



# *Human Capital and the Entrepreneurial Careers of Scientists and Engineers*

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## **Abstract**

I examine the role of human capital in shaping entrepreneurial activity by studying the entrepreneurial careers of scientists and engineers from entry to exit. I analyze how the development of human capital through education and employment affects entrepreneurial entry, performance, and exit. Empirically I utilize the restricted-use National Science Foundation (NSF) Scientists and Engineers Statistical Data System (SESTAT) which is a large data set focused on scientists and engineers to identify possible drivers of transitions to entrepreneurship amongst knowledge workers. Additionally, I am able to analyze the extent to which transitioning to entrepreneurship allows scientists and engineers to increase their financial and non-financial work outcomes and finally, what mechanisms are associated with their exit from entrepreneurship and subsequent return to wage work.

**Category:** Entrepreneurship, Human Capital, Quantitative Methods

**Keywords:** Entrepreneurial motivations, entrepreneurial human capital, high tech entrepreneurship, entrepreneurial work outcomes, educational mismatch, entrepreneurial exit

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## **Executive Summary**

This dissertation lies at the nexus of strategic management and entrepreneurship, with a focus on the role of human capital in shaping entrepreneurial entry, performance and exit. In particular I study the acquisition of general human capital through education and employment. I examine the extent to which certain motivations for building human capital predict whether someone will enter entrepreneurship and how they will perform in entrepreneurship. There is a growing body of literature that examines how workers' employment experiences shape subsequent entrepreneurship. I advance this body of work by considering how work experiences are shaped jointly by both features of the organization and by attributes of the worker, including the degree to which there is a match or mismatch with respect to important dimensions, such as skills and capabilities. I focus on four main research questions.

1. What drives people to leave employment in wage work to enter entrepreneurship?
2. What is the role of human capital in shaping entrepreneurial activity?
3. When people move to entrepreneurship, are they able to increase their pecuniary and non-pecuniary benefits?
4. What mechanisms prompt someone to exit entrepreneurship and return to wage work?

I address these questions in several chapters of my dissertation. In the following, I provide a brief overview of each chapter.

### ***Chapter 1 Educational Mismatch, Work Outcomes, and Entry into Entrepreneurship***

A growing body of research examines how workers' employment experiences shape subsequent entrepreneurship. Recent work considers the joint role of characteristics of the workplace as well as of individual workers, including the degree to which there is a "match" with respect to important dimensions such as skills and capabilities. For example, Astebro et al. (2011) argue that labor market frictions may leave some workers in jobs where their skill profile does not complement well the skills of other workers in the firm. Such mismatched workers will suffer from lower wages, reducing their opportunity cost for

switching jobs and entering entrepreneurship. The focus on labor market frictions as a driver of mismatch is consistent with a large body of prior work that studies skill mismatches and the underutilization of human capital and tends to show negative outcomes for the affected workers (Tsang and Levin 1985, Bowlus 1995, Oyer 2008).

In this chapter, I focus on a particular type of mismatch – when an individual works in a job that is not closely related to his or her training and education (“educational mismatch”). I add to the understanding of educational mismatch and its role in shaping entrepreneurial entry in two important ways. First, I highlight that individuals may be mismatched for very different reasons. While some individuals may be forced into a mismatch due to labor market conditions, others may choose jobs that involve a mismatch for a number of other reasons. Different reasons for a mismatch, in turn, may relate in very different ways to work outcomes such as wages or job satisfaction. Second, while mismatch may have negative consequences in terms of pay and job satisfaction, it may also lead employees to engage in new kinds of activities and to acquire corresponding skills that go beyond what was learned in formal education. The resulting broader set of skills, in turn, may be exactly what is needed to enter entrepreneurship (Lazear 2005). As such, while the prior literature has focused on lower opportunity costs as the primary mechanism mediating the relationship between educational mismatch and entrepreneurship, a broadening of the skill base may provide a complementary explanation.

I draw on longitudinal data from a sample of over 22,000 scientists and engineers in the United States from 2003 to 2008 from the restricted use NSF (National Science Foundation) SESTAT (Scientists and Engineers Statistical Data System) survey database to examine the relationships between educational mismatch and work outcomes such as wages, job satisfaction, and skill variety, as well as the relationship between mismatch and subsequent entry into entrepreneurship. In doing so, I distinguish between different reasons for mismatch, focusing especially on the degree to which the mismatch was “involuntary” due to labor market frictions (i.e., lack of other job opportunities) versus the workers’ choice for career or personal reasons. Descriptively, I find that in my sample of scientists and engineers,

mismatches due to a lack of job opportunities are considerably less common than mismatches for career reasons, suggesting the need to consider different types of mismatch more explicitly.

