with a postgraduate degree has remained stable over time around a value of one third. The premium of having a college degree relative to a high school degree has increased, but roughly as much as the analogous premium for workers,—which implies that the excess return from entrepreneurship has remained stable for this group of workers. Instead the premium for postgraduate education has increased substantially more for entrepreneurs than for workers. On average, entrepreneurs with a post-graduate degree nowadays earn more than twice as much as they used to earn in the early 90's. The analogous percentage increase for entrepreneurs with a college degree is at most 50 percent, while for entrepreneurs with less than a college degree the increase is almost absent. Today an entrepreneur with a postgraduate degree earns on average 100,000 dollars per year more (at constant 2010 prices) than an entrepreneur with a college degree. This difference more than doubles when looking at the higher quantiles of the entrepreneurs' income distribution. In the late 80's, these differences were close to zero. The sharp increase in the skill premium for entrepreneurs with postgraduate education is partly due to the higher dividends paid by the firm they ran and partly due to the higher capital gains realized when selling their business. The premium for postgraduate education holds both for entrepreneurs with a Master or an MBA degree and for those with a PhD, it

has remained high during the Great Recession (despite a drop in absolute returns), it increases substantially when looking at the higher deciles of the entrepreneurs income distribution, and it is little affected by conditioning on the earnings in the previous job of the entrepreneur, which roughly controls for changes in the quality composition of entrepreneurs. All this suggests that the more advanced skills associated with higher education have become increasingly important for entrepreneurial success: the experience of "Mark, Bill and Steve" has been the exception rather than the rule.[4]

Following Lazear (2004, 2005), some recent research has emphasized that entrepreneurs need a balanced mix of skills to succeed. The skills of an entrepreneur come partly from formal education and partly from past labor market experience. An increase in the skill premium can be the result of an increase in the return to education, in the return to labour market experience or in the complementarity between education and experience. We find that the complementarity between higher education and labour market experience has increased substantially. The increased complementarity is specific to entrepreneurship and it accounts almost fully for the rise in the premium to postgraduate education. This holds true after controlling for several alternative explanations for the rise in the premium, including changes (i) in the sectoral specialization of businesses ran by entrepreneurs with different educational levels; (ii) in their access to internal or external finance; (iii) in the importance of vintage technology effects; (iv) in the intergenerational transmission of wealth; or (v) in compensating differentials—due to greater business risk or lower possibilities of recycling entrepreneurial skills into new ventures. Overall our evidence is consistent with the notion that, in the today technologically-advanced highly-competitive world, running successful businesses requires both the advanced theoretical competence provided by higher formal education and the applied practical expertise acquired through labor market experience.

We believe that our findings on the increase of the return to postgraduate education for entrepreneurs is novel. We are not aware of any work documenting the time evolution of

[4]We do not attempt to identify any causal effect of education on entrepreneurship. So our evidence is also consistent with a pure selection story where education provides no additional skills for entrepreneurship, more talented entrepreneurs self-select into higher education and their innate talent for entrepreneurship has become progressively more valuable for running businesses.

the skill premium for entrepreneurs. This lack of evidence is partly explained by inherent difficulties in measuring the return to entrepreneurship discussed in this paper. Kaplan and Rauh (2013) study the characteristics of the 400 wealthiest individuals in the US over the past three decades as tabulated in the Forbes 400 list and document that the share of college graduates in the list has increased from 77 to 87 percent, which is consistent with our findings that the return to education has increased. There is also some cross-sectional evidence on the return to education for entrepreneurs, which is reviewed in Van der Sluis et al. (2008). Generally, there is a positive relationship between the educational level of the entrepreneur and the performance of the firm in terms of survival probabilities, firm profits, and growth (see Queiro (2016) for recent evidence). Van der Sluis et al. (2008) also review studies that compare the return to education for entrepreneurs and employees. Van Praag et al. (2013) use the National Longitudinal Survey of Youth (NLSY) and find a higher return to education for entrepreneurs than for employees, which is consistent with our findings and with the claim by Gennaioli et al. (2013) that educated entrepreneurs matter more for aggregate productivity than educated workers.

The paper by Hamilton (2000) is also related to ours. He studies earnings differentials between self-employed and employees by focusing on a sample of male school leavers from the Survey of Income and Program Participation (SIPP) over the 1983-1986 period. The yearly return from entrepreneurship is measured as the sum of the total income obtained in the year (in the form of either salaries or dividend payments) plus the self-reported change in the value of business equity over the year. He finds that the majority of entrepreneurs earns less than employees with comparable characteristics. Here we focus on the return to education in entrepreneurship, we use a representative sample of the US population (rather than focusing just on school leavers) and we propose an index for the overall long-run return from entrepreneurship.

Hall and Woodward (2010) study the risk adjusted return to entrepreneurship for a sample of entrepreneurs backed by venture capital. They document that the return to entrepreneurship is highly skewed and that, even for modest degrees of risk aversion, the certainty equivalent of the distribution of returns at start-up is only slightly above zero. Even if our measure for entrepreneurial returns does not control for risk, we think that

risk-aversion alone cannot explain the rising premium to higher education observed in the data. This is because we find that the entire distribution of returns has generally become more favorable to highly educated entrepreneurs: failures rates of entrepreneurial ventures have evolved similarly across educational groups while the skill premium to entrepreneurship has increased at all the higher quantiles of the entrepreneurs' income distribution.

Several other studies have used the SCF to study features of US entrepreneurs. De Nardi et al. (2007) establish some stylized facts on the role of liquidity constraints and personal wealth for business development. Moskowitz and Vissing-Jorgensen (2002) and Kartashova (2014) estimate the aggregate return to private equity, which accrues mainly to entrepreneurs, and compare it to the return from investing in public equity. Here we focus on differences in individual entrepreneurial returns due to labor income, dividend payments, initial investment and capital gains, rather than on the aggregate financial return to private equity. None of these papers has focused on the return to education for entrepreneurs and how it has evolved over time.

The rest of the paper is organized as follows. Section 2 discusses how to measure the return from entrepreneurship in the SCF. Section 3 describes the data. Section 4 characterizes the evolution of the average return from entrepreneurship across educational groups while Section 5 focuses on different quantiles of the entrepreneurs' return distribution. Section 6 provides evidence that the complementarity between education and labour market experience has increased and tests for alternative explanations for the rise in the premium to postgraduate education. Section 7 concludes. The Appendix contains some formal derivations, further details on the data and additional empirical results.

## 2 Measuring the return from entrepreneurship

To measure the return from entrepreneurship on SCF data, we recognize that an entrepreneur immobilizes part of his wealth as well as his human capital when running a business. Upon exit, the entrepreneur obtains back some wealth that can be re-invested or consumed, while his human capital can be re-employed in the labor market. For the

sake of comparison with conventional wage regressions (Mincer, 1958), the *return from entrepreneurship* is measured as a flow value, by calculating the yearly income that an entrepreneur expects to obtain during his entrepreneurial venture, as resulting from labor income, dividend payments, and realized capital gains upon selling the business. We define the *excess* return from entrepreneurship as the income that the entrepreneur obtains because of running the business in excess to the income that he would have obtained if he had invested or consumed his wealth and employed his human capital in the labor market. We start considering a simple framework that we later extend to allow for (i) business failure, (ii) heterogeneity in business types, and (iii) repeated episodes of entrepreneurial activity.

### 2.1 Baseline measure

Time is continuous. We start by assuming that the entrepreneur is infinitely lived, risk-neutral and he can run at most one business in his life. Let $k$ denote the initial investment in the business. Let $d$ denote the dividend payments of the business in a period—which in theory can be negative if the entrepreneur injects capital into the business—and $l$ the labor income from the business. The total income obtained by the entrepreneur in a period is then equal to $y \equiv d + l$. We assume that these quantities are constant through time. Nothing changes if $y$ evolves stochastically over time, provided these fluctuations do not lead to a liquidation of the business, an issue we discuss below. Assume the market interest rate is $r \geq 0$ and that the entrepreneur discounts cash flows at rate $\rho > r$. This characterizes the fact that securities placed in hands of a large number of investors have greater liquidity and are better diversified than those privately held by the entrepreneur. We assume that the difference between $\rho$ and $r$ is large enough so that the entrepreneur always sells the business whenever a selling opportunity arises in the market, which happens with instantaneous arrival rate $\mu$. In this case, the entrepreneur sells the business at its market value $M = d/r$, which incorporates the fact that the market discounts dividends at rate $r$. In this simple set-up, $\mu$ also represents the instantaneous probability that the entrepreneur exits the venture, which we denote by $\lambda = \mu$. The

parameter $\lambda$ characterizes the rate at which the entrepreneur can recycle his wealth and his human capital into some alternative uses, and $1/\lambda$ is the expected duration of the entrepreneurial venture. At any point in time, the entrepreneur has the opportunity to work in the labor market to obtain per period income $w$. The labor market value of his human capital is then equal to

$$W = \frac{w}{\rho} \tag{1}$$

Notice that the entrepreneur discounts cash flows at his discount rate $\rho > r$. The value to the entrepreneur of the venture, after the initial investment $k$, is equal to $U$ which solves the following standard asset type equation:

$$\rho U = d + l + \lambda (M + W - U) \tag{2}$$

The left hand side is the yield that the business delivers to the entrepreneur, the right hand side is what the entrepreneur expects to get from the venture. The first term is the instantaneous return, the second is the expected capital gain in case the entrepreneur sells the business in the market, which allows the entrepreneur to cash in the full market value of the business $M$ and to re-employ his human capital in the labor market, which has value $W$. The net value of becoming entrepreneur is denoted by $S$ and it is equal to the difference between the value of the business to the entrepreneur, $U$, and the opportunity cost of the physical capital and human capital that the entrepreneur invests into the business, which has value $k$ and $W$, respectively. So we have

$$S = U - k - W. \tag{3}$$

We convert this net value into a flow value for the sake of comparison with conventional wage regressions, see Mincer (1958). The *excess return* from entrepreneurship for an entrepreneur who has invested $k$ units of wealth in the business is denoted by $\phi$ and it is defined using the notion of Chisini mean (Chisini, 1929). Formally $\phi$ is obtained by equating the actual wealth gains that the entrepreneurs expects to obtain, as measured by $S$ in (3), to the hypothetical expected present value of wealth that the entrepreneur would obtain if he were to receive a constant income flow $\phi$ in each period of his entrepreneurial

venture. Since the entrepreneur exits the venture at Poisson arrival rate $\lambda$, $\phi$ should satisfy the following implicit Chisini's functional equation condition:

$$\frac{\phi}{\lambda+\rho} = S. \tag{4}$$

After using the definition of $S$ in (3) and after noticing that (2) implies that

$$U = \frac{d + l + \lambda (M + W)}{\lambda + \rho}$$

with $W$ given by (1), we obtain that

$$\phi = \theta - w. \tag{5}$$

Here $w$ measures the labor market opportunity flow cost from running the business while

$$\theta = d + l + \lambda (M - k) - \rho k \tag{6}$$

measures the *expected return* from becoming an entrepreneur gross of the opportunity cost of his human capital. This gross return $\theta$ is the sum of three components. The first is the instantaneous income (in the form of dividend payments $d$ and labor income $l$) that the business delivers to the entrepreneur in each period of his entrepreneurial experience. The second component is the *per period* expected capital gains that the business generates. This corresponds to the third term in the right hand side of (6). To understand the expression notice that the entrepreneur invests $k$ units into the business and the expected value of the business upon exit is $M$. So $M - k$ is the realized capital gain from starting up the business. Now let $\tau \geq 0$ denote the overall duration of the entrepreneurial venture. Since the entrepreneur exits the business with Poisson arrival rate $\lambda$, we have that $\tau$ is a negative exponential distribution random variable with expected value equal to $1/\lambda$. So the third term in the right hand side of (6) can be expressed as equal to

$$\frac{M - k}{E(\tau)}, \tag{7}$$

which is a measure of the per period capital gain generated over the (expected) life of the businesses. Finally the last term in the right hand side of (6) measures the cost to the entrepreneur of immobilizing his wealth into the business. Notice the cost is calculated

using $\rho$ rather than $r$, because the entrepreneur should be compensated for the lack liquidity and the (idiosyncratic) risk of his investment in the business.

Our baseline measure for the expected return from entrepreneurship is based on $\theta$ in (6), after recognizing that our data from the SCF are cross-sectional data in discrete time. In particular let $a = 1, 2, 3...$ denote the discretized age of the entrepreneurial venture, and let $h$ be the size of the time interval over which the time line is discretized. Finally we denote current time by $t$, which for simplicity we assume to be discrete. The SCF provides cross-sectional data of entrepreneurs with information about (i) the value of the businesses $M$; (ii) the total income flow obtained by the entrepreneur in a period in the form of either dividend payments $dh$ or labor income $lh$; (iii) the discretized age of the entrepreneurial venture $a$; (iv) the initial investment $k$ of the entrepreneur into the business; and (v) the current time $t$. To measure $\lambda$, we build on Nickell (1979) who observes that hazard rates out of a pool can generally be recovered by combining information on the cross-sectional distribution of age $a$ and the inflow rate into the pool. For each group of entrepreneurs-educational group we construct a measure of the mass of newly started entrepreneurial ventures at time $t$, which we denote by $m_t$.[5] The mass of ventures of age $a$ at time $t$ is then equal to

$$f_{ta} = m_{t-a}\left(1 - \widetilde{\lambda}\right)^a \tag{8}$$

where

$$\widetilde{\lambda} = 1 - \exp(-\lambda h) \simeq \lambda h$$

is the exit rate out of the entrepreneurial venture over an interval of size $h$ and $\exp(-\lambda h)$ is the probability that the entrepreneur does not sell the business in an interval of size $h$. The approximation in the expression above works well when $\lambda h$ is small enough. To use cross sectional data to infer $\lambda$ and to account for possible heterogeneity in the entry rate, an observation pertaining to a given entrepreneur should be normalized by the mass of new ventures started at the time when the entrepreneur started his own venture. We

[5]This index is constructed separately for each educational group: we first use information from the Longitudinal Business Database (LBD) by the US Census Bureau to construct a measure of the total business creation rate in any year since 1976 and then multiply the year-specific value of the index by the share of ventures started in the year by entrepreneurs with the given educational level.

denote by

$$n_{ta} = \frac{f_{ta}}{m_{t-a}} = \left(1 - \widetilde{\lambda}\right)^a \tag{9}$$

the fraction of ventures started at $t-a$ still alive at $t$. In the cross section for any $t$, we can weight each observation by the inverse of the size of the corresponding cohort of newly started ventures and then calculate the resulting weighted average age of ventures. In practice, at any time $t$, we divide the weights in the SCF assigned to an entrepreneur with $a$ periods in the venture by the mass of new ventures started at the time when the entrepreneur started his own venture, as measured by $m_{t-a}$. This amounts to normalizing the entry flow into entrepreneurship to one at any point in time. The cross sectional average age normalized by the magnitude of these cohort effects is then equal to

$$E_n(a) \equiv \frac{\sum_{a=1}^{\infty}(an_{ta})}{\sum_{a=1}^{\infty} n_{ta}} = \frac{\widetilde{\lambda}}{1-\widetilde{\lambda}} \cdot \sum_{a=1}^{\infty}\left[a\left(1-\widetilde{\lambda}\right)^a\right] = \frac{1}{\widetilde{\lambda}} \simeq \frac{1}{\lambda h}. \tag{10}$$

where the second equality makes use of (9). This means that $1/E_n(a)$ measures the exit rate out of entrepreneurship.[6] This implies that the capital gains in (7) can be measured by

$$\frac{M-k}{E_n(a)} \simeq \lambda h\,(M-k)\,. \tag{12}$$

Finally we calculate a measure of the opportunity cost of capital as equal to

$$\rho = R(t-a,t)^{\frac{1}{a}} - 1$$

where $t-a$ is the date of start of a venture which has age $a$ at time $t$ and $R(t-a,t)$ is a measure of the total return obtained by investing in the US stock market over the

[6] We experimented with alternatives to (10) in order to calculate $\lambda h$. These alternatives allow to test for whether the exit rate out of entrepreneurship varies as entrepreneurs age in the business (duration dependence). For each two age groups of ventures, say at age $a$ and at age $a-i$ we can calculate

$$\widetilde{\lambda}_{ai} \equiv 1 - \left(\frac{n_{ta}}{n_{ta-i}}\right)^{\frac{1}{i}} \tag{11}$$

where $n_{tj}$, is the mass at time $t$ of entrepreneurial ventures of age $j$—again normalized by the size of the corresponding cohort of newly created entrepreneurial ventures, as defined in (9). In the absence of duration dependence we would have that $\widetilde{\lambda}_{ai} = \widetilde{\lambda} \simeq \lambda h$. By fixing $i$ and comparing $\widetilde{\lambda}_{ai}$ with $\frac{1}{E_n(\tau)}$ for different values of $a$ we can then evaluate the importance of duration dependence among entrepreneurs. In practice in our data, we do not find strong evidence of duration dependence and we present results by measuring $\lambda$ using (10).

period $(t-a,t)$. Eventually, our baseline measure for the return from entrepreneurship $\theta$ is given by

$$\widetilde{\theta} = dh + lh + \frac{M-k}{E_n(a)} - \left[R(t-a,t)^{\frac{1}{a}} - 1\right] k \tag{13}$$

where $\widetilde{\theta}$ denotes the empirical counterpart of $\theta$ in (13). Small discrepancies between $\widetilde{\theta}$ and $\theta$ can arise because of the approximation in (12) and the discretization of the time line.

### 2.2 Valuation, composition, and recycling bias

So far we have assumed that the entrepreneur exits her entrepreneurial venture only by selling the business. But businesses can fail, before the entrepreneur is able to sell it. This introduces a first type of bias in our baseline measure for the entrepreneurial return $\theta$ in (13), which we call the *valuation bias.* This bias arises because entrepreneurs in the SCF report the market value of their business rather than the wealth that they expect to realize upon exiting from their entrepreneurial venture, which might be due to failure, rather than to selling the business. Moreover there could be heterogeneity in the rate at which entrepreneurs exit their entrepreneurial experience. For example, it could be that worse businesses are more likely to fail or it could be that entrepreneurs running better businesses can sell their businesses more quickly. This heterogeneity in the rate at which entrepreneurs exit their entrepreneurial venture introduces a second type of bias that we call the *composition bias.* Finally, after exiting a given venture, an entrepreneur can recycle his entrepreneurial skills and start-up a new venture. This implies that the return from entrepreneurship should be cumulated over the expected future sequence of entrepreneurial ventures that an entrepreneur might start-up and complete. Failing to control for this might lead to what we call the *recycling bias.* We briefly discuss these three biases and how to handle them in the SCF. The Appendix contains the full details.

**Valuation bias** Assume now that the business can fail with independent instantaneous probability $\delta \geq 0$ and that the business has liquidation value $L$. The overall exit rate from the entrepreneurial venture becomes now equal to $\lambda \equiv \mu + \delta$ where $\mu$ is the arrival rate of a selling opportunity. All the other assumptions of the framework are as before.

We show in the Appendix that in this case the excess return from entrepreneurship $\phi$ of a business with initial investment $k$ is given by

$$\phi_v = \theta_v - w \tag{14}$$

where $\theta_v$ is the gross return from entrepreneurship corrected for the fact that the venture can fail before the entrepreneur is able to sell, which is equal to

$$\theta_v = d + l + \lambda \left[\mathbb{E}_x (V) - k\right] - \rho k, \tag{15}$$

with

$$\mathbb{E}_x (V) = (1-\gamma)M + \gamma L = M - \gamma(M - L) \tag{16}$$

denoting the expected value of the business upon exiting entrepreneurship. In (32) $\gamma = \frac{\delta}{\lambda} < 1$ is the probability of failing conditional on exiting the entrepreneurial venture, while $M = \frac{d+\delta L}{r+\delta}$ is the market value of the business. In SCF, entrepreneurs are asked about the market value of their business and in case they respond the business has no value they are asked to report the liquidation value of their business, which we take as a measure of $L$. The interviews in the SCF are done over a time interval $h$, and we can infer that by averaging the responses on the value of the business we actually measure

$$\overline{V} = (1 - \delta h) M + \delta h L = M - \delta h (M - L) = \mathbb{E}_x (V) + (\gamma - \delta h)(M - L) \tag{17}$$

where $\delta h$ measures the fraction of failed businesses in a cross-sectional wave of the SCF.[7] $\overline{V}$ differs from $\mathbb{E}_x (V)$ because $\gamma$ is generally different from $\delta h = \gamma \lambda h$. This difference is larger the smaller is $h$. For $h\lambda < 1$, we have that $\theta - \theta_v > 0$. This difference is what we call the *valuation bias* measured by

$$\Theta \equiv \theta - \theta_v = \lambda \left[\overline{V} - \mathbb{E}_x (V)\right] = \lambda (\gamma - \delta h) (M - L) = (1 - \lambda h) \delta (M - L). \tag{18}$$

This bias arises because the overall expected return from entrepreneurship depends on the expected value of wealth obtained by the entrepreneur upon exit, $\mathbb{E}_x (V)$, which is

[7] In practice, the fraction of failed businesses in a wave of the SCF is likely to be even smaller than $\delta h$, with $h$ denoting a year interval, because interviews in the SCF are run at a specific date in the months between May and December in each survey year, so the fraction of businesses that fail at the time of the interview is typically smaller than the fraction of business that fail over the entire year—which is equal to $\delta h$.

generally lower than the cross-sectional average value of the business $\overline{V}$. This difference arises because the entrepreneur's conditional probability of exiting due failure $\gamma$ is typically higher than the fraction of failed businesses in the sample $\delta h$. After constructing measures of the failing rate $\delta$ and of the difference between $M$ and $L$, we can then use (15) together with (32) to calculate $\theta_\nu$ as follows:

$$\widetilde{\theta}_v = d + l + \frac{\overline{V} - k}{E_n(a)} - \widetilde{\Theta} - \left[R(0,t)^{\frac{1}{t}} - 1\right] k = \widetilde{\theta} - \widetilde{\Theta}, \tag{19}$$

where $E_n(a)$ is as in (10) and

$$\widetilde{\Theta} = \left[1 - \frac{1}{E_n(a)}\right] \delta \left(M - L\right) \tag{20}$$

measures the valuation bias in (18).[8]

