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 experience, 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, which more than doubles when looking at the higher quantiles of the entrepreneurs' income distribution. In the late 80's, this difference was close to zero. The increase in the premium to postgraduate education is unlikely to be explained by selection or valuation issues related to business failure; by a pattern of sectoral specialization more favourable to postgraduate entrepreneurs; by their easier access to internal or external finance; by their newly created businesses embodying better technologies; or by compensating differentials—due to greater business risk or lower possibilities of recycling entrepreneurial skills into new ventures. All this suggests that the more advanced skills associated with higher education have become increasingly important for running successful businesses.

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1 Introduction

There is widespread evidence that the return to skill of workers (defined, for example, as the wage premium attributable to college or post-college education) has increased over the last decades in most industrialized countries. Prominent explanations for this trend are skill biased technological change and international trade. 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 for entrepreneurs is somewhat mixed. The boom in the number of successful high tech firms created by US entrepreneurs with a PhD degree suggests a potential increase in the return to education of entrepreneurs. But it is also true that some of the most successful recent US companies, such as Apple, Microsoft, Facebook, Twitter or Napster have been started up by Steve Jobs, Bill Gates, Mark Zuckerberg, Evan Williams, and Sean Parker, respectively. These entrepreneurs are all college drop-outs, which might indicate that successful entrepreneurs view formal education as increasingly costly, possibly because of its high opportunity cost in terms of time. But their case is all but exceptional. Past history contains plenty of examples of successful entrepreneurs who received little or no formal education: 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 their high school studies.

In this paper we use the Survey of Consumer Finances (SCF) to collect 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. 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 SCF, which consists of repeated cross-sectional surveys with information just on the date of start of the entrepreneurial venture, current income obtained by the entrepreneur (in the form of either labor income or dividend payments), the current market valuation of the business ran by the entrepreneur and the initial investment made by the entrepreneur to acquire or to start-up the business. We define the *excess* return from entrepreneurship as equal to the income that the entrepreneur obtains because of running the business in excess of the income that the entrepreneur 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.

We also discuss how our measure for the return from entrepreneurship can be used to address some possible inevitable biases due to the repeated cross-section nature of SCF. There could be 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-up new ventures, 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.

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 relative to college education has increased substantially more for entrepreneurs than for workers. On average, entrepreneurs with a post-graduate degree now 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. Now an entrepreneur with a postgraduate degree earns on average 100,000 dollars per year more than an entrepreneur with a college degree, which more than doubles when looking at the higher quantiles of the entrepreneurs' income distribution. In the late 80's, this difference was 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), and it increases substantially when looking at the higher deciles of the entrepreneurs income distribution. All this suggests that the more advanced skills associated with higher education have become increasingly important for the more recent generations of US entrepreneurs and that the experience of "Mark, Bill and Steve" has been the exception rather than the rule.

THEORIES AND HOW WE TEST THEM The increase in the premium to postgraduate education is unlikely to be explained by selection or valuation issues related to business failure; by a pattern of sectoral specialization more favourable to postgraduate entrepreneurs; by their easier access to internal or external finance; by their newly created businesses embodying better technologies; or by compensating differentials—due to greater business risk or lower possibilities of recycling entrepreneurial skills into new ventures. All this suggests that the more advanced skills associated with higher education have become increasingly important for running successful businesses.

Since many individuals face the choice between working as an employee and creating their own business, the return to skill of entrepreneurs and the return to skill of workers might should move together after controlling for compensating differentials. So the higher their outside option as an employee, the higher should be the return to skill of entrepreneurs, after controlling for entrepreneurial business risk. So the higher is the outside option as an employee, the higher is the return to skill of entrepreneurs. But when entreprenerial skills are scarce the skill premum for entrepreneurs and teh skill premium of workers coud depart. Our eveidence suggest that this might have been the case for entrepreneurs with postgraduate education.

We believe that our finding that the return to post graduate education has increased substantially more for entrepreneurs than for workers over the last twenty years is novel. We are aware of no existing evidence documenting the time evolution of the skill premium for entrepreneurs. This lack of evidence is partly explained by the measurement issues with the return to entrepreneurship, that we discuss in this paper. There is 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) uses 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.

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.

Several other studies have used SCF to study features of US entrepreneurs. For example Moskowitz and Vissing-Jorgensen (2002) and Kartashova (2014) estimate the return to private equity for entrepreneurs and compare it to the return from investing in public equity. De Nardi et al. (2007) establish a series of stylized facts on the role of liquidity constraints and personal wealth for business development. None of these papers has focused on the return to education for entrepreneurs and how this skill premium has evolved over time. Also the focus is different, we focus on income not thereturn to capital.

RELATE TO paper by Hall Hall and Woodward (2010)

Section 2 discuss our framework to measure the entrepreneurial excess return with data from SCF. Section 3 describes the data. 4 characterizes the evolution of the entrepreneurial excess return across educational groups. Section **??** contains a regression analysis. Section 7 concludes.

2 Measuring the return from entrepreneurship

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 invested somewhere else or consumed, while his human capital can be re-employed in the labor market. For the sake of comparison with conventional wage regressions, 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 the entrepreneur 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 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 firm in a period—which in theory can be negative if the entrepreneur injects capital into the business. Let l denote the labor income obtained by the entrepreneur in the business. The total income obtained by the entrepreneur in a period is then equal to $y \equiv d + l$. We start assuming 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 ρ 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 μ. 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 μ also represents the instantaneous probability that the entrepreneur exits the venture, which we denote by $\lambda = \mu$. The parameter λ characterizes the rate at which the entrepreneur can recycle his wealth and his human capital into some alternative uses. $1/\lambda$ measures the expected duration of the entrepreneurial venture. At any point in time, the entrepreneur has the opportunity to work in the labor market and obtains 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 $\rho > r$. This is the relevant discount rate given that the entrepreneur is more impatient than the market—so he will immediately consume cash flows rather than investing them in financial markets. 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:

$$\rho U = y + \mu \left(M + W - U \right) \tag{2}$$

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 wage regressions. The *excess return* from entrepreneurship for an entrepreneur who has invested k units of wealth in the business is denoted by ϕ and it is defined using the notion of Chisini mean (Chisini, 1929). Formally ϕ 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 ϕ in each period of his entrepreneurial venture. Since the entrepreneur exits the venture at Poissson arrival rate λ, we have that ϕ 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 (14) implies that

$$U = \frac{y + \lambda \left(M + W \right)}{\lambda + \rho}$$

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 θ 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 invest 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 λ, we have that τ 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 expected capital gain generated in each period of 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 ρ 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 θ in (6), after recognizing that our data from 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 here is 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 over the period in the form of either dividend payments hd or labor income hl; (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 λ, 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 (by educational group and/or income levels) we construct a measure of the mass of newly started entrepreneurial ventures at time t, which we denote by

m_t.[1] 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 λh is small enough. To use cross sectional data to infer λ, an observation pertaining to a given entrepreneur should be normalized by the mass of the cohort of new ventures started at the same time as the one of the given entrepreneur. We denote by

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

the mass of ventures of age a at time t, normalized by the size of the cohort of newly started entrepreneurial ventures. In the cross section for any t, we can weight each observation by the inverse of the size of the corresponding cohort of ventures and then calculate the average age of ventures. At any time t, this amounts to dividing the weight in SCF assigned to an entrepreneur with a periods in the venture by the mass of the cohort of new entrepreneurial ventures started at the same time when the entrepreneur started his own venture, as measured by m_{t-a}, which 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

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

where the first equality makes use of (9). This means that $1/E_n(a)$ measures the exit rate out of entrepreneurship.[2] This implies that the capital gains in (7) can be measured by

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

[1] This index is constructed separately for each educational group: we first use information from the Census on the total business creation rate in all years since 1976 and then multiply this index by the share of entrepreneurs with a given educational level among all entrepreneurs who have just started to operate (at age one, $a = 1$).

[2] In practice, we experimented with alternatives to (10) in order to calculate λh. These alternatives allow to test 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 λ using (10).

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 period $(t-a,t)$. Eventually, our baseline measure for the return from entrepreneurship θ is measured as equal to

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

where "~" refers to the fact that this is how we measure empirically θ in (13). Small discrepancies between $\widetilde{\theta}$ and θ can arise because of (12) and also because the discretization of the time line.

2.1.1 Valuation, composition, and recycling biases

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 θ in (13), which we call the *valuation bias.* This bias arises because entrepreneurs in 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 also 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.*

2.1.2 Valuation bias

Assume now that the business can fail with instantaneous probability δ. In that case the business has liquidation value L. A selling opportunity arises with independent instantaneous probability μ, as before. The overall exit rate from the entrepreneurial experience is now then equal to $\lambda \equiv \mu + \delta$. In this case the value to the entrepreneur of the business with initial investment k is equal to U that solves

$$\rho U = y + \lambda \left[\mathbb{E}_x(V) + W - U\right] \tag{14}$$

where

$$\mathbb{E}_x(V) = (1-\gamma)M + \gamma L = M - \gamma(M-L) \tag{15}$$

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

$$V = \begin{cases} M & \text{with probability } 1-\gamma \\ L & \text{with probability } \gamma \end{cases} \tag{16}$$

and

$$\gamma = \frac{\delta}{\lambda} < 1 \tag{17}$$

measures the probability of failing conditional on exiting the entrepreneurial experience. If the entrepreneur exits his entrepreneurial experience because the business fails, the entrepreneur recovers his human capital but the business yields wealth L to him. The market value of the business is now equal to

$$M = \frac{d}{r+\delta} \tag{18}$$

which takes into account that the business fails at instantaneous rate δ. The net value of becoming an entrepreneur is still given by S in (3). The excess return from entrepreneurship ϕ should still satisfy the condition (4), which yields a measure for the excess return from entrepreneurship equal to

$$\phi_v = \theta_v - w \tag{19}$$

where

$$\theta_v = d + l + \lambda\left[\mathbb{E}_x(V) - k\right] - \rho k \tag{20}$$

which is a measure for the total entrepreneurial return corrected for the fact that the entrepreneur can exit from his entrepreneurial experience because of a business failure before the entrepreneur is able to sell it. 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. We take this as a measure of the liquidation value of the business L. Since over a short period of size h (which here we normalize to one for convenience), businesses fail with probability δ, we can think that by averaging the responses on the value of the business in SCF we actually measure

$$\overline{V} = (1-\delta h)\,M + \delta h L = M - \delta h(M-L) = \mathbb{E}_x(V) + (\gamma - \delta h)(M-L) \tag{21}$$

rather than $\mathbb{E}_x(V)$ in (15). [DROP Notice that in the second equality in (21) we use the normalization $h = 1$.] $\overline{V}$ differs from $\mathbb{E}_x(V)$ because δh is generally different from γ in (**??**) by a factor $1/(h\lambda)$. For $h\lambda < 1$, we have that $\theta - \theta_v > 0$. This difference is what we call the *valuation bias* Θ, which is equal to

$$\Theta \equiv \theta - \theta_v = \lambda\left[\overline{V} - \mathbb{E}_x(V)\right] = \lambda(\gamma - \delta h)(M-L) = (1-\lambda h)\,\delta\,(M-L). \tag{22}$$

[DROP where again we used the convention tha the time line is discretized in time intervals small enough whose size is normalized to one.] This bias arises because the overall expected return from entrepreneurship is determined by the expected value of wealth obtained by the entrepreneur upon exit. This value is generally lower than the current average value of the business because the business can fail before the entrepreneur is able to sell it with a probability that is typically higher than the fraction of failed businesses in the sample. To measure θ_v we can construct a measure of δ and then use (20) to calculate θ_ν. After imputing a value for the market return r and one for the required return for the entrepreneur ρ, we can measure θ_v in (**??**) in the data from SCF as follows:

$$\widetilde{\theta}_v = d + l + \frac{\overline{V} - k}{E_n(a)} - \widetilde{\Theta} - \left[R(0,t)^{\frac{1}{t}} - 1\right] k, \tag{23}$$

where we again approximated the expected capital gains as in (12) and $E_n(a)$ is measured as in (10)—so that $1/E_n(a)$ is a measure of λ—while

$$\widetilde{\Theta} = \left[1 - \frac{1}{E_n(a)}\right] \delta\left(M - L\right) \tag{24}$$

measures the valuation bias in (22). Notice that we have used the convention that the time line is discretized in time intervals small enough whose size is normalized to one. We can measure δ by taking the ratio of the businesses in SCF that claim that their business has liquidation value over the total number of business. This allows us to measure $\delta h = \delta$. While the difference between M and L can be measured as the difference between the average market value of all businesses who claim that the business has some market value and the average liquidation value of all business that claim that the business as no market value. Some approximation error is due to (12) and to the discretization of the time line. This is how we later construct our measure for the return to entrepreneurship corrected for the valuation bias $\widetilde{\theta}_v$ in (23).