Focusing first on the relationships between educational mismatch and work outcomes in current employment, I find that mismatch is generally associated with lower salary and job satisfaction. However, these relationships are much stronger for employees who mismatch due to market frictions than for those who chose a mismatch for career or personal reasons. With respect to skill variety, I find that employees who are mismatched for career or personal reasons engage in a smaller range of R&D activities but in a broader range of non-R&D activities such as finance, sales, and marketing. In contrast, respondents who are mismatched due to labor market frictions perform a smaller range of R&D activities without expanding their range of non-R&D activities. Thus, educational mismatch may have important implications for the development of human capital, though the patterns appear to be different depending on the nature of the mismatch.

Exploiting the longitudinal nature of the data, I find that employees who are mismatched in employment are more likely to transition into entrepreneurship in the next period.<sup>1</sup> However, mobility patterns differ depending on the reasons for a mismatch. Workers who are mismatched due to a lack of positions in their field have high levels of mobility in general, being more likely to move both to new employers and into entrepreneurship. Workers who are mismatched for career or personal reasons are more likely to move into entrepreneurship but are not more likely to leave their jobs for a different employer. Lower opportunity costs (i.e., lower wages and job satisfaction) play an important role as mediators linking educational mismatch to transitions into both new employment and entrepreneurship. Skill variety also strongly relates to subsequent entrepreneurship, although its role as a mediator is more limited.

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<sup>1</sup> Not all cases of self-employment represent entrepreneurship, i.e., the exploitation of opportunities in new ventures. However, in this dissertation I will follow the prior literature in using measures of self-employment as proxies of entrepreneurship, and will use the terms interchangeably in the subsequent discussion. I suggest that the correspondence between self-employment and entrepreneurship is stronger in my sample of highly-trained scientists and engineers than in the general population.

This study contributes to two related literatures. First, I add to a growing body of research on the drivers of entrepreneurial activity. While prior work has considered factors such as individual characteristics, institutional context, or prior employment in small firms, I examine the mismatch between a worker's education and the skill requirements of her job. In doing so, I build upon recent work by Astebro et al. (2011) which highlights the potential role of skill mismatch and provides suggestive evidence using a general population sample from Korea. Conceptually, I complement this prior work by distinguishing between different types of mismatch and by considering not only lower opportunity costs but also skill variety as potential mechanisms linking mismatch to subsequent entrepreneurship. Empirically, I exploit rich data on U.S. knowledge workers that allows me to measure key constructs that are often unobserved, including educational mismatch, non-pecuniary job benefits, as well as skill variety. Taken together, my results highlight the value of studying mismatch between employees and employers as a potential driver of entrepreneurship but also suggest the need to gain a deeper understanding of why individuals work in certain organizational contexts in the first place. Moreover, I integrate different streams of entrepreneurship research – focusing on opportunity cost and skill variety, respectively – to develop a richer conceptual discussion and to examine the relative role of different mechanisms in the same paper.

Second, my results provide new insights into the nature and implications of educational mismatch, a phenomenon that has received considerable attention among scholars as well as policy makers. I highlight that mismatch can occur for several different reasons and my results suggest that its impact on wages and job satisfaction depends on why the mismatch occurred. I also suggest the possibility that while mismatch typically implies an underutilization of the skills acquired during formal training, it may provide learning and training opportunities in new and different types of skills. From an empirical perspective, much of the prior work on educational mismatch has used general population samples, and I provide complementary insights by using data from highly trained knowledge workers. The richness of the survey instrument provides me with unique measures of key constructs while allowing

me to control for a range of factors that are typically unobserved in studies using general population samples.

### *Chapter 2 Does Entrepreneurship Pay or Satisfy?*

With the growing popularity of entrepreneurship as a career path, it is important to understand why people enter and whether it is beneficial to the entrepreneur. There have been mixed results reported on how beneficial entrepreneurship actually is. One stream of research assumes that people enter entrepreneurship because they seek to maximize income and finds that entrepreneurs earn more money than those working in established firms (Rosen and Willen 2002, Fairlie 2005, Braguinsky and Ohyama 2007, Berglann, Moen et al. 2011, Levine and Rubinstein 2013). Conversely, there exists a large body of literature that finds that entrepreneurs earn less than their equivalents in wage work (Evans and Leighton 1989, Hamilton 2000, Moskowitz and Vissing-Jorgensen 2002, Van Praag and Versloot 2007, Parker 2009, Åstebro and Chen 2014). This latter finding has lead researchers to question why workers are willing to enter, as well as remain in self-employment despite receiving returns substantially lower than what they might receive if they were employed in wage work. Many authors have suggested that entrepreneurship must offer certain non-pecuniary benefits compared to employment in an established firm that serve as a compensating differential for lower wages (Blanchflower and Oswald 1998, Hamilton 2000, Kawaguchi 2002, Moskowitz and Vissing-Jorgensen 2002, Hurst and Pugsley 2011).

