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Earnings Effects of Entrepreneurial Experience: Evidence from the Semiconductor Industry

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Although previous studies have examined the rewards available to individuals inside entrepreneurial firms, entrepreneurial experience may provide rewards that are independent of the entrepreneurial context. Building on human capital theory, this study provides theoretical explanations for the effects of experience at a start-up on earnings across an individual's career and then examines these implications in the context of California's semiconductor industry. Comparing the career trajectories of employees who join start-ups with a matched control group of comparable workers without start-up experience, I perform a counterfactual analysis and find that start-up experience in this context has a persistent positive effect on earnings that extend outside the entrepreneurial environment. The results from the matched sample are consistent with the development and revelation of valuable general human capital through entrepreneurial experience and suggest that the rewards to entrepreneurship are not limited to just the rewards available inside entrepreneurial firms.

Key words: start-ups; experience; human capital; compensation; careers; entrepreneurship; risk preferences

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1. Introduction

A broad set of scholars has examined why some individuals become entrepreneurs and some do not (e.g., Blanchflower and Oswald 1998, Douglas and Shepherd 2000, Nicolaou et al. 2008). In this literature, it is recognized that entry into entrepreneurial activity is a choice, and thus potential entrepreneurs weigh their personal expected costs against their expected rewards should they choose to engage in entrepreneurial activity (Amit et al. 1995, Lazear 2005). This presents a very complex calculation for potential entrepreneurs because the expected rewards to entrepreneurial activity include both nonpecuniary benefits, such as job satisfaction and independence (Shane et al. 2003, Benz and Frey 2008), and pecuniary benefits, such as enhanced compensation given their skill set (Hartog et al. 2010) and rewards from residual claimancy (Jones and Butler 1992).

Although there is an active literature on measuring the nonpecuniary and pecuniary rewards of entrepreneurship (e.g., Hamilton 2000, Georgellis et al. 2007, Hartog et al. 2010, Braguinsky et al. 2012), the prior literature has focused only on the rewards available inside entrepreneurial firms. This is an important research objective that adds to the understanding of entrepreneurial firms; however, this approach provides an incomplete view of the full rewards available to individuals should they choose to pursue entrepreneurship. Rewards available to

individuals who engage in entrepreneurial activities are not limited to those associated with a new venture: entrepreneurial experience may also affect the ability of individuals to acquire rewards in other contexts. To understand the rewards available to potential entrepreneurs and thus better understand the decisions of individuals to enter entrepreneurship, it is necessary to examine the full set of outcomes associated with selecting into entrepreneurship and not just the rewards available inside entrepreneurial firms.

This study focuses on the pecuniary rewards available to individuals who select into entrepreneurship and examines whether entrepreneurial experience has an effect on earnings across individuals' careers. First, I examine the entrepreneurial context through the lens of human capital theory to develop a set of candidate explanations for the relationship between entrepreneurial experience and earnings. Then, using linked employer–employee data from California's Unemployment Insurance program that covers all employees employed in California's semiconductor industry from 1990 to 2002, I match every individual that joins a start-up with a similar colleague at his or her previous employer who does not join a start-up. The matched employees serve as a control group for what would have happened to the employees who joined start-ups had they never joined a start-up. I then estimate the differences in earnings between the employees who join start-ups and their

matched counterparts across the next five years in their careers. I find that relative to the matched control group, employees who join start-ups exhibit an initial earnings dip upon joining a start-up but quickly recover, and after four quarters, start-up employees earn more than their matched counterparts. In contrast with expectations, I find that both groups have similar outcomes after firm death, an initial public offering (IPO) and changing jobs to established firms. The findings suggest that there are persistent individual-level pecuniary returns to start-up experience in this industry context. Furthermore, the presence of persistent rewards in this sample suggests that start-up experience leads to the development or revelation of general human capital that would not have occurred in the absence of start-up experience.

Although this analysis focuses on a specific industry context, by controlling for what would have happened to entrepreneurs had they not joined a start-up and then examining the earnings effects of start-up experience, this study contributes to the entrepreneurship literature by providing a generalizable framework to examine individual-level rewards associated with entrepreneurship. Furthermore, by broadening the conceptualization of the pecuniary rewards available through entrepreneurship to include earnings that might occur later in individuals' careers and might occur outside of the entrepreneurial context, this research enhances the understanding of the entrepreneurial entry decision. This improved understanding of the rewards of entrepreneurship can be used to better understand and better model the decisions that potential entrepreneurs make when choosing whether to pursue an entrepreneurial opportunity.

2. Start-up Experience and Individual Earnings

Individuals are the foundation of the entrepreneurial process: they are critical in the recognition (Shane 2003), creation (Alvarez and Barney 2005), and exploitation (Hebert and Link 1989) of opportunities. The importance of individuals to the entrepreneurial process has triggered a long line of research exploring individual-level traits and characteristics that are antecedents to entrepreneurial activities. Scholars have argued that individuals who select into entrepreneurial activity differ, on average, from individuals who do not select into entrepreneurial activity on a variety of dimensions, including standard proxies of skill level such as education (Van der Sluis et al. 2008), intelligence (Hartog et al. 2010), academic human capital (Toole and Czarnitzki 2009), and experiences (Shane and Khurana 2003, Agarwal et al. 2004, Bayus and Agarwal 2007, Dencker et al. 2009); individual differences such as conscientiousness, openness to new experiences, emotional stability and

extroversion (Zhao et al. 2010), confidence/optimism (Hayward et al. 2006, Lowe and Ziedonis 2006), risk preferences (Wu and Knott 2006), and cognitive biases (Busenitz and Barney 1997); demographic characteristics such as gender (Devine 1994) and race (Fairlie and Meyer 2000); access to resources (Blanchflower and Oswald 1998, Evans and Leighton 1989, Hurst and Lusardi 2004, Hvide and Moen 2010); and characteristics of previous employers (Elfenbein et al. 2010, Carnahan et al. 2012).

The purpose of the above line of research is to identify which individual characteristics are important predictors of entry into entrepreneurial activity. Because individuals enter entrepreneurial activities voluntarily as a result of a utility maximizing decision (Douglas and Shepherd 2000), the entry decision is driven by the individual-level costs and rewards associated with the decision. When determining whether to select into an entrepreneurial activity, potential entrepreneurs must assess their expectations of the costs of joining a new venture and the rewards of joining a new venture relative to the opportunity costs associated with not joining a start-up (Amit et al. 1995). The characteristics detailed in the prior paragraph are correlated with entry into entrepreneurship because these characteristics proxy for the individual's willingness and ability to bear the direct and opportunity costs associated with entrepreneurship and the individual's expected rewards from entrepreneurship.

An alternative approach to understanding the entrepreneurial entry decision is to measure the costs and rewards of entrepreneurship directly. Although previous studies have directly examined the costs of new venture formation (e.g., Amit et al. 1995, Wu and Knott 2006) and the rewards available in entrepreneurial environments (e.g., Blanchflower and Oswald 1998, Hamilton 2000), the costs and benefits associated with entrepreneurial experience may extend outside the boundaries of the entrepreneurial venture and may persist across individuals' careers. Thus, focusing on the rewards available only within an entrepreneurial venture paints an incomplete picture of the full rewards associated with entrepreneurial experience. In the rest of this section, I focus on the pecuniary rewards associated with entrepreneurship and draw on human capital theory to explore the relationship between earnings and entrepreneurial experience.

Earnings of individuals with start-up experience can be separated into the component of earnings that is independent of start-up experience and the component that is attributable to start-up experience. These two components are analogous to selection and treatment effects. As demonstrated by Campbell et al. (2012), there is a close connection between

the characteristics that predict entrepreneurship and the characteristics that predict wages. Although entrepreneurial entry is positively correlated with education, intelligence, career experience, and big five personality traits, these characteristics have value in many contexts and thus are positively correlated with earnings as an employee (Becker 1994, Mincer 1974).