2.1.3 Composition bias

A second bias arises because the composition of entrepreneurs in the cross-sectional sample does not necessarily reflect the composition of businesses when entrepreneurs actually started their entrepreneurial experience. Assume for simplicity that there are n types of businesses that pay different level of dividends, d_i, have different market failure rates δ_i and different arrival rates of selling opportunities μ_i, $\forall i = 1....n$. The exit rate from entrepreneurship is denoted by $\lambda_i = \delta_i + \mu_i$. Just for expositional simplicity we normalize the liquidation of the business to zero, $L = 0$. As a result a business of type i also has a market value equal to

$$M_i = \frac{d_i}{r + \delta_i}, \tag{25}$$

which depends on its type i. Also assume that immediately after creating the business the entrepreneur discovers the type of his business, which is of type i with probability α_i, which satisfies $\sum_{i=1}^n \alpha_i = 1$. By following the same steps as in the previous section, we would then obtain that the expected total return from entrepreneurship in (6) is equal to

$$\theta^* = \sum_{i=1}^{N} \alpha_i \theta_i = \sum_{i=1}^{N} \alpha_i \left\{d_i + l_i + \lambda_i \left(M_i - k_i\right) - \rho k_i\right\} \tag{26}$$

In the second equality we used the fact that

$$\theta_i = d_i + l_i + \lambda_i (M_i - k_i) - \rho k_i \tag{27}$$

is the type-i specific measure for the total entrepreneurial return, which is analogous to (6). The (expected) excess return from entrepreneurship is equal to

$$\phi^* = \theta^* - w \tag{28}$$

In practice we are interested in measuring θ^* in the data and in comparing θ^* with the value of θ in (13), that we would obtain by using cross-sectional data when there is heterogeneity in the type of entrepreneurs. The problem is that the unconditional ex-ante expected value of the variable

$$E(x) \equiv \sum_{i=1}^{n} x_i \alpha_i \tag{29}$$

are different from the cross-sectional average $\overline{x}$ for any $x = M,\ k,\ l, d$. 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 business–which corresponds to our normalization of observations by the size of the corresponding cohort of newly created businesses. In steady state, the mass of type i business in the cross section is then equal to

$$f_i = \frac{\alpha_i}{\lambda_i} \tag{30}$$

where $\lambda_i = \mu_i + \delta_i$ is the exit rate from entrepreneurship for entrepreneurs of type i. The overall mass of firms in the economy is simply equal to the sum of existing businesses of all types:

$$F = \sum_{i=1}^{n} f_i \tag{31}$$

In practice, the cross-sectional average of the variable $x = l, M, k$ would then be equal to

$$\overline{x} = \sum_{i=1}^{n} x_i \sigma_i, \tag{32}$$

where the cross sectional shares σ_i's are equal to

$$\sigma_i = \frac{\frac{\alpha_i}{\lambda_i}}{\sum_{j=1}^{n} \frac{\alpha_j}{\lambda_j}} \tag{33}$$

In general the cross-sectional shares σ_i's are different from the true shares in the population α_i's, because entrepreneurs with lower λ_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 (29) generally different from $\overline{x}$ in (32). In general firms with lower failures rate, δ_i and lower selling rate opportunities μ_i are over-represented in the cross section relative to the true share in the population. We can try to compare the magnitude of θ^* relative to θ (or θ_v). The comparison depends on whether the heterogeneity in the exit rate from entrepreneurship λ_i is driven by heterogeneity in failure rates δ_i's or by heterogeneity in the arrival rates of selling opportunities μ_i's. Let's start assuming that all heterogeneity in λ comes from heterogeneity in δ. We can think that failure rates are decreasing in d and thereby decreasing in the market value of the businesses M. If this is the case, entrepreneurs with high return are *over-represented* in the cross-section, which makes case cross-sectional averages larger than true expcted values In this case θ (or θ_v) would tend to overestimate the true overall return from entrepreneurship as measured by θ^* in (26), due to the composition bias. Consider now the case where all heterogeneity in λ comes from heterogeneity in μ. We can also think 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 μ is higher for entrepreneurs running these businesses. If this effect dominates, good businesses are *under-represented* in the cross-section. In this case cross-sectional averages tend to underestimate the true overall unbiased expected averages, which are the relevant inputs to calculate θ^* in (26). 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 δ or in the arrival rate of business selling opportunities μ. This is ultimately an empirical question, whose answer could be different at different points of the distribution of the total return from entrepreneurship.

Parametric control for the composition bias GO TO APPENDIX This bias arises because entrepreneurs who exit more slowly from their entrepreneurial experience are over-represented in the cross-section of existing entrepreneurs. To control for this composition bias we reweight cross sectional observations to penalize entrepreneurs who have spent more time into the business. This allow us to construct a measure for the expected value of current income $yh = dh + lh$, capital gains $M - k$ and initial investment in the business k, which are free of compositional bias. The idea is that the composition bias becomes present as firms age, so by penalizing older businesses we (at least partialy) attenuate the bias. Fo rthe ase of exposition, we discuss the two types of biases separately. These considerations allow to construct measures for the return to entrepreneurship which are free for both the valuation and the composition bias. We then discuss how we later implement these corrections when using data from SCF.

To control for the composition bias, we could re-weight observations to appropriately correct for the fact that cross-sectional shares σ_i's could be different from the true population shares α_i's. We now show how we can calculate a measure for the expected value of $x = M, k$, l, d, which is free of any compositional bias, at least under the parametric assumptions of our model. In practice we will weight each observation (already normalized by the size of entry effects into entrepreneurship) by the following function of the age a of the entrepreneurial experience

$$g(a) = \frac{1}{e \cdot (a-1)!}$$

where ! is the factorial operator. The function $g(a)$ has the property that for any $\widetilde{\lambda}_i = 1 -$

$\exp(-\lambda_i h)$, we have that

$$E_i\left[g(a)\right] \equiv \widetilde{\lambda}_i \cdot \sum_{a=1}^{\infty} \left[(1-\widetilde{\lambda}_i)^{a-1} \frac{1}{e \cdot (a-1)!}\right] = \widetilde{\lambda}_i e^{-\widetilde{\lambda}_i} \simeq \lambda_i h \tag{34}$$

where the first equality follows from the properties of the Poisson distribution with Poisson parameter $\lambda = 1 - \widetilde{\lambda}_i$—whose probabilities are given by $\frac{\lambda^k}{k!}e^{-\lambda}$, $k = 0, 1, 2, ...$—which obviously satisfies $\sum_{k=0}^{\infty} \frac{\lambda^k}{k!} \cdot \frac{1}{e} = e^{\lambda-1}$. The last approximation in (34) follows from taking a first order Taylor expansion of $\widetilde{\lambda}_i e^{-\widetilde{\lambda}_i}$ around $\lambda_i h$ equal to zero, which implies that

$$\widetilde{\lambda}_i e^{-\widetilde{\lambda}_i} \equiv \left(1 - e^{-\lambda_i h}\right) e^{-\left(1-e^{-\lambda_i h}\right)} \simeq \lambda_i h.$$

Notice that $E_i\left[g(a)\right]$ in (34) has the interpretation of the cross sectional mean of the function $g(a)$ conditional on the entrepreneurs of being all of type i whence entry rates into entrepreneurship are normalized to one–i.e. normalized by one over the size of the cohort effect into entrepreneurship. Now let $x = d, l, M, k$ denote the variable for which we want to calculate the expected value upon entry for entrepreneurs. To fix idea, assume that cross-sectionally there is a continuum of entrepreneurs indexed by j over the interval $[0, F]$, where F is the number of firms in the cross-section as given in (31). Let $a(j) \in \{1, 2, ...\}$ denote the discretized age of firm j and by x_j the value of the variable x of interest for entrepreneurs j. Then we calculate

$$x^* = \frac{\int_0^F x_j w_j dj}{\int_0^F w_j dj}, \quad \forall x = d, l, M, k. \tag{35}$$

where

$$w_j = \frac{g(a(j))}{m_{t-a(j)}} \tag{36}$$

Here $m_{t-a(j)}$ denotes the number of entrepreneurs that started their entrepreneurial experience when entrepreneur j started hers. The denominator in (35) is a measure of the total mass of entrepreneurs in the cross-section where each observation is normalized by the size of cohort effects into entrepreneurship and each observation is now also weighted by one over the duration of the entrepreneur in the business using the function $g(a)$. This means that overall, each observation is weighted by $w_j = \frac{g(a(j))}{m_{t-(a-j)}}$, as given in (36). The numerator in (35) is a cross sectional average of the variable $x = d, l, M, k$ using again the weights w_j, which generally sum to a constant different from one. We can show that up to a first order approximation we have that

$$x^* \simeq E(x)$$

To see this, start noticing that

$$\int_0^F w_j dj = \sum_{i=1} \left\{ E\left[g(a(j))\right| i\right] \frac{\alpha_i}{\lambda_i} \right\} \simeq h \tag{37}$$

where $E\left[g(a(j))\right| i] = E_i\left[g(a)\right]$ denotes the expected value of $g(a)$ conditional on the entrepreneur being of type $i = 1, 2...N$, and $\frac{\alpha_i}{\lambda_i}$ is the mass of entrepreneurs of type i in the cross-section whence each observation is weighted by the inverse of the size of the cohort effect of the entry into entrepreneurship $1/m_{t-(a-j)}$. The first equality in (37) comes from conditioning on the type of the firm i. The last approximation in (37) uses (34) together with the fact that $\sum_i \alpha_i = 1$. By applying the same logic to the numerator of (35) we then obtain that

$$\int_0^F x_j w_j dj = \sum_{i=1} \left\{ E\left[x_j g(a(j))\right| i] \frac{\alpha_i}{\lambda_i} \right\} \simeq E(x)h, ... \tag{38}$$

where the approximation again uses (34) and $E(x)$ is the ex-ante value of x as defined in (29). Together with the fact that $\sum_i \alpha_i = 1$. By combining (37) with (38) we then obtain that x^* in (35) is approximately equal to $E(x)$:

$$x^* \simeq E(x)$$

This says that x^* in (35) approximates reasonably well the measure for the ex-ante expected value of the variable x. In this sense it is immune from any composition bias and it can be used to analyze the robustness of our results to the presence of composition effects in the measurement of the expected value of a variable $x = d, l, M, k$. In practice x^* is calculated by multiplying the weights in SCF by the weights w_j in (36). By doing this we penalize firms where the cohort of entrepreneurs are large and, given the size of the cohort, we penalize relatively old entrepreneurs, because we know that entrepreneurs with a low exit rate are overrepresented among this group of entrepreneur by a factor equal to the inverse of their exit rate out of entrepreneurship. Notice that this approach is robust to whether the heterogeneity that leads to the survival composition bias is in the sellling opportunity rate μ or in the failure rate δ.