**Composition bias** A second bias arises because the composition of entrepreneurs in a cross-section does not necessarily reflect the composition of the businesses at the time when entrepreneurs actually started their venture. Assume for simplicity that there are $n$ types of businesses that pay (potentially) different level of dividends, $d_i$, have (potentially) different market failure rates $\delta_i$ and (potentially) different arrival rates of selling opportunities $\mu_i$, which imply different exit rates from entrepreneurship $\lambda_i = \delta_i + \mu_i$, $\forall i = 1....n$. Also assume that immediately after creating the business the entrepreneur discovers the type of his business, which is of type $i$ with probability $\alpha_i$, with $\sum_{i=1}^{n} \alpha_i = 1$. The expected total return from entrepreneurship in (6) is now equal to

$$\theta^* = \sum_{i=1}^{N} \alpha_i \theta_{vi} \tag{21}$$

where $\theta_{vi}$ is the type-$i$ specific measure for the total entrepreneurial return analogous to (15). The (expected) excess return from entrepreneurship is equal to $\phi^* = \theta^* - w$. In practice we are interested in comparing $\theta^*$ with the value of $\theta_v$ in (15), that we would obtain by using cross-sectional data. The problem is that the unconditional ex-ante expected value of the variable $x = d,\, l,\, M,\, k$

$$E(x) \equiv \sum_{i=1}^{n} \alpha_i x_i \tag{22}$$

[8]Notice that we have used the convention that the time line is discretized in time intervals small enough whose size is normalized to one, which in the data will correspond to a year.

is different from its cross-sectional average $\overline{x}$. To analyze this issue more formally, assume for simplicity that at every point in time there is a mass one of new entrepreneurs who start their venture—which corresponds to the previously discussed normalization of the observations in SCF by the size of the cohort of newly started ventures. In steady state, the cross-sectional average of the variable $x = d,\ l,\ M,\ k$ is given by

$$\overline{x} = \sum_{i=1}^{n} \sigma_i x_i, \tag{23}$$

where the (cross sectional) shares $\sigma_i$'s are equal to

$$\sigma_i = \frac{\frac{\alpha_i}{\lambda_i}}{\sum_{j=1}^{n} \frac{\alpha_j}{\lambda_j}}. \tag{24}$$

In general the shares $\sigma_i$'s are different from the true shares in the population $\alpha_i$'s, because entrepreneurs with lower $\lambda_i$ are over-represented in the cross-section and have $\sigma_i > \alpha_i$. This causes what we call the *composition bias*. This makes $E(x)$ in (22) generally different from $\overline{x}$ in (23). We can try to compare the magnitude of $\theta^*$ relative to $\theta_v$ or $\theta$. The comparison depends on whether the heterogeneity in the exit rate from entrepreneurship $\lambda_i$ is driven by heterogeneity in failure rates $\delta_i$'s or by heterogeneity in the arrival rates of selling opportunities $\mu_i$'s. Consider first the case where all heterogeneity in $\lambda$ comes from heterogeneity in $\delta$. We can think that failure rates are decreasing in $d$ and thereby also decreasing in the market value of the businesses $M$. If this is the case, entrepreneurs with high returns are *over-represented* in the cross-section, which makes the cross-sectional average larger than their true expected value. In this case $\theta_v$ (or $\theta$) would tend to overestimate the true overall return from entrepreneurship as measured by $\theta^*$ in (21), due to the composition bias. Consider now the case where all heterogeneity in $\lambda$ comes from heterogeneity in $\mu$. We can also think, as documented by Gompers et al. (2010) that better businesses, which say have higher $d$ and thereby higher $M$, are easier to sell, which would imply that the arrival rate of selling opportunities $\mu$ is higher for entrepreneurs with higher ex-post returns. If this effect dominates, entrepreneurial ventures with high return are *under-represented* in the cross-section. In this case, cross-sectional averages tend to underestimate the true overall unbiased expected values, which are the relevant inputs to calculate $\theta^*$ in (21). This allows us to conclude that the sign of the composition

effect generally depends on whether the composition effect is mainly driven by heterogeneity in failures rates $\delta$ or in the arrival rate of business selling opportunities $\mu$. This is ultimately an empirical question, whose answer could also be different at different points of the distribution of the total return from entrepreneurship.

To evaluate the importance of the composition bias, we notice that this bias is small when focusing on recently started entrepreneurial ventures while it gets potentially more and more important when focusing on relatively old entrepreneurial ventures. Under our assumption that exit rates are constant, we can even calculate a measure for the expected value of $x = d,\ l,\ M,\ k$ free of any compositional bias by looking at recently started entrepreneurial ventures. By comparing this value with the analogous value for relatively old ventures, we can infer the sign and magnitude of the composition bias in measuring entrepreneurial returns.

**Recycling bias** Finally we can extend the framework to allow for the possibility that the entrepreneur can recycle his entrepreneurial skills and start-up another venture, see Gompers et al. (2010) and Hall and Woodward (2010) for evidence about serial entrepreneurship. We assume that after exiting the current venture, the entrepreneur can start another venture with probability $\nu \in [0, 1]$. All the other assumptions are as in Section 2.1. The net return from entrepreneurship with initial investment $k$ now becomes equal to

$$\phi_r = \varphi(\nu)\,(\theta - w) = \varphi(\nu)\phi \tag{25}$$

where entrepreneurial return $\theta$ is exactly as in (15) while

$$\varphi(\nu) = \frac{\rho + \lambda}{\rho + \lambda\,(1 - \nu)}$$

takes into account that entrepreneurs can re-employ their entrepreneurial skills with probability $\nu$, which implies that the return from entrepreneurship should be cumulated over the expected future sequence of entrepreneurial ventures that an entrepreneur might start-up and complete. The expression for the excess return from entrepreneurship $\phi_r$ in (25), takes then into account that the excess return from each venture $\phi$, should be multiplied by the factor $\varphi(\nu)$, which is generally greater than one and increasing in the recycling

probability $\nu$. Only in the absence of recycling possibilities, $\nu = 0$, we have $\varphi = 1$ and the two measures for excess return coincide $\phi_r = \phi$.

## 3 Data

We use data from the Survey of Consumer Finances (SCF) to study how the return from entrepreneurship has evolved over time. The SCF is a triennial cross-sectional survey on US households conducted by the Federal Reserve Board of Governors over the period 1989-2013. Around 4,000 households per wave are sampled, with the exception of the last two surveys where sample size increases to around 6,000 households. The SCF is unique in that it collects data on the household finances of a representative sample of Americans. Wealthy individuals are over-sampled to characterize well the right tail of the income and wealth distribution of US households, where entrepreneurs are more likely to be present. All the analysis in the paper, both in terms of descriptive statistics and regression analysis, is performed using the sampling weights provided by the SCF.[9] The Appendix contains a detailed description of all variables used in the analysis.

We focus the analysis on household heads, who correspond to the male individual in a mixed-sex couple and to the older individual in a same-sex couple. We follow De Nardi et al. (2007) in defining as *entrepreneurs* all respondents who simultaneously satisfy three requirements intended to identify individuals who own the business they run. Since in the SCF an individual who runs and owns a business is explicitly coded as being self-employed in his main job (mnemonic X4106), we first require the respondent to be *self-employed*. Second, the respondent must *own or share ownership in at least one privately-held business* (mnemonic X3103).[10] Finally we require that the respondent *actively manages* the business he owns (mnemonic X3104). According to this definition, around 7% of the

[9] To account for measurement error and missing observations, the SCF reports five separate imputation replicates (implicates) for each record, see Kennickell (1998) for details. All statistics are calculated following the procedure suggested by the SCF: for each implicate we calculate the desired statistic using the SCF sampling weights (mnemonic X42001) and then average across the five implicates.

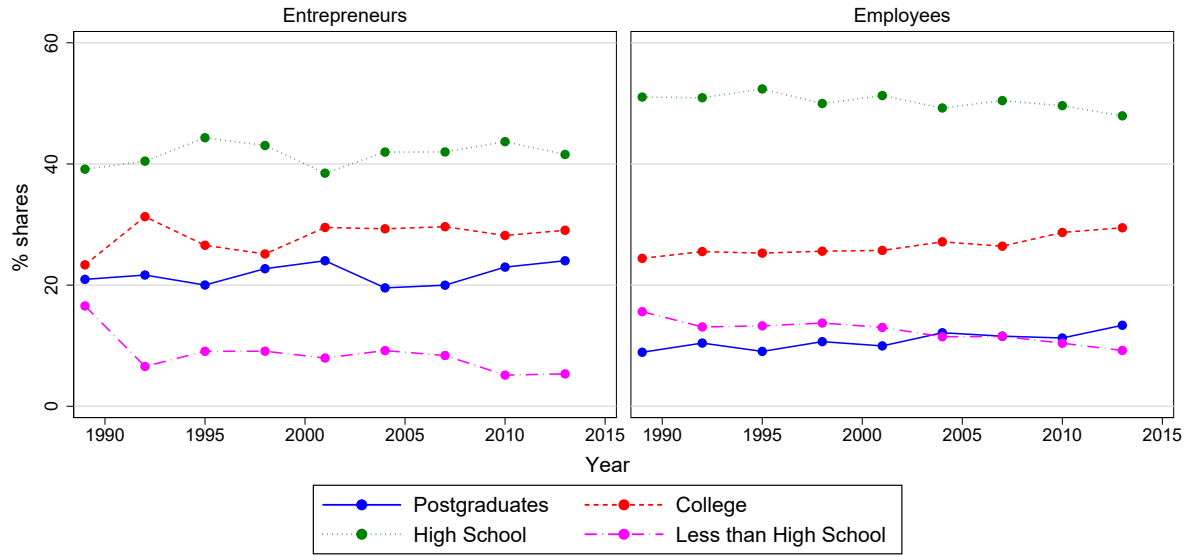
[10] Of those who declare to be self employed, approximately 15% report that they do not share any ownership in privately held businesses. Arguably, these individuals are self-employed who work independently for somebody else. This interpretation is confirmed by the more recent waves (since 2004) of the SCF which contain specific questions for this group of respondents.

household heads in the SCF are entrepreneurs (which corresponds to 11.5% of those employed). The share is stable over time.

We group individuals (either entrepreneurs or employees) in 4 educational groups depending on whether they have a post-graduate degree, a college degree, a high school degree, or they are high school dropouts. We classify as high school dropouts those household heads who report less than 12 years of education; high school graduates are heads who report to have completed high school and, possibly, up to 3 years of college but have no college degree; college graduates must report no more than 16 years of education, have a college degree and no post-graduate degree; postgraduates are heads with a postgraduate degree, either Master's or PhD. Figure 1 characterizes the evolution of the educational composition of the population of entrepreneurs (panel a) and employees (panel b). As in Hacamo and Kleiner (2016), we find that entrepreneurs are on average more educated than employees. The share of college graduates is around 30%, slightly higher among entrepreneurs than among employees, while the share of entrepreneurs with graduate education is twice as large as the analogous share for employees and approximately equal to one quarter. This difference is compensated by a higher share of high school graduates among employees than among entrepreneurs (50% vs. 40%). Shares are fairly stable over time, with a slight increase in the proportion of college graduates and postgraduates, and a corresponding decrease in the relative importance of high school dropouts, whose share falls below 10% among both entrepreneurs and employees. Given their small sample size and their particular socio-economic conditions, we exclude high school dropouts from the rest of the analysis.

To calculate the total return from entrepreneurship $\tilde{\theta}$, we construct each of its components in (13). *Labour income* $l$ is measured using the following question in the SCF (mnemonic X4112): "About how much do you earn before taxes on your main job in salary and wages?". *Dividend payments* $d$ are measured using the following question in the SCF (mnemonic X4131): "In addition to salary and wages, how much do you personally receive from the business before taxes?". The measure for the market *Value of the business* $M$ is obtained from the following question in the SCF (mnemonic X3129): "What is the net worth of (your share of) the business?; Probe: What could you sell it

Figure 1: Entrepreneurs and Employees: Shares by education




**Source:** Survey of Consumer Finances.

for?". The measure for the value of the entrepreneurs' *Initial investment in business* $k$ is obtained using the following question (mnemonic X3130): "If you sold the business now, what would be the cost basis for tax purposes of your share of the business? Probe: What was your original investment? What was the value when you received it? Definition: The tax basis is the amount of the original investment (or the value when it was received) plus additional investments." All variables are calculated at constant 2010 prices. The return to entrepreneurship is then measured as equal to

$$\theta = d + l + \lambda(M - k) - \rho k \tag{26}$$

where $\rho$ is a measure of the opportunity cost of capital over the relevant time period for the entrepreneur, which is calculated as follows:

$$\rho = R(t-\tau, t)^{\frac{1}{\tau}} - 1.$$

$R(t-\tau, t)$ is the total return obtained by investing in the US stock market over the period $[t-\tau, t]$, using the real value (nominal returns deflated with the CPI) of the S&P500 Total Return Index taken from Bloomberg, which also includes income from dividend payments;

$t$ is the current date, $\tau$ is the age of the venture so that $t - \tau$ is the starting date of the venture; $\lambda$ is our measure of the exit rate out of entrepreneurship, which is calculated separately for each education group as the inverse of the average age of entrepreneurial ventures in the SCF, after normalizing the weight of each venture for the size of the entry flow into entrepreneurship, as discussed in Section 2.1.[11]

Table 1 reports descriptive statistics for the population of employees and entrepreneurs. Entrepreneurs tend to be seven years older than employees, more likely to be married, white and male and they have one more year of schooling than employees. The labor income of entrepreneurs and employees is similar, but entrepreneurs' total income (which also includes dividend payments and expected capital gains) is twice as large as employees' average labor income. Entrepreneurs' total income is also more disperse than employees' labor income: median income is similar, but the ratio between the income at the $90^{th}$ percentile and the median is 2.3 for employees while it is 6.4 for entrepreneurs. More than 10% of entrepreneurs have negative returns, and the returns at the bottom quartile of the distribution of entrepreneurial income is a modest 12,000$, half of the amount of employees' income at the same quartile. When looking at the different components of total entrepreneurial income, we find that the sum of labor income and dividends accounts for a large share of it. The average market value of a venture is about 900,000$ and the initial investment is 457,720$. The sectoral composition is similar for entrepreneurs and employees, with the exception of manufacturing, where entrepreneurs are under-represented, and construction, where the opposite occurs, which reflects the fact that firm size, as measured by employment, is on average larger in manufacturing than in construction.

Table 2 reports descriptive statistics for entrepreneurs with different educational levels. We include all the variables later used in the regression analysis. In general more educated

[11] Until 2007, respondents in the SCF report details for up to three actively managed businesses as well as the total market value and the initial investment in all remaining businesses actively managed by the entrepreneur. After 2007, individuals report separate information only for the first two businesses, while the information on the third business is aggregated together with the information on all the remaining businesses. See the Appendix for details on how we aggregate information for all businesses actively managed by the entrepreneur. We checked that results are robust to alternative aggregation choices, for example to focussing the analysis just on the first actively managed business by the entrepreneur.

Table 1: Descriptive Statistics: Employees and Entrepreneurs

| Variable | Mean | sd | p10 | p25 | p50 | p75 | p90 |
|---|---|---|---|---|---|---|---|
| **Employees** | | | | | | | |
| Labor income, $l$ | 55.7 | 99.0 | 15.6 | 26.9 | 43.1 | 65.1 | 97.2 |
| Age | 41.7 | 12.5 | 26 | 32 | 41 | 50 | 59 |
| Female | 0.26 | 0.44 | 0 | 0 | 0 | 1 | 1 |
| White | 0.74 | 0.44 | 0 | 0 | 1 | 1 | 1 |
| Married | 0.60 | 0.49 | 0 | 0 | 1 | 1 | 1 |
| Years of schooling | 14.1 | 1.9 | 12 | 12 | 14 | 16 | 17 |
| Agriculture | 0.02 | 0.11 | 0 | 0 | 0 | 0 | 0 |
| Mining and Construction | 0.07 | 0.26 | 0 | 0 | 0 | 0 | 0 |
| Manufacturing | 0.18 | 0.38 | 0 | 0 | 0 | 0 | 1 |
| Trade | 0.16 | 0.36 | 0 | 0 | 0 | 0 | 1 |
| Finance and Services | 0.12 | 0.32 | 0 | 0 | 0 | 0 | 1 |
| Transp., Communic. and Utilities | 0.37 | 0.48 | 0 | 0 | 0 | 1 | 1 |
| Public Administration | 0.08 | 0.28 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | |
| **Entrepreneurs** | | | | | | | |
| Total return, $\theta$ | 125.6 | 811.7 | -0.6 | 11.9 | 47.3 | 125.1 | 303.0 |
| Labor income, $l$ | 46.3 | 141.0 | 0.0 | 0.0 | 0.0 | 51.9 | 130.0 |
| Dividends, $d$ | 73.1 | 429.2 | 0.0 | 0.0 | 11.2 | 5.5 | 153.9 |
| Value of business, $M$ | 898.9 | 5586.4 | 0.0 | 21.0 | 105.2 | 460.8 | 1535.4 |
| Initial investment, $k$ | 457.7 | 5007.1 | 0.0 | 3.0 | 30.0 | 158.2 | 647.6 |
| Gross capital gains, $\lambda(M-k)$ | 35.6 | 423.0 | -4.3 | -0.01 | 2.1 | 16.9 | 68.9 |
| Net capital gains, $\lambda(M-k)-\rho k$ | 6.0 | 619.5 | -27.6 | -3.3 | 0.24 | 10.6 | 50.8 |
| Age | 49.0 | 12.6 | 33 | 40 | 49 | 58 | 66 |
| Female | 0.09 | 0.29 | 0 | 0 | 0 | 0 | 0 |
| White | 0.88 | 0.33 | 0 | 1 | 1 | 1 | 1 |
| Married | 0.78 | 0.42 | 0 | 1 | 1 | 1 | 1 |
| Years of schooling | 14.7 | 2.0 | 12 | 12 | 16 | 17 | 17 |
| Agriculture | 0.05 | 0.21 | 0 | 0 | 0 | 0 | 0 |
| Mining and Construction | 0.18 | 0.38 | 0 | 0 | 0 | 0 | 1 |
| Manufacturing | 0.08 | 0.27 | 0 | 0 | 0 | 0 | 0 |
| Trade | 0.15 | 0.36 | 0 | 0 | 0 | 0 | 1 |
| Finance and Services | 0.19 | 0.39 | 0 | 0 | 0 | 0 | 1 |
| Transp., Communic. and Utilities | 0.36 | 0.48 | 0 | 0 | 0 | 1 | 1 |

**Note:** Pooled SCF data over the period 1989-2013. All monetary values are in thousands of dollars at 2010 constant prices. Age is in years; Female, White and Married are dummies; Years of schooling is the number of completed years of schooling; Agriculture, Mining and Construction, Manufacturing, Trade, Finance and Services, Transp., Communic. and Utilities ad Public Administration are dummies for the sector of occupation. See the appendix for more details.

entrepreneurs tend to experience a higher total return from entrepreneurship $\theta$. The market value of the business $M$ also increases with education. Entrepreneurs without a college degree are also more likely to run an unlimited liability company and to operate in construction or trade, while postgraduates entrepreneurs are more likely to operate their

Table 2: Entrepreneurs characteristics by educational level

| | **High school** | | **College** | | **Postgraduate** | |
|---|---|---|---|---|---|---|
| Variable | mean | sd | mean | sd | mean | sd |
| Total return, $\theta$ | 62.2 | 532.0 | 138.9 | 916.7 | 229.2 | 1059.9 |
| Dividends, $d$ | 35.8 | 264.1 | 71.6 | 453.3 | 146.5 | 605.8 |
| Labor income, $l$ | 26.2 | 59.1 | 50.3 | 146.4 | 79.8 | 217.4 |
| Value of business, $M$ | 532.5 | 3601.2 | 1149.2 | 6325.1 | 1274.9 | 7359.3 |
| Initial investment, $k$ | 301.9 | 3346.9 | 551.2 | 6017.7 | 634.3 | 6086.9 |
| Gross capital gains, $\lambda(M-k)$ | 19.4 | 317.3 | 52.5 | 488.1 | 44.6 | 500.1 |
| Net capital gains, $\lambda(M-k)-\rho k$ | 0.2 | 445.1 | 17.0 | 727.4 | 2.9 | 741.7 |
| Age | 48.00 | 13.00 | 48.14 | 12.19 | 52.09 | 11.87 |
| Female | 0.09 | 0.29 | 0.09 | 0.29 | 0.09 | 0.29 |
| White | 0.87 | 0.34 | 0.88 | 0.32 | 0.90 | 0.30 |
| Married | 0.78 | 0.42 | 0.76 | 0.43 | 0.81 | 0.39 |
| Collateral | 0.20 | 0.40 | 0.25 | 0.43 | 0.24 | 0.43 |
| Value of collateral | 294.3 | 2355.6 | 887.3 | 4108.5 | 653.3 | 3242.2 |
| Previous experience | 0.61 | 0.49 | 0.58 | 0.49 | 0.57 | 0.50 |
| Inherited business | 0.04 | 0.19 | 0.04 | 0.19 | 0.03 | 0.17 |
| Number of employees | 8.99 | 49.65 | 22.04 | 167.16 | 56.20 | 316.96 |
| Number of businesses managed | 1.21 | 0.64 | 1.35 | 0.89 | 1.39 | 1.09 |
| Past earnings | 26.2 | 92.1 | 52.6 | 586.8 | 51.0 | 134.3 |
| Age of entrepreneurial venture | 13.20 | 11.11 | 12.35 | 10.04 | 14.21 | 11.57 |
| Uncertain Income | 0.43 | 0.40 | 0.35 | 0.48 | 0.28 | 0.45 |
| Unlimited liability | 0.70 | 0.46 | 0.52 | 0.50 | 0.54 | 0.50 |
| Agriculture | 0.07 | 0.26 | 0.03 | 0.17 | 0.02 | 0.13 |
| Mining and Construction | 0.29 | 0.45 | 0.13 | 0.34 | 0.02 | 0.15 |
| Manufacturing | 0.09 | 0.29 | 0.09 | 0.29 | 0.04 | 0.20 |
| Trade | 0.16 | 0.37 | 0.19 | 0.39 | 0.07 | 0.25 |
| Finance and Services | 0.17 | 0.37 | 0.25 | 0.43 | 0.14 | 0.35 |
| Transp., Communic. and Utilities | 0.21 | 0.41 | 0.31 | 0.46 | 0.71 | 0.46 |

**Notes:** Pooled SCF data over the period 1989-2013. High school are heads who have completed high school but have no college degree; college graduates have a college but no post-graduate degree; postgraduates have a postgraduate degree, either a Master or a PhD. All monetary values are in thousands of dollars at 2010 constant prices. Age is in years; Female, White and Married are dummies; Collateral is a dummy for using personal assets as collateral or supplying guarantees to obtain credit and Value of collateral is the value of such assets and guarantees; Previous experience is a dummy for labor market experience before starting or acquiring the current business; Inherited business is a dummy if the business was inherited; Number of employees is the number of employees working for the business, including the entrepreneur; Number of businesses is the number of businesses that the entrepreneur runs; Past earnings is earnings in the main job before starting or acquiring the business (conditional on having worked before); Age of entrepreneurial venture is the number of years since the individual started or acquired the business; Uncertain income is a dummy for entrepreneurs who do not have a good idea of next year's income; Unlimited Liability is a dummy for non incorporated businesses; Agriculture, Mining and Construction, Manufacturing, Trade, Finance and Services, Transportation, Communication and Utilities are dummies for the sector of occupation. See the appendix for more details.

business in Transportation, Communication and Utilities (TCU).