One of the concerns with the current literature is that a majority of studies use cross sectional data which allows the examination of salary at one point in time, but does not allow for the study of how the wages change over time. Additionally, while many of these studies argue that there are non-pecuniary benefits to entrepreneurship, they do not have an actual measure to test this theory and merely assume that there must be non-pecuniary benefits to compensate for lower wages in entrepreneurship. The prior literature also implicitly looks at the average entrepreneur as a homogenous group in terms of motivating factors. I argue that whether becoming an entrepreneur changes a worker's wages and non-pecuniary benefits depends on why someone transitioned in the first place. For example, if someone chooses to enter entrepreneurship because they do not feel that they can increase their compensation with their current

employer and believe that they could make more money by starting their own business, this motivator may impact an entrepreneur's wages and non-pecuniary benefits more greatly than someone who lost their job and enters entrepreneurship because they believe that they have no other options in established companies.

In this chapter I address the gaps in the literature by using longitudinal SESTAT data on more than 28,000 scientists and engineers from 2003 to 2010 to analyze whether there are improvements to wage workers' work outcomes when they enter entrepreneurship. Instead of comparing the average salaries of entrepreneurs to wage workers, as has been often done in the past, I use longitudinal data to answer the call for much needed analysis of the differences in earnings before and after an entrepreneurial transition for a given individual (Åstebro and Chen 2014). Additionally I perform analyses of non-pecuniary benefits before and after the entrepreneurial transition using job satisfaction as a proxy. I am able to analyze whether non-pecuniary benefits actually increase when someone enters self-employment. I compare the changes in work outcomes of those who transition into entrepreneurship to not only wage workers who do not change employers but also to those who switch to a new employer in wage work. This allows me to take a more in depth look at the work outcome changes resulting from different mobility patterns of wage workers. Additionally, I use data on worker's reported reasons for why they change employers to take a deeper look into motivations for these different types of labor mobility and the corresponding implications for work outcomes.

I find that on average, workers who transition to self-employment experience less growth in their wages and more growth in job satisfaction upon transitioning. I also find that these results differ depending on the reason someone transitioned to self-employment in the first place. I suggest that previous literature that treated entrepreneurs as a homogenous group in their motivations were not accounting for significant heterogeneity which has important consequences for work outcomes. I find that those who move to self-employment with the intention of increasing their wages are able to do so, just not as significantly as those who moved to a new employer in wage work. Those who moved to self-employment because they wanted to improve their career benefits were able to improve their job



satisfaction. In general when transitioning to self-employment, former wage workers were allowed to improve the work outcomes that they intended to improve. However, I also find that those who entered self-employment for reasons such as market or personal reasons saw no significant improvements in either their wages or job satisfaction. While my results are consistent with the theory that people who enter self-employment may be willing to take a reduction in salary for an increase in non-pecuniary benefits, I also find that those who change employers in wage work also experience a very similar increase in their job satisfaction. Job satisfaction seems to improve for movers in general, not just those who transition into entrepreneurship.

I find that entrepreneurship is not a uniform experience, different people with different motivations for entry have different work outcomes, both pecuniary and non-pecuniary. These findings suggest that future research should consider motivations for entry when analyzing work outcomes in entrepreneurship.

### *Chapter 3 Entrepreneurial Exit*

There exists a large body of research on which mechanisms predict entrepreneurial entry, yet the amount of research conducted on which mechanisms affect entrepreneurial exit is considerably less. A number of studies suggest that small businesses are highly likely to fail and to fail quickly (Mata and Portugal 1994, Amit, Muller et al. 1995, Shane 2009). Yet others have suggested that entrepreneurship is a fairly transitory state between periods of employment and that a majority of entrepreneurial spells are terminated voluntarily for a move to alternative work in wage work (Taylor 1999). Therefore, this study plans to contribute to a greater understanding of what factors attribute to individuals leaving entrepreneurship and returning to wage work.