2.1.4 Recycling bias

We now extend the model by allowing for the possibility that the entrepreneur can recycling his entrepreneurial skills and start-up another business. We assume that after exiting the current business, the entrepreneur can restart another business with probability $\nu \in [0, 1]$. All the other assumptions are as in the baseline framework of Section 2.1. The value to the entrepreneur of the business with initial investment k is still denoted by U, which now evolves as follows:

$$\rho U = y + \lambda \left[\mathbb{E}_x (V) + \nu S + W - U\right] \tag{39}$$

where $\mathbb{E}_x (V)$ is still given by (15) and W by (1), while νS incorporates the fact that upon exit, with probability ν, the entrepreneur can recycle his entrepreneurial skills and start-up another business of which has 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 flow value by imposing the condition

$$\frac{\phi_r}{\rho + \lambda} = S, \tag{40}$$

which equates the hypothetical present value of wealth obtained under the constant per period income ϕ_r to the excess expected wealth actually obtained by the entrepreneur by running the current firm, which corresponds to the right-hand side of the expression. After using the definition of S in (3) and after noticing that (14), we obtain that (39) implies that

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

which can be used in (40) to solve for ϕ_r as follows:

$$\phi_r = \varphi(\nu)\left(\theta - w\right) = \varphi(\nu)\phi \tag{41}$$

where

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

takes now into account that entrepreneurial skills can be recycled while the entrepreneurial return, while

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

exactly as in (6), which explain the last equality in (41). Changes in the recycling possibilities of entrepreneurial skills $\varphi(\nu)$ due to changes in ν can then explain why the return to entrepreneurial skills have evolved differently over time for different skill group of workers. It is not clear what we want to do with (41). Probably we should have it as a extension, to explain the time trend in the unexplained component of ϕ. For example ϕ can fall if $\varphi(\nu)$, increases because any free entry condition in an entrepreneurial career should imply that ϕ_r is what matter for the return to entrepreneurship. This would be a candidate to explain the trend in the unexplained component of the excess return from entrepreneurship.

3 Data

We use the data from of the Survey of Consumer Finances (SCF) to explore how the return from entrepreneurship varies by educational groups and how it has evolved over time. SCF is a triennial cross-sectional survey on US households' characteristics conducted by the Federal Reserve Board of Governors. Over the period 1989-2013, data were collected for around 4,000 households per wave, with the exception of the last two surveys, where the number of observations was increased to around 6,000. Households in the sample are selected using a two-step stratification technique to ensure geographical representativeness and wealthy households are over-sampled to better characterize the right tail of the income and wealth distribution of US households where entrepreneurs are more likely to be present. The survey contains sample weights that allow to replicate the population of US households and we use such weights throughout all our analysis.[3]

[3]To account for measurement error and missing observations SCF reports 5 replicates for each record. Missing or inconsistent data are imputed via a an iterative procedure (see Kennickell (1998) for details). Data are available in the following two formats: the Public Full Dataset, that contains the answers to the whole questionnaire (over

The unit of observation is the household. In households comprised by a couple, the head of the household is either the male in a mixed-sex couple or the older individual in the case of a same-sex couple. The demographics that we use in the analysis are referred to the head of the household. Following De Nardi et al. (2007), we classify a household as *entrepreneur* if the head of the household declares being **self-employed as a primary job**, **owning or sharing ownership in any privately-held businesses** which is **actively managed**. According to this criterion, around 7% of of the overall observations pertain to entrepreneurs (11.5% of those employed). The shares are stable over time.

The SCF collects detailed information on educational attainments. We classify individuals (either entrepreneurs or employees) in 4 groups depending on whether they have a post-graduate degree, a college degree, a high school or higher education but with no college degree, or they are high school dropouts.[4] Figure 1 characterizes the evolution of the educational composition of the population of entrepreneurs (panel a) and employees (panel b). Entrepreneurs are on average more educated than employees. In particular, the share of entrepreneurs with graduate education is approximately one quarter towards the end of the sample, twice as large as that of employees. The share of college graduates is similar in the two groups, around 30%, while that with less than college is higher among employees (50% vs. 40%). The shares are farily stable over time, with a slight increase in the proportion of college graduates and post graduates in both groups, and a corresponding decrease in highs school dropouts. Indeed, highs school dropouts fall below 10% both for entrepreneurs and employees. Given the small sample size, and that dropping out of high school tends to be related to difficult socio-economic conditions, we exclude high school dropouts from the rest of the analysis and focus on the other three educational categories. SCF has essentially the nature of a repeated cross-section. The return to entrepreneurship is measured as equal to

$$\theta = d + l + \lambda(V - k) - \rho k \tag{42}$$

where l is *Labour income* as defined above, d are *Dividend Payments*, V is our measure for the *Value of the business* while k is the *Value of the entrepreneurs' investment in the business* at constant 2010 prices. Finally ρ is a measure of the opportunity cost of capital over the relevant time period for the entrepreneur, which is calculated as follows:

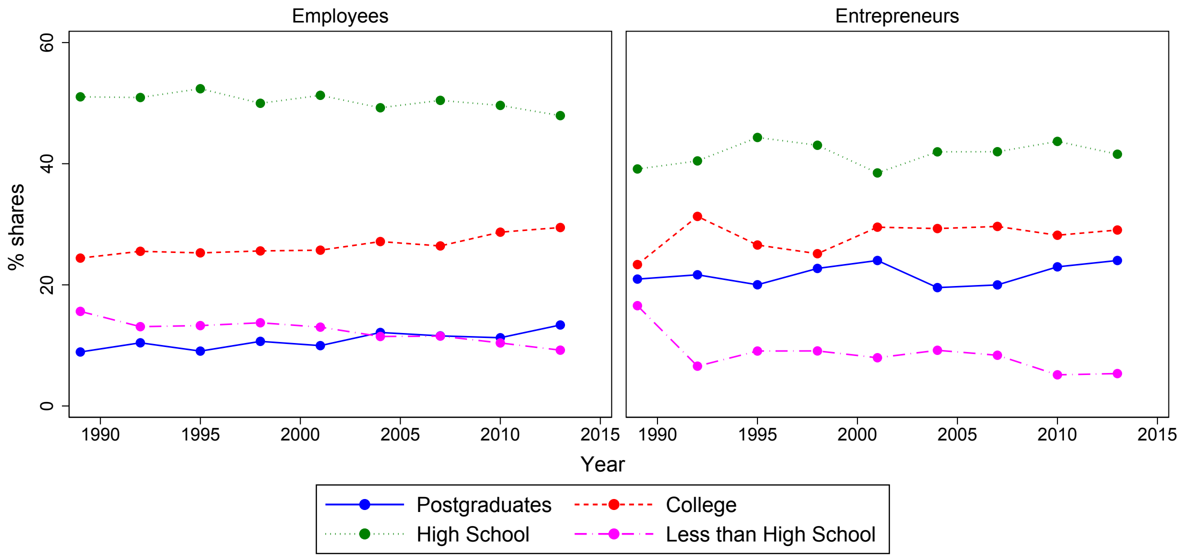
$$\rho = R(0, \tau)^{\frac{1}{\tau}} - 1$$

where zero is the date of creation of the business and τ is the current date while $R(0, \tau)$ is a measure of the total return obtained by investing in the US stock market over the period

5000 variables); and the Summary Extracts, that contains aggregates and synthetic variables computed by the Fed which are also used for official publications such as the Federal Reserve Bulletin. To compute statistics, we follow the SCF suggested procedure to calculate for each replicate the desired statistic using the sample weights (mnemonic X42001 in SCF) and then average across the five replicates.

[4] We classify as high school dropouts those who report less than 12 years of education; high school or more but no college those who report to have completed high school and, possibly, up to 3 years of college; college those who report either no more than 16 years of education and have a college degree or that the highest degree earned is a college degree or a bachelor's; graduate those who report a graduate degree.

Figure 1: Entrepreneurs and Employees: Shares by education



$(0, \tau)$, measured using the real (using CPI) value of the S&P500 Total Return Index taken from Bloomberg, which also includes income from dividend payments.[5]

Table 1 below reports descriptive statistics for the population of employees and entrepreneurs. On average, entrepreneurs are older than employees (49 vs. 42), more likely to be married, white and male. They have on average more than one year of schooling. Entrepreneurs and employee have similar labor income, but after including dividend payments and expected capita gains an average entrepreneur earns more than twice as much as an average employee. Income is also more disperse: the median (total) income is similar across the two groups while the ratio between the 90^{th} percentile and the median is 2.3 for employees and 6.4 for entrepreneurs. More than 10% of entrepreneurs have negative returns, and the returns at the 25^{th} percentile of the distribution are a modest 12,000$, half of the of employees. In terms of the decomposition of total entrepreneurial returns θ, it turns out that most of the income comes in the form of labor income and dividends, while the component related to capital gains is modest. The average value of the business is almost 900,000$ and the initial investment is 457,720$. The sectoral composition is similar for entrepreneurs and employees, with the exception of manufacturing, where the share of entrepreneurs is lower than that of employees, and construction, where the opposite occurs.

[5]In the SCF, respondents report details for up to three actively managed businesses until 2007, and then the aggregates for V and k for all remaining businesses. Since 2007, individuals reports separate information only for the first two businesses, aggregating the information for all the remaining businesses. For consistency, we compute the total V and k as the sum of the two main businesses and all the remaining businesses for all years. Given that for remaining businesses we have no information on the date of acquisition or startup, we use assume that it is the same as that of the second business and use the price deflator and the opportunity cost of capital applied to the second business. Results are robust to alternative choices, for example just focussing on the first business.

This reflects the different average size of firms in manufacturing and construction.

Table 1: Descriptive Statistics

Variable	Mean	sd	p10	p25	p50	p75	p90
Employees							
Age	41.91	12.68	26	32	41	51	59
Female	0.25	0.43	0	0	0	1	1
White	0.71	0.45	0	0	1	1	1
Married	0.61	0.49	0	0	1	1	1
Years of schooling	13.47	2.65	11	12	13	16	17
Labor income, l	52.61	95.37	14.40	24.35	40.46	62.16	93.24
Agriculture	0.02	0.14	0	0	0	0	0
Mining and Construction	0.09	0.28	0	0	0	0	0
Manufacturing	0.19	0.39	0	0	0	0	1
Trade	0.16	0.37	0	0	0	0	1
Finance and Services	0.12	0.32	0	0	0	0	1
Utilities	0.36	0.48	0	0	0	1	1
Public Administration	0.08	0.26	0	0	0	0	0
Entrepreneurs							
Age	49.02	12.61	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	14.72	1.98	12	12	16	17	17
Labor income, l	46.37	141.02	0.00	0.00	0.00	51.95	130.00
Dividends, d	73.17	429.25	0.00	0.00	11.23	53.51	153.94
Entrepreneurial Return, θ	125.57	811.67	-0.64	11.93	47.34	125.10	303.03
Value of business, M	898.86	5586.41	0.00	21.03	105.17	460.85	1535.42
Investment in business, k	457.72	5007.14	0.00	3.03	30.05	158.18	647.61
Expected gross capital gains, $\lambda(M-k)$	35.58	423.03	-4.35	-0.01	2.15	16.85	68.87
Expected net capital gains, $\lambda(M-k)-\rho k$	6.03	619.49	-27.61	-3.26	0.24	10.65	50.79
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., Communication and Utilities	0.36	0.48	0	0	0	1	1

Note: Based on the pooled SCF data.

Table 2 reports descriptive statistics for entreprenurs only, distinguishing by educational level. Total returns increase sharply with education. The value of the business also increases, but only marginal when comparing college vs. graduates. Entrepreneurs without a college degree are also more likely to run an unlimited liability company and to operate in construction or trade, while graduates are over-represented in Transportation, Communication and Utilities.

Table 2: Entrepreneurs characteristics by educational level

	High school graduates		College graduates		Postgraduates	
Variable	mean	sd	mean	sd	mean	sd
θ	62.24	532.00	138.94	916.64	229.16	1059.82
d	35.84	264.38	71.61	453.27	146.45	605.93
l	26.20	59.13	50.32	146.41	79.77	217.40
M	532.48	3603.50	1149.18	6324.73	1274.85	7359.26
k	301.90	3349.39	551.25	6017.42	634.33	6086.35
$\lambda(M-k)$	19.36	317.67	52.54	488.33	44.63	500.13
$\lambda(M-k)-\rho k$	0.21	445.16	17.01	727.53	2.95	741.56
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
Transportation, Communications and Utilities	0.21	0.41	0.31	0.46	0.71	0.46

Note: Based on the pooled SCF data.