This implies that individuals who are likely to succeed in an entrepreneurial context (and thus are more likely to select in to entrepreneurship) are also likely to earn high rewards as an employee. In other words, there is a component of the compensation of individuals with start-up experience that is independent of experience at a start-up and reflects human capital that has value to established firms. Although this selection component plays an important role in the earnings of employees with start-up experience, it is secondary to the objective of this research. The objective is to understand how experience at a start-up *changes* the earnings of individuals. In other words, the objective is to examine the treatment effect of start-up experience.

I explore the treatment effect of start-up experience on earnings using a simple framework of employee earnings where an individual's total compensation is determined by the level of general human capital observed on the labor market, and the division of compensation between pecuniary and nonpecuniary benefits is determined by characteristics of the worker-firm dyad. Human capital theory suggests that general human capital is an important predictor of compensation because workers with general human capital can credibly threaten to take their skills elsewhere and thus appropriate the value generated by their general human capital. On the other hand, human capital that is specific to a firm is likely to be unrelated to total compensation because workers cannot use the threat of mobility to bargain for the value of that human capital (Becker 1994). The total compensation earned by a worker represents both pecuniary and nonpecuniary rewards, and the theory of compensating differentials argues that individuals make trade-offs between these two types of rewards in search of the compensation package that provides them with the greatest utility (Rosen 1986, Smith 1978).

This simple framework is relevant to the examination of the impact of start-up experience on earnings because start-ups differ from established firms in human capital aspects and in the mix of compensation available. Relative to experience at an established firm, experience at a start-up may create, reveal, or signal additional human capital that is valuable in other contexts and thus increases the market value of an individual. Also, because of resource constraints, the availability of psychological rewards, the potential

of liquidity events, and the high risk of failure, start-ups may offer a different mix of compensation than established firms. These compensating differentials would affect earnings within the start-up but would not persist if the worker leaves and joins an established firm.

While a worker is attached to a start-up, his or her earnings reflect both the general human capital effect and the compensating differentials effect; however, once the employee separates from the start-up, the human capital effect persists while the compensating differentials effect changes to reflect the characteristics of the new firm. This insight facilitates the examination of the role of these mechanisms on the earnings of employees across their careers. Because prior research on the pecuniary returns of start-up employment has only focused on the returns accrued while at a start-up, previous studies have not been able to distinguish between the roles that these two mechanisms play in determining earnings outcomes for individuals with entrepreneurial experience. I explore the mechanisms in more detail with the objective of examining the earnings trajectories of employees with start-up experience through the lens of these mechanisms.

2.1. Start-up Experience and General Human Capital

Experience at an entrepreneurial venture may affect the level of general human capital and thus the level of total compensation. Start-up experience affects workers' general human capital through exposure to new tasks and responsibilities that will lead to the development of general human capital, through the revelation of latent general human capital that would otherwise be unrevealed while employed at established firms, and through signaling hard-to-observe general human capital. These factors will have an effect on total employee compensation both inside a start-up and after the worker and start-up separate.

Entrepreneurial firms, like established firms, require a broad range of skills for success (Lazear 2005). However, unlike established firms, entrepreneurial firms are typically resource constrained (Aldrich 1999), which has important implications for job design and work organization. Specifically, entrepreneurial firms lack the resources necessary to implement job specialization (Rosen 1983); thus, the broad range of tasks necessary for organizational success are likely to be performed by a small number of individuals. As a result, individuals at start-ups will gain experience in more areas and roles than individuals at established firms. Similarly, individuals at start-ups may gain experience on higher-level tasks because hierarchies may be flatter in resource constrained start-ups than established firms. Also, resource-constrained

entrepreneurial firms are likely to engage in bricolage of their existing resources (Baker and Nelson 2005). One resource that can be the focus of bricolage is human capital (Banerjee and Campbell 2009). As human capital is reallocated and recombined through the process of bricolage, individuals develop experience in new areas. As a result, workers at start-ups are more likely to develop human capital in new areas than workers at established firms.

The additional human capital that is gained from involvement in a start-up will be a mix of human capital that is transferrable to other firms and human capital that is not transferrable to alternative employers. If individuals gain human capital from their experience at an entrepreneurial firm that is both transferrable and valuable to outside employers, their compensation should increase to match their value on the external market. Furthermore, this increase should persist even after exiting the start-up.

Another reason that involvement with a start-up could affect the compensation profile of an individual across his or her career (i.e., even after separating from the start-up) is that choosing to work at an entrepreneurial firm reveals human capital or other attributes that would otherwise be unobserved. Applying the Spence (1973) signaling model, if some individuals have unobserved human capital or other attributes that reduce their costs of working at a start-up or increase their expected return from start-up employment, they will select into entrepreneurial environments. This revealed preference signals these hidden characteristics to alternative employers. For individuals without these abilities and traits, it would not be optimal to leave an established employer, so they will not select into start-up employment that signals their lack of these attributes. Some examples of latent characteristics that may be revealed by selecting into an entrepreneurial context include the ability to recognize entrepreneurial opportunities (Shane 2003); the ability to leverage start-up specific capabilities and resources (Gompers et al. 2005), risk, or uncertainty tolerance (Brockhaus 1980); and a balanced human capital portfolio (Lazear 2004).

Start-up performance provides another signal on the quality of employees that can have lasting labor market implications. Rider et al. (2012) demonstrate that association with a failed employer has an adverse impact on the career outcomes of ex-employees. If start-ups are more likely to fail (Stinchcombe 1965, Freeman et al. 1983) even if failure is only loosely associated with firm performance (Gimeno et al. 1997), and association with a failed firm is stigmatizing, then workers at start-ups are more likely to be exposed to the risk of future labor market discrimination based on their past employment experiences. On the other hand, there may also be halo

effects, where workers who have been associated with a respected start-up receive favorable treatment at future employers. The halo effect may be generated through association with a firm with demonstrated market success and may also exist in the absence of firm success if the firm was funded by respected investors, such as top-tier venture capitalists. The legitimacy bestowed on members of a start-up team by the support of top investors may persist outside the boundaries of the start-up even if the start-up fails. The stigma and halo effects are most likely to occur where human capital is hard to observe and thus would otherwise limit mobility (Chiang and Chiang 1990). In the absence of good information on the knowledge, skills, and abilities of an individual, a potential employer may turn to the success of the individual's previous employers to predict the value of the individual. If there are stigma (halo) effects, employment at a failed (successful) start-up will have a negative (positive) effect on compensation at future employers.

Together, these channels describe several important mechanisms through which experience at a start-up can affect the market value of a worker. By developing additional human capital, by revealing latent human capital, and by signaling the value of hard-to-observe human capital, experience at a start-up may have a different impact on total compensation than experience elsewhere. Additionally, to the extent that start-up experience imparts or reveals general human capital, the effect on total compensation will persist even after a worker separates from a start-up.

2.2. Start-up Experience and Compensating Differentials

The division of total compensation between pecuniary and nonpecuniary components determines the share of compensation that workers earn as cash compensation. Because entrepreneurial firms are likely to experience liquidity constraints (Evans and Leighton 1989), they are likely to offer compensation packages that skew toward nonpecuniary rewards. Instead of offering compensation primarily in the form of wages and salary, start-ups can offer noncash psychological benefits as well as an array of delayed compensation.

As Hamilton (2000) argues, individuals earn less compensation when selecting into self-employment than an observably equivalent worker who works at an established firm. Hamilton posits that there are compensating differentials in the form of non-cash compensation that attract individuals to self-employment. For example, if individuals value the ability to "be their own boss," they will be attracted to and remain in self-employment despite lower compensation. The same logic can be applied to all individuals at a start-up. If there are desirable attributes

associated with a start-up but not with an established firm, individuals would be willing to accept less compensation to work at a start-up than they would to work at an established firm. This is consistent with evidence that the self-employed have higher work satisfaction than the employed (Benz and Frey 2008, Georgellis et al. 2007). On a related note, small (entrepreneurial) firms may have access to a different set of incentive mechanisms than established firms (Zenger 1992), and thus small firms can offer customized incentives and less cash compensation than larger firms (Krzycki 2012). The presence of greater noncash benefits at a start-up would result in a negative effect on compensation for workers at a start-up relative to an established firm. This effect would not persist if the employee left the start-up for employment at an established firm.

