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Examining the Financial Payoffs to Prior Entrepreneurial Experience

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Examining the Financial Payoffs to Prior Entrepreneurial Experience

Xian Cao, PhD

University of Connecticut, 2018

My dissertation includes three essays with an attempt to understand the financial payoffs to prior entrepreneurial experience. In essay one, we re-visit the important relationship between prior entrepreneurial experience and the probability of switching into entrepreneurship from wage employment using two different models: logistic regression – a standard statistical model commonly used by management scholars and random forests – a powerful machine learning tool for analyzing big data. Through comparing the findings of these two models, essay one reconciles the theoretical and empirical uncertainty on this relationship. It also illuminates the benefits of using contemporary approaches to handle big data in re-visiting fundamental questions in entrepreneurship. In essay two, we examine the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. Testing from a sample of entrepreneurs who were at risk of making a career choice between serial entrepreneurship and wage employment, our study shows that the financial payoffs to prior entrepreneurial experience can be extended, and much higher, in serial entrepreneurship than in wage employment. By doing so, it holds a host of novel implications for understanding the motivation of entrepreneurship and also adds to the research of serial entrepreneurship. In essay three, we argue that the matching model, which suggests individuals self-select themselves into a career with relative advantages, may help explain serial entrepreneurship. Through decomposing prior entrepreneurial experience into venture success experience, venture managerial experience and venture industry experience, we find partial supports for this argument. Essay three then enhances our understanding for the motivation of serial entrepreneurship.

Examining the Financial Payoffs to Prior Entrepreneurial Experience

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B.A., Nanjing University, 2005

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A Dissertation

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Doctor of Philosophy

At the

University of Connecticut

2018

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2018

APPROVAL PAGE

Doctor of Philosophy Dissertation

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CHAPTER 1 INTRODUCTION

1. Motivation

The literature has consistently shown that prior entrepreneurial experience is one of the most important determinants of entrepreneurial entry and the financial payoffs to venturing. Yet a key premise of my dissertation is that these relationships deserve additional attention. The three essays of my dissertation are devoted to re-examining these relationships. The remainder of this introduction describes the reasons for undertaking this effort, and how each of the three essays contributes to these relationships.

Prior entrepreneurial experience is one of the most important explanatory variables in entrepreneurship research, primarily because of its influences on individuals' financial payoffs. In particular, in searching for the motivation of entrepreneurship, many scholars have adopted a rational perspective where entry into entrepreneurship is a career choice determined by expected payoffs in the venture versus alternatives (Baumol, 1990; Campbell, 1992; Douglas and Shepherd, 2000, 2002; Eisenhauer, 1995; Gifford, 1993). Payoffs may be financial, such as earnings and ownership, or nonfinancial, such as job satisfaction and independence. Because prior entrepreneurial experience can shape how individuals discover, evaluate, and exploit opportunities (Shane and Venkataraman, 2000), and also help them identify the most appropriate actions (Minniti and Bygrave, 2001), prior studies have associated it closely with financial payoffs. Unsurprisingly, a broad set of studies have examined the role of prior entrepreneurial experience in influencing individuals' subsequent entrepreneurial performance and career choices (Amaral and Baptista, 2007; Amaral, Baptista, and Lima, 2011; Cope, 2005; Davidsson and Honig, 2003; Evans and Leighton, 1989; Gompers *et al.*, 2010; Hamilton, 2000;

Hessels *et al.*, 2011; Metzger, 2008; Parker, 2013; Rerup, 2005; Santarelli and Tran, 2013; Stam, Audretsch, and Meijaard, 2008; Stuart and Abetti, 1990; Wright, Robbie, and Ennew, 1997a, 1997b). Yet, there remains considerable uncertainties preventing these studies from fully investigating these relationships. In the following, we will discuss these uncertainties and how my dissertation essays may help resolve them.