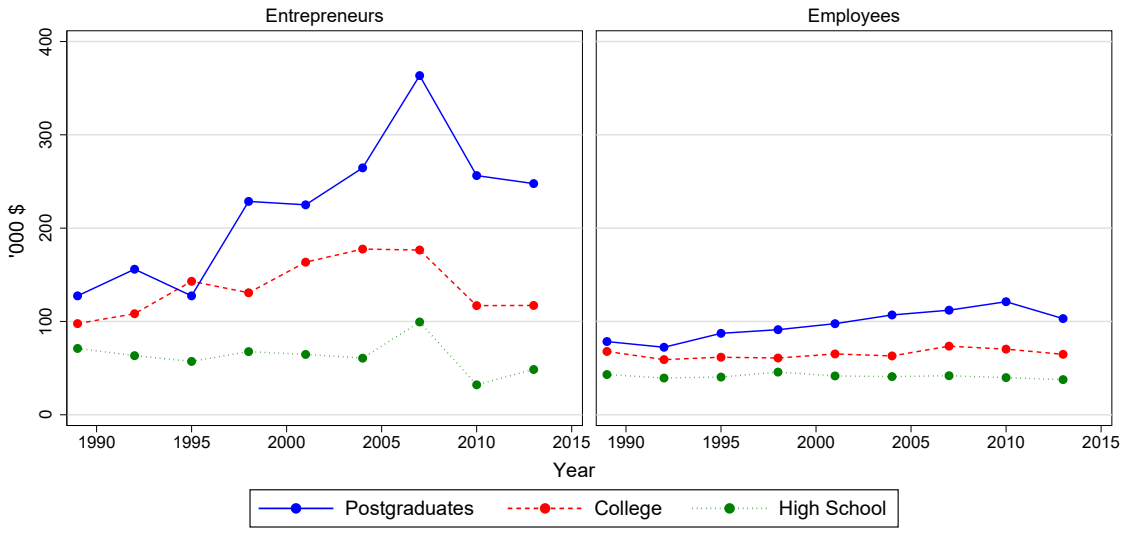
## 4 Empirical results

We start describing the evolution of entrepreneurial returns for different educational groups, using our baseline measure $\theta$. Then we analyze the robustness of the results when accounting for the possible presence of the valuation, composition or recycling biases discussed in Section 2.2, as well as controlling for earnings in the main previous job, which we take as a general measure of labor market ability.

### 4.1 Entrepreneurs' and employee income over time

Figure 2 characterizes the time evolution of the yearly return from entrepreneurship $\theta$ for the three educational groups. For entrepreneurs with a high school degree, returns have remained stable through time around a value of 62,000$. Until the mid 90's returns were similar for college graduates and postgraduates and just above 100,000$. But since then, the return for postgraduates has increased sharply while that of college graduates has increased just mildly: today an entrepreneur with a postgraduate degree earns on average 100,000$ more than an entrepreneur with just a college degree. In panel (a) of Figure 3 we separately study returns for entrepreneurs with a master's degree (MA, MS or MBA) and for those with a PhD, an MD, or a JD—which is the finest partition of postgraduate degrees available in the public version of the SCF. On average PhDs earn more, but the time profile of returns is fairly similar for the two groups. The second panel of Figure 2 characterizes the evolution of (average) wage income for employees. The wage income of high school graduates has remained fairly stable through time, slightly decreasing towards the end of the sample period. The wage income of employees with a college degree has increased slightly, from around 60,000$ to 70,000$, while wages of postgraduates have risen more markedly, from 80,000$ to above 100,000$. Although this pattern matches qualitatively the evolution of returns for entrepreneurs, there are also some large quantitative differences. Panel (b) of Figure 3 plots the difference between the entrepreneurial return $\theta$ of a given educational group and the corresponding wage income

Figure 2: Entrepreneurs returns $\theta$ and Employees wage income $w$

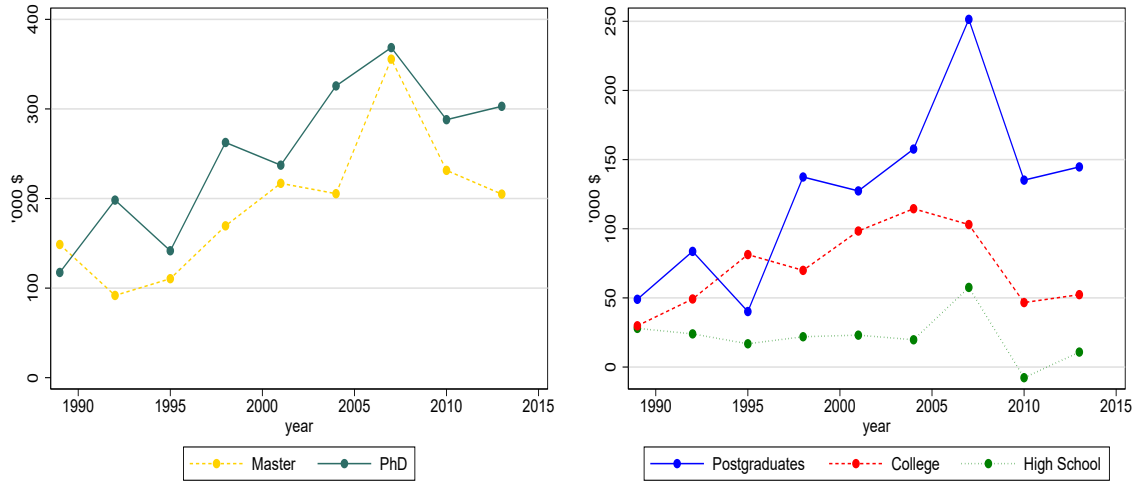



**Source:** Own calculations using data from the Survey of Consumer Finances, the Longitudinal Business Database and the S&P500 Total Return Index. Values are in thousands of dollars at 2010 constant prices.

of employees $w$. The excess return return from entrepreneurship $\phi = \theta - w$ has remained stable for high-school graduates, turning negative in 2010. Excess returns have increased for both college graduates and postgraduates, but the increase for postgraduates is much more pronounced: excess returns have quadrupled for post-graduates while they have doubled for college graduates. Excess returns have dropped during the Great Recession, but the relative differences have remained unchanged. In particular excess returns for postgraduates have remained almost three times larger than their level at the beginning of the sample period.

Figure 4 plots separately the time profile of the different components of $\theta$ for the three educational groups. Panel (a) focuses on the income flow, as measured by the sum of labor income and dividends $d + l$. The profiles of $d + l$ match closely those of total returns, for all educational groups. This conforms the evidence of Tables 1 an 2 that income flows represent a major part of total entrepreneurial income. Panel (b) of Figure 4 characterizes the profile of Gross Capital Gains defined as $\lambda(M - k)$. Gross Capital Gains have increased

Figure 3: Entrepreneurs returns for postgraduates and Excess returns




(a) $\theta$, Master's vs. PhD

(b) Excess Return, $\phi = \theta - w$

**Source:** Own calculations using data from the Survey of Consumer Finances, the Longitudinal Business Database and the S&P500 Total Return Index. Values are in thousands of dollars at 2010 constant prices.

for college graduates and postgraduates, but their value never exceeds 100,000\$. Moreover, once we subtract our measure of the opportunity cost of capital in the business, $\rho k$, we obtain that these net capital gains $\lambda(M - k) - \rho k$ are close to (and sometimes below) zero, with no clear time series pattern. This is a manifestation of the private equity premium puzzle analyzed by Moskowitz and Vissing-Jorgensen (2002) and Kartashova (2014). Overall this indicates that capital gains accounts for a small share of the return from entrepreneurship. This does not mean that the wealth that entrepreneurs cash in upon an IPO or selling the business is small: the average market value of businesses is half a million dollars for high school graduates, with a stable time patters, while it goes from around that value at the beginning of the sample period to more than 1.5 million of dollars at the end of the sample for both college and postgraduates (panel d). The relatively small contribution of capital gains to total entrepreneurial income is rather due to the fact that capital gains are converted into flow values and that a typical entrepreneurship spell is around 10 years, see panel (f). Moreover capital gains have increased just slightly for both college graduates and postgraduates both because the initial investment in the business

$k$ has increased (see panel e) and because the exit rate out of entrepreneurship $\lambda$ has declined (see panel f), with a similar pattern for college graduates and postgraduates.[12]

We now use regressions to quantify the differential changes in returns across educational groups after controlling for observable characteristics. We always take high school graduates as the reference group and focus on three different specifications, the first two reported in the main text, the last one in the Appendix. The first specification is based on the following regression model:

$$y_{it} = \beta_1 \text{College} + \beta_2 \text{Postgrad} + \beta_3 \text{College} \times \text{Post} + \beta_4 \text{Postgrad} \times \text{Post} + D_t + \beta_5' X_{it} + \epsilon_{it} \quad (27)$$

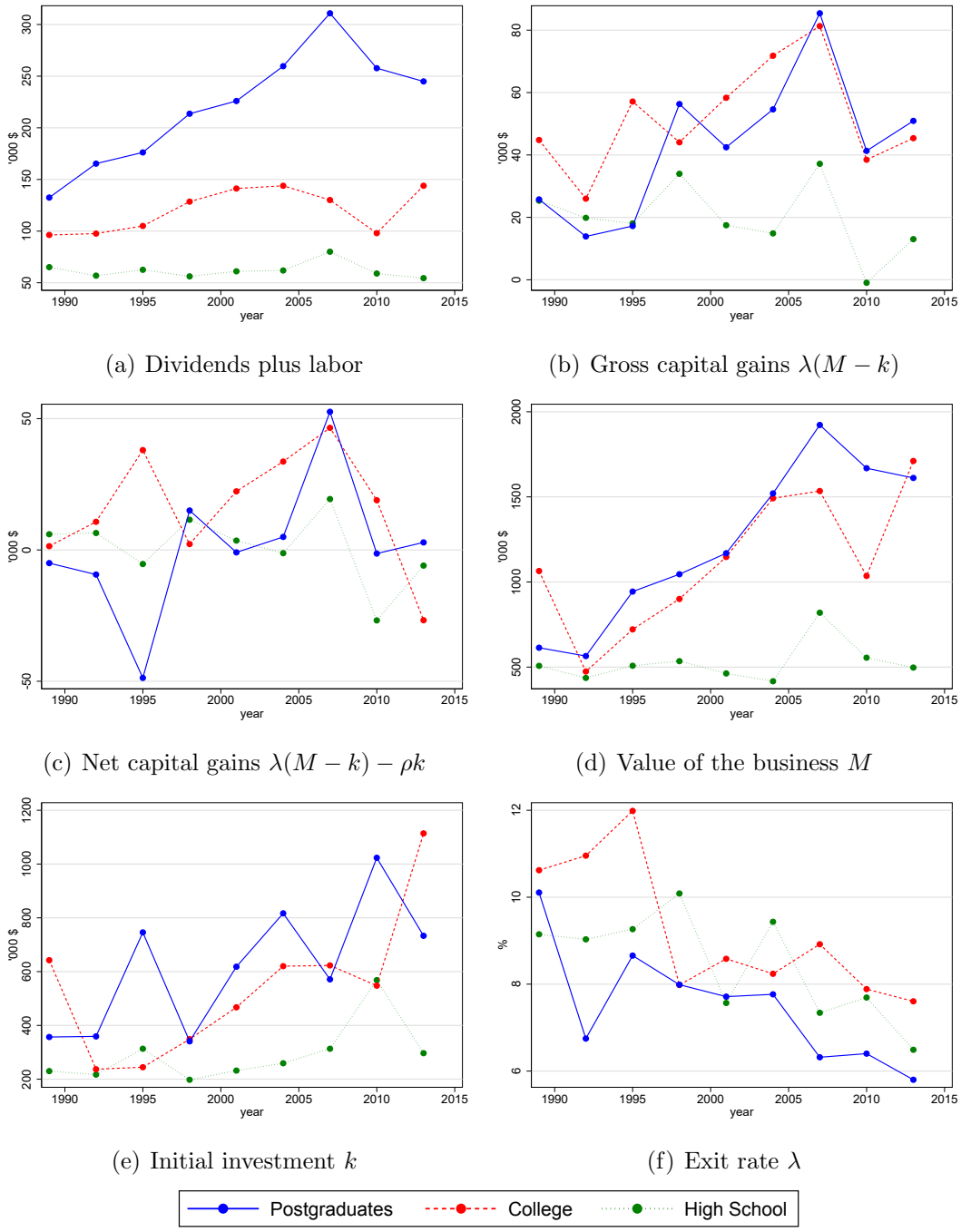
where $y_{it}$ is a measure of entrepreneurial returns (excess, total or one of its components), *College* and *Postgrad* are the education dummies previously discussed, *Post* is a post-2000 dummy equal to one for any year after 2000, $D_t$ are year dummies, and $X_{it}$ are individual controls (including a quadratic polynomial in age as well as dummies for female, married and white entrepreneur). Given that a substantial share of entrepreneurs have negative returns, we run the regressions in levels rather than in logs. In an alternative second specification we interact the educational dummies with a linear trend rather than with the post-2000 dummy, which allows for differential trends in returns across educational groups without having to a specify a break date. Finally, in the Appendix we also report results for a specification where educational dummies are interacted with a full set of time dummies, which leaves the time profile of returns parametrically free. All regressions are run with sampling weights and standard errors are bootstrapped using 200 replications.[13]

Table 3 focuses on the pre-post specification of equation (27). Column 1 shows that, before the 2000's, college graduates and postgraduates earned on average 56,000 and 94,000$ more per year than high school graduates. Since the 2000's, postgraduates earn an extra premium relative to high school graduates of around 112,000$. The extra premium for college graduates in the post-2000 period is substantially smaller (26,000$) and not

[12]The reduction in the exit rate out of entrepreneurship, and the corresponding increase in the average firm age, is in line with the evidence that points to a reduction in the dynamism of the US economy, as discussed, among others, by Decker, Haltiwanger, Jarmin, and Miranda (2014).

[13]To deal with the repeated-imputation inference method of the SCF, which reports five implicates for each variable, all regressions are run and standard errors are calculated using the SCFcombo routine for STATA, described at https://www.federalreserve.gov/Standard_Error_Documentation.pdf.

Figure 4: Time profiles of the components of entrepreneurial returns $\theta$




(a) Dividends plus labor

(b) Gross capital gains $\lambda(M-k)$

(c) Net capital gains $\lambda(M-k)-\rho k$

(d) Value of the business $M$

(e) Initial investment $k$

(f) Exit rate $\lambda$

**Source:** Own calculations using data from the Survey of Consumer Finances, the Longitudinal Business Database and the S&P500 Total Return Index. Values are in thousands of dollars at 2010 constant prices.

statistically significantly different from zero. The last line in Table 3 also indicates that we strongly reject the null hypothesis that the extra premium in the post-2000 period is equal

Table 3: Trend in Skill premium: Pre-post specification

| | (1) $\theta$ | (2) $\phi$ | (3) $d+l$ | (4) $M$ | (5) $k$ | (6) GCG | (7) NCG |
|---|---|---|---|---|---|---|---|
| College | 56.2*** | 36.2*** | 50.4*** | 318.7*** | 154.9** | 18.2*** | 5.8 |
| | (12.7) | (12.6) | (8.3) | (82.5) | (62.5) | (7.0) | (9.3) |
| Postgraduate | 94.4*** | 54.3*** | 107.3*** | 175.2* | 115.0 | 1.4 | -12.9 |
| | (17.2) | (17.1) | (10.7) | (100.2) | (91.6) | (9.3) | (15.3) |
| College × Post | 26.8 | 19.5 | 11.8 | 477.8*** | 169.8* | 22.9** | 14.9 |
| | (16.7) | (16.6) | (10.0) | (115.5) | (92.9) | (9.8) | (13.3) |
| Postgraduate×Post | 112.7*** | 84.6*** | 82.7*** | 737.6*** | 216.6* | 34.5*** | 30.0* |
| | (24.2) | (24.1) | (16.8) | (134.8) | (120.6) | (11.6) | (18.2) |
| Age | 16.7*** | 16.7*** | 10.3*** | 36.3*** | -25.9 | 4.7*** | 6.4*** |
| | (2.6) | (2.6) | (1.0) | (13.9) | (18.8) | (1.5) | (2.3) |
| Age$^2$ | -0.2*** | -0.2*** | -0.1*** | -0.1 | 0.5** | -0.0*** | -0.1*** |
| | (0.0) | (0.0) | (0.0) | (0.1) | (0.2) | (0.0) | (0.0) |
| Female | -49.0*** | -48.6*** | -44.1*** | -435.8*** | -201.0*** | -18.1*** | -4.9 |
| | (10.6) | (10.5) | (8.2) | (67.2) | (52.2) | (4.5) | (6.3) |
| White | 33.3*** | 33.2*** | 31.5*** | 161.2** | 86.4* | 6.0 | 1.8 |
| | (9.5) | (9.5) | (6.3) | (72.1) | (46.6) | (4.9) | (6.6) |
| Married | 27.8*** | 28.2*** | 34.7*** | 354.1*** | 249.0*** | 9.1* | -6.8 |
| | (10.3) | (10.3) | (6.7) | (63.6) | (50.8) | (4.9) | (6.7) |
| $H_0$: College×Post = Postgrad×Post | | | | | | | |
| F-stat | 12.680 | 7.330 | 14.680 | 3.215 | 0.161 | 0.978 | 0.701 |
| P-value | 0.000 | 0.007 | 0.000 | 0.073 | 0.688 | 0.323 | 0.402 |
| N. of Obs. | 7,250 | 7,250 | 7,250 | 7,250 | 7,250 | 7,250 | 7,250 |

**Notes:** All monetary values are in thousands of dollars at 2010 constant prices. GCG denotes gross capital gains equal to $\lambda(M-k)$, NCG denotes net capital gains equal to $\lambda(M-k)-\rho k$. Post is a dummy equal to 1 for years after 2000. All regressions include year dummies. See Table 2 for the definition of other variables. Bootstrapped standard errors in parentheses, *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

for college graduates and postgraduates. This confirms that the return to postgraduate education has increased substantially over time for entrepreneurs. In terms of other controls, we find evidence in favor of the typical concave age profile of income, that female entrepreneurs earn almost 50,000$ less than men, that white entrepreneurs earns 33,000$ more than non white and that married entrepreneurs earns 28,000$ more than single entrepreneurs.

In Column (2) we report results when using as a dependent variable the excess returns to entrepreneurship $\phi$, equal to the difference between total return $\theta$ and the wage

income of employees in the corresponding educational group. In terms of excess returns, the increase in the premium for postgraduates falls to 84,000$ but remains positive, statistically significant at any level of significance and the null hypothesis that the excess return has increased equally for college graduates and postgraduates is still rejected at any conventional level of significance.

In Columns 3 to 7 we use as dependent variable the different components of total returns. The increase in the premium for postgraduates is explained mostly by current income $d + l$ (column 3). The market value of businesses has increased substantially for both college graduates and postgraduates in the post-2000 period (column 4), but so has the value of the initial investment (column 5). As a result, the differential effect on capital gains between college graduates and postgraduates are positive and sizeable, but smaller than those due to current income. For example the increase in net capital gains for college graduates is 15,000$, which is not significantly different from zero, while it is 30,000$ for postgraduates, which is significantly different from zero at the 10% level, and account for approximately one fourth of the overall increase.

Table 4 reports the results when focusing on the specification with a linear trend. Here the coefficient of the interaction of the educational dummies with the year-trend characterizes the differential yearly growth of returns relative to the excluded category (high school graduates), whose trend is measured by the full set of time dummies included in the regressions. Column (1) indicates that the yearly average increase in returns for postgraduates has been 7,300$, while it has been 1,600$ for college graduates (which is not significantly different from zero). The last line of Table 4 also indicates that we reject strongly the null hypothesis that growth in total returns has been equal for college graduates and postgraduates. Even in this set of specifications we find that the largest contribution to the differential trend in returns comes from current income $d+l$. The year dummy specification in the Appendix confirms the robustness of all these results. The difference in the increase in returns of postgraduates starts to be statistically significantly different from zero in 1998, which suggests that, if anything, our pre-post specification, that uses 2000 as the firs post year, tends to underestimate actual differences in the increase of entrepreneurial returns.