4 Empirical results

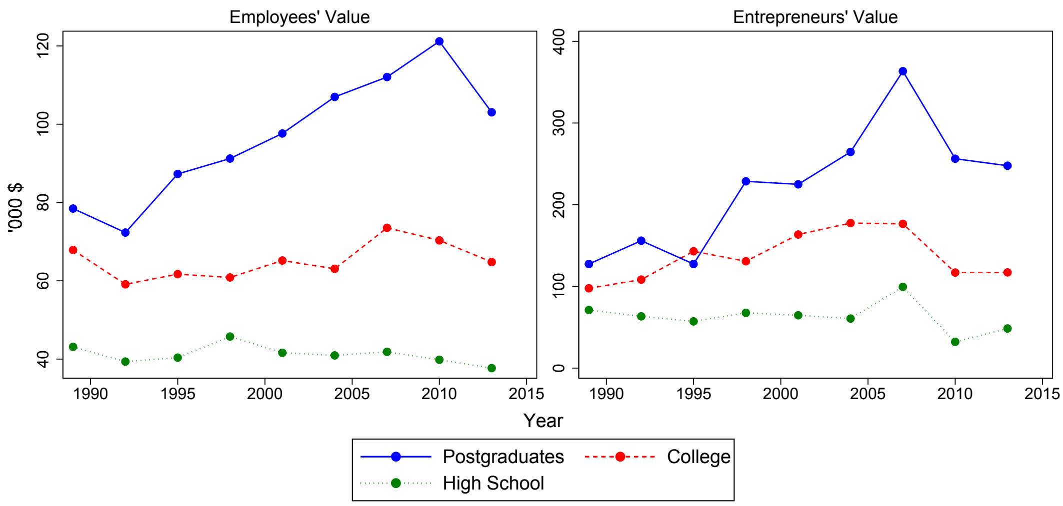
We start describing how the return from entrepreneurship has evolved over time for different educational groups. Then we perform some regression analysis, to better understand the determinants of the differences.

4.1 Entrepreneurs' and employee income over time

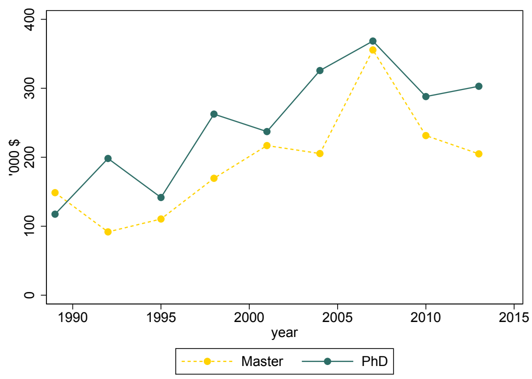
Panel (a) of Figure 2 characterizes the evolution of the return from entrepreneurship for the three educational groups. The return from entrepreneurship has remained stable for entrepreneurs with a high school degree. Until the mid 90's the return from entrepreneurship was similar for entrepreneurs with a college degree and for entrepreneurs with a post-graduate degree. Today an entrepreneur with a postgraduate degree earns on average 100,000 dollars more than an entrepreneur with just a college degree: higher education pays out in entrepreneurship. In panel (b) we further decompose graduates into those holding an MA, a MS and an MBA on one side and a Ph.D., an MD, a law or JD on the other (this is the finest division in the public version of the SCF). In turns out that on average Ph.D.'s earn more, but the time profile of the two is fairly similar, implying that MA/MBA's and Ph.D's. have witnessed a similar increase in returns compared to college graduates.

One important question is if the increase in the returns to education in entrepreneurship is specific to this occupation or if it rather reflects a more general increase in the returns to

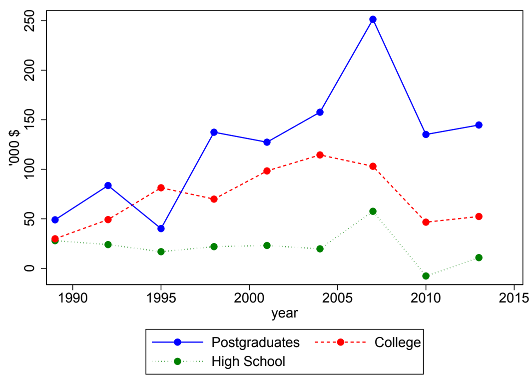
Figure 2: Entrepreneurs and Employees: Education premium (CPI deflated 2010 prices, weighted)



(a) Employees Value, w vs Entrepreneurs Value, θ



(b) θ, Masters vs. PhD.



(c) Excess Return Value: $\phi = \theta - w$

education documented in the literature. Panel (c) considers employees. The labor income of high school graduates has remained fairly stable over time, slightly decreasing towards the end of the sample period. The labor income of employees with a college degree has increased only slightly, from around 60,000 to 70,000\$, while that of post-graduates has gone up more markedly, from 80,000 to above 100,000\$. Qualitatively, therefore, the patters from entrepreneurs and employees are the same. However, the increased for entrepreneurs with higher education has been much more consistent. In panel (d) we plot the difference between the returns of entrepreneurs and employees. The "excess" returns to higher education in entrepreneurship - defined as the returns in entrepreneurship net of the returns in paid employment- is clear. Excess returns have been stable for individuals with a high school degree, turning negative in 2010. They have increased for both college and post-graduates, but much more markeadky for the latter, The excess return from entrepreneurship has almost quadrupled for entrepreneurs with a post-graduate degree while the excess return for entrepreneurs with a college degree has "just" doubled. Excess returns have decreased during the big recession, indicating that entrepreneurs have suffered more than employees. Even so, for postgraduates excess returns where almost three times as large as those at the beginning of the sample period even during the crisis.

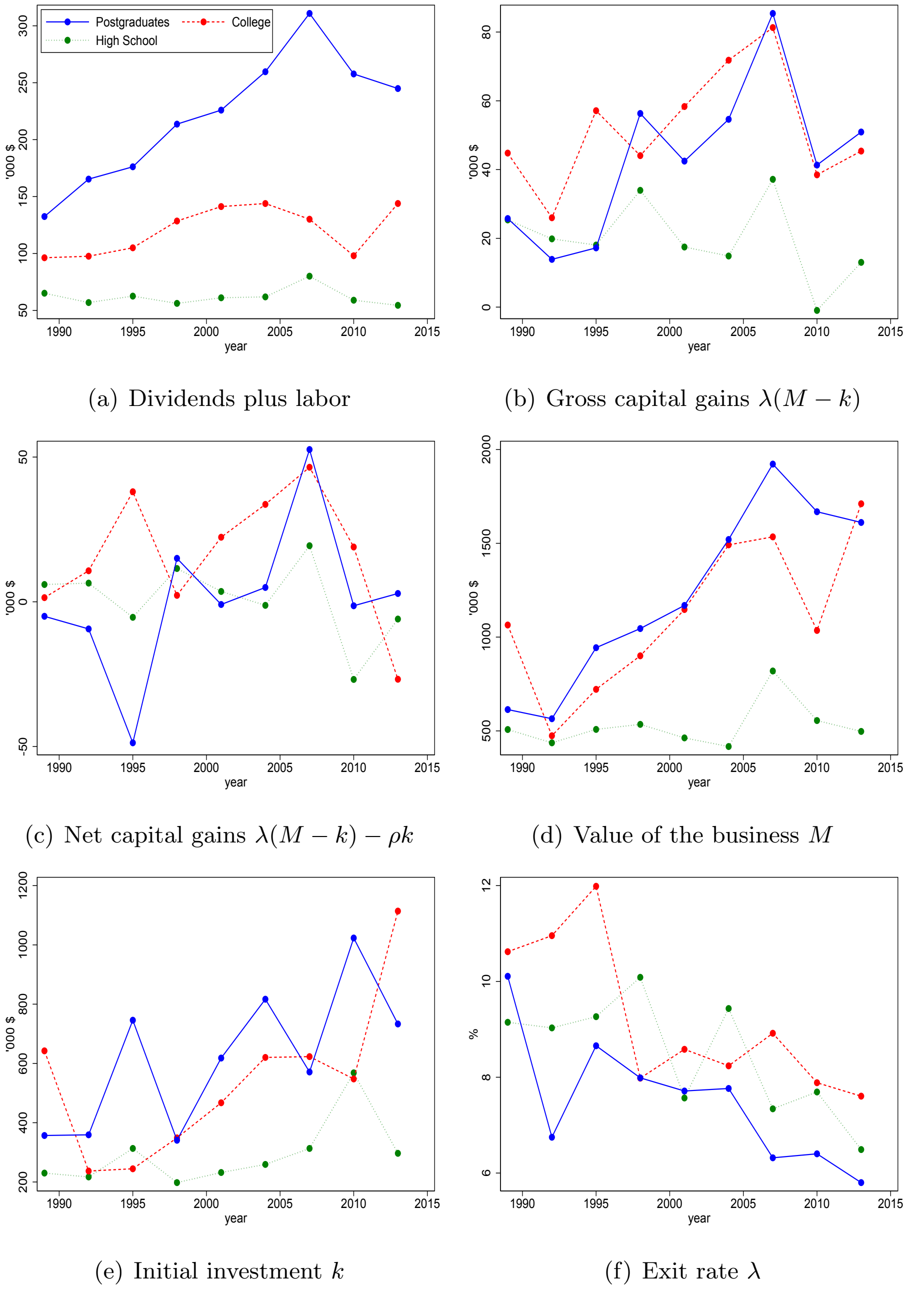
Figure 3 plots various components of the return from entrepreneurship θ. Panel (a) reports labor income plus dividends, that is, the flow returns from entrepreneurship. It follows a profile very similar to total returns, both in terms of magnitude and of trend for all educational groups. This suggests that flow returns, as opposed to capital gains, constitute the major source of entrepreneurial income. Gross capital gains ($\frac{V-k}{\tau}$ have increased for college and postgraduates, but their value never exceeds 100,000$ (pabel b). Moreover, once we subtract the opportunity cost of capital ρk and consider net capital gains, we onvtain values that are often close (or below) zero, with no clear time series pattern. This indicates that capital gains are less important than the income flows that accrues to entrepreneurs as both labor compensation and dividends to explain total returns: the experience of entrepreneurs becoming rich with an IPO is rather the exception than the norm. Note that the average value of the businesses is substantial: it amounts to half a million dollars for high school graduates, with a stable time patters, while it goes from around that value in the beginning of the sample to more that 1.5 million dollars at the end for both college and postgraduates (panel d). So the amount of wealth that more educated entrepreneurs can cash in apon exit is substantial. The fact that net capital gains are small and do not increase can be explained by two factors. First, panel (e) shows that also the initial investment has been increasing for college and postgraduates. Second, exit rates have been declining over the period for all educational groups (panel f), which reduces the flow value of a given selling value upon exit.[6]

After the graphical analysis, we now move on to the regression framework, which allows to control for correlated effects and supplies standard errors to assess the statistical properties of the trends that we have plotted above. We regress returns to education and its various components on dummies for the educational groups, using high school graduates as the reference group. To capture changes in the skill premium, we interact the educational dummies with a post 2000 dummy, that is a dummy that is equal to 1 for the years after 2000. Returns are are in thousands dollars at 2010 constant prices. Given that a substantial share of entrepreneurs has negative returns, we run the regressions in levels rather than in logs.[7] We include the standard control for the wage equations: a quadratic in age, gender, a dummy for white, a dummy for married and year dummies. The regressions are corrected for the existence of multiple replicates for the same record using a routine supplied by the Philadelphia Fed. Due the the presence of imputed

[6]The reduction in exit rate, and the corresponding increase un the average firm age, is in line with the evidence that points to a reduction in dynamism of the US economy, as discussed, among others, by (**?**)

[7]This explains the very low values of the adjusted R^2, as the log transformation clearly smoothes out returns and reduces their variability.