First, prior studies have generally agreed that individuals with greater prior entrepreneurial experience are more likely to again become an entrepreneur (e.g. Amaral and Baptista, 2007; Amaral, *et al.*, 2011; Evans and Leighton, 1989; Hamilton, 2000; Hessels *et al.*, 2011; Metzger, 2008; Stam, Audretsch, and Meijaard, 2008). One implied premise of these studies is that individuals with greater prior entrepreneurial experience may perform better in their next entrepreneurial spell than those with less experience. However, one possibility that prior entrepreneurial experience can also develop and reveal individuals' general human capital (Campbell, 2013), which is valuable to wage employers, has been ignored. As Gimeno *et al.* (1997) explained, entrepreneurial entry occurs if the expected payoffs of entrepreneurship exceed the expected payoffs of alternative employment (e.g. wage employment) minus the cost inherent in switching. If the relative financial payoffs to prior entrepreneurial experience are possibly higher in wage employment, the nature of the relationship between prior entrepreneurial experience and the likelihood of again becoming entrepreneurs is likely to be more complicated than previously suggested.

It then follows that the literature may have not unveiled the true relationship between prior entrepreneurial experience and the likelihood of again becoming entrepreneurs. We believe that one possible explanation for this theoretical and empirical

uncertainty is that the standard statistical models commonly used by management scholars are less capable of unveiling the true relationship, especially in the context of big data. Big data features the sheer size of the dataset due to the aggregation of a large number of variables or observations for each variable (George *et al.*, 2016). Given the immense volume of data means that everything can be significant (Cumming *et al.*, 2017; George, Haas, and Pentland, 2014), the statistical significance relying on *p*-values may not imply economic significance. In addition, in the context of big data, more flexible relationships than simple linear relationships (i.e. linear, curvilinear, cubic, *etc.*) are possible (Varian, 2014). Therefore, examining big data requires the use of more powerful computation techniques, such as machine learning tools. However, although many studies have used census data that has features of big data to examine this relationship between prior entrepreneurial experience and the likelihood of again becoming an entrepreneur (i.e. Evans and Leighton, 1989; Amaral *et al.*, 2011), few of them have appropriately handled it.

Essay one re-visits this important relationship using two different models: logistic regression – a standard statistical model commonly used by management scholars and random forests – a powerful machine learning tool for analyzing big data. Testing from a sample of over 19,000 individuals, our results show that logistic regression and random forests present different findings. In particular, logistic regression shows a U-shaped relationship between prior entrepreneurial experience and the probability of switching into entrepreneurship. However, random forests shows that the probability of switching into entrepreneurship decreases as individuals have more experience in entrepreneurship, but soon flattens out. Through comparing the findings of these two models, this study

illuminates the importance of appropriately handling big data and also helps reconcile the theoretical and empirical uncertainty raised above.

Second, the literature has not investigated the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. Although prior studies have explored the financial payoffs to prior entrepreneurial experience inside the entrepreneurial context (Cope, 2005; Davidsson and Honig, 2003; Gompers *et al.*, 2010; Parker, 2013; Rerup, 2005; Santarelli and Tran, 2013; Stuart and Abetti, 1990; Wright *et al.*, 1997a, 1997b), they hardly give us a complete view because the recent development in the literature reminds us an alternative possibility – prior entrepreneurial experience can also develop and reveal general human capital, the value of which may be able to extend outside the entrepreneurship context (Campbell, 2013). Therefore, what became fundamental is an investigation of the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. Such an investigation will make contributions to the literature particularly from two perspectives.

On one hand, it will contribute to our understanding of the motivation of entrepreneurship. Although Hamilton (2000) suggested that the reason why most individuals enter and persist in entrepreneurship despite the fact that they have both lower initial earnings and lower earnings growth than in wage employment is because of the desirable attributes of entrepreneurship, such as “being your own boss”, his study merely investigated the financial payoffs associated with prior entrepreneurial experience inside the entrepreneurial firms. If the financial payoffs to prior entrepreneurial experience can be extended outside the entrepreneurial context, individuals may enter entrepreneurship because it provides more career mobility and persistent rewards even after leaving

entrepreneurship (Campbell, 2013). Exploring this possibility may then offer an alternative explanation to the finding of Hamilton (2000).