Table 4: Trend in Skill premium: Time Trend specification

| | (1) $\theta$ | (2) $\phi$ | (3) $d+l$ | (4) $M$ | (5) $k$ | (6) GCG | (7) NCG |
|---|---|---|---|---|---|---|---|
| College | 54.5*** | 36.1* | 45.8*** | 218.4* | 90.4 | 17.6* | 8.7 |
| | (18.5) | (18.5) | (11.4) | (119.7) | (98.8) | (10.4) | (14.4) |
| Postgraduate | 53.3** | 22.0 | 78.0*** | -55.3 | 93.0 | -10.0 | -24.7 |
| | (20.8) | (20.5) | (13.5) | (120.3) | (126.3) | (11.1) | (19.4) |
| College×Year | 1.3 | 0.9 | 0.8 | 28.2*** | 12.1* | 1.1 | 0.5 |
| | (1.2) | (1.2) | (0.7) | (7.9) | (7.3) | (0.7) | (1.0) |
| Postgraduate×Year | 7.9*** | 6.0*** | 5.7*** | 48.9*** | 11.1 | 2.3*** | 2.2* |
| | (1.4) | (1.4) | (0.9) | (8.7) | (8.5) | (0.7) | (1.2) |
| Age | 17.0*** | 16.9*** | 10.5*** | 37.0*** | -26.0 | 4.7*** | 6.5*** |
| | (2.6) | (2.6) | (1.0) | (14.0) | (18.9) | (1.5) | (2.3) |
| Age$^2$ | -0.2*** | -0.2*** | -0.1*** | -0.1 | 0.5** | -0.0*** | -0.1*** |
| | (0.0) | (0.0) | (0.0) | (0.1) | (0.2) | (0.0) | (0.0) |
| Female | -49.0*** | -48.4*** | -44.1*** | -438.9*** | -203.5*** | -18.1*** | -4.9 |
| | (10.6) | (10.6) | (8.3) | (68.4) | (52.7) | (4.6) | (6.3) |
| White | 33.6*** | 33.4*** | 31.7*** | 162.8** | 86.4* | 6.1 | 1.9 |
| | (9.5) | (9.5) | (6.3) | (72.2) | (46.6) | (4.9) | (6.6) |
| Married | 28.4*** | 28.6*** | 34.7*** | 359.0*** | 248.7*** | 9.5* | -6.4 |
| | (10.4) | (10.4) | (6.9) | (64.1) | (51.2) | (4.9) | (6.7) |
| $H_0$ : College×Year = Postgraduate×Year | | | | | | | |
| F-stat | 17.670 | 10.950 | 18.370 | 3.709 | 0.013 | 2.420 | 1.843 |
| p-value | 0.000 | 0.001 | 0.000 | 0.054 | 0.909 | 0.120 | 0.175 |
| N. of Obs. | 7,250 | 7,250 | 7,250 | 7,250 | 7,250 | 7,250 | 7,250 |

**Notes:** All monetary values are in thousands of dollars at 2010 constant prices. GCG denotes gross capital gains equal to $\lambda(M-k)$, NCG denotes net capital gains equal to $\lambda(M-k)-\rho k$. Year is a variable equal to the calendar year. All regressions include year dummies. See Table 2 for the definition of all other variables. Bootstrapped standard errors in parentheses, *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

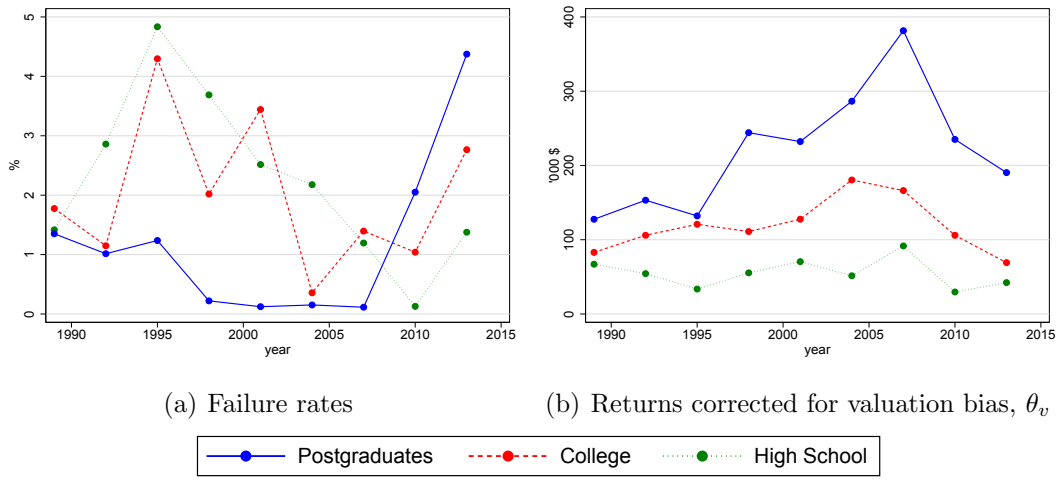
### 4.2 Measurement biases and past earnings ability

We discuss the robustness of results when accounting for the possible presence of the valuation, composition or recycling biases discussed in Section 2.2 as well as for the entrepreneur's past earnings ability.

**Valuation bias** To obtain a measure of entrepreneurial returns $\widetilde{\theta}_v$ which is free of any valuation bias, we evaluate the correction in (20) and insert it into (19). To calculate (20) we construct, for each educational group, measures of the failure rate of businesses $\delta$ and

of their liquidation value $L$. We identify a business as failed if it is older than two years old and has zero sales and no employees.[14] For each educational group, $L$ is measured by the average value of the businesses that we classified as failed while $\delta$ is measured by the ratio of the number of failed businesses over the total number of businesses in the corresponding group. Panel (a) of Figure 5 plots the time profile of our index of failure rates. There is

Figure 5: Assessing the valuation bias




(a) Failure rates (b) Returns corrected for valuation bias, $\theta_v$

**Source:** Own calculations using data from the Survey of Consumer Finances, the Longitudinal Business Database and the S&P500 Total Return Index. Values are in thousands of dollars at 2010 constant prices.

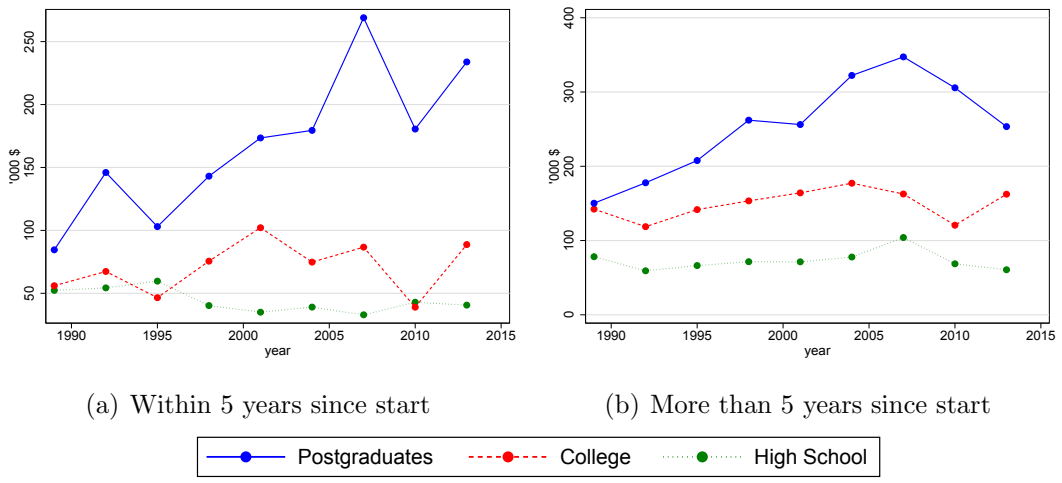
some evidence of a declining trend, which is reverted during the crisis years. But the trend is common across educational groups, which implies that the valuation bias is unlikely to explain the differential trend in returns. Panel (b) confirms this conjecture by showing that the measures of return purged of valuation biases $\widetilde{\theta}_v$ exhibit profiles which are quite similar to the ones obtained with our baseline measure of returns $\widetilde{\theta}$, as plotted in Figure 3.

**Composition bias** The composition bias arises because entrepreneurs who exit more slowly from their entrepreneurial venture are over-represented in the cross-section of existing entrepreneurs. We have seen that the sign of the bias generally depends on whether the composition effect is driven by heterogeneity in failures rates $\delta$ or in the arrival rate

[14] We also experimented with alternative definitions of failure, for example by dropping the requirement of no employment. Results are similar, although entrepreneurial returns become slightly more volatile.

of business selling opportunities $\mu$. To assess the relevance of this issue, we noticed that this bias is small when focusing on recently started entrepreneurial ventures while it gets potentially more and more important when focusing on relatively old entrepreneurial ventures. So by comparing the value of current income $d + l$—which represents a major component of entrepreneurial returns— for recently started entrepreneurial ventures with the analogous value for relatively older ventures, we can evaluate the sign and relevance of the composition bias in measuring entrepreneurial returns. In Figure 6 we report the time profile of $d + l$ for relatively young ventures (within 5 years since the start of the venture) and old entrepreneurial ventures (more than 5 years since start). We exclude ventures in their first year of existence, as they are unlikely to distribute any dividends, but results are similar when we also include them. The time profile of total current income $d + l$ is similar for young and old ventures and in both groups returns for postgraduates have increased substantially more than the returns for college and high school graduates, which indicates that the composition bias is unlikely to account for the rising premium to postgraduate education in entrepreneurship.

Figure 6: Composition bias: dividends plus labor income for different age windows




(a) Within 5 years since start

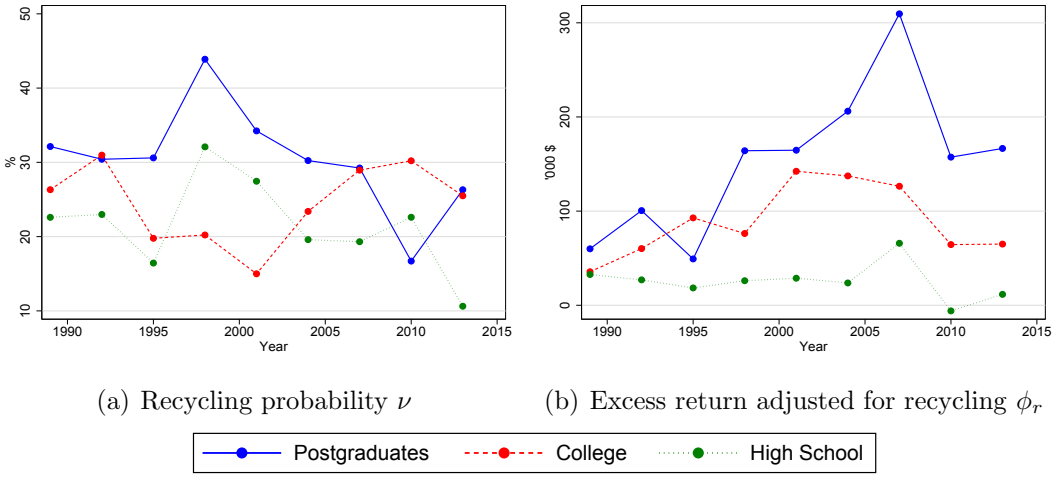
(b) More than 5 years since start

**Source:** Own calculations using data from the Survey of Consumer Finances, the Longitudinal Business Database and the S&P500 Total Return Index. Values are in thousands of dollars at 2010 constant prices.

**Recycling bias** To analyze the effect of serial entrepreneurship on returns we rely on $\phi_r$ in (25). To calculate $\phi_r$, we need to gauge the correction factor $\varphi(\nu) = \frac{\rho+\lambda}{\rho+\lambda(1-\nu)}$ which

requires to evaluate the *Recycling probability* $\nu$ equal to the entrepreneur's probability of starting a new venture after exiting the previous one. We construct a measure of $\nu$ by identifying in the SCF the set of individuals who were entrepreneurs in their past job and then calculate $\nu$ as the ratio of individuals who are *Entrepreneurs* today and were entrepreneurs in their past job over the total number of individuals who were entrepreneurs in their past job.[15] The time profile of $\nu$ for the different educational groups is plotted in panel (a) of Figure 7, while the adjusted measure of excess returns $\phi_r$ is in panel (b). Overall the recycling probability has remained constant through time for all educational groups. The resulting adjusted measures for the excess returns $\phi_r$ have evolved very similarly to the baseline measure plotted in Figure 3, which suggests that changes in the patterns of serial entrepreneurship are unlikely to explain the rising return to education for entrepreneurs.

Figure 7: Recycling bias




(a) Recycling probability $\nu$ (b) Excess return adjusted for recycling $\phi_r$

**Source:** Own calculations using data from the Survey of Consumer Finances, the Longitudinal Business Database and the S&P500 Total Return Index. Values are in thousands of dollars at 2010 constant prices.

**Controlling for earnings in the main previous job** One issue with the interpretation of our results is that they are also consistent with the hypothesis that entrepreneur-

[15] An individual is identified as an entrepreneur in his past job if he declared to be self-employed, which is consistent with the practice in the SCF, where an individual who runs and owns a business in his main job is coded as being self-employed.

ship has attracted progressively more able individuals, and that ability is correlated with educational achievements. Although interesting, this story is different from one in which education in itself has become more useful for entrepreneurs. To assess the likelihood of these different explanations, we exploit the fact that the SCF reports information on the main previous job. We take earnings in such job as a general measure of ability. To focus on the possibility that selection into entrepreneurship has changed, we focus on entrepreneurs whose previous job was as employees (results including also those who were entrepreneurs are very similar) and re-run the regressions of Table 3 adding a quadratic in the previous job wage. If our results are driven by selection, we should find that the increase in the education premium disappears once we control flexibly for earnings in the previous job. Table 5 reports the result for total returns $\theta$ (Columns 1-3) and excess returns (Columns 4-6). Columns (1) and (4) show that the result in the sub-sample of entrepreneurs with a previous job as employees are similar to those for the full sample, the main difference being that the premium is even larger, something on which we will come back below. In Columns 2 and 5 we include the quadratic in the previous wage. Both total and excess returns drop, from 153.000$ to 120.000$ for total and from 120.00$ to 92.00 for excess returns, indicating that there might have been a change in selection into entrepreneurship. However, the increase in the premium for postgraduates still emerges and is highly statistically significant, and selection can account for around one fifth of the overall increase.

An additional concern is that the increase in the returns might be related to general skills, such as innate ability, rather than those acquired through education. To address this concern, in Columns 3 and 6 we allow the coefficient of the quadratic in the previous wage to vary between the pre and post specification. An increase in the general skills should result in an increase in the coefficients of the previous wage, and a corresponding decrease in the education dummies in the post-2000 period. As the regressions show, none of the wage×post interaction is statistically significant and, if anything, the coefficient of the Postgrad×Post interaction gets larger, suggesting that the increase in the returns is specific to skills acquired through education. We have performed the analysis also for the other components of returns, as well as for the time trend and the full-years-dummy

Table 5: Trend in Skill premium controlling for earnings in the previous job

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | **Total returns $\theta$** | | | **Excess returns $\phi$** | | |
| College | 66.1*** | 42.9** | 46.6*** | 46.1*** | 23.0 | 26.6* |
| | (14.8) | (16.7) | (14.2) | (14.6) | (16.5) | (14.0) |
| Postgrads | 82.9*** | 62.1** | 65.1** | 43.2 | 22.4 | 25.4 |
| | (30.7) | (30.6) | (30.6) | (30.5) | (30.5) | (30.4) |
| College×Post | 32.5 | 32.2 | 30.1 | 25.2 | 24.9 | 22.8 |
| | (20.2) | (19.9) | (23.2) | (20.2) | (19.9) | (23.2) |
| Postgrad×Post | 153.1*** | 120.1*** | 120.5*** | 124.7*** | 91.8** | 92.2** |
| | (35.2) | (38.4) | (43.0) | (34.8) | (38.1) | (42.7) |
| Past wage | | 1.0*** | 0.8*** | | 1.0*** | 0.8*** |
| | | (0.3) | (0.2) | | (0.3) | (0.2) |
| Past wage$^2$ | | -0.4 | -0.3 | | -0.4 | -0.3 |
| | | (0.4) | (1.1) | | (0.4) | (1.1) |
| Past wage×Post | | | 0.1 | | | 0.1 |
| | | | (0.5) | | | (0.5) |
| Past wage$^2$.×Post | | | 0.3 | | | 0.3 |
| | | | (1.5) | | | (1.5) |
| Age | 15.9*** | 11.8*** | 12.1*** | 15.9*** | 11.8*** | 12.1*** |
| | (3.8) | (3.9) | (3.8) | (3.8) | (3.9) | (3.8) |
| Age$^2$ | -0.2*** | -0.1*** | -0.1*** | -0.2*** | -0.1*** | -0.1*** |
| | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) | (0.0) |
| Female | -47.7*** | -30.9** | -32.7** | -47.4*** | -30.5** | -32.4** |
| | (14.6) | (14.6) | (14.9) | (14.5) | (14.5) | (14.8) |
| White | 39.8*** | 39.7** | 41.4*** | 39.9*** | 39.8** | 41.4*** |
| | (14.1) | (15.6) | (15.7) | (14.0) | (15.6) | (15.7) |
| Married | 32.0** | 32.6*** | 31.6** | 32.3** | 33.0*** | 32.0** |
| | (13.1) | (12.5) | (12.6) | (13.1) | (12.5) | (12.6) |
| $H_0$: College×Post = Postgrad×Post | | | | | | |
| F-stat | 9.738 | 4.693 | 5.298 | 6.719 | 2.749 | 3.164 |
| P-value | 0.002 | 0.030 | 0.021 | 0.009 | 0.097 | 0.075 |
| N. of Obs. | 3,472 | 3,472 | 3,472 | 3,472 | 3,472 | 3,472 |

**Notes:** The sample comprises of entrepreneurs with a working experience as employees prior to running the business. All monetary values are in thousands of dollars at 2010 constant prices. Education dummies (College and Postgraduate) are included but not reported to economize on space. All regressions include year dummies, a quadratic in age, dummies for female, white and married entrepreneurs. Past earnings square is divided by 1000. See Table 2 for the definition of other variables. Bootstrapped standard errors in parentheses, *** p-value < 0.01, ** p-value < 0.05, * p-value < 0.1.

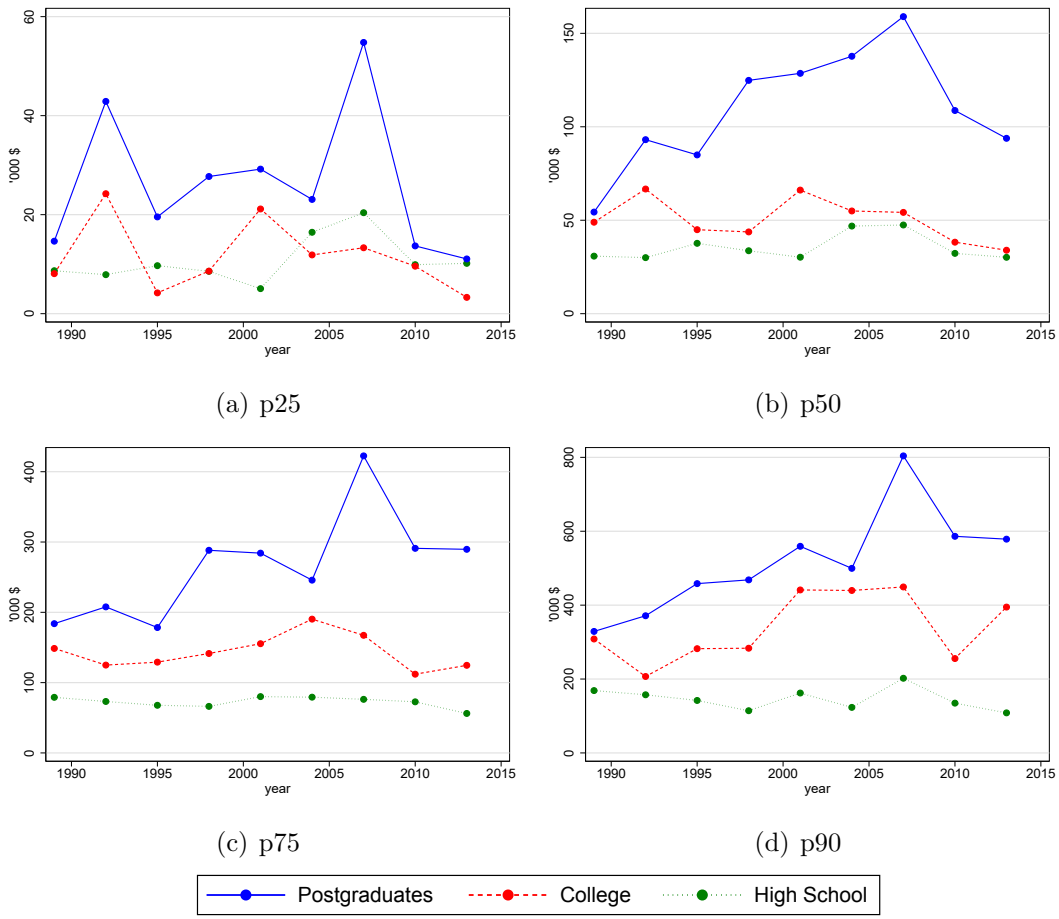
specification, finding very similar results (unreported to save on space).

## 5 Differences across the distribution of returns

We now study whether the return to education has increased differently at different quantiles of the distribution of returns. Figure 8 reports total returns $\theta$ of the three educational groups at the $25^{th}$ (panel a), $50^{th}$ (panel b), $75^{th}$ (panel c) and $90^{th}$ (panel d) percentile. Returns at the lowest quartile are meager, with an average of about 20,000$, slightly higher for postgraduates than for the other two educational groups. The overall time profile of this quartile is flat for all educational groups. Indeed, after a sharp increase in 2007, returns for postgraduates have dropped substantially and have remained aligned with those for the other two educational groups. The increase in the premium to higher education emerges very clearly at the median, and it increases (in absolute value) at the higher percentiles of the distribution. This suggests that the increase in average returns is attributable to a shift in the right part of the returns distribution, while the returns of low performing entrepreneurs have behaved similarly across educational groups.

The graphical evidence is confirmed by the regression analysis. In Table 6 we report the results of quantile regressions at the $25^{th}$, the $50^{th}$, the $75^{th}$, the $90^{th}$ and the $95^{th}$ percentile of the distribution of returns for the pre-post specification. The specifications with time trends and time dummies are reported in the Appendix. There is no evidence of an increase in the return to education at the bottom quartile of the return distribution: the coefficients for total returns for both college graduates and postgraduates tend to be negative when interacted with the post-2000 dummy, although the effects are not significantly different from zero, and there is no statistically significant evidence that any component of returns has behaved differently across educational groups in the post-2000 period. For postgraduates the increase in the premium relative to high school graduates in the post-2000 period already emerges when looking at the median: the increase in total return is equal to around 32,000$ and almost entirely accounted for by the sum of labor income and dividends. The increase in the premium to postgraduate education is higher when looking at the higher percentile of the return distribution, and it is above

Figure 8: Total returns $\theta$ at different percentiles of the return distribution




(a) p25 (b) p50

(c) p75 (d) p90

**Source:** Own calculations using data from the Survey of Consumer Finances, the Longitudinal Business Database and the S&P500 Total Return Index. Values are in thousands of dollars at 2010 constant prices.

300,000$ per year at the top five percent of returns. Interestingly, in this case capital gains accounts for almost a quarter of the increase in returns, which reflects the fact that, at this percentile, the value of the business has increased by almost 2 million more for postgraduates than for high school graduates. For college graduates, the increase in returns is statistically significant only at the $90^{th}$ and $95^{th}$ percentiles, where it is equal to 132,000$ and 178,000$ per year, respectively. At the $95^{th}$ percentile the contribution of the net capital gain is even more important than for postgraduates. A similar picture emerges when looking at the results with the time trend or the time dummies specification in the appendix.