Furthermore, individuals working at entrepreneurial firms that experience a liquidity event, such as an IPO or an acquisition by an established firm, may share in the proceeds of the liquidity event. If workers have an equity stake in their start-up, they receive an increase in net worth when their equity becomes liquid. If workers who enter a firm early are likely to have equity stakes (because of cash constraints at firm foundation), then they would share in the proceeds of liquidity events. This would result in compensation spikes as employee owners cash out additional liquidity of the firm. In the logic of compensating differentials, this allows start-ups to offer lower base cash compensation as a trade-off for the potential spike of compensation after liquidity events.

To the extent that start-ups offer greater nonsalary rewards than established firms, they can offer lower cash compensation than established firms to attract and retain an individual with the same market value. This effect is especially strong for workers who highly value the psychological benefits and delayed compensation possibilities of start-up employment. However, the compensating differentials logic also works against the ability of start-ups to offer lower cash compensation. Workers who derive disutility from the noncash benefits of start-ups will need to receive greater cash compensation, as will workers who are highly risk averse and thus seek to avoid equity compensation.

Entrepreneurial environments are riskier (Wu and Knott 2006) and/or more uncertain (Alvarez and Barney 2005) than established firms. For an individual, this implies that the distribution of potential compensation is more varied or more unpredictable at a start-up than at an established firm. If individuals are at all risk averse, then the variance and unpredictability of future earnings decreases the desirability of start-up employment (Kihlstrom and Laffont 1979).

As a result, start-ups would need to offer a compensating differential to attract workers (Dorsey and Walzer 1983). The compensating differential could come in the form of either pecuniary or nonpecuniary benefits. Focusing just on cash compensation, the compensating differential logic would result in an immediate compensation premium for workers at a start-up relative to similar workers at an established firm that declines over time as start-ups become less risky or uncertain, and the premium would not persist outside the borders of the start-up.

Whereas the compensating differentials logic does not necessarily affect the total compensation available to a worker, it does affect the mix of cash and noncash compensation. Thus, examination of the observed pecuniary returns associated with start-up experience must account for both the level of total compensation and the mix of benefits offered by firms. By focusing on workers' earnings as they move in and out of start-up firms, it is possible to separate the general human capital effects of start-up experience from the confounding firm-specific compensating differentials component of earnings.

3. Data and Methodology

The approach of the empirical analysis is to examine the impact of start-up experience on individuals' pecuniary rewards across the subsequent five years of their career. The analysis focuses on California's semiconductor industry from 1990 to 2002 through the lens of the factors previously described. The objective is to measure the effects of start-up experience on earnings across a variety of events in an employee's career using a matched control group approach and then examine the results in light of the mechanisms through which start-up experience might affect earnings.

3.1. Empirical Context

Before the late 1980s, the semiconductor manufacturing industry was characterized by rapid technological change and very high capital costs accompanied by continual product price declines and demanding quality standards. These industry characteristics led to the growth of large integrated firms where design, manufacturing, testing, and marketing were all done in-house. Because fabrication capacity was very expensive, the barriers to entry for small firms were large (Brown and Linden 2009).

However, in the late 1980s, this traditional market structure was altered with the introduction of the semiconductor foundry model. Foundries owned fabrication capacity and would fabricate the designs for other firms on a contract basis eliminating the need for new firms to invest in fabrication plants. With lower barriers of entry in the 1990s, the semiconductor

industry experienced large numbers of firm births and deaths in an innovative and competitive environment.

Because of the low barriers to entry and a high reliance on human capital in this industry (Brown and Linden 2009), this is a strong context in which to study the connection between employment at start-ups and development of human capital. However, this industry has some important idiosyncracies that temper the generalizability of this study to other contexts. First, the industry has intense cyclicalities marked by the boom in 1999–2000 and the subsequent crash in 2001. Second, the clustering of the industry in California facilitates employee mobility (Saxenian 1994), which may increase the competition for employees and thus support employees' ability to appropriate the value they generate. Similarly, standardization of tools and technology in this industry (Brown and Linden 2009) further facilitated mobility and employees' value appropriation. As a result, relative to other industries and other time periods, this context may not be representative in terms of employees' ability to appropriate value at either established firms or start-ups.

Third, and perhaps most important for this study, many of the start-ups in this industry in this time period were backed by venture capital (VC). The presence of venture capitalists may affect earnings of individuals with start-up experience through both the selection effect and the treatment effect previously described. VCs may be more likely to invest in organizations with a high likelihood of success (Shepherd 1999), thus their investments may be positively correlated with the general human capital of the start-up team which may exacerbate the positive relationship between general human capital and earnings at a start-up. Also, VC investments may signal to the external market that the founder has valuable skills and attributes that were not previously observable to the market. Similarly, VC investments may increase the likelihood of venture success (Barney et al. 1996, Gompers et al. 2010) and thus increase the likelihood of a "halo" effect around the start-up team, both of these signals would positively affect workers' wages even after separation from the start-up.

3.2. Data Sources and Variable Creation

To examine the effect of start-up experience on individuals' earnings in California's semiconductor industry, I construct a data set combining administrative data collected as part of the California Unemployment Insurance (UI) program with stock market data from the Center for Research in Security Prices (CRSP). The UI data allow me to track the earnings and employers of California workers covered by the UI program. The CRSP data allow me to identify which firms are publicly traded and when these firms became publicly traded.

The California UI program compiles quarterly earnings and employment records for all workers covered by the UI program. The data span the first quarter of 1990 to the last quarter in 2002. For each quarter in the sample, I obtain wages and employer information for all workers who were employed in the semiconductor industry (as defined by Standard Industry Classification and North American Industry Classification system codes) for at least four quarters at any time between 1990 and 2002.

Each observation includes a worker identifier, firm identifier, and quarterly earnings for each quarter in the data. The resulting data set covers 52 quarters and includes over 18 million records. On average, there are 340,000 observations in each quarter with up to 100,000 observations actively working in the semiconductor industry at any one time. *Earnings* is a key variable, which include wage and salary earnings, all taxable bonuses (including cash and nonpecuniary bonuses), and taxable stock options. I construct a panel data set tracking individuals' employment history and earnings.

To identify employees who join start-ups and estimate the return employees' experiences at start-ups, I must accurately calculate the date of a variety of firm life-cycle events, such as firm birth, death, and an IPO. I identify new firms by the first quarter the firm appears in the data.¹ Specifically, I examine employees who leave an established firm in the semiconductor industry and join a start-up in the start-up firm's first quarter of record. This date represents the first quarter that a firm pays payroll taxes so the start-ups in the data are more established than the iconic garage-based company. Similarly, firm death is identified as the last (uncensored) quarter of record for each firm. Table 1 presents tabulations of firm births and deaths by year for the California semiconductor industry. Of the valid firm births,² 12% die within their first four quarters of existence, 19% die within their first two years of existence, and 27% die within their first three years of existence. Presence in the data indicates that a firm has already acquired some form of revenue or venture financing that allows them to pay their employees. Given that these start-ups are mature

¹ All start-ups in the sample are "spin-outs" (Agarwal et al. 2004), which are firms that are founded by workers who left an established firm in the same industry. New firm identifiers in the data that are likely to be spin-offs of established firms, a division of an out-of-state or out-of-country established firm that enters California for the first time, or an administrative recoding are excluded. Detailed information on the rules implemented to identify these excluded firms is provided in the electronic companion (available at <http://ssrn.com/author=968002>).

² Because of administrative recodes, mergers and acquisitions, and firms entering and exiting California, there are "artificial" firm births and deaths in the data. For more information on the methods used to identify artificial births and deaths, see the electronic companion.

Table 1 Firm Birth and Exit by Year

Birth year	Exit year											Survives
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
1990 and earlier	31	28	29	26	30	13	15	18	19	24	25	275
1991		0	5	4	0	1	3	3	0	1	0	20
1992			2	5	1	1	1	3	0	3	3	20
1993				3	3	1	5	3	2	1	1	17
1994					1	6	4	1	3	4	4	25
1995						4	4	2	4	8	2	26
1996							4	5	6	4	5	44
1997								5	4	5	7	36
1998									3	5	7	43
1999										1	3	45
2000											1	44
2001												3
	31	28	36	38	35	26	36	40	41	56	58	598
												1,023

Source. Campbell (2005). Reprinted with kind permission of Springer Science + Business Media.