Figure 3: Decomposition of θ over time



(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 λ

values we report bootstrapped standard errors based on 200 replications.

Table 3 reports the results for total returns and its components. Column 1 shows that, up to 2000, college grads and post grads earned on average 56,000 and 94,000$ more than high school grads. More interestingly, returns to education have increased substantially over time. Postgraduates earn an extra premium of around 112,000$ in the post 2000 years, while the value is much lower (26,000$) and not statistically different from zero for college graduates. These results confirm the graphical evidence seen above: returns to post grad education have increased substantially over time. The last line of the table reports the p-value for the test of the equality of coefficients of college $\times$ post and postgraduates $\times$ post: we reject the null very strongly. In terms of other controls, we find the the typical concave profile in age, female entrepreneurs earn almost 50,000$ less than men, whites 33,000$ more and married entrepreneurs 28,000$ more. In the next column we report the regression in which the dependent variable is the excess returns to entrepreneurship ϕ, that is, returns net of the corresponding value for employees. We find qualitatively similar results. In particular, the increase in the premium for postgraduates drops from 112,000 to 84,000$ but remains statistically significant at the 1% level. The null of equality of the increase for college and postgraduates is rejected at the 1% level.

In columns 3 to 7 we use as dependent variable the main components of the total returns. The increase in the premium for post graduate education is explained mostly by dividends plus labor income. In fact, the value of the business has increased substantially for both college grads and post grads in the post-2000 business (column 4), but so has the value of the initial investment (column 5), so that the capital gains are modest. In particular, once we subtract the opportunity cost of capital, the net capital gain is 15,000 for college grads, but not statistically significant, and 30,000 for post grads, significant at the 10% level. The contribution of capital gains is therefore positive and noneligible, but smaller than that of labor income plus dividends.

The previous analysis cold be criticized based on the fact that we arbitrarily chose 2000 as the dividing year. We therefore estimate two alternative specifications. In the first one, we interact the education dummy with a time trend, so that the coefficient is interpretable in terms of yearly growth of returns with respect to the excluded category (the no college grads). Results in Table 4 show that the yearly average increase in returns for post grads has been of 7,300$, while only 1,600$ for college grads (not statistically different from zero). Even with this specification the largest contribution comes from labor income plus dividends. This shows that the increase in returns to education is not attributable to the particular year used to define the post period. In a third specification we interact the educational dummies with the single year dummies. The results, reported in the appendix, are again fully in line with those of the more parsimonious specifications. In particular, the increase in returns for post grads is already statistically significant in 1998, suggesting that, if anything, our pre-post speciation underestimates the overall increase in returns.

4.2 Measurement biases

Address the valuation and composition biases.

4.2.1 Valuation bias

To address the valuation bias, we need a measure of failure. Unfortunately in SCF there is no direct way to identify failing businesses. We define a failing business as one that have both

Table 3: Trend in the Skill premium

	(1) θ	(2) ϕ	(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)
Postgraduates	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 $\times$ 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 $\times$ 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)
Obs.	7,250	7,250	7,250	7,250	7,250	7,250	7,250
H_0: College $\times$ Post = Postgrad $\times$ 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

Notes: Gross capital gains (GCG) are $\lambda(M-k)$, net capital gains (NCG) are $\lambda(M-k)-\rho k$. All regressions include year dummies. F-stat and P-value refer to the null hypothesis that College $\times$ Post = Postgrad $\times$ Post Bootstrapped standard errors in parentheses, *** p-value < 0.01, ** p-value < 0.05, * p-value < 0.1.

zero sales and zero employees, excluding from the calculations businesses that are less than two years old. Lack of revenue and employees is a clear signal that the business is not doing well. Figure , panel (a), reports the failure rates. **Togliamo?** The values implied by our definition are somehow on the low side.[8] There is some evidence of a declining trend, which is reverted during the crisis years. More importantly, this trend are common across occupational groups, which implies that the valuation bias is unlikely to explain the differences in returns documented above. In fact, panel (b) reports the bias-corrected total returns. They are extremely similar to the basic ones, confirming that the valuation bias is not likely to affect our calculations.

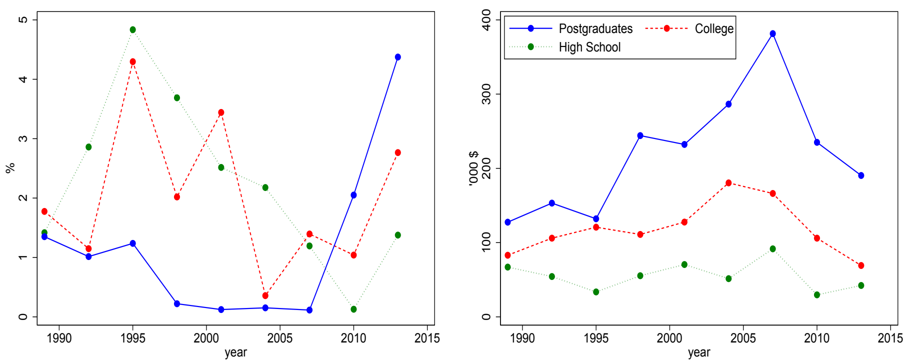
[8] We have experimented with alterantive definitions of failure, such as only imposing zero sales. We find qualitatively similar results, although returns become slightly more volatile.

Table 4: Trend in the Skill premium, alternative specification

	(1) θ	(2) ϕ	(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)
Postgraduates	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)
Obs.	7,250	7,250	7,250	7,250	7,250	7,250	7,250

Notes: Gross capital gains (GCG) are $\lambda(M-k)$, net capital gains (NCG) are $\lambda(M-k)-\rho k$. All regressions include year dummies. Bootstrapped standard errors in parentheses, *** p-value < 0.01, ** p-value < 0.05, * p-value < 0.1.

Figure 4: Assessing the valuation bias



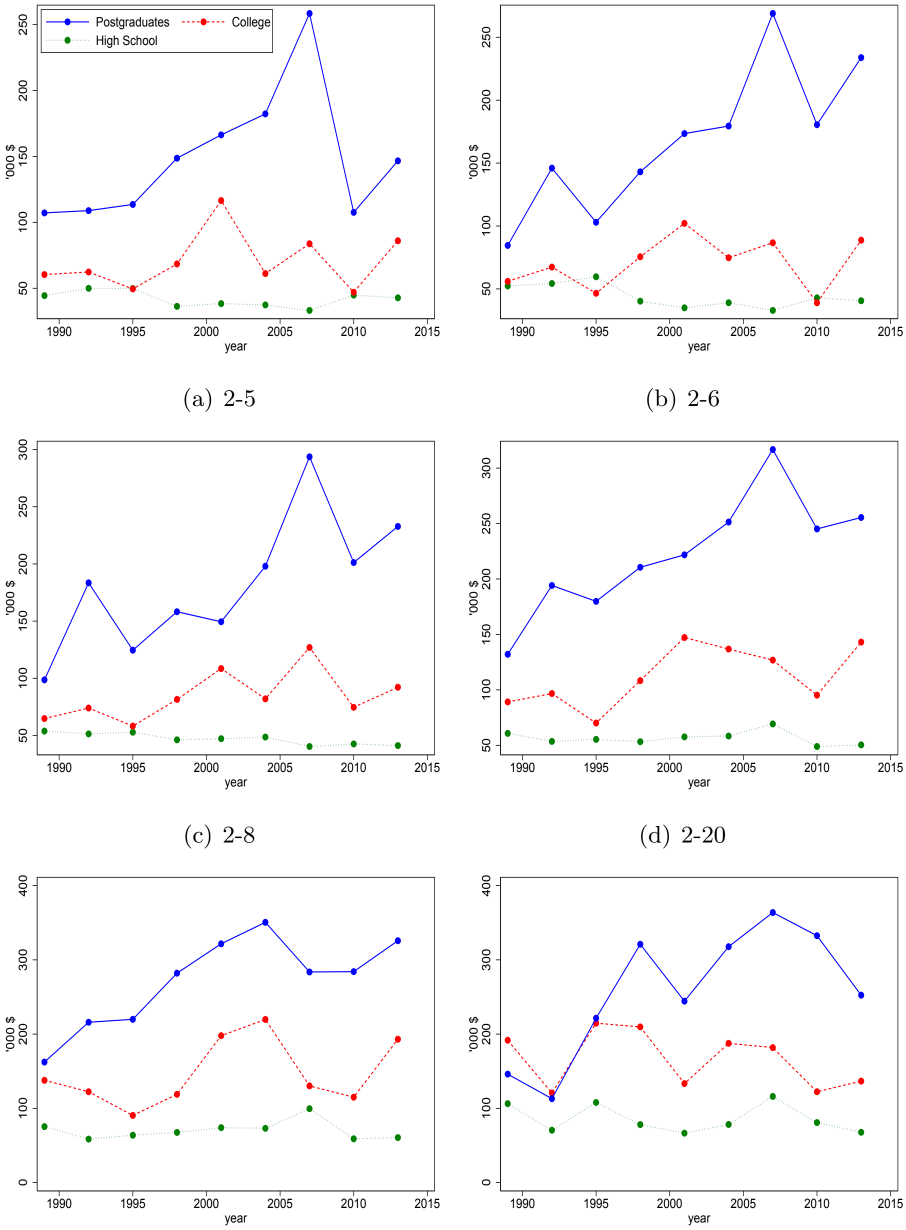
(a) Failure rates (b) Valuation bias-corrected returns

4.2.2 Composition bias

Another potential source of heterogeneity is the rate at which entrepreneurs exit their entrepreneurial experience. On one side, worse businesses are more likely to fail; on the other, it could also be that entrepreneurs running better businesses can sell their businesses more quickly. This heterogeneity in the rate at which entrepreneurs exit their entrepreneurial experience introduce a second type of bias that we call the *composition bias*. This bias arises because entrepreneurs who exit more slowly from their entrepreneurial experience are over-represented in the cross-section of existing entrepreneurs. In general firms with lower failures rate, δ_i and lower selling rate opportunities μ_i are over-represented in the cross section relative to the true share in the population. The bias depends on whether the heterogeneity in the exit rate from entrepreneurship λ_i is driven by heterogeneity in failure rates δ_i's or by heterogeneity in the arrival rates of selling opportunities μ_i's. Let's start assuming that all heterogeneity in λ comes from heterogeneity in δ. We can think that failure rates are decreasing in d and thereby decreasing in the market value of the businesses M. If this is the case, entrepreneurs with high return are *over-represented* in the cross-section, which makes case cross-sectional averages larger than true expected values. In this case θ (or θ_v) would tend to overestimate the true overall return from entrepreneurship as measured by θ^* in (26), due to the composition bias. Consider now the case where all heterogeneity in λ comes from heterogeneity in μ. We can also think 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 μ is higher for entrepreneurs running these businesses. This is in fact the case for the sample of vanture-backed entrepreneurs studied by Hall and Woodward (2010). If this effect dominates, good businesses are *under-represented* in the cross-section. In this case cross-sectional averages tend to underestimate the true overall unbiased expected averages. 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 δ or in the arrival rate of business selling opportunities μ. This is ultimately an empirical question, whose answer could be different at different points of the distribution of the total return from entrepreneurship.

To assess the relevance of this issue, we notice that the composition bias derives from the fact that older businesses are selected. On the contrary, the effect of selection should be smaller for younger businesses. An indirect assessment of the selection effect is therefore to check if the profiles for returns change when restricting the analysis to different age groups. Note that, once we allow λ to be age dependent, we cannot compute the total returns θ anymore. We therefore consider labor income plus dividends, that, as seen before, represents the main component of the increase in returns. In Figure 5 we report the paths for labor income plus dividends when we restrict the analysis to firms within a certain age bracket. We exclude firms with zero or 1 year, as they are less likely to be subject to failure or sales (results are similar when we include such firms). The patterns are qualitatively similar in all cases: returns for post grads have increased substantially more than for the other two educational groups. We conclude that selection is unlikely to explain our results.