Table 6: Quantile Regressions, Pre-post specification

| | (1) $\theta$ | (2) $\phi$ | (3) $d+l$ | (4) $M$ | (5) $k$ | (6) GCG | (7) $NCG$ |
|---|---|---|---|---|---|---|---|
| Post interacted with: | | | | | | | |
| **$25^{th}$ pct** | | | | | | | |
| College | -3.2 | -5.6 | -1.7 | 6.4 | 2.0 | -0.1 | -1.2 |
| | (4.4) | (4.3) | (5.0) | (5.3) | (1.7) | (0.2) | (1.0) |
| Postgrad | -8.7 | -14.8** | -8.6 | 13.9 | 1.3 | 0.0 | 3.7 |
| | (6.6) | (7.0) | (7.4) | (9.8) | (1.5) | (0.3) | (4.6) |
| **$50^{th}$ pct** | | | | | | | |
| College | -4.5 | -10.0 | 2.6 | 35.6 | 16.5** | -0.1 | -0.6 |
| | (6.5) | (6.8) | (5.5) | (25.6) | (6.6) | (1.0) | (0.4) |
| Postgrad | 32.6*** | 15.9 | 32.0** | 59.3* | 16.5 | 1.1 | 0.2 |
| | (12.6) | (11.8) | (13.0) | (34.7) | (13.6) | (1.0) | (0.5) |
| **$75^{th}$ pct** | | | | | | | |
| College | 6.7 | -1.9 | 9.6 | 86.7 | 71.2** | 0.9 | 0.0 |
| | (16.0) | (16.0) | (12.8) | (86.1) | (31.8) | (8.0) | (5.2) |
| Postgrad | 66.1*** | 36.0 | 51.3** | 399.0*** | 141.2*** | 6.8 | 4.2 |
| | (25.1) | (22.5) | (21.1) | (86.9) | (52.6) | (4.3) | (4.2) |
| **$90^{th}$ pct** | | | | | | | |
| College | 131.9*** | 117.7** | 42.4 | 1,452.4*** | 336.0** | 28.4 | 10.7 |
| | (50.0) | (51.9) | (36.1) | (355.0) | (169.7) | (26.9) | (24.9) |
| Postgrad | 183.4*** | 128.6** | 153.2*** | 1,715.7*** | 566.0*** | 47.7** | 40.5** |
| | (54.1) | (52.0) | (52.7) | (367.1) | (137.4) | (22.5) | (16.6) |
| **$95^{th}$ pct** | | | | | | | |
| College | 177.9* | 150.4 | 112.2 | 3,198.2*** | 809.2** | 138.2*** | 103.6** |
| | (99.9) | (99.6) | (80.4) | (756.9) | (401.5) | (48.3) | (41.8) |
| Postgrad | 315.0*** | 208.3** | 254.7*** | 1,967.7** | 1,040.2** | 82.7 | 92.9** |
| | (90.5) | (97.3) | (72.7) | (821.8) | (474.0) | (52.7) | (36.5) |

**Notes:** Results for separate quantile regression. All monetary values are in thousands of dollars at 2010 constant prices. GCG denotes gross capital gains equal to $\lambda(M-k)$, NCG denotes net capital gains equal to $\lambda(M-k)-\rho k$. To save on space, we only report the education dummies College and Postgrad interacted with the Post dummy. All regressions also include education dummies not interacted with the post dummy, year dummies, a quadratic in age, dummies for female, white and married entrepreneurs. See Table 2 for the definition of other variables. Bootstrapped standard errors in parentheses, *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

Overall there is evidence that the increase in the return to education is concentrated in the right tail of the distribution of returns, while returns at the bottom have behaved similarly across educational groups. For postgraduates, the increase in the premium relative to high school graduates emerges at the median and it rises as we move to the right tail of the distribution of returns, while for college graduates it only shows up when looking at the higher percentiles of the distribution of returns, where the contribution of

the capital gain component increases. Combining the evidence of Figure 5 and 8, we can conclude that the entire distribution of returns has generally become more favorable to highly educated entrepreneurs: failures rates of entrepreneurial ventures and returns at the bottom of the distribution of returns have evolved similarly across educational groups while the skill premium to entrepreneurship has increased at all the higher quantiles of the entrepreneurs' income distribution. This also suggests that compensating differential due to risk-aversion and increased business risk cannot explain the rising premium to higher education observed in the data.

To sum up: the increase in the premium to postgraduate education is unlikely to be fully explained by changes in the skill composition of entrepreneurs unrelated to education, by selection or valuation issues related to business failure or by compensating differentials—due to lower possibilities of recycling entrepreneurial skills into new ventures or greater business risk. We now explore alternative explanations for the rising premium to postgraduate education for entrepreneurs. For space considerations, we focus the analysis on the pre-post specification, but all results discussed below are robust to the time trend and time dummy specification, reported in the Appendix.

## 6 What explains the increase in the skill premium?

We document that the complementarity between higher level education and labour market experience has increased and that this increased complementarity accounts for a large part of the rise in the premium to postgraduate education. We then show that this conclusion is robust to controlling for several alternative explanations for the rise in the premium.

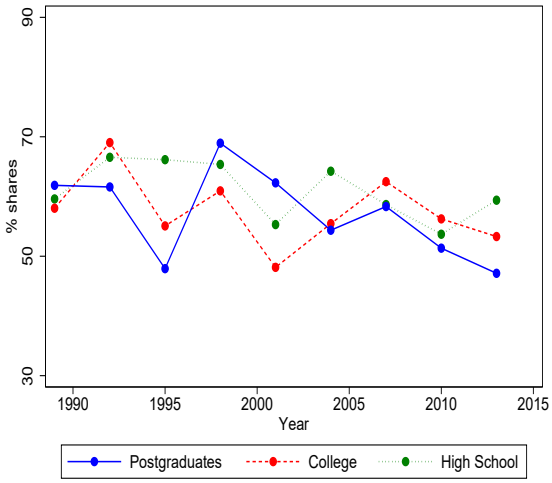
### 6.1 Complementarity between education and experience

The skills relevant for entrepreneurship are acquired partly through formal education and partly through labor market experience (Evans and Leighton, 1989) and entrepreneurs might require both theoretical competence and practical expertise to succeed. The idea that entrepreneurs need a balanced mix of skills to succeed is known as the 'jack-of-all-trades' hypothesis and was first put forward by Lazear (2004, 2005); see Wagner (2006),

Silva (2007), Astebro and Thompson (2011) for some supportive empirical evidence. We now investigate whether the complementarity between theoretical competence provided by formal education and the practical expertise acquired through labor market experience has changed over time and if this contributes to account for the differential time profiles of returns across educational groups. To fix ideas, we can think that the total return of an entrepreneur $\theta(s, x)$ is a function of both formal education $s$ and labor market experience $x$. An increase in the skill premium $\theta$ can then be the result of an increase in the return to education $\theta_s$, in the return to experience $\theta_x$, or in the complementarity between education and experience $\theta_{sx}$.

To analyze the evolution of the complementarity between formal education and experience, we construct a dummy for whether the entrepreneur had some previous labor market experience before starting or acquiring the current venture, $YX$=1, and one if she did not, $NX$=1 (SCF mnemonic X4514). Figure 9 plots the share of entrepreneurs with $YX$=1. This share has evolved very similarly across educational groups and has fallen slightly over time from around 60 percent in the late 80's to around 55 percent in the last years of the sample.

Figure 9: Share of entrepreneurs with previous labor market experience




**Source:** Survey of Consumer Finances.

We then run the same regressions as in Table 3, but we now interact the two labour

market experience dummies $YX$ and $NX$ with the three possible educational level of entrepreneurs and we allow these interactions to vary in the pre-2000 and post-2000 period. Entrepreneurs with a high school degree and no labour market experience are the reference group. Table 7 show the results. The data indicate that the return from entrepreneurship

Table 7: Trends in the Skill Premium by Labor Market Experience

| | (1) $\theta$ | (2) $\phi$ | (3) $d+l$ | (4) $M$ | (5) $k$ | (6) GCG | (7) NCG |
|---|---|---|---|---|---|---|---|
| High Sch.×YX | -28.1* | -28.1* | -25.1*** | -333.4*** | -147.0** | -15.6 | -3.1 |
| | (15.0) | (15.0) | (8.0) | (116.9) | (67.6) | (10.1) | (11.2) |
| College×NX | 31.1 | 11.1 | 47.7*** | 308.6* | 280.1* | 3.8 | -16.6 |
| | (25.1) | (25.2) | (15.8) | (173.3) | (153.6) | (14.0) | (20.3) |
| College×YX | 42.2** | 22.1 | 25.4** | -29.5 | -81.0 | 10.7 | 16.7 |
| | (18.8) | (18.8) | (10.5) | (134.1) | (71.7) | (12.3) | (13.7) |
| Postgrad×NX | 105.3*** | 65.2*** | 95.4*** | 19.0 | -98.4 | 5.4 | 10.0 |
| | (24.5) | (24.5) | (15.3) | (174.3) | (115.9) | (14.0) | (16.9) |
| Postgrad×YX | 57.2** | 17.2 | 87.6*** | -89.8 | 87.7 | -17.9 | -30.4 |
| | (26.5) | (26.4) | (15.1) | (136.2) | (140.5) | (14.2) | (24.3) |
| Post interacted with: | | | | | | | |
| High Sch.×YX | 23.1 | 22.9 | 6.3 | 106.4 | -85.5 | 16.2 | 16.8 |
| | (20.5) | (20.5) | (9.6) | (140.0) | (135.1) | (12.6) | (17.0) |
| College×NX | 26.4 | 19.1 | -10.4 | 405.8* | -17.5 | 35.9* | 36.8 |
| | (31.7) | (31.6) | (18.2) | (227.4) | (215.3) | (18.5) | (27.2) |
| College×YX | 56.1** | 48.7* | 37.2** | 650.9*** | 209.6 | 32.1** | 18.9 |
| | (27.3) | (27.3) | (15.1) | (170.8) | (145.1) | (15.4) | (20.0) |
| Postgrad×NX | 61.9* | 33.4 | 48.7** | 482.8** | 134.0 | 23.7 | 13.2 |
| | (34.3) | (34.4) | (24.0) | (227.7) | (179.6) | (17.4) | (22.9) |
| Postgrad×YX | 177.4*** | 149.4*** | 120.0*** | 1,095.1*** | 237.2 | 60.0*** | 57.4* |
| | (36.9) | (37.1) | (23.6) | (171.6) | (204.7) | (17.3) | (29.8) |
| $H_0$: College×$NX$×Post =College×$YX$×Post | | | | | | | |
| F-stat | 0.801 | 0.798 | 4.904 | 1.372 | 1.516 | 0.046 | 0.491 |
| p-value | 0.371 | 0.372 | 0.027 | 0.241 | 0.218 | 0.829 | 0.484 |
| $H_0$: Postgrad×$NX$×Post =Postgrad×$YX$×Post | | | | | | | |
| F-stat | 8.423 | 8.501 | 5.665 | 8.108 | 0.293 | 4.969 | 2.703 |
| p-value | 0.004 | 0.004 | 0.017 | 0.004 | 0.588 | 0.026 | 0.100 |
| Obs | 7,250 | 7,250 | 7,250 | 7,250 | 7,250 | 7,250 | 7,250 |

**Notes:** All monetary values are in thousands of dollars at 2010 constant prices. $NX$ is a dummy for no previous labor market experience before staring the business and $YX$ is a dummy for some previous labor market experience. GCG denotes gross capital gains equal to $\lambda(M-k)$, NCG denotes net capital gains equal to $\lambda(M-k)-\rho k$. All regressions include year dummies, a quadratic in age, dummies for female, white and married entrepreneurs. See Table 2 for the definition of other variables. Bootstrapped standard errors in parentheses, *** p-value < 0.01, ** p-value < 0.05, * p-value < 0.1.

has increased mainly for entrepreneurs with some previous labour market experience and provided they are sufficiently educated. There is no increase in the return to entrepreneurship for high school graduates independently of their experience level. The difference in

the increase in the return between experienced and unexperienced entrepreneurs starts to emerge for college graduates and it is large and significant for post-graduates. The return for entrepreneurs with post-graduate education and some labour market experience has increased by around 177,000$ in the post-2000 period relative to previous period. The analogous increase for entrepreneurs with post-graduate education but with no previous experience is instead just about 62,000$, marginally (at 10 percent) statistically significant.[16] This indicates that the complementarity between formal education and labour market experience $\theta_{sx}$ has increased and particularly so for postgraduates. The last panel in Table 7 shows the significance level for the null hypothesis that the increase in the return to education has been the same for entrepreneurs with and without some previous labour market experience. The null hypothesis of equality cannot be rejected for college graduates while it is strongly rejected for entrepreneurs with a postgraduate degree. Overall this evidence indicates that combining together the advanced theoretical competence provided by postgraduate education with the applied practical expertise acquired through past labor market experience has become increasingly valuable to run successful businesses.[17]

**Decomposition** We now quantify how much of the differential time profile of entrepreneurial returns across educational groups can be explained by changes in the complementarity between higher education and labour market experience. Let $\omega_s(x)$ denote the fraction of entrepreneurs with education $s$ who have labour market experience $x$, where $x = y$ and $x = n$ identifies entrepreneurs with and without previous experience, respectively. Then, the average return for entrepreneurs with education $s$ can be written

[16] One concern is that entrepreneurs with labor market experience might be mostly entrepreneurs with an MBA, which typically requires some previous labor market experience before enrollment. To check that the increase in the return to experience for postgraduates does not reflect just an increase in return to an MBA, we run the same regression as in Table 7 after excluding all entrepreneurs with a master degree degree. This specification yields very similar results: entrepreneurs with a postgraduate degree (PhD) and some previous labour market experience record an increase in returns of 158,000$ per year (significant at the 1 percent level) while those without any experience experience an increase of just 73,000$, significantly different from zero only at the 10 percent level.

[17] Interestingly, the increased complementarity is specific to entrepreneurship: when we run the same regression as in Table 7 but on a sample of employees rather than of entrepreneurs, we find that the increase in wages for postgraduates with or without previous labor market experience is quantitatively similar (31.000$ vs. 27.000$) and not statistically different. The increase in wages for employees with a college degree is also invariant to their previous labour market experience.

as equal to

$$\mathbf{E_s}(\theta) = \sum_{x=y,n} \theta(s,x)\omega_s(x), \tag{28}$$

whose change over time, denoted by $\Delta$, can be written as the sum of three terms

$$\Delta\mathbf{E_s}(\theta) = \mathbf{A_s} + \mathbf{B_s} + \mathbf{C_s} \tag{29}$$

where $\mathbf{A_s} = \sum_{x=y,n} \Delta\theta(s,x)\omega_s(x)$ measures the contribution of changes in returns for entrepreneurs with and without experience, $\mathbf{B_s} = \sum_{x=y,n} \theta(s,x)\Delta\omega_s(x)$ quantifies the effects of changes in the distribution of experience levels and $\mathbf{C_s} = \sum_{x=y,n} \Delta\theta(s,x)\Delta\omega_s(x)$ represents a cross term. Given (29), the change of the differential return to entrepreneurship for two educational levels $\hat{s}$ and $s$ can finally be decomposed as follows:

$$\Delta\mathbf{E_{\hat{s}}}(\theta) - \Delta\mathbf{E_s}(\theta) = (\mathbf{A_{\hat{s}}} - \mathbf{A_s}) + (\mathbf{B_{\hat{s}}} - \mathbf{B_s}) + (\mathbf{C_{\hat{s}}} - \mathbf{C_s}), \tag{30}$$

whose interpretation is analogous to that of (29). In our application, $\hat{s}$ corresponds to entrepreneurs with a postgraduate degree and $s$ to entrepreneurs with either a high school degree or a college degree. In the data the shares $\omega_s(x)$ have remained relatively stable over time and have behaved very similarly across educational educational groups, see Figure 9.[18] We now rely on (30) to decompose the differential increase in entrepreneurial returns between postgraduates and high school graduates. The contribution of the increased complementarity between education and labour market experience to the overall change in differential returns is measured by the term $\Delta\theta(\hat{s},y)\omega_{\hat{s}}(y) - \Delta\theta(s,y)\omega_s(y)$. Given the estimates for $\Delta\theta(\hat{s},y)$ in Table 7 and the value of the shares $\omega_s(y)$ in the pre-2000 sample period, this term is approximately equal to 111,000$ dollars per year which accounts for virtually all of the differential increase in entrepreneurial returns between postgraduates and high school graduates equal to around 113,000$ per year, see Table 3. All the other terms of the decomposition in (30) are indeed negligible. When we perform the same decomposition for the differential change in return between postgraduates and college graduates, we find that the increased complementarity between past labour market

[18] For example the share of entrepreneurs with some previous labour market experience in the pre-2000 period, $\omega_{\hat{s}}(y)$, is equal to 60% among both high school and college graduates while it is equal to 58% among postgraduates. In the post-2000 period, these shares have fallen by 6%, 5% and 1% for high school, college and post graduates, respectively.

experience and higher education explains around 96 percent of the differential increase in returns.

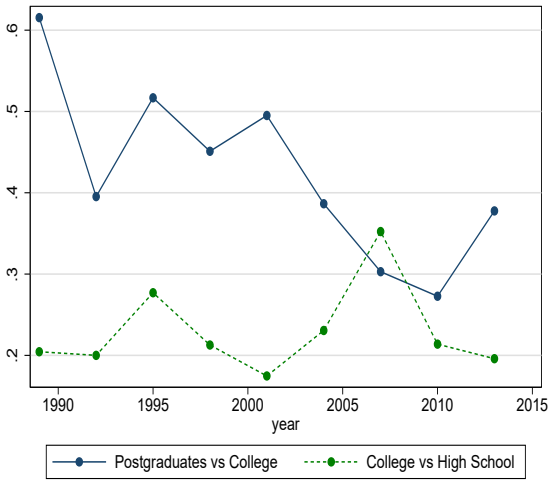
### 6.2 Robustness to alternative explanations

We now study the robustness of the conclusion that the increased complementarity between postgraduate education and previous labor market experience accounts for most of the rise in the return to postgraduate education. We show that this conclusion holds true after controlling for several alternative explanations for the rise in the premium, including changes (i) in the sectoral specialization of businesses ran by entrepreneurs; (ii) in access to internal or external finance; (iii) in their span of control; (iv) in compensating differentials due to greater business risk; (v) in the relevance of vintage technology effects; or (vi) in the intergenerational transmission of wealth. All variables used in the analysis are fully discussed in the Appendix, with some descriptive statistics reported in Table 2.

**Sectoral specialization** As shown in Table 2, entrepreneurs with different educational levels operate in different sectors and returns could vary by sector, say because entrepreneurial opportunities and entry barriers differ by sector. The rising premium to postgraduate education could then be due to a pattern of sectoral specialization increasingly more favorable to postgraduate entrepreneurs either because postgraduate entrepreneurs have become increasingly specialized in high return sectors or because sectoral returns have relatively increased in sectors where postgraduate entrepreneurs tend naturally to run their ventures. In practice, the sectoral composition of entrepreneurial ventures has remained stable over time and, if anything, the patterns of sectoral specialization of entrepreneurs with a college degree and of those with a postgraduate degree have progressively become more similar. Figure 10 plots the time profile of a simple index to measure differences in the pattern of sectoral specialization of two groups of entrepreneurs who differ in their educational level $e_1$ and $e_2$. The index, which builds on Krugman (1993), is equal to $S(e_1, e_2) = \frac{1}{2}\sum_{n=1}^{N} |s_n^{e_1} - s_n^{e_2}|$, where $s_n^j$ is the fraction of entrepreneurs of educational group $j = e_1, e_2$ running their venture in sector $n = 1, 2, ...N$. The index has support on the $[0, 1]$-interval, it is equal to zero when the two groups have

the same sectoral shares while it is equal to one when shares are perfectly orthogonal. When comparing entrepreneurs with a postgraduate degree and those with a college degree, we find that the index has fallen by 30 basis points since the late 80's, which indicates substantially more similarity in the pattern of sectoral specialization of the two groups.

Figure 10: Differences in patterns of sectoral specialization $S(e_1, e_2)$




**Source:** Survey of Consumer Finances. The index is equal to $S(e_1, e_2) = \frac{1}{2}\sum_i |s_i^{e_1} - s_i^{e_1}|$, where $s_i^j$ is the fraction of entrepreneurs of educational group $j = e_1, e_2$ working in sector $i$, which borrows from Krugman (1993).

To formally evaluate the role of sectoral specialization in determining the rising premium to postgraduate education and the increased complementarity between education and experience, we augment the regressions of Table 7 with a full set of sectoral dummies both in levels and interacted with the post-2000 year dummy. The excluded category is Mining and Construction. In the years up to 2000, the only significant sector dummy is the Manufacturing dummy, although also ventures in Finance and TCU show some evidence of yielding higher returns. In the post-2000 period, there is a significant increase in returns in the Finance sector while, if anything, returns in TCU, where postgraduates tend to specialize, have marginally decreased. The estimated coefficients for the changes in the return are reported in the first column of Table 8.[19] Overall, controlling for sectoral

[19]To save on space, we only report results for overall returns $\theta$ and for the education dummies interacted with the post dummies.

Table 8: Education-Experience Complementarity for total returns $\theta$: Additional Controls

| | (1) Sector | (2) Collateral | (3) Span | (4) Uncertainty | (5) Vintage | (6) Inherited |
|---|---|---|---|---|---|---|
| Post interacted with: | | | | | | |
| High Sch.× $YX$ | 32.0 | 24.6 | 21.2 | 29.3 | 20.4 | 23.3 |
| | (20.4) | (20.8) | (21.2) | (21.8) | (19.5) | (20.4) |
| College× $NX$ | 23.3 | 29.8 | 23.0 | -0.5 | 22.7 | 27.6 |
| | (33.3) | (31.7) | (32.0) | (32.6) | (34.3) | (31.8) |
| College× $YX$ | 60.6** | 61.7** | 48.6* | 68.2** | 52.0* | 56.8** |
| | (27.5) | (29.0) | (27.9) | (28.3) | (30.8) | (27.2) ) |
| Postgrad× $NX$ | 59.3* | 65.5* | 48.9 | 58.4 | 49.7 | 62.2* |
| | (34.2) | (34.4) | (34.1) | (37.5) | (39.0) | (34.6) |
| Postgrad× $YX$ | 178.1*** | 180.7*** | 158.7*** | 165.2*** | 183.4*** | 175.6*** |
| | (35.7) | (37.9) | (37.7) | (42.5) | (41.8) | (36.5) |
| Collateral | | 26.3 | | | | |
| | | (19.8) | | | | |
| Value of collateral | | -0.0 | | | | |
| | | (0.0) | | | | |
| Nr. of employees | | | 0.5*** | | | |
| | | | (0.1) | | | |
| Nr. of businesses | | | 14.9 | | | |
| | | | (11.5) | | | |
| Uncertain income | | | | -41.3*** | | |
| | | | | (9.3) | | |
| Inherited business | | | | | | 43.0 |
| | | | | | | (28.3) |
| $H_0$: College×$NX$×Post =College× $YX$×Post | | | | | | |
| F-stat | 1.276 | 0.919 | 0.613 | 4.375 | 0.846 | 0.776 |
| p-value | 0.259 | 0.338 | 0.434 | 0.0365 | 0.358 | 0.378 |
| $H_0$: College×$NX$×Post =College×$YX$×Post | | | | | | |
| F-stat | 8.900 | 8.034 | 8.072 | 6.064 | 11.17 | 8.038 |
| p-value | 0.003 | 0.005 | 0.004 | 0.014 | 0.001 | 0.005 |
| N. of Obs. | 7250 | 7250 | 7250 | 6772 | 7250 | 7250 |

**Notes:** The dependent variable is the total entrepreneurial returns $\theta$. Education dummies interacted with the experience dummies (High Sch.× $YX$, College×$NX$, College× $YX$, Postgrad× $NX$ Postgrad× $YX$) are included but not reported to save on space. All monetary values are in thousands of dollars at 2010 constant prices. $NX$ is a dummy for no previous labor market experience and $YX$ is a dummy for previous labor market experience. Collateral is a dummy for those who posted a collateral to obtain credit, Amount collateral posted is value of the collateral, Nr. of employees is the number of employees working for the business, including the entrepreneur, Nr. of businesses is the number of businesses that the entrepreneur runs, Uncertain income is a dummy for entrepreneurs reporting of not having a good idea for what the income for next year will be, Inherited Business is a dummy for businesses that were inherited. All regressions include year dummies, a quadratic in age, dummies female, white and married entrepreneurs. Column 1 includes 6 industry dummies and their interaction with the post dummy; Column 5 includes 6 cohort dummies and their interaction with the post dummy. See Table 2 for the definition of all other variables. Bootstrapped standard errors in parentheses, *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

composition and allowing for time varying sectoral returns has no significant effect on the estimated coefficients. For example, the Postgraduate×Post dummy for experienced entrepreneurs (YX=1) just increases from 177,400$ of the baseline specification in Table 7 to 178,100$. For unexperienced entrepreneurs (NX=1) with a postgraduate degree, the increase in the baseline specification is 61,900$ while it is equal to to 59,300$ in Table 8.