Note. "Birth year" indicates the first year a firm has a payroll in California. "Exit year" indicates year of last appearance in the data.

enough to have a payroll, these mortality rates are fairly large. There are 107 firms in the data that are publicly traded. Of these 107 firms, 22 firms were born and became publicly traded during the period of observation. Three of the remaining 22 firms experienced an IPO before they entered California. Of the firms with observable firm birth date and IPO date, 8 firms became public within three years of firm birth. This implies that the probability of a start-up becoming publicly traded within three years of birth is just under 1.5% (8 firms out of 542 potential firms). To summarize the success and failure rates facing new firms in this industry and time period, 1.5% of start-ups go public within three years and 27% of start-ups die within three years. In other words, start-ups in this context are 18 times more likely to die than to go public during their first three years of existence.

The strength of the data is that it is universal and covers a long time period. Furthermore, the data are administrative, which minimize the concern of entrepreneurs underreporting their earnings (Parker 2004). The primary weakness is that there are few controls in the data. Specifically, there are no controls for the standard demographics of age, gender, and race, nor are there controls for the standard human capital variables of education and occupation. In the empirical analyses, I employ a matching methodology to mitigate the effect of these data limitations.

3.3. Construction of the Matched Control Group

As demonstrated in Figure 1, individuals with start-up experience exhibit higher earnings than the rest of the sample. This result is consistent with the selection effect identified earlier, and thus comparing outcomes

Figure 1 Median Earnings of Employees with Start-up Experience vs. Rest of Sample

Source. Campbell (2005). Reprinted with kind permission of Springer Science + Business Media.

Table 2 Earnings Distribution of Employees with Start-up Experience and the Matched Control Group (\$2,001)

	Employees with start-up experience	Matched employees	Difference
Quarterly earnings			
First quartile	8,536	9,184	−648
Median	17,365	17,529	−164
Third quartile	29,949	29,518	431
Annual earnings			
First quartile	36,202	38,184	−1,982
Median	69,906	69,904	2
Third quartile	119,416	116,810	2,606
<i>N</i>	1,078	1,078	

Source. Author's own tabulations from California UI data.

Note. "Matched employees" are the nearest neighbors to the employees with start-up experience at their prior employer in the quarter prior to separation.

for employees with start-up experience relative to the rest of the sample would substantially overstate the earnings effects of start-up experience. To control for observable differences between employees who join start-ups and other employees, I construct a reference group of similar workers who have never worked at a start-up.

The matched control group is constructed by identifying each focal employee's nearest neighbor in the wage distribution at the focal employee's pre-start-up employer prior to the focal employee's start-up mobility event. In other words, before an individual leaves for a start-up, he or she is matched with an employee at the same established firm who earns a very similar amount. On average, each employee with start-up experience should be matched to a worker with very similar skills, background, and other characteristics that may affect earnings potential.³

The fundamental counterfactual is that the matched employees represent the outcomes for the focal employees had they not chosen to leave their established employer to join a start-up. The groups may differ across unobservable characteristics such as age, experience, occupation, field of specialization, latent talent, opportunity to work at a start-up, or underlying risk preferences; however, the two groups are constructed to have similar observable characteristics and face similar economic conditions.

Table 2 presents the earnings distributions for the employees with start-up experience and their matched counterparts in the quarter prior to the focal employee leaving for a start-up. By construction, the distributions of quarterly earnings and annual earnings are

very similar. At the median, annual earnings differ across the two groups by just \$2, which suggests that both groups of workers have human capital bundles that are similarly valued. Note also that the average earnings of employees who join start-ups is approximately what a young engineer would earn in this industry (Brown and Campbell 2001). This is consistent with expectations on which employees are most likely to join start-ups in this context.

3.4. Estimation

In the analysis, I adapt the methodology of Jacobson et al. (1993) to examine the impact of firm life-cycle events on the earnings profiles of workers. I examine the impact of firm events on the earnings and earnings profiles of employees with start-up experience relative to their matched counterparts. To allow coefficients to vary between the employees with start-up experience and their reference group, I estimate the following interacted model:

$$\ln W_{it} = \alpha_i + x_{it}\beta + D_{it}\delta + C_i \cdot x_{it}\beta^c + C_i \cdot D_{it}\delta + \epsilon_{it}, \quad (1)$$

where W_{it} is total quarterly earnings, C_i is a dummy variable that equals 1 if the individual was employed at a start-up firm in any quarter of the sample, and α_i is an individual fixed effect capturing all permanent observed and unobserved worker characteristics (including demographics such as age, race, and gender, and other time-invariant characteristics such as risk preferences). The vector x_{it} contains observed time-varying characteristics of individuals and their jobs. The vector D_{it} contains a series of dummy variables that indicate the timing of a firm life-cycle event during an individual's work history. The life-cycle events of interest include an individual who is employed at a firm in the firm's first quarter of existence, an individual who changes jobs, an individual who is employed at a firm when the firm dies, and an individual who is employed in a firm when the firm has an IPO. The dummy variables are constructed to capture the years before, the quarter of, and the years after the firm event occurred.

This model yields estimates of the effect of personal characteristics and work-history events on the earnings of employees who join start-ups and their matched counterparts. This specification is a generalization of difference in differences that accounts for the impact of permanent observed and unobserved characteristics and time-varying observed characteristics, and, of most interest, the effect of work history events on the pre- and postevent earnings of both groups of workers. This methodology yields unbiased results even if workers' observed or unobserved permanent characteristics are related to their job-change status (Jacobson et al. 1993). In the following section, I apply the model in Equation (1) to examine the effect

³ An important set of robustness checks of the results is to explore alternative matching methodologies and verify that the results associated with this methodology are consistent across a variety of matching algorithms. A change in data access regulations in the middle of the analysis limited the ability to perform such robustness tests. As such, I suggest this limitation as a direction for future research.

Figure 2 Median Earnings of Employees with Start-up Experience vs. Matched Counterparts

Source. Author's own tabulations using California UI data.

of choosing to work for a start-up relative to staying with the same established employer.

4. Results

4.1. Earnings Effects of Start-up Experience

Figure 2 demonstrates the earnings profile of employees with start-up experience before and after leaving an established employer to work at a start-up as compared to the matched control group. Because of the matching methodology, earnings of the employees with start-up experience and the matched control group are very similar prior to the focal employees leaving for the start-up. After leaving their established employer, employees with start-up experience exhibit a large immediate earnings dip in the quarter of job change, return to their initial earnings level one quarter after the job change, and then experience a higher earnings trajectory than the matched counterparts. The data suggest that there are positive returns to joining a start-up after an initial period of earnings loss that may reflect time out of the labor force between jobs or unpaid time before the start-up began to compensate their employees. Earnings recovery occurs more quickly than anticipated and reflects that the firms only appear in the data when they pay payroll taxes, thus the new firms are likely to have received some form of funding that is then used to compensate early stage employees.

The size of the earnings dip for the median worker is \$2,166, which represents approximately two weeks of earnings for the median worker. After two years, employees with start-up experience have earned \$1,425 more than their counterparts, after three years, \$4,556 more, and after five years, \$13,772 more than the matched counterpart.

Table 3 provides the estimates for Equation (1) as applied to the same comparison previously discussed. I present two specifications. Model I includes only the timing variables indicating the years before and after a worker leaves an established firm to work for a start-up. Model II includes worker and job controls. All reported standard errors are robust standard errors clustered on individuals.