Figure 5: Composition bias: dividends plus labor income for different age windows



(a) 2-5

(b) 2-6

(c) 2-8

(d) 2-20

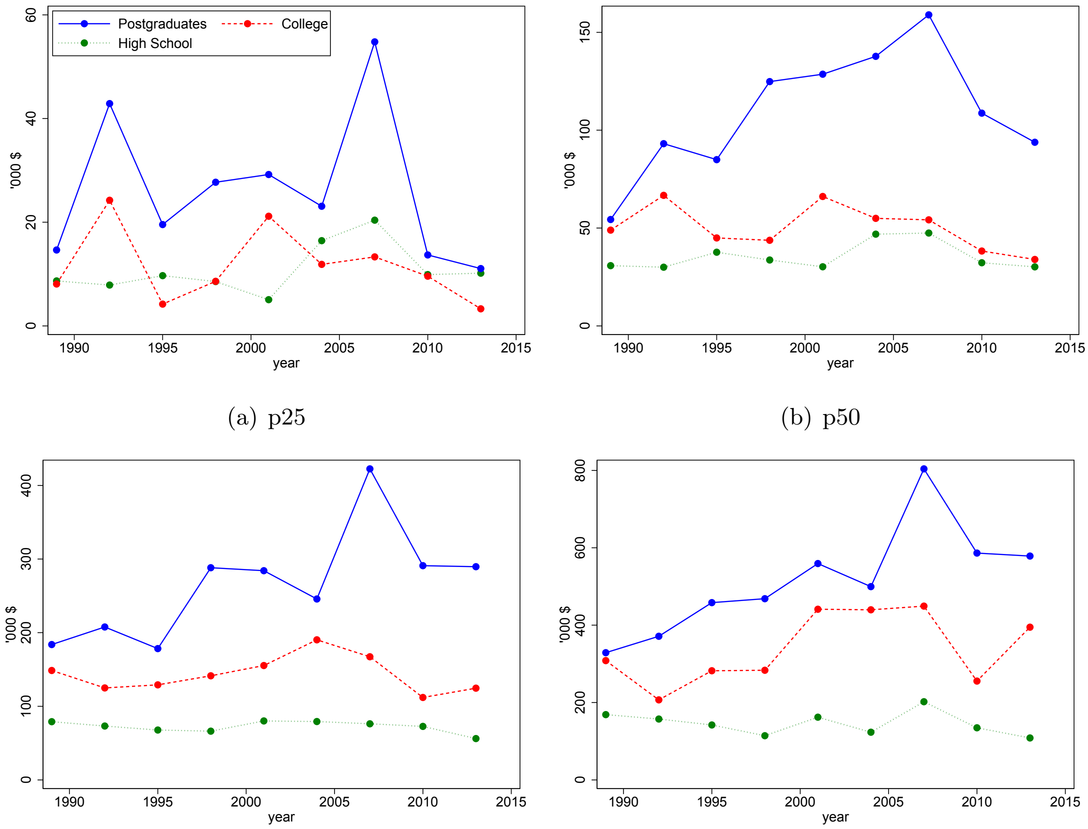
(e) 10-20

(f) 20+

5 Are the effects heterogeneous across the returns distribution?

We now study the evolution of returns at different percentiles of the returns distribution. We want to ascertain if the increase in returns to higher education was uniform across the returns level or if it was more concentrated in some parts of the distribution. Figure 6 reports total returns θ at the 25^{th}, 50^{th}, 75^{th} and 90^{th} percentiles. Returns at the lower percentiles are

Figure 6: Total returns θ at different percentiles of the return distribution



(a) p25

(b) p50

(c) p75

(d) p90

meager, with an average of about 20,000$, slightly higher for postgrads than for the other two occupational goups. Moreover, there is no evidence of an increase in returns at the 25^{th} percentiles for postgraduates. Indeed, after a sharp increase in 2007, returns for postgraduates drop substantially during the crisis, a period in which no difference emerges across the three educational groups: all unhappy entrepreneurs are unhappy the same way, independently from education. The increase in the premium for higher education however already emerges very clearly at the median, and it increases (in absolute value) for the higher percentiles. This suggests that the increase in average returns is attributable to a shift in the right part of the returns distribution, while the low performing entrepreneurs have not seen any increase in returns, for all educational levels.

The graphical evidence is confirmed by the regression analysis. In Table 5 we report the results of quantile regressions at the 25^{th}, 50^{th}, 75^{th} and 90^{th} percentile of the distribution of returns. To save on space, we only report the college*post and postgrad*post coefficients (full tables available upon request). No evidence of an increase in the education premium emerges in the lower part of the returns distribution: indeed, the coefficients for total returns for both College and Graduate in the post period are negative, although not statistically significant.

Interestingly, the excess return ϕ is negative. **ZZZ HERE WE SUBTRACT THE AVERAGE W, SHALL WE TAKE THE CORRESPONDING PCT INSTEAD?** None of the components of returns is statistically different from zero. The increase in the education premium already emerges for graduates at the median, equal to 32,000$ and almost entirely accounted for by labor income and dividends. The increase is higher at higher quantiles, and it reaches almost 200,000$ at the 90^{th} percentile. Interestingly, in this case also the capital gains contribute to almost a quarter of this value. The value of the business has increased by 1.7 million. For college graduates, the increase in returns is statistically significant only at the 90^{th} percentile, where it is equal to 183,000$.

Table 5: Quantile Regressions, Pre-post Specification

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	θ	ϕ	$d+l$	M	k	GCG	NCG
25^{th} pct							
College × Post	-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 × Post	-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 × Post	-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 × Post	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 × Post	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 × Post	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 × Post	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 × Post	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)

Notes: Bootstrapped standard errors in parentheses, *** p-value < 0.01, ** p-value < 0.05, * p-value $<$ 0.1. The table reports the coefficients of the quantile regressions estimated on the pooled SCF sample. All regressions are weighted. The specification includes individual characteristics of the entrepreneur, education dummies and year dummies.

Table 6 repeats the exercise with the time trend specification. Results are fully consistent with those of the pre-post specification: there is no increase at the 25^{th} percentile, while we detect differences in the evolution already at the median. The differences are larger for higher percentiles. We conclude that the increase in the education premium is not a general shift in the returns distribution. Rather, for postgraduates it emerges at the median and it increases as we move to the right of the distribution, while for college graduates it only shows up at the

Table 6: Quantile Regressions, Time trend specification

	(1) θ	(2) ϕ	(3) $d+l$	(4) M	(5) k	(6) GCG	(7) NCG
25^{th} pct							
Year × 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)
Year × 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							
Year × 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)
Year × 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							
Year × 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)
Year × 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							
Year × 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)
Year × 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)

Note: Bootstrapped standard errors in parentheses, *** p-value < 0.01, ** p-value < 0.05, * p-value < 0.1. The table reports the coefficients of the quantile regressions estimated on the pooled SCF sample. All regressions are weighted. The specification includes individual characteristics of the entrepreneur, education dummies and year dummies.

higher percentiles of the distribution.

6 What explains the increase in the education premium?

In this section we investigate different channels through which the education premium might have been increased. A first possibility relates to sectoral composition and sectoral returns.[9] Table 2 shows that different educational attainments[10] are related to different specialization patterns: over the sample period, high school graduates are over-represented in Construction, college graduates in Finance and postgraduates in Transport, Communication and Utilities (TCU).

[9] The SCF reports two types of information on sector of employment. The first is referred to the respondent's current main job (variable X7402) while the second is referred to each business reported by the respondent. The first classification has been recorded consistently across waves while the second has changed over the years. We use the first as our preferred measure and show the robustness of the results using the second in the appendix. For entrepreneurs with multiple firms, we use the sector of the one related to the main job.

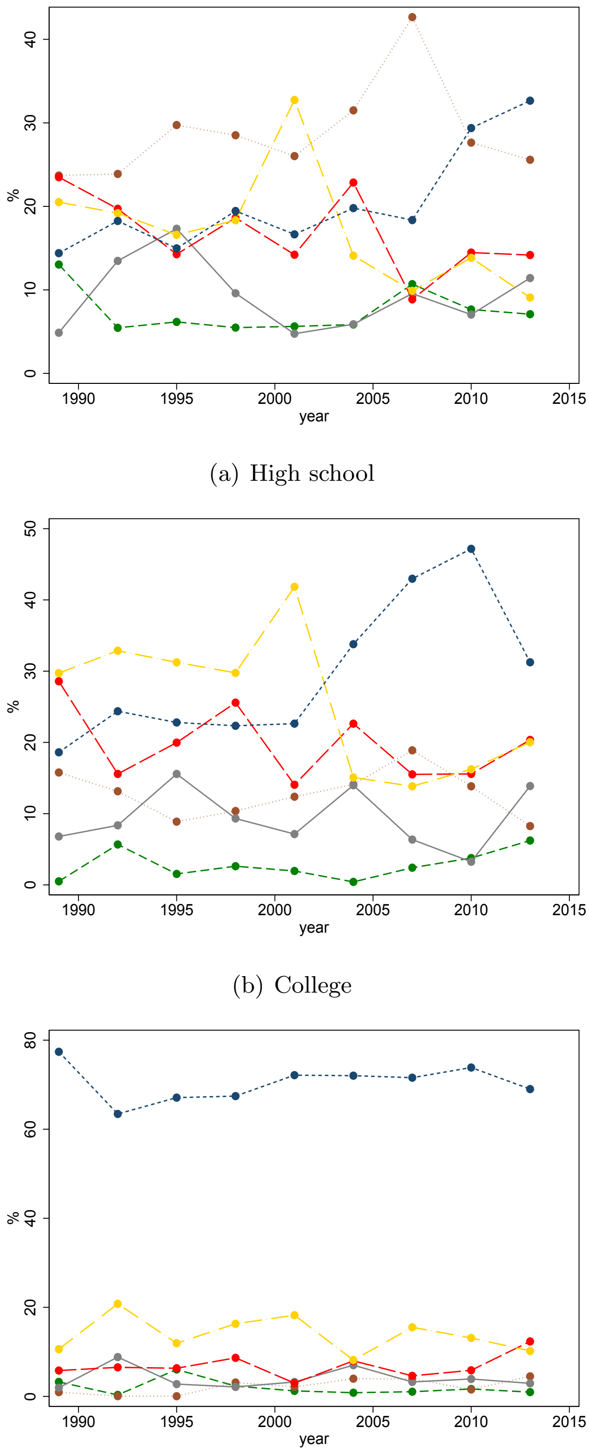
[10] Unfortunately, as explained above the public version of the SCF has a very coarse sectoral classification, so that we can only perform the analysis for aggregated sectors.

Sectoral composition might matter for two reasons. First, returns to entrepreneurship might be higher in certain sectors than in others. If the sectoral composition has changed differently for the three occupational groups, for example with graduates moving disproportionately into high returns sector, this could explain part of the observed patters of returns. Second, it might also be that returns to entrepreneurship in different sectors have changed over time, possibly increasing more in sectors in which graduates are over-represented.

Figure 7 reports the sectoral composition for the three educational groups. Postgraduates have a stable sectoral composition, with TCU accounting for a large majority of firms. For the other two groups, there is a drop in Finance and an increase in TCU, with no other clear trends emerging.

To assess the role of sectoral specialization in determining returns to education, we run the same regressions as those reported in Table 3 augmented with sectoral dummies and sectoral dummies interacted with the post dummies. The excluded category is Mining and Construction. In the years up to 2000, the only significant coefficient is on the Manufacturing dummy, although also Finance and TCU show some evidence of higher returns. In the post period, there is a significant increase in returns in the Finance sector while, if anything, returns in TCU (the sector of specialization of graduates) have marginally decreased. Indeed, controlling for sectoral composition and changes in returns to sectors does not change evolution of the skill premium: the estimates we find are very close to the baseline ones both for the overall returns and its components. This is true for the pre-post regressions (Table **??**) as well as for the specification with differential time trends (where, in addition to sector dummies, we also include sector dummies interacted with the time trend, and for the most demanding specification, where both education dummies and sector dummies are interacted with year dummies (Appendix zzz).