**Access to finance** Another potential explanation for the rising premium to education could be related to financial constraints and the possibility that better education helps in obtaining more (internal or external) funds to finance ventures. For example postgraduates could obtain more credit because they can pledge more collateral. This might be either because they are paid higher wages when working as employees, which allows them to accumulate more wealth before starting their venture, or simply because they receive larger inheritances from their parents, which is consistent with the evidence that the education of offsprings is positively correlated with the wealth of their parents and that this correlation has risen over time (Belley and Lochner, 2007). The SCF enquires about the use of collateral or personal guarantees to obtain loans to finance the venture. We then construct a *Collateral dummy* which is equal to one if the entrepreneur has used personal wealth to guarantee a loan for his venture and create a variable which measures the *Value of collateral* posted by the entrepreneur. Column 2 of Table Table 8 shows that offering personal guarantees to finance the business is related to larger entrepreneurial returns. However, the effects on total returns are not significantly different from zero. Moreover, the time profile of the return to postgraduate education with and without previous experience remains practically unchanged after controlling for personal guarantees. Of course, the entrepreneur can obtain external financing also without offering any personal guarantees and education might provide greater financial literacy and other skills useful to interact with external financiers. For example, Parker and Van Praag (2006) use a sample of Dutch entrepreneurs and provide evidence consistent with the idea that education helps in relaxing firms' financial constraints. To test for this hypothesis, we exploit a robust prediction of models of firm growth due to financial constraints (Cooley and Quadrini, 2001; Clementi and Hopenhayn, 2006; Michelacci and Quadrini, 2009),

Table 9: Financial Constraints and the age profile of entrepreneurial returns

| | (1) $d+l$ | (2) $M$ | (3) $\theta$ |
|---|---|---|---|
| Post interacted with: | | | |
| High Sch.$\times YX$ | 8.1 | -8.4 | 13.0 |
| | (9.4) | (131.8) | (16.5) |
| College$\times$ $NX$ | 17.7 | 182.8 | 18.7 |
| | (19.4) | (268.1) | (33.9) |
| College$\times$ $YX$ | 55.6*** | 322.5 | 39.3 |
| | (18.9) | (206.8) | (34.0) |
| Postgrad$\times$ $NX$ | 24.2 | -348.4 | 42.7 |
| | (27.2) | (257.3) | (38.9) |
| Postgrad$\times$ $YX$ | 104.1*** | 393.6* | 152.6*** |
| | (25.5) | (214.2) | (35.8) |
| Tenure$\times$College | 2.8*** | 25.4 | 0.8 |
| | (1.0) | (18.2) | (2.9) |
| Tenure$\times$Postgrad | 0.4 | -30.6*** | -0.6 |
| | (0.9) | (11.3) | (1.6) |
| Tenure$\times$College$\times$Post | -2.1* | 9.3 | 0.2 |
| | (1.1) | (19.3) | (3.3) |
| Tenure$\times$Postgrad$\times$Post | 1.6 | 53.5*** | 1.4 |
| | (1.2) | (13.8) | (2.6) |
| Tenure$\times$Post | 0.8 | -21.9** | -2.2 |
| | (0.5) | (9.9) | (1.9) |
| Tenure | 1.5*** | 38.4*** | 1.9 |
| | (0.4) | (9.2) | (1.2) |
| $H_0$: College$\times$ $NX\times$Post =College$\times YX\times$Post | | | |
| F-stat | 3.456 | 0.407 | 0.452 |
| p-value | 0.063 | 0.523 | 0.501 |
| $H_0$: Postgrad$\times NX\times$Post =Postgrad$\times YX\times$Post | | | |
| F-stat | 7.029 | 11.41 | 7.337 |
| p-value | 0.008 | 0.001 | 0.007 |
| Obs | 7,250 | 7,250 | 7,250 |

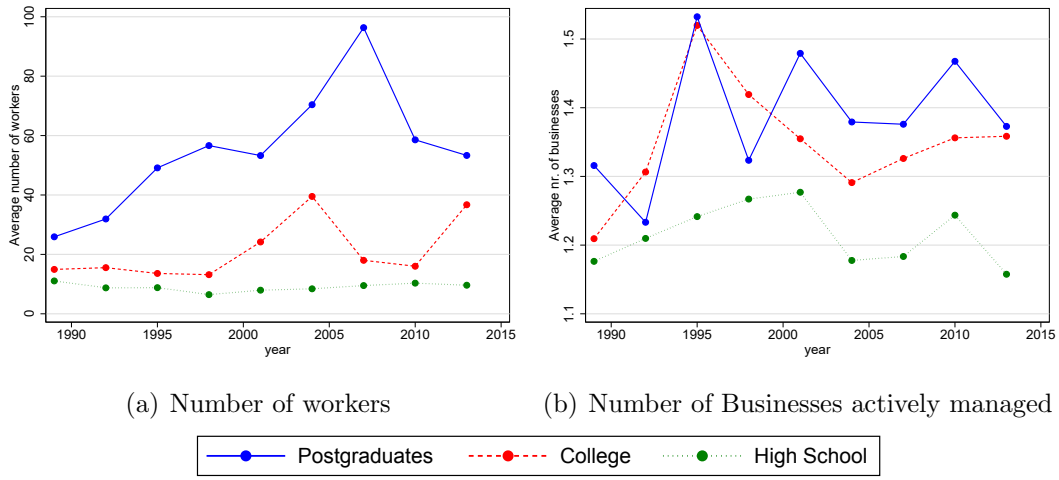
**Notes:** All monetary values are in thousands of dollars at 2010 constant prices. Education dummies interacted with the experience dummies (High Sch.$\times YX$, College$\times$ $NX$, College$\times$ $YX$, Postgrad$\times$ $NX$, Postgrad$\times$ $YX$) are included but not reported to save on space. $NX$ is a dummy for no previous labor market experience and $YX$ is a dummy for previous labor market experience, Tenure is the number of years since the entrepreneurs started running the business. All regressions include year dummies, a quadratic in age, dummies for female, white and married entrepreneurs. See Table 2 for the definition of all other variables. Bootstrapped standard errors in parentheses, *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

which implies that more financially constrained ventures have a steeper dividends profile with respect to the age of the venture. This is because financially constrained firms rely more on retained earnings to finance firm growth, which implies that dividend payments increase faster as the venture ages. To test whether ventures ran by postgraduates, with or without previous labor market experience, have progressively become less financially constrained over time, we then check whether the age profile of dividends has become flatter for postgraduates than for college graduates. To test for this hypothesis we regress dividends on the usual controls plus the current age of the entrepreneurial venture which we interact with our educational dummies and allow this interaction to vary across sub-periods. If ventures ran by postgraduates (with or without experience) have become less financially constrained, we should observe a coefficient for venture age×post×postgrad which is more negative than the coefficient for age×post×college. The results in Table 9 indicate that there is little support for this null hypothesis. If something, when focusing on total income $d + l$ (Column 1), we even find support for the opposite implication. Similar conclusions are reached if we look at business value (Column 2) or total returns (Column 3). Overall the evidence in Table 9 suggests that the increased complementarity between postgraduate education and labour market experience is unlikely to be due to a relaxation of financial constraints.

**Span of control** The recent ICT revolution might have favored the adoption of organizational practices favoring larger businesses; see Garicano and Rossi-Hansberg (2015) for a review of the recent literature on how the acquisition, use, and communication of knowledge affects the organization of the firm. If higher education is complementary with the adoption of organizational practices intensive in ICT (Caroli and Van Reenen, 2001; Bresnahan et al., 2002), it could be that the span of control of highly educated entrepreneurs has (relatively) increased, allowing them to run larger ventures today than they used to do in the past. To test for this hypothesis, we consider two variables measuring the span of control of entrepreneurs. The first is the *Number of workers* employed by the entrepreneur in his first actively managed businesses, the second is the *Number of actively managed businesses*. Panel (a) of Figure 11 shows that the number of work-

ers employed by postgraduates has increased over time, from an average of around 25 workers in 1989 to around 60 workers in the 2000's. The *Number of workers* has increased somehow for college graduates but less so than for postgraduates, while it has remained stable for high school graduates. The *Number of actively managed businesses* has instead increased mildly and very similarly for college graduates and postgraduates, see panel (b). To quantify the effect of the size of entrepreneurial ventures (in terms

Figure 11: Firm size and Span of Control




(a) Number of workers (b) Number of Businesses actively managed

**Source:** Own calculations using data from the Survey of Consumer Finances, the Longitudinal Business Database and the S&P500 Total Return Index. Values are in thousands of dollars at 2010 constant prices.

of number employees or number of actively managed businesses) on the rising premium to postgraduate education, we augment our baseline regressions with our two measures of the span of control of entrepreneurs. The results are reported in column 3 of Table 8. On average, employing one additional worker is associated with an increase in total entrepreneurial returns $\theta$ by 500\$. The effect of the number of businesses is also positive, but it is not statistically significantly different from zero. Results are similar when adding a quadratic polynomial in our size measures, or when we logged our size variables. Relative to Table 3, the increase in the premium in the post 2000 period is slightly reduced for both college graduates and postgraduates: for postgraduates with some labour market experience it goes down from 177,400\$ in Table 7 to 158,700\$ in Table 8. This suggests that the combination of postgraduate education and experience has become progressively

more important in managing larger organizations. But firm size can not account for the full story, because the difference in the increase in returns between experienced and unexperienced postgraduate entrepreneurs remains statistically significant and of a similar order of magnitude as before and significantly greater than the one experienced by college graduates.

**Income uncertainty** We have already argued is Section 5, based on the shift of the distribution of returns at various quantiles, that our results are unlikely to be explained by an increase in the risk faced by entrepreneurs with higher education. As a further check, we consider a direct measure of income uncertainty. Starting in 1992, the SCF asks the following question: "At this time, do you have a good idea of what your income for next year will be?" We construct the dummy *Uncertain Income* equal to one for entrepreneurs who respond negatively to the question. Table 2 shows that the share of entrepreneurs who are uncertain about their future business income decreases with education. Column 4 of Table 8 reports the results when including this additional control in the regression model. We find that entrepreneurs with uncertain future income record lower returns. However, the coefficient of interests are hardly affected. For example entrepreneurs with Postgraduate education and some previous experience now show an increase in returns of 165.000$ per year in the post-2000 period compared with the baseline increase of 177.000$ per year reported in column 1 of Table 7.[20] As a further check (unreported for brevity), we have also controlled for the possibility that highly educated entrepreneurs might engage in riskier activities that pay greater expected returns, because they are better protected by the legal structure of their businesses, see Table 2 for evidence that more educated entrepreneurs are more likely to run limited liability companies. In practice we find that our results remain unchanged after controlling for the legal structure of businesses.

**Vintage effects** Another explanation for the increase in the premium to postgraduate education is related to vintage effects and the fact that newly created businesses might

[20]In practice the drop with respect to the baseline results is caused by the exclusion of the 1989 survey, due to the unavailability of the variable *Uncertain Income* in that year. In fact, when we run the baseline regression of Table 7 after excluding the 1989 survey, we obtain a change in returns of 163.000$ per year very close to the value in column 4 of Table 8.

embody more advanced technologies and/or better organizational practices, possibly related to ICT (Bloom et al., 2012). As first emphasized by Arrow (1962) and as stressed by the managerial literature (Christensen and Rosenbloom, 1995), entrants have an advantage in undertaking disruptive innovations. It might be that, during a period of booming entrepreneurial opportunities as in the US over the 90's and the 2000's, postgraduates have been particularly successful in embodying into their newly created ventures the new technologies and business ideas available at the time when their venture was started. Under this interpretation, the increase in the premium to postgraduate education should be at least partly attributable to the date of creation of the venture. To evaluate this hypothesis, we augment the baseline regressions of Table 7 by considering a set of cohort dummies identifying the year when the entrepreneurial venture was started. We consider six cohort dummies depending on whether the venture started before 1960, between 1960 and 1969, 1970 and 1979, 1980 and 1989, 1990 and 1999, and after 2000. We then interact these cohort dummies with our educational dummies and include them in the regressions. The estimated coefficients for the changes in the return are reported in Column 5 of Table 8. Overall, controlling for cohort effects has little effects on the magnitude of the increase in the premium to postgraduate education as well as on the difference in the increase in returns between experienced and unexperienced entrepreneurs. This indicates that the increased complementarity between postgraduate education and labor market experience is independent from the date when the venture was started, which suggests that the combination of postgraduate education and experience has become increasingly important for entrepreneurial returns independently of the technology/organization embodied in the business at the date of its creation.

**Intergenerational transmission of wealth** As a final possibility we explore the role played by the intergenerational transmission of wealth. It might simply be that more educated entrepreneurs inherit better businesses from their wealthy parents. To check for this possibility we added to our baseline specifications a dummy for whether the venture ran today by the entrepreneur is an *Inherited businesses*. Column 6 of Table 8 shows that an *Inherited businesses* has a return which is higher by 44,000$, although the effect

is not statistically significantly different from zero. But again, the increase in the return to education for entrepreneurs with or without previous labor market experience in the post 2000 period remains unaffected after adding this additional control.

We conclude that higher education combined with labour market experience provides entrepreneurial skills that have become more valuable over time. This is partly reflected in the fact that postgraduates run larger businesses, but the effect of the combination of education and experience on returns goes beyond a pure size effect. All in all, we take this evidence as consistent with the notion that running successful businesses requires both the advanced theoretical competence provided by higher formal education and the applied practical expertise acquired through labor market experience and that this mix has become increasingly important in today technologically-advanced highly-competitive world.

## 7 Conclusions

We have studied how the educational composition and the return to education has evolved over time since the late 80's for US entrepreneurs. The fraction of entrepreneurs with a college degree has increased, while the fraction of entrepreneurs with a post-college degree has remained stable over time. The premium of having a college degree relative to a high school degree has increased, but roughly by the same amount as the analogous premium for workers. The premium for postgraduate education relative to a college degree has increased substantially more for entrepreneurs than for workers: now an entrepreneur with a post-graduate degree earns fifty percent more than an entrepreneur with a college degree, while in the late 80's their earnings were approximately equal. The analogous skill premium for workers is just 10-20 percent. The sharp increase in the skill premium for entrepreneurs with postgraduate education is partly due to the higher dividends paid by the firm they ran and partly due to the higher capital gains realized when selling their business. The premium for postgraduate education holds both for entrepreneurs with a Master or an MBA degree and for those with a PhD, it has remained high during the Great Recession (despite a drop in absolute returns), and it increases substantially when

looking at the higher deciles of the entrepreneurs income distribution.

Independently of whether education fosters valuable entrepreneurial skills, our evidence suggests two conclusions. The first is that skill has become progressively more important for entrepreneurship, which is consistent with the notion that technological progress has been skill biased and more so for entrepreneurs than for employees. The second is that the advanced entrepreneurial skills associated with higher education have progressively become scarcer over the period, since, after controlling for compensating differentials, the excess return from entrepreneurship should remain unchanged under a perfectly elastic supply of entrepreneurial skills and an individual's choice between working as an employee and creating a business. The observation of a skill bias in entrepreneurship generally implies that the supply of skill into entrepreneurship has progressively become a more important determinant of a country's economic performance, which is a novel claim that can shed new light on the determinants of recent changes in income disparities across world economies. The observation that, even in the US, high skill entrepreneurs have progressively become scarce naturally leads to the question of how this supply can be increased. Both questions deserve further investigation.

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## A Some theoretical derivations

**Valuation bias: Derivation of equation (15)** When the business can fail with probability $\delta$, the value to the entrepreneur of the business with initial investment $k$ is equal to $U$ that solves

$$\rho U = d + l + \lambda \left[ \mathbb{E}_x \left( V \right) + W - U \right] \tag{31}$$

where

$$\mathbb{E}_x \left( V \right) = (1 - \gamma) M + \gamma L = M - \gamma (M - L) \tag{32}$$

is the expected value of the business upon exiting entrepreneurship, with

$$\gamma = \frac{\delta}{\lambda} < 1 \tag{33}$$

and

$$M = \frac{d + \delta L}{r + \delta}. \tag{34}$$

The net value of becoming an entrepreneur is still given by $S$ in (3), while the excess return from entrepreneurship $\phi$ should still satisfy the condition (4), which immediately yields (14) where $\theta_v$ is given by (15).

**Recycling bias: Derivation of equation (25)** When the entrepreneur can start-up another business with probability $\nu$, the value to the entrepreneur of the business evolves as follows:

$$\rho U = d + l + \lambda \left[ \mathbb{E}_x \left( V \right) + \nu S + W - U \right] \tag{35}$$

where $\mathbb{E}_x \left( V \right)$ is still given by (32) and $W$ by (1), while $\nu S$ incorporates the fact that upon exiting the current entrepreneurial venture, with probability $\nu$, the entrepreneur starts another venture with net value

$$S = U - k - W,$$

which is as in (3). As in Section 2.1, the value of becoming an entrepreneur is converted into a flow value by imposing the condition

$$\frac{\phi_r}{\rho + \lambda} = S, \tag{36}$$

which equates the hypothetical present value of wealth obtained under the constant per period income $\phi_r$ to the net value of becoming an entrepreneur. After using the definition of $S$ in (3), we obtain that (35) implies that

$$U = \frac{d + l + \lambda \left[ \mathbb{E}_x \left( V \right) + \nu S + W - U \right]}{\rho + \lambda},$$

which can be substituted in (36) to solve for $\phi_r$ as given in (25).

## B Data appendix

The Survey of Consumer Finances (SCF) is conducted every three years by the Board of Governors of the Federal Reserve System. We use all waves since 1989 up to the latest available survey of 2013. The SCF is unique in that it collects data on the household finances of a large sample of Americans. Wealthy individuals are over-sampled and, once weighted, SCF data are representative of the entire wealth distribution of US households. Around 4,000 households per wave are sampled, with the exception of the last two surveys where sample size increases to around 6,000 households. All statistics are calculated using the SCF provided sampling weights and closely following the SCF guidelines to deal with the repeated-imputation inference method of the survey, which reports five implicates for each variable. All regressions are run and standard errors are calculated using the SCFcombo routine for STATA, described at `https://www.federalreserve.gov/Standard/Error/Documentation.pdf`. We combine information from the SCF with information from the Longitudinal Business Database (LBD) compiled by the Census, the FRED database, and Stock market returns from Standard & Poor's. Below we describe in more details the construction of the variables used in the paper following an alphabetical order.

***Age of household head*** The age of the household head is obtained using variable "Reconciled age" (mnemonic X14).

***Age of entrepreneurial venture***, $\tau$ This is the number of years since the entrepreneur started or acquired the main business he actively manages. We combine information on the current year with answers to the question `"In what year did you start/acquire the business?"` (mnemonic X3110), and compute the *Age of entrepreneurial venture* as current year minus year of acquisition plus one.

***Collateral*** This dummy variable is constructed using answers to the question `"Are you or your family living here using personal assets as collateral or did you have to co-sign or guarantee any loans for this business?"`, which is available separately for business one and two under mnemonics X3120 and X3220, respectively. *Collateral* is equal to one if X3120=1 or X3220=1.

***Dividend payments, d*** This corresponds to the annual earnings gross of taxes from the main job, other than wages and salary for household heads who are *Entrepreneurs*. Current USD amounts are deflated with CPI at constant 2010 prices from FRED. *Dividend payments* are obtained by multiplying the dollar amount from the question X4131 with the frequency of payments within a year as obtained from X4132 for Entrepreneurs who report receiving some additional non labor income as obtained from X4127. The text of the questions X4127, X4131 and X4132 is as follows: X4127: `"Do you also receive some other kind of income?"`; X4131: `"In addition to regular salary and wages, how much do you personally receive from the business before taxes?"`; and X4132: `"How often do you receive that amount?"`.

***Educational dummies*** The educational groups are determined based on the following three questions: `"What is the highest grade of school or year of college you completed?"` (mnemonic X5901); `"Did you get a college`

degree?" (mnemonic X5904); and "What is the highest degree you have earned?" (mnemonic X5905). Variable X5901 allows for the following answers: "(-1) No grades completed; (1) 1st grade; (2) 2nd grade; (3) 3rd grade; (4) 4th grade; (5) 5th grade; (6) 6th grade; (7) 7th grade; (8) 8th grade; (9) 9th grade; (10) 10th grade; (11) 11th grade; (12) 12th grade; (13) 1 year college; (14) 2 years college; (14) 3 years college; (15) 3 years college; (16) 4 years college; (17) Graduate school." Answers to X5905 allows for the following options: "(1) Associate's and other junior college degree; (2) Bachelor's; (3) MA/MS, MBA and other master's; (4) Ph.D (including post-doctorate), MD, DDS/DMD, Doctor of Osteopathy, Law JD, Other doctorate (DVM, Doctor of Divinity, etc.); (10) Nursing degree (RN, LPN) or other certificate, Chiropractic, Naprapathy, Homeopathy, Pharmacology, teaching certificate." The dummy variable for *Less than High School* is equal to one if X5909<12. The dummy variable for *High School* includes college dropouts: it is equal to one if X5909=12, or 13≤X5909≤16 but X5904=5, which means that the household head has not obtained any college degree. The dummy variable for *College* identifies household heads who have obtained a college degree without having any postgraduate degree: it is equal to one if X5901≤16, X5904=1, and X5905=1 or X5905=2. The dummy variable for *Postgraduate* is equal to one if X5901=17, and X5905=3 (Master's) or X5905=4 (PhD). In the public version of the SCF, X5905=3 also includes MBA's while X5905=4 also includes JD's and MD's.