In Model I (i.e., the specification without controls), workers who join start-ups experience a small (although statistically insignificant) earnings dip during the quarter of job change to the start-up. In subsequent years, the employees with start-up experience exhibit higher earnings than their control group. After three years, employees with start-up experience earn approximately 50% more than they earned in the year prior to joining the start-up.⁴

In Model II, I include controls for the number of quarters the observation has been in the sample (a proxy for industry experience), the number of previous jobs the observation held during the sample, the number of jobs held in the quarter, firm size, and an indicator for publicly traded firms. I also interact these controls with a dummy variable indicating that a worker has start-up experience. I find that employees with start-up experience exhibit an

⁴ Panel data on wages are likely to exhibit autocorrelation of the error terms. If error terms are autocorrelated, then the positive effect of experience at a start-up might actually reflect a persistent earnings shock that happened to trigger an employee to join a start-up. Estimating the models while controlling for autocorrelation either show no difference from the uncontrolled specifications, which is consistent with prior literature using this empirical approach (Stevens 1997) or demonstrate slightly larger effects than the uncontrolled specifications. These results suggest that models that do not adjust for autocorrelation provide conservative measures of the earnings effect of start-up experience.

Table 3 Joining a Start-up vs. Staying at an Established Firm

Dependent variable = Log(Quarterly earnings)		
	Model I	Model II
Three years prior to firm birth	−0.4032*** (0.0589)	−0.2665*** (0.0585)
Two years prior to firm birth	−0.0434 (0.0401)	−0.0001 (0.0397)
Quarter of firm birth	−0.0501 (0.0565)	−0.1338** (0.0564)
One year after firm birth	0.2723*** (0.0415)	0.2096*** (0.0427)
Two years after firm birth	0.3846*** (0.0466)	0.2555*** (0.0484)
Three years after firm birth	0.5007*** (0.0558)	0.3052*** (0.0581)
Four years after firm birth	0.5622*** (0.0609)	0.3203*** (0.0638)
Five+ years after firm birth	0.7682*** (0.0689)	0.4185*** (0.0709)
Number of quarters in sample		0.0111*** (0.0010)
Start-up experience? × Quarters in sample		−0.0015 (0.0015)
Job change		0.0195** (0.0092)
Start-up experience? × Job change		0.0018 (0.0133)
Number of jobs in quarter		0.1739*** (0.0165)
Start-up experience? × Number of jobs in quarter		−0.0191 (0.0219)
Firm size (1,000s)		0.0114*** (0.0031)
Start-up experience? × Firm size (1,000s)		0.0030 (0.0056)
Publicly traded firm		0.0461 (0.0543)
Start-up experience? × Publicly traded		−0.0797 (0.0740)
Constant	9.0428*** (0.0624)	8.8848*** (0.0711)
Number of observations	70,104	70,104
Number of individuals in sample	2,098	2,098
R ² within	0.0366	0.0941
R ² between	0.0138	0.0114
R ² overall	0.0239	0.0367

Source. Author's own tabulations from California UI data.

Notes. All models are fixed-effects regressions. Excluded group is "one year prior to firm birth." Model II includes seasonal dummies. Reported standard errors are robust standard errors clustered on individuals.

95% significance; *99% significance.

earnings dip of 13% during the quarter of job change, but quickly recover and earn 31% more than their pre-separation income after three years. After 12 quarters, an employee who joins a start-up earns approximately 42% more than his or her pre-separation earnings, and workers in the matched control group earn

13% more than their base earnings.⁵ At the mean, start-up employees outperform their matched counterparts, even after controlling for individual fixed effects and time varying observables.

I also find that the return to holding previous jobs is positive and significant for both groups of workers, although the effect is not significantly different between the two groups of workers. The firm size premium is also positive and significant for both groups, but not significantly different between groups. Publicly traded firms pay significantly higher wages, although employees with start-up experience receive less of a wage premium from employment at public firms.

These results suggest that there are sustained pecuniary rewards that are associated with experience at a start-up in this context. Through the lens of human capital theory, this suggests that experience at a start-up may make individuals more attractive to the broader labor market in a manner that is consistent with the development or revelation of human capital that would not have occurred absent start-up experience. However, an alternative explanation of this result is that the observed earnings premium associated with start-up experience may be driven primarily by characteristics and outcomes of start-up firms instead of by characteristics of individuals. For example, the results might be capturing a risk premium paid by start-ups to compensate for an increased likelihood of firm death, or the results might reflect an increased likelihood of liquidity events at start-ups that increase the observed earnings of employees.

4.2. Earnings Effect of Firm Death and IPO

To address the concern that the results may reflect firm characteristics rather than individual experience, I first look at the earnings effect of working at a firm in the quarter in which it dies and the earnings effect of working at a firm in the quarter in which it goes public. The intuition is that if the earnings premium associated with start-up experience represents firm characteristics, the premium for an individual would disappear after firm death and if the premium is driven by start-up liquidity events, IPO events would have a large impact on the earnings of employees who started the firm.

Annual earnings for employees with start-up experience and the matched sample before and after firm death and an IPO are quite noisy. Using the data extract of matched workers yields small sample sizes

⁵ The returns to experience at the start-up at the three-year mark is the return to being an employee at a start-up that has been in existence for 12 quarters (0.3052) plus 12 quarters of additional experience for workers who have start-up experience (12 · (0.0111 − 0.0015)). This total equals 42.04%.

of workers who experienced firm death and/or an IPO, so the effects are difficult to measure precisely. The results on firm death and an IPO are in the left panel of Table 4. In the table, “charter” indicates that an employee was part of the focal firm at the firm’s founding. In the quarter of firm death, employees

at dying firms experience an earnings dip of 21%, but workers experience full recovery in the following period. There are no significant differences in the effect of firm death on the career profiles of workers in the focal sample relative to all other workers. In other words, although firm death has an adverse effect on all employees, it is temporary, and it does not have a larger effect on employees with start-up experience.

The effects of experiencing an IPO on the earnings profiles of individuals are presented in the right panel of Table 4. Although acquisitions might be an important liquidity event for start-up firms in this industry, these events are excluded. Because of data constraints, it is impossible to identify who is the acquirer and who is the acquired, so I limit the analytical focus on the effect of liquidity events to IPOs. The exclusion of acquisitions may bias the results downward.

Average earnings for employees without start-up experience are not affected by IPOs. Average earnings for employees with start-up experience demonstrate a significant increase in the quarter of an IPO, but that increase disappears in subsequent years. These results are difficult to interpret because the data do not capture all noncash compensation and the sample size is small. If workers at publicly held firms are compensated in a manner that is not reportable to the California UI program (for example, through certain forms of stock options), then total compensation is undervalued in this sample. However, in terms of reported taxable earnings, the effect of an IPO on earnings profiles is small.

Firm death has very little impact on the earnings profiles of employees with start-up experience relative to their matched counterparts, whereas the effect of an IPO is more challenging to assess because of measurement issues. The finding on firm death is consistent with the role of human capital and individual experiences in explaining the earnings effect associated with working at a start-up.

4.3. Risk Preferences and Start-up Choice

Despite firm death and an IPO having little impact on the earnings of employees with start-up experience, working for a start-up represents a higher risk/higher reward choice relative to employment at established firms. The full distributions of outcomes for both employees with start-up experience and their matched counterparts after five years are depicted in Figure 3. This figure includes kernel density estimates of the total earnings after start-up separation for both sets of employees. The figure depicts total earnings as the multiple of each individual’s pre-start-up earnings to control for differences in base levels of earnings. The figure demonstrates that the distribution of