Figure 7: Sectoral composition by educational group



(a) High school

(b) College

(c) Postgraduate

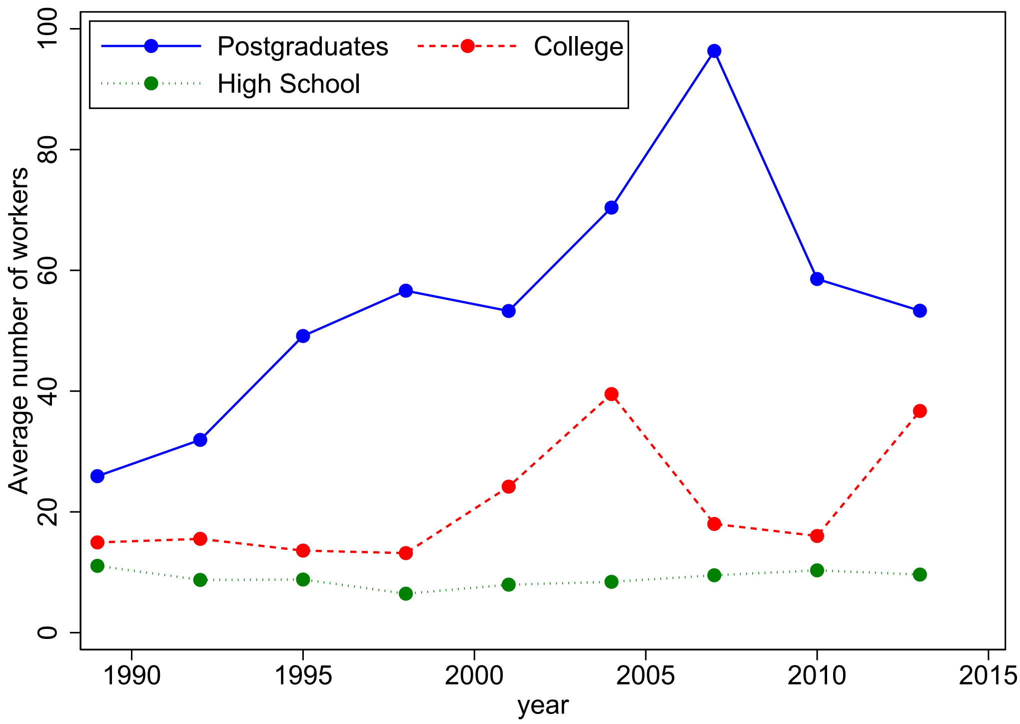
A second channel is related to vintage effects. The technology sectors have witnessed the birth of many successful startups, most notably in ICT, but also in biotech, entertainments, etc. Even in traditional sectors, such as in retail, firms growth and success has been related to the capacity to adopt and implement new organizational practices, related to ICT (Bloom et al., 2012). A large managerial literature claims that entrants have an advantage in undertaking disruptive innovations (Christensen and Rosenbloom, 1995). It might be that postgraduates managed to start businesses better able to generate and/or embody new technologies. If this interpretation is true, the increase in the skill premium should be attributable to some extent to the younger cohorts of businesses by postgraduates. To quantify this channel, we augment the basic framework by adding cohort dummies. We define six cohorts – for businesses started or acquired before 1960, between 1960 and 1969, 1970 and 1979, 1980 and 1989, 1990 and 1999, and since 2000 –, create corresponding dummies, interact them with the education dummies and include them in the regressions. We find no systematic pattern in the cohort effects (coefficients unreported to save on space). More importantly, the skill premium is again very similar to the one of the basic regressions. The same conclusion emerges from the specification with the year trend and with the full set of year dummies interacted with educational dummies. This analysis rule out the hypothesis that the increase in the skill premium is due to vintage effects: it rather entails businesses independently from the cohort they belong to.

Cohort table here - MARCO: AS WE PUT ALL THE ROBUSTNESS CHECKS IN ONE TABLE SHALL I PUT IT AT THE END OF THE PARAGRAPH?

The previous story assumed that technology is embodied in the firm at entry. In reality, existing firms can also innovate and adopt new technologies. As argued above, the adoption of organizational practices related to ICT might have improved the management of firms' operations and lessened constraints that limit the span of control **Citations. Check rossi-halsberg Garicano...**. In turns, higher education might be complementary to ICT adoption (Caroli and Van Reenen, 2001; Bresnahan et al., 2002). More in general, it could be that education provides the skills required to run larger businesses. To check for this possibility, we first analyze the evolution of firm size for the three educational groups. Figure 8 shows that, indeed, the average number of employees has increased substantially for firms run by postgraduates, from around 25 to 60, it has increased somehow for college graduates and it has remained stable for high school graduates.

To check the role of changes in the size of firms managed by entrepreneurs with different educational attainments we re-run the basic specification adding the number of workers as additional control (Table 8). On average, one additional worker accounts for 540$ of extra returns per year, an increase in firm value of almost 5,000$ and in the startup cost of slightly below 2,000$. The increase in the premium is slightly reduced for college graduates and more substantially for postgraduates. In particular, with respect to the basic specification of Table 3, the increase in total returns for postgraduates drops from 112,000 to 99,000$ and that in total firm value from 737,000 to 625,000$. The increase in startup cost is no longer significant,

Figure 8: Firm size (number of workers)



in line with a proportional relationship between startup cost and firm size. This suggests that education has become progressively more important in managing large organizations. However, even controlling for firm size, the increase in the skill premium for postgraduates is still large and different from the other educational groups. This indicate that the capacity to manage larger organization only accounts for part of the increase in the skill premium.[11]

Size table here: DITTO

Another potential explanation relates to financial constraints. Postgraduates might have gained better access to credit because they can pledge more collateral, given their possibly higher wealth. For example, the increase in the skill premium for employees implies that higher education individuals can accumulate more wealth by investing their human capital in the labour market. More educated individuals also tend to inherit more wealth from their parents, as education of offsprings is correlated with the wealth of parents–and this correlation has become stronger over time (Belley and Lochner, 2007). The SCF enquires about the use of personal wealth as collateral for the firm's loans. We create a dummy equal to one for entrepreneurs that report having supplied a personal guarantee to the firm as we as the total amount of the guarantee supplied. Results, reported in Table 8, show that the amount of collateral is related

[11] **We have experimented with different controls: square, log, size dummies**

to larger labor plus dividends income, larger firm value as well as larger startup costs. Overall, the effects on total returns are not statistically different from zero. Returns to education are not affected by the inclusion of these additional controls, suggesting that the higher returns to education are not related to differential capacity to post collateral of highly educate individuals.

Collateral table here: DITTO

Of course, posting collateral is not the only way to get access to external finance. Education gives formal skills useful to interact with financiers: postgraduates write better business plans, have a higher level of financial literacy and might therefore have access to more external finance. Using a sample of Dutch entrepreneurs, Parker and Van Praag (2006) find that higher education is related to lower capital constraints at startup. Ideally, we would like to check whether business debt has increased more for businesses ran by postgraduates. This information is not available in SCF. However, we can use a common implication of the theories of firm growth under financial constraints[12] to indirectly test for this channel. If more educated entrepreneurs have a higher debt capacity, their businesses need less internal wealth to finance growth and as a result they are created at (or closer to) their optimal size. Such businesses should therefore be able to pay dividends early on, while constrained businesses will refrain from distributing dividends to finance growth internally. To test for this possibility, we check whether the return to entrepreneurial tenure have fallen for businesses ran by post graduates relative to the businesses ran by less educated entrepreneurs. We regress dividends on the usual controls plus tenure interacted with the educational dummies and the post dummies. If education has weakened financial constraints, we should find a negative coefficient for tenure*post*college and, more markedly, for tenure*post*postgrad.

Not sure it is worth a table

This is the most complicated: how much do we want to talk about risk? How much do we want to push our measure of failure? Yet another possibility is that graduates can engage in more risky activities, given the legal structure of the businesses they run. Table 2 shows that 70% of high school graduates run unlimited liability companies, while the share is about 50% for both college graduates and postgraduates.[13] It might be that, given the legal structure of their business, they engage in high return-high risk projects in a context where very successful businesses are more valuable because of scale effects (winner takes it all or first mover advantage effects). To check for this possibility, we included in the regression a dummy equal to one for unlimited liability businesses. We find that such businesses are less valuable and deliver substantially lower returns. However, our coefficients of interests are hardly effected. We have also checked for the evolution of failure rates (Figure 4, panel (a)) , finding no evidence that they have evolved differentially.

[12]See, for example, Cooley and Quadrini (2001), Clementi and Hopenhayn (2006), Michelacci and Quadrini (2009).

[13]An alternative, less plausible story, would be that it is a compensation for the risk they take given the legal structure of their business. This is clearly not supported by the data, given that education goes together with more limited liability businesses.

Limited liability table here: DITTO

A final possibility we explore is related to the intergenerational transmission of wealth. It might be that educated entrepreneurs inherit better businesses from their wealthy parents. We have therefore added a dummy for inherited businesses. We do find that inherited businesses are worth more (around 860,000$), with a positive effect on total return (but not statistically significant). Again, the returns to education are unaffected when adding these additional control.

All in all, we conclude that higher education provides entrepreneurial skills that have become more valuable over time. Partly this is reflected in the fact that postgraduates run larger businesses, but the effect of education on returns goes beyond the pure size effect.

Recycling of entrepreneurial skills Buonasera,

in allegato il plot della frazione di entrepreneur in SCF che dichiarano di essere stati ”Self Emplyed” (i.e. not sure in an actively managed business as in our definition of enrtrepreneur) nella loro esperienza lavorativa passata. L’occupazione è espressamente diversa da quella attuale.

La share è la weighted average della dummy pastentr=(X4515==2) Ecco le domande a cui fare riferimento nel codebook (2013 in questo caso):

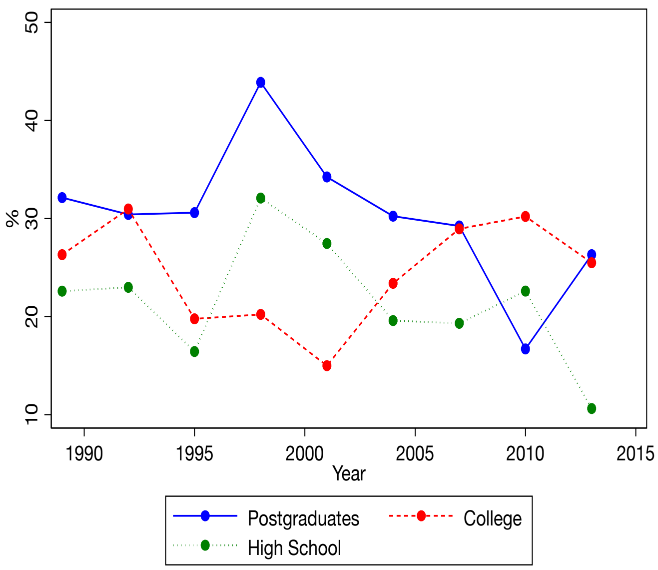
X4514(1) Now, not counting (your/his/her/his or her) current job, X5114(2) (have you/has he/has she/has he or she) ever had a full-time job with a different employer that lasted three years or more?

TREAT SELF-EMPLOYMENT AS ONE EMPLOYER. 1. *YES

X4515(1) I would like to know about the longest such job (you/he/she/ X5115(2) he or she) had. Did (you/he/she/he or she) work for someone else, (were you/was he/was she/was he or she) self-employed, or something else?