On the other hand, it will add to the research of serial entrepreneurship. As mentioned above, the literature has generally agreed that individuals with greater prior entrepreneurial experience have a higher preference to again become entrepreneurs than become wage-employed (Amaral and Baptista, 2007; Amaral *et al.*, 2011; Evans and Leighton, 1989; Hamilton, 2000; Hessels *et al.*, 2011; Metzger, 2008; Stam *et al.*, 2008). One implied premise of these studies is that individuals with greater prior entrepreneurial experience may perform better in their next entrepreneurial spell than those with less experience. However, this premise renders an incomplete view because the financial payoffs associated with prior entrepreneurial experience may be able to be extended outside the entrepreneurial context (Campbell, 2013). If individuals with greater prior entrepreneurial experience can obtain higher earnings in wage employment than in entrepreneurship, there must be some alternative explanations of serial entrepreneurship awaiting us to explore.

Therefore, exploring the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context is important and necessary. Although several studies has explored the financial payoffs to prior entrepreneurial experience in entrepreneurship or wage employment (e.g. Evans and Leighton, 1989; Hamilton, 2000; Campbell, 2013), they has not fully illuminated this problem mainly because of the limitation of their sample design. For example, Campbell (2013) compared the earnings of employees who joined start-up with a matched control group of comparable wage employees without start-up experience. Therefore, his findings can

only be used to conclude whether the financial payoffs to prior entrepreneurial experience can be extended outside the entrepreneurial context, but does not imply anything about the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. In addition, his study lacks data on important control variables, such as age and education.

Essay two investigates the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. Through sampling a group of 26,235 entrepreneurs who were at risk of making a career choice between serial entrepreneurship and wage employment upon exiting their previous ventures, we empirically compare the relative financial payoffs to prior entrepreneurial experience between these two career choices. By doing so, our findings hold a host of novel implications for understanding the motivation of entrepreneurship and also add to the research of serial entrepreneurship.

Third, the literature has not fully illuminated the motivation of serial entrepreneurship. Serial entrepreneurs are defined as “individuals who have sold/closed a business in which they had a minority or majority ownership stake, and they currently have a minority or majority ownership stake in a single independent business that is either new, purchased or inherited” (Westhead, Ucbasaran, and Wright, 2005, pp. 393-417). One distinct difference of serial entrepreneurs from first-time entrepreneurs is that they are repeat business owners with prior entrepreneurial experience. Therefore, many scholars have used human capital theory (Becker, 1962) to examine the effects of prior entrepreneurial experience on the performance of serial entrepreneurs (Cope, 2005; Davidsson and Honig, 2003; Gompers *et al.*, 2010; Parker, 2013; Rerup, 2005; Santarelli

and Tran, 2013; Stuart and Abetti, 1990; Wright, *et al.*, 1997). However, fewer efforts have been devoted to explore their motivation.

We argue that the matching model (Jovanovic, 1982; Roy, 1951), which suggests individuals self-select themselves into a career in which they have relative advantages, may help explain serial entrepreneurship. In particular, the matching model states that individuals have imperfect information about their abilities and learn about their true abilities over time. Individuals who experience bad outcomes then may quit and choose alternative occupations if the financial payoffs to their abilities are greater there (Jovanovic, 1982; Roy, 1951). Since prior entrepreneurial experience can reflect individuals' knowledge and abilities that are specific to entrepreneurship, and may also develop and reveal their general human capital that is valuable to wage employers (Campbell, 2013), individuals with greater prior entrepreneurial experience should have a lower level of uncertainties about their ability. Therefore, associating prior entrepreneurial experience with the matching model (Jovanovic, 1982; Roy, 1951) may help explain their subsequent career choices between serial entrepreneurship and wage employment.