Table 4 Earnings Implications of Firm Death and IPO

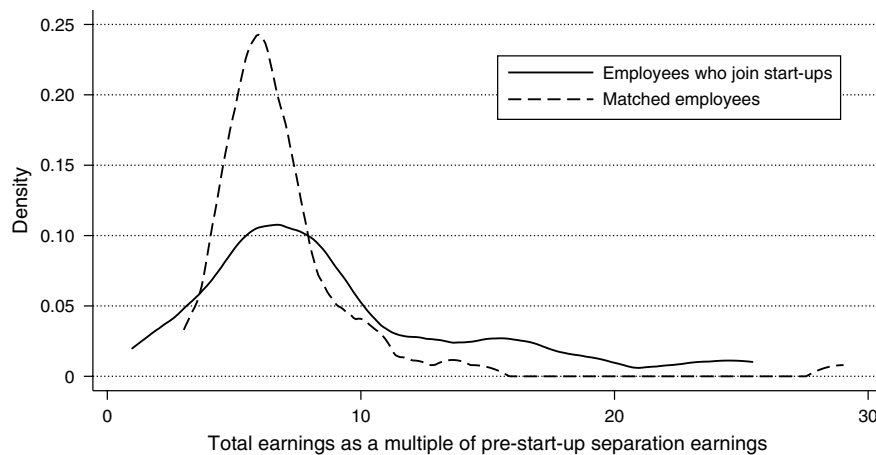
Dependent variable = Log(<i>Quarterly earnings</i>)		
	Event = Firm death	Event = IPO
<i>Three years prior to event</i>	0.0508** (0.0247)	−0.0528 (0.0466)
<i>Two years prior to event</i>	0.0947*** (0.0177)	0.0526 (0.0345)
<i>Quarter of event</i>	−0.2083*** (0.0254)	−0.0960 (0.0823)
<i>One year after event</i>	−0.0276 (0.0296)	−0.1474 (0.1392)
<i>Two years after event</i>	−0.0276 (0.0343)	−0.2310 (0.1600)
<i>Three years after event</i>	0.0172 (0.0427)	−0.1709 (0.1496)
<i>Four years after event</i>	−0.0174 (0.0485)	−0.1633 (0.1474)
<i>Five + years after event</i>	−0.0193 (0.0540)	−0.1677 (0.1475)
<i>Charter × Three years prior to event</i>	0.0893 (0.0906)	0.1341 (0.1014)
<i>Charter × Two years prior to event</i>	0.1094 (0.0725)	0.0493 (0.0803)
<i>Charter × Quarter of event</i>	0.1153 (0.0801)	0.2131* (0.1148)
<i>Charter × One year after event</i>	0.0838 (0.0520)	0.2354 (0.1485)
<i>Charter × Two years after event</i>	−0.0440 (0.1097)	0.2006 (0.1940)
<i>Charter × Three years after event</i>	0.0493 (0.1009)	0.2052 (0.1801)
<i>Charter × Four years after event</i>	−0.1571 (0.1455)	0.0079 (0.2065)
<i>Charter × Five+ years after event</i>	0.0146 (0.1209)	0.1670 (0.1899)
Worker and job characteristics?	Yes	Yes
Number of observations	70,104	70,104
Number of individuals	2,098	2,098
<i>R</i> ² within	0.0853	0.083
<i>R</i> ² between	0.0089	0.0035
<i>R</i> ² overall	0.0279	0.024

Source. Author’s own tabulations from California UI data.

Notes. All models are fixed-effects regressions. Excluded group is “one year prior to event.” “Charter” indicates individual was employed at the founding firm at the firm’s inception. Worker and job characteristics include number of quarters in the sample, job-change indicator, number of jobs held in the quarter, total number of previous jobs, firm size, publicly traded employer indicator, seasonal dummies, and interactions with the charter employee indicator. Reported standard errors are robust standard errors clustered on individuals.

*90% significance; **95% significance; ***99% significance.

Figure 3 Total Earnings in the First Five Years After Start-up Separation—Density of Employees with Start-up Experience and Matched Sample



Source. Campbell (2005). Reprinted with kind permission of Springer Science + Business Media.

Notes. Total earnings after start-up separation are total earnings earned since focal employee left for a start-up. The figures presented are multiples of pre-start-up separation annual earnings.

outcomes for employees with start-up experience has a larger median and mean value and has much larger variance than the distribution of outcomes for the control group. Specifically, five years after separation, the mean earnings for the employees with start-up experience is 1.47 times larger than the mean earnings associated with employment at an established firm and the standard deviation is 1.74 times greater.

Focusing only on pecuniary rewards and assuming that workers choose between joining a start-up and staying at an established firm, the two distributions in Figure 3 can be used to make inferences on the risk preferences of employees who join start-ups. I focus on risk aversion, which is an individual characteristic that captures individuals' disutility of bearing risk (or equivalently, how much compensation individuals require to bear risk). By definition, highly risk-averse individuals will require a higher premium than less risk-averse individuals to willingly engage in a risky activity. Assuming that labor markets work reasonably well, the premium (i.e., the mean return) associated with a risky employment choice will get pushed to a level where the supply of individuals willing to accept the risky option is equal to the demand for those individuals. At this premium, there is a threshold level of risk aversion where all individuals who choose the risky option are less risk averse than the threshold and all individuals who do not choose the risky option are more risk averse than the threshold.

Applying this logic to this context, given the full range of outcomes and the resulting ex post examination of the full distribution of the risks and rewards facing employees with start-up experience and their matched counterparts, I can estimate the threshold level of risk aversion that sorts individuals in to high reward/high risk start-up employment or low reward/low risk employment at an established firm.

The intuition is that individuals who are less risk averse than the threshold would select into risky start-ups, whereas individuals who are more risk averse than the threshold will select into low-risk outcomes associated with employment at an established firm. To estimate the threshold, I calculate the expected utility associated with both start-up experience and employment at an established firm across the full range of observed outcomes under the assumption that individuals have constant relative risk-aversion utility. I then calculate the threshold as the degree of risk aversion at which an average individual is indifferent between low mean/low risk employment at an established firm and high mean/high risk employment at a start-up.⁶

Under the assumptions that individuals have constant relative risk aversion, their earnings are a random draw from the observed distribution of earnings for their type, and they have full information on the distribution of earnings for both types, the level of risk aversion necessary for an individual to be indifferent between joining a start-up and staying at an established firm is extremely high. In fact, the estimated level of risk aversion necessary for individuals to be indifferent between the paths is two to three times the level typically observed in the population as a whole.⁷ This suggests that if individuals had perfect foresight on the full distribution of possible

⁶ Additional detail on the methodology is available in the electronic companion.

⁷ Looking at a five-year time horizon, I find that a coefficient of relative risk aversion of 1.99 is necessary for individuals to be indifferent between the two options. Chetty (2006) summarizes 33 studies that use labor supply decisions to estimate individuals' level of risk aversion and argues that the population has a coefficient of relative risk aversion of between 0.71 and 0.97 depending on the underlying assumptions.

outcomes, only extremely risk-averse individuals would choose *not* to join a start-up in this industry and time period. Although approximately 25% of employees with start-up experience are worse off than their matched counterparts, the high returns to success in this context make start-up employment very attractive for all but the most risk-averse workers. Adding nonpecuniary rewards into the calculation would make start-up experience even more attractive.

Together, these results suggest that the earnings effect of start-up experience is not driven by firm characteristics. First, the premium for individuals does not disappear after firm death, which suggests that the earnings premium is attached to the individual and not to the firm. Second, the premium is not dominated by an IPO, which is suggestive that the results are not purely driven by the likelihood of start-ups in this industry to provide windfalls to their early employees. Finally, the results do not just represent a compensating differential for working in a risky environment. These results are consistent with the suggestion that experience at a start-up increases the market value of an individual and that this increased value persists over time even if the start-up fails.

5. Robustness Checks and Additional Analyses

Another potential explanation for the previous results is the endogeneity of job change. Workers will only change jobs if the expected value of the new job is greater than the expected value of the previous job. If this is true, then it is not surprising that workers who change jobs to work at start-ups are better off than had they not changed jobs. I address this concern by comparing the earnings profiles of employees with start-up experience before and after joining a start-up with the earnings profiles of the same group of workers before and after a job change to a non-start-up.

A second alternative explanation for the results is that employees with start-up experience are systematically better at choosing new jobs, so when they change jobs they acquire better outcomes than when the matched sample changes jobs. To address this concern, I compare the outcomes of employees with start-up experience before and after a job change to an established firm to the outcomes of matched workers before and after the matched workers change jobs to an established firm. The intuition is to check if earnings for employees with start-up experience and their matched counterparts behave the same after traditional job changes. If they do, I can rule out the alternative explanation that employees with start-up experience have greater ability to find more lucrative job opportunities.