***Employee*** The household head works for someone else (mnemonic X4106=1) and he does not own or share ownership in any privately-held businesses (mnemonic X3103=5).

***Entrepreneur*** An household head is classified as an *Entrepreneur* if the three following conditions are jointly satisfied: i) his main job is either self-employed or owns a closely held business (mnemonic X4106=2); ii) he holds shares or owns some privately held businesses (mnemonic X3103=1); iii) he has an active management role in any of these businesses (mnemonic X3104=1). The text of the questions X4106, X3103 and X3104 is as follows: X4106: "Do you work for someone else, are you self-employed, or what?"; X3103: "Do you own or share ownership in any privately-held businesses, farms, professional practices, limited partnerships or any other types of partnerships?"; and X3104: "Do you have an active management role in any of these businesses?". The answers to questions X4106 is as follows: 1. Someone else; 2. Self-employed, other closely held business owned by PEU, Partnership, law firm, medical/dental partnership, other non-publicly-traded business in which he has an interest, contractor. The *Entrepreneur* dummy is equal to one if X3104=1, X3103=1 and X4106=2. Notice that in the SCF an individual who runs and owns a business is explicitly coded as being self-employed in his main job (X4106=2).

***Entrepreneurial return***, $\boldsymbol{\theta}$ It is the sum of *Dividend payments, d* defined above, *Labor income, l* and the *Expected net capital gains*, $\lambda(M-k)-\rho k$, defined below.

***Exit rate***, $\boldsymbol{\lambda}$ The household can separately report values for up to three actively managed businesses until 2007, and up to two afterwards. The exit rate out of the entrepreneurial

venture $\lambda_i$, $i = 1, 2$ is calculated for up to the first two actively managed businesses. The exit rate $\lambda$ is a weighted average between $\lambda_1$ and $\lambda_2$ with the weight of $\lambda_2$ equal to the fraction of entrepreneurs with at least two actively managed businesses. For each business $i = 1, 2$, $\lambda_i$ is calculated as the inverse of the average normalized *Age of entrepreneurial venture*, $\tau_i$. *Age of entrepreneurial venture* is normalized by the amount of firm entry of the corresponding educational (and/or income) group of the year when the venture was started. The index of firm entry is obtained by combining data from LBD with information from the SCF on the educational composition of newly started ventures. From LBD, we obtain the number of newly created firms, which is available since 1977. For each wave of the SCF, we calculate the educational (and/or income) shares of entrepreneurs who started their venture within the last three years. These shares are then multiplied with the previously discussed measure of firm creation from LBD to construct an education/income specific index of entry into entrepreneurship. Educational shares are available for the period 1989-2013, business creation data are available since 1977, while in the SCF there are ventures that started as back as in 1922. To extend our series we impute the last available observation in the sample to all the previous years. For each educational (income) group we divide the individual specific weights in the SCF (mnemonic X42001) by the corresponding index of business creation of the year when the venture was started. With these normalized weights, and separately for business one and two, we then calculate the average age of all entrepreneurial ventures in each wave of the SCF. By inverting this average we then obtain our measure of the exit rate.

***Expected gross capital gains***, $\boldsymbol{\lambda(M-k)}$ This is obtained by multiplying the *Exit rate* $\lambda$ defined above by the difference of the *Value of business*, $M$ and the *Initial Investment in business*, $k$, which are both described below.

***Expected net capital gains***, $\boldsymbol{\lambda(M-k)-\rho k}$ This is the difference between the *Expected gross capital gains*, $\lambda(M-k)$ and a measure of the opportunity cost of the capital invested by the entrepreneur in the business $\rho k$. $\rho k$ is calculated as equal to $\rho_1 k_1 + \rho_2(k_2 + k_{res})$, where the variables $\rho_1$ and $\rho_2$ are defined in the construction of the variable *Opportunity cost of capital*, while $k_1$, $k_2$, and $k_{res}$ are defined in the construction of the variable *Initial investment in business*.

***Experience Dummies***, $\mathbf{YX}, \mathbf{NX}$ These dummies distinguish between entrepreneurs with at least one full-time job that lasted three years or more before starting or acquiring the current business (YX=1) and those without any such job (NX=1). They are constructed using question X4514, "Now, not counting your current job, have you ever had a full-time job with a different employer that lasted three years or more?" and X4515, "I would like to know about the longest such job you had. Did you work for someone else, were you self-employed, or something else?". The possible answers to question X4514 are: "(1) Yes; (5) No; (0) Inappropriate"; those to question X4515 are "(1) Someone else; (2) Self-employed, other non-corporate business owned by PEU; (3) partnership, law firm, medical/dental partnership, other non-publicly-traded business in which R/SP has an interest; (6) consultant/contractor; (7) other; (0) Inappropriate (no job longer than 3 years; volunteer work not considered a

job)". The dummy YX is equal to 1 if X4514=1 and X4515 is different from zero and the dummy NX is equal to one if X4514=5 or X4515=0. The two dummies are exhaustive and exclusive.

***Failure rate*, $\delta$** The household can separately report values for up to three actively managed businesses until 2007, and up to two afterwards. We calculate a measure of the failure rate for each educational group, $\delta_i$, $i = 1, 2$ for the first two actively managed businesses by the entrepreneur. $\delta$ is then calculated as a weighted average between $\delta_1$ and $\delta_2$ with weight equal to the fraction of entrepreneurs with at least two actively managed businesses. A business has failed if: (i) it has zero sales (answer "-1. Nothing" to the question "What were the gross sales of the business as a whole?," mnemonic X3131 and X3231 for business one and two, respectively); and (ii) it has zero employees (answer "-1. No one working in business: business is about to be sold" to the question "How many people work in this business, including you, members of your family, or anyone who is working without pay?," mnemonic X3111 and X3211 for business one and two, respectively), excluding the entrepreneur itself (X3111=1 or X3211=1 admitted). We exclude from the calculation firms which are less than 2 years old. $\delta_i$ is calculated as the ratio of the number of failed businesses over the total number of businesses in the corresponding age and educational group.

***Female*** This is a dummy variable which is equal to one if mnemonic X8021=2; zero otherwise. It identifies whether the household head is a female.

***Industry dummies*** The industry dummies are obtained from the variable X7402 which contains answers to the question "What kind of business or industry do you work in?", which is recorded consistently though all waves of the SCF. In the public version of the dataset, the Census 1998 3-digit industry codes have been collapsed to the seven groups discussed in the paper.

***Inherited business*** This variable is constructed using answers to the question "How did you first acquire this business; was it bought or invested in, started by you, inherited, given to you, or what?" (mnemonic X3108), which focuses on business one. The following answers are available: 1. "Bought/Invested; 2. Started; 3. Inherited; 4. Given; 5. Joined/Became partner/ Promotion; -7 other." The venture is classified as being *Inherited* if X3108=3 or X3108=4.

***Initial investment in business*, $k$** The household can separately report values for up to three actively managed businesses until 2007, and up to two afterwards. The initial investment in the first three actively managed businesses is computed using answers to the following question "If you sold the business now, what would be the cost basis for tax purposes (of your share of this business)? Probe: What was your original investment? What was the value when you received it? Definition: The tax basis is the amount of the original investment (or the value when it was received) plus additional investments", which correspond to mnemonics X3130, X3230, and X3330 for first, second and third business, respectively. These values are denoted as $k_1$, $k_2$, ad $k_3$, respectively. To construct the variable for the total *Initial Investment in business*, $k$, we add the value of the investment in all remaining businesses actively managed by the household (mnemonic X3336), to the sum

of the value of the initial investment in first, second and third business as obtained above. The initial investment in the third business is available up to 2007. We denote by $k_{res}$ the sum the value of the investment in all remaining businesses actively managed by the household (mnemonic X3336) plus the initial investment in business three $k_3$. The current USD amounts are deflated using CPI index at constant 2010 prices (2010=100) taken from FRED. To deflate initial investment we need information on the year when the venture was started which for business one and two is available from the variable X3110 and X3210, respectively. For all the remaining businesses (including the third one to guarantee consistency over time), we use the CPI deflator associated with the start of business two.

***Labor income***, ***l*** This corresponds to the annual earnings gross of taxes from main job. Current USD amounts are deflated with CPI at constant 2010 prices (2010=100) from FRED. Annual wage income is obtained by multiplying the dollar amount from mnemonic X4112 with the frequency of payments within a year as obtained from mnemonic X4113. Variable X4112 reports answers to the question "About how much do you earn before taxes on main job in salary or wages?". Variable X4112 reports answers to the question "How often do you receive that amount?".

***Liquidation value of business***, ***L*** A business has failed if it satisfies the criteria used to construct the variable *Failure rate*. For all failed businesses we calculate the average value from the question "What is the net worth your share of this business?. If Respondent says the business is worth nothing or can not be sold ask: About how much would it cost to buy a similar asset?" (mnemonic X3129 and X3229 for first and second business, respectively).

***Married*** It identifies whether the household head is married or has a partner using mnemonic X8023. It is a dummy variable which is equal to one if X8023=1 or X8023=2 and zero otherwise.

***Number of businesses actively managed*** This is the answer of an *Entrepreneur* to the following question: "Including your (farm/ranch) business, in how many (farms/ranches), privately-held businesses, professional practices, limited partnerships, or other business investments that are not publicly traded do you own or share ownership in and also have an active management role?", which corresponds to mnemonic X3105.

***Number of employees*** The household can separately report values for up to three actively managed businesses until 2007, and up to two afterwards. For homogeneity, we therefore calculate employment in the first two actively managed businesses. *Number of workers* is the sum employment in business one and two. *Number of workers* in business $i = 1, 2$ is obtained from the answers to the questions "How many people work in this business, including you, members of your family, or anyone who is working without pay?", whose mnemonic for business one and two is equal to X3111 and X3211, respectively.

***Opportunity cost of capital***, $\boldsymbol{\rho}$ We calculate a measure of the opportunity cost of capital $\rho_i$, $i = 1, 2$ for up to the first two actively managed businesses by the entrepreneur.

The value obtained for business two is then imputed also to all the other businesses actively managed by the entrepreneur, if any. $\rho_i$, $i = 1, 2$ is calculated combining information on the age $\tau_i$ of the entrepreneurial venture of business $i$ together with information on the average return from investing in the US stock market, as measured by the S&P500 Total Return Index which comprises also dividend payments as taken from Bloomberg. The S&P500 Total Return Index is deflated using CPI at constant 2010 prices (2010=100) taken from FRED. $\rho_i$, $i = 1, 2$ is then calculated as follows: $\rho_i = R(t - \tau_i, t)^{\frac{1}{\tau_i}} - 1$, where $R(t - \tau_i, t)$ is the increase in the CPI-deflated S&P500 Total Return Index from $t - \tau_i$ to $t$, where $t$ is the current date.

***Past earnings*** (mnemonics X4520 and X4521). This corresponds to the annual earnings gross of taxes from the longest previous job, among the jobs that lasted at least 3 years. Current USD amounts are deflated with CPI at constant 2010 prices as obtained from FRED. Annual wage income is obtained by multiplying the dollar amount from mnemonic X4520 with the frequency of payments within a year as obtained from variable X4521. Variable X4520 reports answers to the question `"About how much were you earning before taxes when you stopped?"`. Variable X4521 reports answers to the question `"And that amount is per...? Day. Week..."`.

***Recycling correction***, $\boldsymbol{\varphi(\nu) = \frac{\rho+\lambda}{\rho+\lambda(1-\nu)}}$ The recycling correction is calculated using the formula $\varphi(\nu) = \frac{\rho+\lambda}{\rho+\lambda(1-\nu)}$ where $\rho$ is the *Opportunity cost of capital*, $\lambda$ is the *Exit rate* and $\nu$ is the *Recycling probability* discussed below.

***Recycling probability***, $\boldsymbol{\nu}$ We identify the set of individuals who were entrepreneurs in their past job using the following two questions: `"Not counting your current job, have you ever had a full-time job with a different employer that lasted three years or more?"` (mnemonic X4514); and `"I would like to know about the longest such job you had. Did you work for someone else, were you self-employed, or something else?"` (mnemonic X4515). A individual is identified as entrepreneurs in his past job if he declared to be self-employed (X4515=2). Notice that in the SCF an individual who runs and owns a business is explicitly coded as being self-employed in his main job. The *Recycling probability*, $\nu$ is calculated as the ratio of individuals who are *Entrepreneur* today and were self-employed in their past job (X4514=1 and X4515=2) over the total number of individuals who were self-employed in their past job (X4514=1 and X4515=2).

***Uncertain Income*** This is a dummy equal to one for entrepreneurs that respond negatively to the following questions: `"At this time, do you have a good idea of what your income for next year will be?"` (Mnemonic X7586). The question is not present in the first wave of the survey (1989).

***Unlimited liability*** This variable is constructed using answers to the question `"Is it a partnership, a sole proprietorship, a subchapter S corporation, another type of corporation, or what?"` (mnemonic X3119), which focuses on business one. The following answers are available: `"1. Partnerships; 2. Sole proprietorship; 3. Subchapter S; 4. Other Corporation (including C chapter corps); 6. Foreign business type; 11. Limited partnership; 12. Limited liabil-`

ity company (LLC); 15. Cooperative; 40. Not a formal business type; -7 other. The venture is classified as having *Unlimited liability* if X3119=1 or X3119=2 or X3119=15 or X3119=40 or X3119=-7.

***Value of business***, ***M*** This is the self-reported market value of the shares owned by the household in all actively managed businesses, net of credits or debts with the household. The household can separately report values for up to three actively managed businesses until 2007, and up to two afterwards. The value of the first three actively managed businesses is computed as follows: sum of the net worth of household's shares of the business (mnemonic X3129, X3229 and X3329 for first, second and third business, respectively), plus the amount of money owed to the household by the business (mnemonics X3124, X3224, and X3324 for first, second and third business, respectively) minus the amount the household owes to the business (mnemonics X3126, X3226, and X3326 for first, second, and third business, respectively). To construct the variable for the total *value of business* we add the value of all remaining businesses actively managed by the *Entrepreneur* to the sum of the value of the first and second business as calculated above. The value of all remaining businesses is calculated as the sum of the net worth of the third business, which is available up to 2007, to the value of the shares in all the remaining actively managed businesses, which is obtained from mnemonic X3335. The current USD amounts are deflated using CPI at constant 2010 prices (2010=100) taken from FRED.

***Value of collateral*** This is constructed using answers to the question "How much is guaranteed or collateralized?" which is available separately for business one and two under mnemonics X3121 and X3221, respectively. *Amount of personal guarantees* is the product of the *Collateral* dummy discussed above and the positive values of the variable X3121 and X3221.

***White*** This is a dummy variable which is equal to one if mnemonic X5909=5 until wave 1995, then X6809=1; zero otherwise. It identifies whether the household head is white.

***Year of schooling*** This is the answer to the following question: "What is the highest grade of school or year of college you completed?" (Mnemonic X5901). It goes from 1 (first grade) to 17 (graduate school).

## C Additional empirical results

For expositional simplicity, in the main text we allowed the effects of education to be different in the pre-1995 and in the post-1995 period. Here we provide the results when the effects of education are allowed to vary at each point in time, by interacting the education dummies with a full set of time dummies. We also report the results of some further specifications, such as the quantile regressions with the time trend.

Table A1: Trend in the Skill premium, year dummies specification

| | (1) $\theta$ | (2) $\phi$ | (3) $d+l$ | (4) $M$ | (5) $k$ | (6) GCG | (7) NCG |
|---|---|---|---|---|---|---|---|
| 1992×College | 28.4 | 33.4 | 17.0 | -488.1* | -393.7 | -10.9 | 11.4 |
| | (47.8) | (48.0) | (25.3) | (249.6) | (249.1) | (26.3) | (38.9) |
| 1995×College | 68.5 | 72.0 | 21.9 | -220.7 | -402.8 | 23.3 | 46.6 |
| | (52.5) | (52.6) | (26.6) | (284.7) | (262.3) | (29.2) | (41.3) |
| 1998×College | 50.7 | 60.4 | 48.7* | -228.1 | -332.3 | -7.3 | 2.0 |
| | (51.7) | (51.9) | (25.5) | (321.6) | (248.8) | (31.7) | (42.3) |
| 2001×College | 69.9 | 71.1 | 45.0* | 86.8 | -212.7 | 20.9 | 25.0 |
| | (48.6) | (48.7) | (25.9) | (290.6) | (256.6) | (27.1) | (39.1) |
| 2004×College | 98.1** | 100.7** | 52.9** | 466.9* | -122.9 | 38.7 | 45.3 |
| | (49.3) | (49.4) | (23.7) | (283.7) | (279.5) | (27.9) | (42.2) |
| 2007×College | 58.2 | 51.2 | 23.0 | 142.1 | -137.0 | 25.9 | 35.1 |
| | (52.7) | (52.9) | (26.1) | (322.6) | (260.0) | (31.5) | (42.6) |
| 2010×College | 53.4 | 47.7 | 2.0 | -163.4 | -490.3 | 17.4 | 51.4 |
| | (55.0) | (54.9) | (23.8) | (277.0) | (312.6) | (29.7) | (44.7) |
| 2013×College | 42.5 | 40.1 | 57.1** | 633.2* | 379.2 | 13.0 | -14.6 |
| | (54.1) | (54.3) | (28.4) | (334.9) | (314.1) | (30.6) | (45.2) |
| 1992×Postgrad | 55.7 | 58.1 | 50.0* | -40.0 | -97.2 | -3.1 | 5.7 |
| | (46.3) | (45.6) | (27.8) | (239.6) | (209.3) | (24.1) | (36.9) |
| 1995×Postgrad | 42.3 | 30.7 | 61.0** | 285.5 | 180.1 | 4.3 | -18.7 |
| | (59.9) | (60.3) | (27.4) | (300.0) | (339.1) | (31.4) | (58.1) |
| 1998×Postgrad | 125.0** | 114.9** | 101.6*** | 387.7 | -58.5 | 26.0 | 23.5 |
| | (50.3) | (49.2) | (30.1) | (285.0) | (215.8) | (25.6) | (38.1) |
| 2001×Postgrad | 122.0** | 101.3** | 107.9*** | 604.3** | 206.9 | 28.7 | 14.1 |
| | (49.7) | (48.6) | (36.8) | (265.3) | (210.7) | (23.8) | (36.4) |
| 2004×Postgrad | 158.9** | 128.2** | 135.8*** | 980.5*** | 378.9 | 41.9* | 23.1 |
| | (62.1) | (61.1) | (42.5) | (306.4) | (283.0) | (25.3) | (39.8) |
| 2007×Postgrad | 225.9*** | 191.0*** | 172.4*** | 955.6*** | 40.2 | 51.2* | 53.5 |
| | (45.2) | (43.8) | (31.4) | (359.3) | (215.5) | (27.6) | (37.7) |
| 2010×Postgrad | 182.2*** | 136.2** | 137.7*** | 949.0*** | 236.5 | 44.0 | 44.5 |
| | (53.6) | (53.1) | (29.8) | (291.9) | (323.6) | (28.7) | (45.2) |
| 2013×Postgrad | 174.7*** | 144.7*** | 141.5*** | 1,009.3*** | 212.6 | 44.5** | 33.2 |
| | (48.2) | (47.4) | (34.5) | (298.7) | (245.4) | (21.9) | (35.5) |
| N. of Obs. | 7250 | 7250 | 7250 | 7250 | 7250 | 7250 | 7250 |

**Notes:** All monetary values are in thousands of dollars at 2010 constant prices. Education dummies (College and Postgrad) are included but not reported to save on space. All regressions include year dummies, a quadratic in age, dummies female, white and married entrepreneurs. GCG denotes gross capital gains equal to $\lambda(M-k)$, NCG denotes net capital gains equal to $\lambda(M-k)-\rho k$. See Table 2 for the definition of all other variables. Bootstrapped standard errors in parentheses, *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

Table A2: Quantile Regressions, Time Trend specification

| | (1) $\theta$ | (2) $\phi$ | (3) $d+l$ | (4) $M$ | (5) $k$ | (6) GCG | (7) $NCG$ |
|---|---|---|---|---|---|---|---|
| Year ×: | | | | | | | |
| **$25^{th}$ pct** | | | | | | | |
| ×College | -0.4 | -0.4* | -0.3 | 0.4 | 0.1 | 0.0 | -0.2* |
| | (0.3) | (0.3) | (0.3) | (0.3) | (0.1) | (0.0) | (0.1) |
| ×Postgrad | -0.6 | -1.0** | -0.7* | 0.7 | 0.1 | 0.0 | 0.2 |
| | (0.4) | (0.4) | (0.4) | (0.6) | (0.1) | (0.0) | (0.3) |
| **$50^{th}$ pct** | | | | | | | |
| ×College | -0.7* | -1.0** | -0.1 | 2.2 | 1.5*** | -0.1 | -0.1* |
| | (0.4) | (0.4) | (0.3) | (1.8) | (0.5) | (0.1) | (0.0) |
| ×Postgrad | 2.1** | 1.0 | 2.4** | 3.2 | 1.4 | 0.1 | 0.0 |
| | (0.8) | (0.8) | (1.0) | (2.1) | (1.0) | (0.1) | (0.0) |
| **$75^{th}$ pct** | | | | | | | |
| ×College | 0.1 | -0.5 | 0.7 | 6.4 | 8.4*** | -0.3 | -0.5 |
| | (1.3) | (1.2) | (1.1) | (6.3) | (2.5) | (0.5) | (0.4) |
| ×Postgrad | 5.3*** | 3.0** | 4.1*** | 30.4*** | 10.0*** | 0.6* | 0.2 |
| | (1.4) | (1.4) | (1.3) | (6.2) | (3.7) | (0.3) | (0.3) |
| **$90^{th}$ pct** | | | | | | | |
| ×College | 6.7** | 5.8* | 2.2 | 72.6** | 33.9*** | -0.4 | -1.0 |
| | (3.1) | (3.3) | (2.6) | (28.7) | (12.3) | (1.7) | (1.5) |
| ×Postgrad | 13.5*** | 9.7*** | 11.2*** | 103.6*** | 37.7*** | 3.4*** | 2.8*** |
| | (3.1) | (3.4) | (3.2) | (23.5) | (12.3) | (1.3) | (1.0) |
| **$95^{th}$ pct** | | | | | | | |
| Year×College | 8.5 | 6.8 | 6.9 | 224.4*** | 65.3*** | 6.1** | 4.7* |
| | (6.5) | (6.6) | (5.0) | (42.4) | (22.9) | (2.7) | (2.5) |
| Year×Postgrad | 19.3*** | 12.2* | 23.2*** | 135.0*** | 57.7 | 6.4** | 6.4*** |
| | (7.0) | (7.1) | (5.4) | (44.8) | (39.9) | (3.0) | (2.0) |