Although this theoretical argument is of significant importance for us to understand the motivation of serial entrepreneurship, prior studies have not fully investigated it, primarily because their definition of prior entrepreneurial experience is limited. For example, Hamilton (2000) rejected the theoretical argument that self-selection explains the earnings differentials between entrepreneurship and wage employment. However, he defined prior entrepreneurial experience using whether the individual had been self-employed before or how long the individual had stayed in

entrepreneurship, which merely gauge the quantitative differences of prior entrepreneurial experience. Intuitively, even spending the same amount of time in entrepreneurship, individuals can learn differently. Therefore, to fully investigate whether the matching model (Jovanovic, 1982; Roy, 1951) can help explain serial entrepreneurship and individuals' sector-specific skills, we need to further study the qualitative differences of prior entrepreneurial experience.

Essay three investigates whether the matching model (Jovanovic, 1982; Roy, 1951) helps explain serial entrepreneurship. We propose that prior entrepreneurial experience can be further decomposed into three dimensions: (1) venture success experience (i.e. the extent to which an individuals' previous venture was financially successful), (2) venture managerial experience (i.e. managerial expertise individuals have developed through leadership experience in their previous entrepreneurial spell) and (3) venture industry experience (i.e. venture industry expertise individuals have developed specific to the target industry in their previous entrepreneurial spell). We argue that while some experience dimensions are more transferrable to wage employment (i.e. venture industry experience), leading to higher wage earnings, some are more specific and useful in entrepreneurship (i.e. venture success experience and venture managerial experience). Individuals with more transferrable experience may prefer to become wage-employed, and those with more specific experience tend to self-select to again become entrepreneurs. By doing so, this study provides a fine-grained view for the motivation of serial entrepreneurship.

The research questions of the three essays are summarized in Table 1.

Insert Table 1 about here

2. Research Setting

My dissertation uses the data drawn from a set of three matched longitudinal data sources on the entire Swedish high-technology labor market. The first source is LOUISE that contains demographic and financial information for all legal residents of Sweden over the age of sixteen in 1989. The second source is RAMS that tracks employment flows for all firms having at least one employee or earning a profit. The third source is RSU that provides financial information for each firm. The special abstract that I used for the dissertation is called EPRO (Entrepreneurial Processes Databases) that covers any individuals in high-technology manufacturing or knowledge-intensive service sectors from 1989 to 2002. The original data contains 11,182,628 observations with 482,249 unique individual identifications.

This sample has several distinct advantages. First, the information in this sample is universal. The sample tracks individuals' employment statuses and firms' financial performance over thirteen years based on an annual mandatory survey for all firms having at least one employee or earnings profit. Thus, it allows us to closely observe individuals' employment flow and associated financial payoffs. Second, the sample provides sufficient information to examine the qualitative differences of individuals' prior entrepreneurial experience.

In the following, Chapter 2-4 offer distinct essays on the issues elaborated above. In conducting this research, it is my hope to enrich our understanding of how prior entrepreneurial experience influences entrepreneurial entry and financial payoffs in both

entrepreneurship and wage employment. The final Chapter clarifies and summarizes my contribution.

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Table 1 Summary of Research Questions of the Three Essays

	Title	Research Question
Essay one	Analyzing big data in management – re-visiting the entrepreneurial entry problem	We re-visit the relationship between prior entrepreneurial experience and the probability of switching into entrepreneurship from wage employment using two different models: logistic regression – a standard statistical model commonly used by management scholars, and random forests – a powerful machine learning tool for analyzing big data. Through comparing the discrepant findings of these two models, we assert the benefits of using contemporary approaches to handle big data in re-visiting fundamental questions in entrepreneurship.
Essay two	The relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context	We investigate the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. Testing from the sample of 26,235 entrepreneurs who were at risk of making a career choice between serial entrepreneurship or wage employment, we find that greater prior entrepreneurial experience leads to a higher financial payoff in wage employment than in serial entrepreneurship, implying that the financial payoffs to prior entrepreneurial experience can be extended, and much higher, outside the entrepreneurial context. Our findings hold a host of novel implications for understanding the motivation of entrepreneurship and also add to the research of serial entrepreneurship.
Essay three	Who becomes a serial entrepreneur: developing a multi-dimensional definition of prior entrepreneurial experience	We argue that the matching model, which suggests individuals self-select themselves into a career in which they have relative advantages, may explain serial entrepreneurship. To test this theoretical argument, we propose to investigate the qualitative differences of prior entrepreneurial experience: venture success experience, venture managerial experience and venture industry experience. Testing from the sample of 16,888 entrepreneurs who were at risk of making a career choice between serial entrepreneurship or wage employment partially confirms this argument. Our study then provides a fine-grained view for the motivation of serial entrepreneurship.