A third factor that may be driving the results is the idiosyncrasy of the 1990–2002 time period in this

industry. Revenues in the California semiconductor industry increased dramatically in 1999 and 2000 and then plummeted in 2001 and 2002 after the technology sector bubble popped. A potential concern with the results is that the positive effect of start-up experience may be driven by extreme returns to entrepreneurship in the 1999–2000 time period, which overshadows the effect of start-up experience during more representative industry conditions. To explore this potential issue, I perform subsample analyses of the models in the 1990–1998 and 1999–2000 time periods.

5.1. Job Change to Start-up vs. Job Change to Established Firm

To address the concerns of the potential endogeneity of job change and selection bias, I implement the same approaches as previously mentioned, now focusing on a different counterfactual: What would employees with start-up experience have earned had they changed jobs to an established firm instead of to a start-up?

Figure 4 depicts the outcomes of three job-change events: employees before and after they join start-ups; employees with start-up experience before and after they change jobs to established firms; and matched workers before and after they change jobs to established firms. All three mobility events exhibit a large dip in the quarter of separation, a quick recovery in the quarter after separation, and then an upward sloping earnings profile.

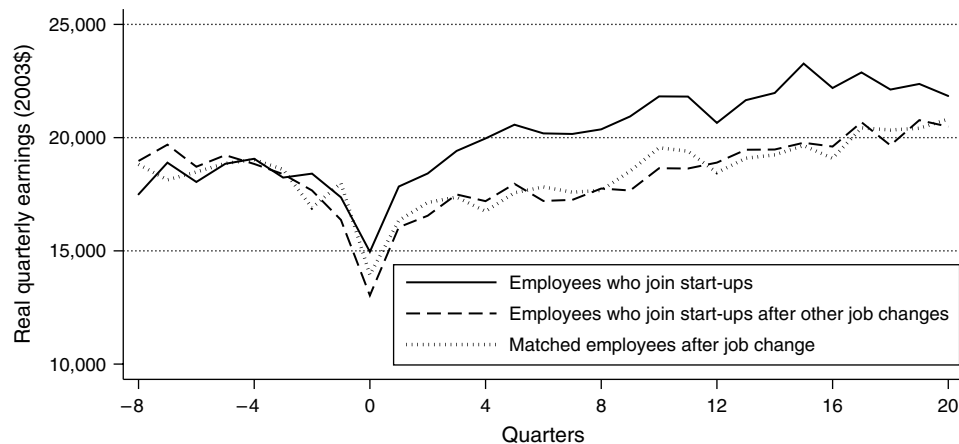
All three paths are very similar prior to the separation, but after the job-change event the path of employees who join start-ups dominates the earnings paths of both sets of employees changing jobs to established firms. The difference in earnings after job change to established firms is similar for both the employees with start-up experience and their matched counterparts.

In other words, employees who have start-up experience earn significantly more after changing jobs to a start-up than when they change jobs to an established firm. Additionally, when employees with start-up experience change jobs to an established firm, they display the same postmobility earnings trajectory as traditional employees.

These results indicate that even within the career paths of employees with start-up experience, job change from an established firm to a start-up dominates job change from an established firm to an established firm. This result suggests that the observed rewards associated with start-up experience reflect the effect of working at a start-up and not just the effect of an endogenous job change.

The finding that employees with start-up experience and their matched counterparts do not substantially differ after job changes from established firms

Figure 4 Return to Job Change to Start-up vs. Return to Job Change to Established Firm: Employees with Start-up Experience vs. Matched Sample



Source. Author's own tabulations of median earnings using California UI data.

to established firms indicates that the results are not driven by systematic differences between employees with start-up experience and their matched counterparts with respect to their ability to choose new jobs and to succeed at new jobs. Additionally, the similarity in earnings profiles between the two classes of employees before and after traditional job change increases confidence in the quality of the matching methodology.

5.2. Earnings Effects of Start-up Experience in 1990–1998 and 1999–2000

A potential alternative explanation for the results is that the positive effect of start-up experience is driven by extreme returns to entrepreneurship during the technology bubble of 1999–2000. Labor market conditions at the time of market entry have long-term effects on individual outcomes (Oyer 2006), and this effect may extend to entry into entrepreneurship. Although the time frame covers a boom and bust cycle, the technology bubble of the late 1990s and early 2000s may be dominating the results. If, because of increasing availability of start-up financing, there is increasing demand for employees with start-up experience, then compensation for employees with start-up experience will rise in the late time period, potentially explaining all of the results. To explore this issue, I perform subsample analyses comparing the results of the early stable period (1990–1998) and the latter bubble period (2001–2002). In this robustness check, I omit the 2001–2002 time period because of the very small number of start-ups in this industry during this time period.

The pattern in the 1990–1998 time period is very similar to what is observed in the full sample in Model II of Table 3: after an initial dip during the transition from employment at an established firm to

a start-up, earnings quickly recover and then outperform those of the matched sample. However, in the bubble period, the pattern differs slightly. Specifically, the 1999–2000 results are not significantly different from the 1990–1998 results except for the estimated wage premium for employees with start-up experience four and five years after joining a start-up. These coefficients, although still positive, are significantly lower in the bubble period than in the stable period. Note also that in the bubble period, the initial earnings dip that occurs for employees who join start-ups in the quarter of firm birth is not statistically significantly different from zero (although it is also not significantly different from the corresponding coefficient in the stable time period). This is in contrast to all other models where there is a consistently strong earnings dip in the quarter of firm birth.

Together, these results suggest some small but important differences in outcomes between the stable period and the bubble period. New start-up employees are not penalized as much in the bubble period and experienced start-up employees earn a smaller premium during the bubble period. The results are consistent with an increased valuation of employees at brand-new start-ups relative to employees at established firms and older start-ups during the bubble.

6. Discussion

This research focuses on adding to the understanding of the rewards available to entrepreneurs by examining the earnings implications of experience at a start-up. Exploring the pecuniary rewards available to potential entrepreneurs adds to the research on why some people choose to pursue entrepreneurial activity and some do not. First, I examine the entrepreneurial context through the lens of human

capital theory to explore how experience at a start-up may affect the earnings of individuals. Second, using a data set covering the universe of workers in California's semiconductor industry from 1990–2002, I estimate the returns to experience at a start-up. The main empirical findings for this industry are as follows: workers who leave established firms to work for start-ups suffer an initial earnings dip but quickly recover and earn more than their matched counterparts; workers who change jobs to start-ups experience substantially better earnings than matched employees who change jobs to established firms; workers who change jobs to start-ups have higher earnings growth than when they themselves change jobs to established firms; and firm death has very little impact on the cash earnings of both employees with start-up experience and their matched counterparts in this industry and time period. In this context, the substantial return for workers who work at start-ups is accompanied by very little (ex post) risk.

Comparing the findings to the mechanisms through which human capital theory suggests that start-up experience may affect workers' earnings highlights the importance of the development or revelation of general human capital. Individuals receive an earnings premium relative to employment at an established firm soon after joining a start-up, and that premium increases over time and persists even after firm death. This is exactly what is expected to happen to individuals who develop or reveal human capital that is valuable and transferrable to other firms. As the level of observable transferrable human capital increases, an individual's value to alternative employers increases, and the individual can appropriate higher compensation from his or her current employer by threatening mobility. This finding on human capital acquisition is consistent with other findings on learning in the semiconductor industry (Hatch and Dyer 2004).

I do not observe the same earnings effects when individuals move to established firms, even when focusing on non-start-up mobility events within the careers of employees with start-up experience. This implies that the earnings premium is not purely attributable to the observed or unobserved characteristics of employees who select into entrepreneurial activity. In other words, the earnings premium at start-ups is attributable to a treatment effect, where experience at a start-up affects employees in a manner that would not exist absent start-up experience.

Additionally, the factors that are driven by compensating differentials logic appear to play a minimal role on workers' outcomes. I find that employees with start-up experience earn a premium relative to what they would have earned at an established firm, which suggests that neither start-up-specific benefits

nor cash constraints at entrepreneurial firms drive the results. I also demonstrate that in this context the earnings of employees with start-up experience are not adversely affected by firm death which is inconsistent with stigma effects. Furthermore, I show that participation in a start-up in this context is not high risk for individual workers. As a result, the start-up earnings premium does not behave as a risk/uncertainty premium. Also, I demonstrate that IPOs do not provide a sustained effect for workers at start-ups, demonstrating that neither halo effects nor the effect of liquidity events explain the results.