**Notes: Notes:** Each percentile reports the results of a separate quantile regression. All monetary values are in thousands of dollars at 2010 constant prices. GCG denotes gross capital gains equal to $\lambda(M-k)$, NCG denotes net capital gains equal to $\lambda(M-k)-\rho k$. Year is a variable equal to the calendar year. To save on space, we only report the education dummies College and Postgrad interacted with Year. All regressions include education dummies not interacted, year dummies, a quadratic in age, dummies female, white and married entrepreneurs dummies. See Table 2 for the definition of all other variables. Bootstrapped standard errors in parentheses, *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

Table A3: Quantile regressions, year dummies specification

| | **Total return $\theta$** | | | | **Excess return $\phi$** | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (1) | (2) | (3) | (4) |
| | p25 | p50 | p75 | p90 | p25 | p50 | p75 | p90 |
| 1992×College | 18.84 | 29.69* | -5.22 | -93.84 | 22.19 | 29.78* | -6.69 | -87.66 |
| | (15.07) | (17.16) | (44.98) | (126.26) | (15.08) | (17.15) | (45.20) | (127.11) |
| 1995×College | -3.75 | 7.63 | -5.51 | -6.89 | -1.86 | 5.27 | -9.24 | -1.28 |
| | (9.00) | (18.60) | (48.40) | (156.97) | (8.99) | (18.64) | (48.58) | (157.23) |
| 1998×College | 9.12 | 10.40 | 16.91 | 6.97 | 13.85 | 11.31 | 15.15 | 18.77 |
| | (11.07) | (18.57) | (49.87) | (149.71) | (11.40) | (18.46) | (49.78) | (150.18) |
| 2001×College | 22.20* | 22.54 | 6.82 | 132.71 | 22.38* | 17.99 | -3.51 | 128.49 |
| | (12.55) | (19.87) | (54.53) | (155.26) | (12.51) | (19.81) | (54.39) | (155.17) |
| 2004×College | -2.84 | 14.92 | 41.78 | 147.32 | -1.17 | 10.40 | 34.99 | 145.19 |
| | (10.79) | (17.75) | (48.75) | (133.90) | (10.60) | (17.95) | (48.97) | (133.94) |
| 2007×College | -4.04 | 9.73 | 11.97 | 80.46 | -5.74 | 0.03 | -0.30 | 71.61 |
| | (10.54) | (19.84) | (44.96) | (222.62) | (10.27) | (20.00) | (44.66) | (223.01) |
| 2010×College | 3.80 | 3.01 | -28.45 | -50.80 | 4.82 | -2.06 | -37.89 | -53.97 |
| | (8.63) | (17.41) | (47.80) | (131.57) | (8.54) | (17.29) | (47.67) | (131.82) |
| 2013×College | -2.41 | 0.93 | -0.10 | 108.91 | -1.75 | -1.79 | -9.55 | 96.85 |
| | (7.79) | (17.94) | (49.38) | (136.47) | (7.82) | (18.06) | (49.23) | (137.07) |
| 1992×Postgrad | 37.66 | 26.68 | 38.15 | 11.65 | 38.12 | 20.90 | 35.76 | 9.67 |
| | (23.15) | (27.63) | (53.11) | (89.04) | (23.67) | (28.45) | (53.09) | (93.29) |
| 1995×Postgrad | 24.63 | 18.46 | 29.23 | 148.34 | 28.77 | 11.27 | 19.46 | 122.69 |
| | (17.79) | (24.38) | (46.12) | (118.63) | (18.16) | (24.43) | (46.32) | (123.43) |
| 1998×Postgrad | 27.83 | 55.12 | 127.65** | 173.54* | 29.47 | 41.15 | 117.43** | 160.24* |
| | (24.52) | (42.28) | (49.61) | (92.39) | (24.59) | (42.03) | (48.88) | (94.17) |
| 2001×Postgrad | 26.07 | 61.05* | 100.58 | 213.16* | 24.64 | 48.93 | 81.99 | 165.87 |
| | (18.45) | (34.47) | (61.42) | (120.80) | (18.46) | (34.42) | (60.95) | (120.20) |
| 2004×Postgrad | 5.13 | 55.73* | 62.27 | 175.08 | -2.69 | 33.43 | 21.83 | 131.22 |
| | (22.78) | (30.47) | (47.70) | (132.02) | (23.45) | (30.65) | (47.23) | (131.49) |
| 2007×Postgrad | 33.58 | 79.49** | 235.06*** | 411.80*** | 33.00 | 55.87* | 213.11*** | 373.34*** |
| | (21.05) | (32.46) | (73.85) | (101.15) | (21.10) | (32.10) | (73.35) | (103.26) |
| 2010×Postgrad | 7.46 | 53.25* | 126.70** | 260.03** | -0.31 | 22.88 | 71.36 | 139.87 |
| | (18.39) | (27.75) | (56.10) | (123.07) | (18.45) | (28.32) | (56.42) | (127.74) |
| 2013×Postgrad | 7.01 | 34.40 | 130.52*** | 307.46*** | 4.23 | 16.15 | 95.37** | 245.23** |
| | (18.76) | (26.05) | (47.14) | (117.51) | (19.05) | (25.97) | (47.17) | (120.39) |

**Notes:** All monetary values are in thousands of dollars at 2010 constant prices. Education dummies (College and Postgrad) are included but not reported to save on space. All regressions include year dummies, a quadratic in age, dummies female, white and married entrepreneurs. GCG denotes gross capital gains equal to $\lambda(M-k)$, NCG denotes net capital gains equal to $\lambda(M-k)-\rho k$. See Table 2 for the definition of all other variables. Bootstrapped standard errors in parentheses, *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$. Bootstrapped standard errors in parentheses, ** See Table 2 for the definition of all other variables.* p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

Table A4: Quantile regressions, year dummies specification cont'd

| | **Total current income $d+l$** | | | | **Firms market value $M$** | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (1) | (2) | (3) | (4) |
| | p25 | p50 | p75 | p90 | p25 | p50 | p75 | p90 |
| 1992×College | 21.91** | 29.74*** | 39.69 | -66.14 | 8.80 | 38.01 | -317.75 | -946.90** |
| | (9.39) | (10.25) | (28.48) | (118.11) | (16.82) | (67.84) | (296.12) | (372.15) |
| 1995×College | 1.65 | 13.74 | 46.21* | 3.80 | -1.66 | -6.84 | -254.92 | -504.45 |
| | (8.33) | (10.95) | (23.89) | (116.03) | (14.26) | (66.48) | (297.32) | (426.10) |
| 1998×College | 19.89** | 23.86** | 81.64** | 62.57 | 12.35 | 9.84 | -175.77 | -416.70 |
| | (9.32) | (10.57) | (34.49) | (119.34) | (15.25) | (69.01) | (307.54) | (932.59) |
| 2001×College | 29.41*** | 29.65*** | 47.62 | 76.61 | 23.25 | 12.82 | -159.82 | 623.72 |
| | (7.59) | (11.41) | (32.13) | (118.30) | (18.96) | (74.07) | (325.65) | (690.05) |
| 2004×College | 2.60 | 25.79** | 93.52*** | 71.29 | 21.93 | 130.97* | -26.19 | 1,607.71** |
| | (9.36) | (10.50) | (26.19) | (125.47) | (24.15) | (75.96) | (347.83) | (728.45) |
| 2007×College | -2.62 | 21.91* | 44.52* | -28.17 | 7.01 | 32.54 | -239.19 | 550.41 |
| | (8.32) | (12.14) | (25.81) | (116.49) | (14.17) | (78.38) | (300.19) | (1,564.84) |
| 2010×College | 2.77 | 10.43 | 20.90 | -43.16 | 6.56 | -11.17 | -264.14 | 365.59 |
| | (6.68) | (9.37) | (23.16) | (109.39) | (13.16) | (66.85) | (289.84) | (970.27) |
| 2013×College | 6.29 | 14.88 | 96.21** | 85.76 | 16.78 | 154.47 | 297.66 | 1,282.99 |
| | (6.92) | (9.81) | (37.35) | (133.69) | (16.02) | (94.51) | (450.39) | (1,233.05) |
| 1992×Postgrad | 21.83 | 35.41 | 27.18 | 64.83 | 9.46 | 6.79 | 151.93 | -145.08 |
| | (18.31) | (28.65) | (41.92) | (70.20) | (21.11) | (66.51) | (119.72) | (526.49) |
| 1995×Postgrad | 18.02 | 26.83 | 12.72 | 164.48* | -4.63 | -73.94 | 273.54** | 286.08 |
| | (20.14) | (24.41) | (40.87) | (95.51) | (17.39) | (60.44) | (132.72) | (533.59) |
| 1998×Postgrad | 17.30 | 73.21** | 88.86** | 195.48** | 28.57 | 33.92 | 350.17** | 1,428.29 |
| | (26.91) | (33.48) | (40.22) | (76.03) | (19.15) | (74.91) | (175.08) | (900.58) |
| 2001×Postgrad | 15.14 | 66.87** | 73.35 | 229.94** | 37.25 | 30.02 | 523.08*** | 1,395.93** |
| | (19.26) | (29.69) | (52.68) | (91.69) | (25.06) | (67.08) | (150.56) | (587.91) |
| 2004×Postgrad | 8.32 | 65.62** | 54.25 | 173.08 | 5.96 | 64.36 | 468.13*** | 2,805.25*** |
| | (21.70) | (27.55) | (36.09) | (115.10) | (23.20) | (88.87) | (164.33) | (1,034.29) |
| 2007×Postgrad | 23.76 | 82.83*** | 145.55** | 377.17*** | 53.79** | 33.65 | 666.64*** | 2,746.35** |
| | (19.91) | (30.48) | (67.84) | (79.87) | (27.17) | (86.98) | (187.38) | (1,175.90) |
| 2010×Postgrad | -4.91 | 64.71** | 91.72* | 267.76*** | 13.00 | 79.72 | 580.89*** | 1,062.97 |
| | (17.92) | (30.87) | (51.73) | (94.55) | (21.53) | (90.44) | (196.52) | (812.54) |
| 2013×Postgrad | -1.10 | 56.11* | 92.27** | 241.00** | 20.37 | 58.98 | 753.67*** | 2,124.83*** |
| | (18.00) | (30.19) | (39.04) | (108.25) | (18.17) | (73.54) | (227.25) | (626.13) |

**Notes:** All values are in thousands of dollars at 2010 constant prices. GCG denotes gross capital gains equal to $\lambda(M-k)$, NCG denotes net capital gains equal to $\lambda(M-k)-\rho k$. All regressions include entrepreneur's characteristics (gender, race and marital status dummies and a quadratic polynomial in age), year dummies and a constant. Bootstrapped standard errors in parentheses, *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

Table A5: Quantile regressions, year dummies specification cont'd

| | **Initial investment $k$** | | | | **Gross Capital gains, GCG** | | | | **Net Capital gains, NCG** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (1) | (2) | (3) | (4) | (1) | (2) | (3) | (4) |
| | p25 | p50 | p75 | p90 | p25 | p50 | p75 | p90 | p25 | p50 | p75 | p90 |
| 1992×College | 2.15 | 12.91 | 78.38 | -20.86 | -0.09 | 0.92 | -29.46 | -86.61** | -0.99 | -0.51 | -21.97 | -86.31** |
| | (4.05) | (11.15) | (112.80) | (306.37) | (0.67) | (4.03) | (44.01) | (41.37) | (5.09) | (2.93) | (40.52) | (40.88) |
| 1995×College | -2.22 | 12.52 | 117.87 | 122.00 | 0.04 | -2.54 | -29.73 | -54.41 | -3.58 | -2.28 | -25.68 | -67.42 |
| | (4.62) | (10.75) | (109.45) | (270.90) | (0.63) | (3.58) | (43.68) | (51.16) | (5.16) | (3.33) | (40.28) | (54.50) |
| 1998×College | 3.10 | 24.49 | 137.12 | 213.16 | 0.39 | -2.00 | -41.09 | -68.32 | -7.43 | -2.51 | -41.04 | -95.37** |
| | (4.39) | (18.38) | (115.28) | (344.56) | (0.64) | (3.47) | (44.42) | (52.66) | (7.94) | (3.09) | (39.59) | (45.63) |
| 2001×College | 1.37 | 21.02 | 94.54 | 143.44 | -0.00 | -0.41 | -24.83 | -24.01 | -2.41 | -0.21 | -15.38 | -38.94 |
| | (6.20) | (17.39) | (116.29) | (331.75) | (0.73) | (3.53) | (42.53) | (59.75) | (5.53) | (3.12) | (38.32) | (59.27) |
| 2004×College | 6.44 | 51.16*** | 248.16* | 410.35 | -0.33 | -0.78 | -24.14 | 21.95 | -6.84 | -3.12 | -18.24 | -13.09 |
| | (5.67) | (17.99) | (135.00) | (321.77) | (0.89) | (3.89) | (44.11) | (59.98) | (6.04) | (3.59) | (42.15) | (69.10) |
| 2007×College | 1.86 | 18.48 | 131.51 | 260.38 | 0.01 | -1.30 | -23.91 | 15.04 | -2.67 | -2.16 | -22.66 | -57.98 |
| | (4.51) | (11.65) | (112.51) | (293.91) | (0.70) | (4.24) | (41.36) | (96.02) | (4.93) | (3.22) | (39.49) | (95.49) |
| 2010×College | -0.60 | 12.69 | 87.03 | 244.93 | -0.03 | -1.82 | -39.29 | -68.79 | -3.20 | -2.46 | -33.74 | -63.77 |
| | (4.44) | (12.71) | (118.05) | (504.63) | (0.56) | (3.52) | (42.78) | (47.43) | (4.91) | (3.26) | (40.20) | (48.05) |
| 2013×College | 6.16 | 75.89*** | 526.91** | 1,819.54*** | 0.15 | -1.33 | -28.78 | -54.85 | -15.38 | -2.71 | -34.77 | -93.17* |
| | (5.02) | (28.53) | (215.36) | (477.34) | (0.60) | (3.41) | (43.41) | (52.45) | (11.34) | (3.09) | (39.72) | (48.12) |
| 1992×Postgrad | 1.33 | -27.90 | -31.36 | 29.38 | 0.53 | 2.19 | 5.01 | -9.97 | 17.51 | 0.30 | 7.39 | -11.09 |
| | (5.04) | (43.16) | (119.39) | (547.41) | (2.68) | (2.68) | (9.14) | (39.07) | (12.14) | (1.94) | (10.13) | (31.67) |
| 1995×Postgrad | 1.66 | -7.81 | 95.26 | 377.54 | -1.30 | -0.15 | 2.28 | 11.44 | 5.30 | -0.79 | -2.19 | 4.13 |
| | (5.98) | (46.73) | (144.49) | (590.86) | (2.81) | (2.04) | (8.45) | (45.51) | (12.24) | (2.41) | (9.16) | (35.01) |
| 1998×Postgrad | 2.25 | -7.89 | 64.70 | 346.56 | 1.18 | 3.31 | 9.51 | 71.09 | 14.83 | 0.55 | 2.22 | 35.36 |
| | (6.07) | (43.81) | (127.92) | (585.73) | (2.74) | (3.29) | (12.35) | (59.04) | (13.54) | (2.02) | (14.09) | (38.40) |
| 2001×Postgrad | -1.15 | -12.76 | 83.61 | 791.26 | 0.70 | 5.10* | 17.49* | 50.53 | 17.42 | 3.27 | 15.28 | 47.38 |
| | (5.53) | (45.07) | (128.08) | (560.11) | (2.87) | (3.04) | (10.48) | (49.84) | (12.66) | (2.51) | (11.83) | (39.03) |
| 2004×Postgrad | 7.76 | 4.11 | 317.43** | 818.15 | 0.11 | 0.05 | 4.60 | 45.46 | 13.62 | -1.82 | 1.56 | 25.58 |
| | (8.48) | (55.14) | (151.43) | (810.41) | (2.91) | (2.29) | (9.26) | (57.61) | (13.45) | (2.02) | (12.05) | (43.32) |
| 2007×Postgrad | 1.74 | -11.57 | 119.62 | 724.23 | 0.48 | 4.14 | 15.04 | 106.29 | 15.26 | 1.15 | 3.34 | 45.24 |
| | (5.30) | (45.61) | (145.52) | (630.61) | (2.77) | (2.69) | (12.93) | (68.27) | (12.17) | (2.38) | (13.35) | (64.39) |
| 2010×Postgrad | 0.97 | 32.93 | 305.26** | 711.90 | 0.05 | 1.19 | 7.86 | 9.47 | 12.66 | -0.10 | 4.76 | 10.30 |
| | (6.19) | (48.35) | (152.71) | (652.68) | (2.82) | (2.10) | (11.03) | (44.32) | (12.37) | (1.90) | (10.57) | (32.73) |
| 2013×Postgrad | 3.53 | 11.54 | 104.35 | 671.74 | 0.58 | 2.55 | 26.47* | 90.46** | 16.09 | 0.73 | 11.77 | 80.72** |
| | (5.31) | (43.15) | (144.55) | (626.00) | (2.72) | (2.10) | (14.48) | (41.24) | (12.14) | (1.91) | (12.79) | (33.48) |

**Notes:** All values are in thousands of dollars at 2010 constant prices. GCG denotes gross capital gains equal to $\lambda(M-k)$, NCG denotes net capital gains equal to $\lambda(M-k)-\rho k$. All regressions include entrepreneur's characteristics (gender, race and marital status dummies and a quadratic polynomial in age), year dummies and a constant. Bootstrapped standard errors in parentheses, *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.

Table A6: Sectoral specialization, year dummies specification

| | (1) $\theta$ | (2) $\phi$ | (3) $d+l$ | (4) $M$ | (5) $k$ | (6) GCG | (7) NCG |
|---|---|---|---|---|---|---|---|
| College | -5.5 | -30.2 | 27.2 | 597.6** | 588.0** | 6.1 | -32.6 |
| | (52.3) | (52.3) | (22.3) | (244.6) | (294.3) | (28.2) | (45.9) |
| Postgraduates | 46.1 | 10.8 | 61.5*** | 293.6 | 262.0 | 7.7 | -15.4 |
| | (40.0) | (39.2) | (23.1) | (250.3) | (193.5) | (21.7) | (31.3) |
| 1992×College | 51.8 | 56.8 | 14.4 | -501.9* | -535.4* | 2.4 | 37.4 |
| | (54.6) | (54.8) | (26.0) | (259.3) | (304.6) | (29.1) | (47.3) |
| 1995×College | 95.9 | 99.3 | 20.2 | -325.2 | -616.2* | 34.9 | 75.7 |
| | (60.6) | (60.7) | (28.5) | (303.9) | (320.8) | (32.9) | (50.2) |
| 1998×College | 73.2 | 82.9 | 48.2* | -324.4 | -492.9 | 0.2 | 25.1 |
| | (58.7) | (58.7) | (27.8) | (328.6) | (301.9) | (33.9) | (49.8) |
| 2001×College | 88.8 | 90.0 | 40.6 | 27.7 | -363.2 | 31.2 | 48.2 |
| | (55.5) | (55.5) | (27.0) | (299.1) | (309.6) | (30.2) | (47.7) |
| 2004×College | 126.0** | 128.6** | 55.9** | 512.6* | -228.6 | 53.5* | 70.0 |
| | (56.7) | (56.8) | (26.6) | (301.5) | (341.5) | (30.0) | (50.1) |
| 2007×College | 74.1 | 67.1 | 16.9 | 267.5 | -178.6 | 41.1 | 57.2 |
| | (62.3) | (62.5) | (26.7) | (359.0) | (316.1) | (36.9) | (52.8) |
| 2010×College | 75.3 | 69.5 | -3.8 | -90.7 | -591.9 | 33.8 | 79.0 |
| | (62.3) | (62.2) | (25.0) | (288.3) | (368.1) | (32.8) | (53.1) |
| 2013×College | 50.3 | 47.9 | 41.8 | 466.9 | 177.2 | 20.1 | 8.5 |
| | (61.3) | (61.6) | (29.4) | (326.4) | (355.6) | (33.2) | (52.9) |
| 1992×Postgrad | 23.8 | 26.2 | 18.5 | -274.8 | -220.1 | -14.7 | 5.3 |
| | (47.7) | (47.0) | (30.3) | (283.3) | (247.9) | (24.6) | (36.5) |
| 1995×Postgrad | 55.6 | 44.0 | 50.2* | 241.9 | 13.9 | 14.9 | 5.4 |
| | (58.1) | (58.4) | (28.1) | (349.8) | (324.2) | (30.2) | (51.4) |
| 1998×Postgrad | 113.4** | 103.3** | 82.1*** | 309.1 | -165.8 | 26.1 | 31.3 |
| | (47.1) | (46.2) | (30.3) | (337.6) | (237.1) | (25.9) | (35.7) |
| 2001×Postgrad | 112.8** | 92.1* | 99.0** | 645.0* | 205.1 | 29.1 | 13.8 |
| | (54.6) | (53.7) | (39.1) | (335.5) | (224.1) | (26.7) | (35.9) |
| 2004×Postgrad | 152.4** | 121.7* | 131.6*** | 979.7*** | 400.3 | 36.6 | 20.9 |
| | (63.3) | (62.2) | (42.4) | (364.0) | (297.5) | (27.2) | (39.0) |
| 2007×Postgrad | 210.2*** | 175.4*** | 152.7*** | 1,100.0** | 86.1 | 53.5* | 57.6 |
| | (52.8) | (51.4) | (35.2) | (428.3) | (219.9) | (31.5) | (38.7) |
| 2010×Postgrad | 149.7*** | 103.7* | 113.8*** | 928.6*** | 316.5 | 31.9 | 35.9 |
| | (55.9) | (55.4) | (32.3) | (342.7) | (340.6) | (29.9) | (44.8) |
| 2013×Postgrad | 153.7*** | 123.7** | 122.7*** | 864.7** | 140.6 | 35.3 | 30.9 |
| | (51.1) | (50.3) | (36.5) | (343.5) | (281.4) | (23.2) | (36.1) |
| N. of Obs. | 7250 | 7250 | 7250 | 7250 | 7250 | 7250 | 7250 |

**Notes:** All values are in thousands of dollars at 2010 constant prices. GCG denotes gross capital gains equal to $\lambda(M-k)$, NCG denotes net capital gains equal to $\lambda(M-k)-\rho k$. All regressions include entrepreneur's characteristics (gender, race and marital status dummies and a quadratic polynomial in age), year dummies and a constant. Bootstrapped standard errors in parentheses, *** p-value $< 0.01$, ** p-value $< 0.05$, * p-value $< 0.1$.