Prior literature assumes that the firms that performed the best were the most likely to survive (Penrose 1952, Taylor 1999), and these studies indicate that those who produce low financial returns simply fail altogether and exit entrepreneurship. Other research has found that the determinants of performance and survival may differ (Kalleberg and Leicht 1991, Gimeno, Folta et al. 1997, DeTienne, Shepherd et al. 2008). They claim that many entrepreneurs persist in entrepreneurship for long periods of

time without making large financial returns and without any intention of growing (Hurst and Pugsley 2011). This finding implies that producing only low wages does not mean an entrepreneur is necessarily going to leave entrepreneurship; they may choose to remain in self-employment for the non-pecuniary benefits of entrepreneurship.

A model is needed that combines both the impacts of financial and non-financial benefits. The goal of this paper is to demonstrate that studies that do not include a measure of non-pecuniary benefits with research on transitions in and out of entrepreneurship are missing out on a fundamental component. I argue that even those studies that include factors other than performance variables, such as human capital variables, are not documenting the full picture as entrepreneurial human capital is associated with both the pecuniary and non-pecuniary benefits of self-employment. This opens the question asking who exactly is exiting entrepreneurship. Is it those who are unsatisfied in it, since non-pecuniary benefits are a main motivator into entrepreneurship (Hamilton 2000), or is it those who are not earning high salaries in entrepreneurship? I argue that it is a combination of both mechanisms that influences entrepreneurial exit and that this relationship is largely dependent on the entrepreneur's human capital.

One of the concerns with the current literature is that while studies claim that people may remain in entrepreneurship for the non-pecuniary benefits of entrepreneurship regardless of financial performance, there is little empirical evidence examining the relationship between non-pecuniary benefits and entrepreneurial exit. Additionally, the literature has begun to acknowledge that human capital and traits of the individual entrepreneur influence financial performance in entrepreneurship, yet there has still been little work done on the relationship between entrepreneurial human capital and non-pecuniary benefits.

I argue that people enter entrepreneurship for a variety of different reasons and with varied skills sets. Those people then experience different outcomes in entrepreneurship, with some attaining high entrepreneurial salaries, some experiencing high degrees of non-pecuniary benefits, some experience a mix of both, and some having neither. Additionally, individual entrepreneurs inherently possess different opportunity costs. Thus, exit decisions may reflect both financial and non-financial benefits and how

those financial opportunities compare to outside options. This in turn, depends on the individual's skills and how valuable those skills are in self-employment versus employment.

Using a longitudinal sample of over 8,000 highly educated entrepreneurs in science and engineering in the United States from 2003 to 2010 from the SESTAT survey database, I use proxy measures for both non-pecuniary benefits and skill variety to better analyze the relationship between entrepreneurial human capital, the non-pecuniary benefits of entrepreneurship and entrepreneurial exit. I then analyze what happens to entrepreneurs' work outcomes once they exit entrepreneurship and return to wage work. I find that there is a positive but non-linear (inverted u-shaped) relationship between salary and entrepreneurial exit and a significant negative linear relationship between job satisfaction and entrepreneurial exit. I find that those with lower job satisfaction are more likely to exit entrepreneurship, regardless of salary. Those with greater R&D skill sets are those who are more likely to report lower job satisfaction but higher salaries in entrepreneurship compared to other entrepreneurs. They are the most likely to exit entrepreneurship, with their greater opportunity costs to remaining in self-employment and the marketability of their specialized skill set in wage work, compared to those with a more generalized skill set. For those who exit entrepreneurship and return to wage work, I find that they are able to significantly increase their salary but not their job satisfaction, compared to remaining in self-employment.

I add to the understanding of entrepreneurial exit in three important ways. First, I highlight that decisions made by individuals to exit entrepreneurship and return to wage work are largely influenced by not only their salary but also the non-financial benefits they derive from entrepreneurship. Second, I speak to the emerging literature on human capital and entrepreneurial exit by highlighting the importance of human capital in entrepreneurial exit decisions. While prior work in this domain has considered how the entrepreneur's human capital relates to the financial performance of the firm which influences exit (Gimeno, Folta et al. 1997), I expand this to consider how the entrepreneur's human capital relates to the non-financial benefits an individual gains from entrepreneurship, which may influence exit. Finally, I use longitudinal data to analyze the changes in financial and non-financial outcomes for those who re-enter

wage work. Overall I find those who are the most successful in terms of both salary and non-pecuniary benefits in entrepreneurship are remaining in entrepreneurship.

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