In summary, the full range of results suggests that the earnings effect associated with the revelation and development of general human capital through start-up experience overshadows the start-up effect attributable to compensating differentials in this sample. This implication supports an expanded conceptualization of the rewards available through entrepreneurship as compared to the previous literature that examined the rewards available inside entrepreneurial organizations (e.g., Hamilton 2000, Georgellis et al. 2007, Hartog et al. 2010, Braguinsky et al. 2012). The application of human capital theory to the entrepreneurial context highlights that entrepreneurial experience can change the labor market value of an individual. This provides a valuable extension to the literature on why some individuals choose to pursue entrepreneurship: individuals may choose entrepreneurship not just for the rewards associated with being an entrepreneur (Amit et al. 1995, Lazear 2005) but also for the rewards *after* being an entrepreneur. Furthermore, these findings contribute to the literature on which individual characteristics are predictors of entrepreneurial entry (such as recent work by Van der Sluis et al. 2008, Hartog et al. 2010, and Toole and Czarnitzki 2009) by suggesting that characteristics that facilitate learning while at a start-up and characteristics that facilitate the transition out of entrepreneurship are also important to the decisions of prospective entrepreneurs. Also, in contrast to Blanchflower and Oswald (1998) and Hamilton (2000), these findings suggest that, in at least one context, compensating differentials are not strongly related to the pecuniary earnings available inside start-ups. In this context, the general human capital effect dominates any compensating differential effect.

There are several limitations and alternative mechanisms that affect interpretation and generalizability of the findings and suggest future research. First, given data constraints, it is not possible to separate whether an individual's labor market value is changed because he or she was able to learn and develop new skills in a start-up or because selecting into a start-up revealed human capital that was otherwise unobservable to the labor market; however, both mechanisms can

result in sustained returns to an individual's choice to enter an entrepreneurial context. Second, the analysis is performed on one industry in one state during what is potentially an idiosyncratic time period for the industry, so generalizing to other contexts must be done with great caution. In fact, the results contrast previous evidence on the negative relationship between pecuniary rewards and entrepreneurial experience (Hamilton 2000, Braguinsky et al. 2012) and that small and/or young firms offer lower returns to human capital (Troske 1999, Winter-Ebmer and Zweimüller 1999, Brown and Medoff 1989). Additional studies looking at other industries and other time periods would allow examination of the extent to which idiosyncratic industry characteristics play a role in the phenomenon.

Also, the empirical results are limited by the quality of the matching algorithm. An important robustness test is to check the consistency of the results across different matching algorithms and approaches. The current methodology matches employees who join start-ups with coworkers who had similar earnings in the year prior to their counterpart joining the start-up. As demonstrated in the baseline regression results in Table 3, earnings are also indistinguishable between employees who join start-ups and their counterparts two years prior to the focal employee leaving the established firm. However, employees who join start-ups earn significantly less than their counterparts three years prior to separation. This suggests that the earnings trajectory of employees who join start-ups and their counterparts differed prior to separation. A potential explanation for this pattern is that employees who join start-ups, on average, had faster rising earnings than their counterparts between years $t-3$ and $t-2$, but leveled off between $t-2$ and $t-1$, which triggered their mobility to a start-up. Future research on this phenomenon could match employees on individual's entire career, such as the Coarsened Exact Matching algorithm (Iacus et al. 2012) as implemented in Azoulay et al. (2011). This would benefit the construction of the counterfactual group by matching on more characteristics, but it would come at the cost of reducing the size of the universe from which matches are drawn (Azoulay et al. 2011). Matching within an employer is critical to the methodology of this study; thus, the available universe of matches is already small, and deeper matching methods would restrict the universe even further. However, this limitation could be addressed with a nested matching approach. Allowing employee matches to occur outside of the employing firm but within a set of comparable/matched firms might allow for richer matching without reducing sample size. Furthermore, loosening the bands around wages and other characteristics in the matching algorithm

would also increase the universe of potential matches without degrading the quality of the overall matched sample.

Another weakness of the matching process is that the data have extremely limited demographic variables; thus, the range of possible alternative matching approaches is limited. Important characteristics that might affect the propensity to join a start-up and also affect earnings profiles (such as age, education, and gender) are not available in the data and thus cannot be considered in the match. This limits the matching options and may bias any matched sample. For example, a senior male employee and junior female employee who happen to earn the same amount for one year might be matched although their ambitions, risk preferences, human capital, and time horizons may be quite different. If this type of error is not randomly distributed, then the counterfactual group could be biased. Similarly, the matching algorithm does not account for different types of skills. Consider two employees who earn the same amount at an established firm, yet one employee has extensive experience and little creative ability and the other employee has low experience but a high degree of creative ability. Because entrepreneurial firms provide different returns to skills than established firms (Hartog et al. 2010), the second employee might be more highly valued in a start-up, and again, the counterfactual group could be biased. These issues could be resolved with additional data that include demographic variables, rich measures of human capital, and career histories, which would facilitate use of richer matching algorithms such as Propensity Score Matching (Rosenbaum and Rubin 1983) and Coarsened Exact Matching (Iacus et al. 2012).

There are several alternative explanations for the findings. The differences in compensation between start-ups and established firms may reflect differences in work organization and noncash compensation as well as founders' inside information on worker quality and positive screening of start-ups by investors. One alternative explanation that cannot be rejected by the data is that if workers at start-ups work more hours than workers at established firms, then the earnings premium of employees with start-up experience may not be reflected when calculated on a per hour basis (Carrington et al. 1996). Another alternative explanation for the findings is that founders have inside information on worker quality because of social networks (Montgomery 1991). If founders hire people they know when starting a firm, then the matching methodology as implemented is biased. For example, if a founder is choosing a first hire from two observably equivalent employees at her previous firm (i.e., the sort of pair who would be matched by the matching algorithm), and she has

inside information on unobservable skills, she will choose the employee with greater unobserved skills, which means the results are driven by the fact that start-up workers are, in some sense, just better workers. Also, the lack of a negative effect associated with firm death could be driven by social networks in the semiconductor industry. In this industry, it is well established that start-up firms participate in regional networks (Appleyard 1996, Almeida and Kogut 1999, Almeida et al. 2003) and develop alliances with stronger firms (Eisenhardt and Schoonhoven 1996). As a result, workers in start-ups often have strong social networks and may be able to more quickly find alternative employment if their firm fails than workers with less extensive social networks.

Also, perhaps start-ups that appear in the data (that is, they actually pay their employees and pay taxes on their payroll) are highly likely to be venture backed. However, if venture capitalists only back start-ups with high growth potential (Shepherd 1999), then the gap in earnings between start-ups and established firms could just be proxying for a gap in compensation between slow growth and high growth firms, or as mentioned earlier, the gap in earnings could reflect greater resources available in venture-backed firms or halo effects associated with receiving venture capital (Barney et al. 1996, Gompers et al. 2010). The first two factors reflect local effects that would not persist after firm death, but the last factor represents an alternative explanation for the earnings effects associated with start-up experience. Examination of the role of funding environment on the career consequences of start-up experience represents a rich avenue of future research.

Despite these potential limitations, this study contributes to the entrepreneurship literature by providing a foundation for understanding the earnings implications of start-up experience across workers' careers. In this context, start-up experience provides persistent rewards that extend outside the entrepreneurial environment. This finding enhances the previous research on the pecuniary rewards available to entrepreneurs that focuses only on the returns available to individuals while employed in an entrepreneurial context (Hamilton 2000, Hartog et al. 2010). Although "What are the pecuniary rewards available inside entrepreneurial firms?" is an important research question, it is a fundamentally different question than "What are the pecuniary rewards available to entrepreneurs?" When potential entrepreneurs compare the total costs and total benefits associated with pursuit of an entrepreneurial opportunity, they should consider how entrepreneurial experience will affect their human capital and thus alter their earnings potential over the course of their career.

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