THE JOB REPORTED HERE SHOULD NOT BE THE SAME AS THE CURRENT JOB. 1. *Someone else 2. *Self-employed; other non-corporate business owned by PEU

Figure 9: Estimate of the recycling probability ν



Span of control

Look at Number of businesses

Type of degree

7 Conclusions

We study 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 entrepreneurs 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 is partly due to the fact that they run better business (in terms of dividend payments and firm value) and partly because they realize capital gains earlier by selling the business more quickly. The premium to post-graduate education has remained high during the Great Recession, it is unlikely to be explained by selection issues related to business failure and it is still present when looking at the higher deciles of the entrepreneurs income distribution.

References

Belley, P. and L. Lochner (2007). The changing role of family income and ability in determining educational achievement. *Journal of Human Capital 1*(1), 37–89.

Bloom, N., R. Sadun, and J. V. Reenen (2012, February). Americans Do IT Better: US Multinationals and the Productivity Miracle. *American Economic Review 102*(1), 167–201.

Bresnahan, T. F., E. Brynjolfsson, and L. M. Hitt (2002). Information technology, workplace organization, and the demand for skilled labor: Firm-level evidence. *Quarterly Journal of Economics 117*(1), 339–376.

Card, D. (1999). The causal effect of education on earnings. In O. Ashenfelter (Ed.), *Handbook of labor economics, Vol. 3A*, pp. 1801–1863. Elsevier.

Caroli, E. and J. Van Reenen (2001). Skill-biased organizational change? evidence from a panel of british and french establishments. *Quarterly journal of economics*, 1449–1492.

Chisini, O. (1929). Sul concetto di media. *Periodico di Matematiche 4*, 106–116.

Christensen, C. M. and R. S. Rosenbloom (1995). Explaining the attacker's advantage: Technological paradigms, organizational dynamics, and the value network. *Research policy 24*(2), 233–257.

Clementi, G. L. and H. A. Hopenhayn (2006). A theory of financing constraints and firm dynamics. *Quarterly Journal of Economics*, 229–265.

Cooley, T. F. and V. Quadrini (2001). Financial markets and firm dynamics. *American economic review*, 1286–1310.

De Nardi, M., P. Doctor, and S. D. Krane (2007). Evidence on entrepreneurs in the united states: Data from the 1989-2004 survey of consumer finances. *Economic Perspectives, Federal Reserve Bank of Chicago 31*(4), 18.

Hall, R. E. and S. E. Woodward (2010). The burden of the nondiversifiable risk of entrepreneurship. *American Economic Review 100*, 1163–1194.

Hamilton, B. H. (2000). Does entrepreneurship pay? an empirical analysis of the returns to self-employment. *Journal of Political economy 108*(3), 604–631.

Kartashova, K. (2014). Private equity premium puzzle revisited. *American Economic Review 104*(10), 3297–3334.

Kennickell, A. B. (1998). Multiple imputation in the survey of consumer finances. In *Proceedings of the Section on Survey Research Methods.*

Michelacci, C. and V. Quadrini (2009). Financial markets and wages. *Review of Economic Studies 76*(2), 795–827.

Moskowitz, T. J. and A. Vissing-Jorgensen (2002). The returns of entrepreneurial investment: A private equity premium puzzle? *American Economic Review 92*(4), 745–778.

Nickell, S. (1979,). Estimating the probability of leaving unemployment. *Econometrica 47*(5), 1249–1266.

Parker, S. C. and C. M. Van Praag (2006). Schooling, capital constraints, and entrepreneurial performance: The endogenous triangle. *Journal of Business & Economic Statistics 24*(4), 416–431.

Queiro, F. (2016). The effect of manager education on firm growth. Mimeo, Harvard University.

Van der Sluis, J., M. Van Praag, and W. Vijverberg (2008). Education and entrepreneurship selection and performance: A review of the empirical literature. *Journal of economic surveys 22*(5), 795–841.

Van Praag, M., A. Van Witteloostuijn, and J. Van der Sluis (2013). The higher returns to formal education for entrepreneurs versus employees. *Small Business Economics 40*(2), 375–396.

Table 7: Sectoral Specialization and Skill Premium

	(1) θ	(2) ϕ	(3) $d+l$	(4) M	(5) k	(6) GCG	(7) NCG
College × Post	30.2*	22.9	13.5	556.6***	203.9**	26.8***	16.7
	(16.8)	(16.8)	(10.0)	(115.1)	(100.4)	(10.0)	(14.0)
Postgraduate × Post	110.3***	82.2***	80.4***	741.1***	217.7*	34.6***	29.8
	(24.1)	(23.9)	(18.2)	(158.7)	(121.3)	(11.8)	(16.9)
Agriculture × College	-68.0	-68.1	-22.2	-313.3	29.3	-34.5	-45.8
	(60.1)	(60.2)	(29.9)	(304.9)	(409.0)	(25.6)	(55.8)
Manufacturing × College	93.8**	94.3**	28.8	312.8	-190.2	49.2*	65.0**
	(45.3)	(45.3)	(28.3)	(337.9)	(184.2)	(27.7)	(31.1)
Trade × College	13.5	14.4	-16.0	-207.7	-331.2	9.9	29.6
	(34.4)	(34.3)	(14.5)	(228.7)	(247.7)	(19.8)	(30.1)
Finance × College	59.6**	60.5**	7.3	0.8	-331.9*	29.7**	52.2**
	(25.3)	(25.3)	(15.7)	(197.2)	(174.7)	(14.1)	(21.2)
TCU × College	13.9	14.2	-11.6	-518.7***	-449.6***	-5.1	25.5
	(24.9)	(24.8)	(14.0)	(199.7)	(159.8)	(13.5)	(18.7)
Agriculture × Postgrad	-165.1*	-166.1*	-46.6	-983.4	355.1	-89.2**	-118.6*
	(92.9)	(93.2)	(55.1)	(703.8)	(585.7)	(41.1)	(67.7)
Manufacturing × Postgrad	-61.1	-59.7	-63.4	-134.8	-99.7	-1.7	2.4
	(74.2)	(74.3)	(48.4)	(685.9)	(297.1)	(39.3)	(40.2)
Trade × Postgrad	-119.9*	-119.0*	-87.3**	-578.7	-93.0	-29.6	-32.6
	(65.1)	(65.2)	(39.7)	(678.8)	(367.3)	(39.3)	(45.2)
Finance × Postgrad	35.6	37.5	65.4	218.1	370.9	-7.7	-29.9
	(64.9)	(65.2)	(45.3)	(638.7)	(334.0)	(36.0)	(39.7)
TCU × Postgrad	-58.7	-58.0	20.7	-1,339.3**	-131.2	-83.6***	-79.5**
	(57.5)	(57.6)	(38.5)	(588.3)	(256.0)	(32.4)	(32.7)
Agriculture	-10.1	-9.9	2.1	-40.4	17.5	-4.7	-12.2
	(14.0)	(13.9)	(7.2)	(67.8)	(72.1)	(6.6)	(11.1)
Manufacturing	51.8**	51.9**	37.2***	394.2***	107.7	24.8**	14.7
	(20.4)	(20.4)	(11.6)	(135.6)	(84.9)	(11.2)	(13.3)
Trade	14.9	14.5	24.9***	304.3***	262.9	4.9	-9.9
	(22.3)	(22.3)	(7.1)	(91.8)	(165.6)	(13.1)	(21.0)
Finance	12.7	12.0	28.9***	337.5***	290.6***	3.1	-16.2
	(13.2)	(13.3)	(7.1)	(93.0)	(85.9)	(6.8)	(10.6)
TCU	23.0**	23.0**	18.3***	41.6	-25.6	5.5	4.7
	(9.6)	(9.6)	(6.3)	(75.1)	(43.2)	(4.8)	(5.7)
Obs	7,250	7,250	7,250	7,250	7,250	7,250	7,250
H_0 : College × Post = Post Graduate × Post							
F-stat	10.550	5.788	12.280	1.433	0.012	0.421	0.512
p-value	0.001	0.016	0.000	0.231	0.912	0.516	0.474

Notes: Gross capital gains (GCG) are $\lambda(M-k)$, net capital gains (NCG) are $\lambda(M-k)-\rho k$. The specification includes individual characteristics of the entrepreneur, education dummies and year dummies. Construction is the reference industry. *phi* is computed in deviation from the year-sector-education group average employees' wage. Bootstrapped standard errors in parentheses, *** p-value $<$ 0.01, ** p-value $<$ 0.05, * p-value $<$ 0.1.

Table 8: Additional Controls

	(1) θ	(2) ϕ	(3) $d+l$	(4) M	(5) k	(6) GCG	(7) NCG
Panel A: Cohorts							
College × Post	21.2	14.3	13.6	686.3***	326.1**	28.5**	7.6
	(21.4)	(21.4)	(11.4)	(144.3)	(133.1)	(12.9)	(18.1)
Postgraduate × Post	110.1***	84.1***	97.5***	842.2***	375.3**	31.8**	12.7
	(29.6)	(29.6)	(19.6)	(156.5)	(165.6)	(14.6)	(23.2)
Panel B: Size							
College × Post	21.8	14.6	7.8	435.1***	152.2*	20.9**	14.0
	(16.9)	(16.9)	(9.8)	(117.2)	(92.5)	(10.1)	(13.5)
Postgraduate × Post	99.7***	71.6***	72.1***	625.7***	170.7	29.1**	27.6
	(24.0)	(23.9)	(15.7)	(133.6)	(120.6)	(11.8)	(18.4)
Employment	0.5***	0.5***	0.4***	4.6***	1.9***	0.2***	0.1
	(0.1)	(0.1)	(0.1)	(1.0)	(0.5)	(0.1)	(0.1)
Panel C: Collateral							
College × Post	30.7*	23.4	8.0	373.7***	63.8	23.3**	22.7
	(17.8)	(17.8)	(9.8)	(109.4)	(96.5)	(10.0)	(14.1)
Postgraduate × Post	115.2***	87.0***	80.3***	672.7***	150.2	34.8***	34.9*
	(24.4)	(24.3)	(16.7)	(132.8)	(118.4)	(11.6)	(18.0)
Posted collateral?	29.1	29.1	0.0	308.6***	9.0	26.1***	29.0*
	(19.9)	(19.9)	(7.4)	(82.9)	(117.3)	(9.2)	(17.2)
Amount collateral posted	-0.0	-0.0	0.0***	0.9***	0.8***	0.0	-0.0*
	(0.0)	(0.0)	(0.0)	(0.1)	(0.2)	(0.0)	(0.0)
Panel D: Legal Form							
College × Post	23.7	16.5	9.7	439.1***	153.5*	21.1**	14.1
	(16.7)	(16.7)	(10.0)	(112.7)	(93.2)	(9.7)	(13.3)
Postgraduate × Post	106.5***	78.4***	78.2***	658.1***	183.1	30.8***	28.3
	(24.3)	(24.2)	(16.8)	(137.2)	(123.0)	(11.7)	(18.3)
Unlimited Liability	-86.0***	-85.8***	-62.0***	-1,103.6***	-464.0***	-52.0***	-23.9***
Panel E: Inherited							
College × Post	27.6*	20.3	12.5	494.3***	177.3*	23.7**	15.1
	(16.7)	(16.6)	(9.9)	(112.8)	(92.7)	(9.7)	(13.3)
Postgraduate × Post	111.8***	83.6***	82.0***	719.5***	208.3*	33.7***	29.8
	(24.1)	(24.0)	(16.6)	(132.5)	(119.3)	(11.6)	(18.1)
Business inherited?	44.6	44.7	34.6*	862.9***	392.0***	37.9***	10.0
	(28.1)	(28.0)	(17.9)	(184.3)	(120.3)	(13.3)	(17.6)

Notes: Gross capital gains (GCG) are $\lambda(M-k)$, net capital gains (NCG) are $\lambda(M-k)-\rho k$. The specifications include individual characteristics of the entrepreneur, education dummies and year dummies. Bootstrapped standard errors in parentheses, *** p-value < 0.01, ** p-value < 0.05, * p-value < 0.1.