ESSAY ONE
ANALYZING BIG DATA IN MANAGEMENT: RE-VISITING THE
ENTREPRENEURIAL ENTRY PROBLEM

ABSTRACT

We argue that the standard statistical models commonly used by management scholars to investigate the relationship between prior entrepreneurial experience and the probability of switching into entrepreneurship from wage employment are less capable of unveiling the true relationship, especially in the context of big data. In particular, because the immense volume of data means that almost everything can be significant, the statistical significance relying on p -values may not imply economic significance. In addition, in the context of big data, more flexible relationships than simple linear relationships (linear, curvilinear, cubic, *etc.*) are possible, yet the standard statistical models that pre-specify the linear relationships between the independent and dependent variables lack the capability of detecting such relationships. To illuminate these concerns, we re-visit this important relationship using two different models: logistic regression – a standard statistical model commonly used by management scholars, and random forests – a powerful machine learning tool for analyzing big data. Through comparing the discrepant findings of these two models, we assert the benefits of using contemporary approaches to handle big data in re-visiting fundamental questions in entrepreneurship.

Keywords: Entrepreneurial Entry, Prior Entrepreneurial Experience, Logistic Regression, Random Forests, Big Data

1. Introduction

Prior empirical research on entrepreneurial entry has generally agreed that individuals with greater prior entrepreneurial experience are more likely to re-enter entrepreneurship (Amaral and Baptista, 2007; Amaral, Baptista, and Lima, 2011; Evans and Leighton, 1989; Hamilton, 2000; Hessels *et al.*, 2011; Metzger, 2008; Stam, Audretsch, and Meijaard, 2008). One implied assumption of these studies is that because prior entrepreneurial experience can shape how individuals discover, evaluate, and exploit opportunities (Shane and Venkataraman, 2000), and also help them identify the most appropriate actions (Minniti and Bygrave, 2001), individuals with greater prior entrepreneurial experience may perform better than those with less experience. However, one possibility that prior entrepreneurial experience can also develop and reveal individuals' general human capital (Campbell, 2013), which is valuable to wage employers, has been ignored. As Gimeno *et al.* (1997) explained, entrepreneurial entry occurs if the expected payoffs of entrepreneurship exceed the expected payoffs of alternative employment (e.g. wage employment) minus the cost inherent in switching. If the relative financial payoffs to prior entrepreneurial experience are possibly higher in wage employment, the nature of the relationship between prior entrepreneurial experience and the likelihood of again becoming entrepreneurs is likely to be more complicated than previously suggested.

We argue that one possible explanation for this theoretical and empirical uncertainty is – the standard statistical models commonly used by management scholars are less capable of unveiling the true relationship, especially in the context of big data. In particular, big data features the sheer size of the dataset due to the aggregation of a large

number of variables or observations for each variable (George *et al.*, 2016).¹ Because the immense volume of data means that almost everything can be significant (Cumming *et al.*, 2017; George, Hass, and Pentland, 2014), the statistical significance relying on *p*-values may not imply economic significance. In addition, in the context of big data, more flexible relationships than simple linear relationships (i.e. linear, curvilinear, cubic, *etc.*) are highly possible (Varian, 2014), yet these standard statistical models that pre-specify the linear relationships between dependent and independent variables lack the capability of detecting such relationships.

Indeed, Since George *et al.* (2014) published “*Big data and management*” in 2014, the paper has collected more than three hundred scholarly citations, which signal that the topic is of significant importance. As they commented, big data requires the use of more powerful computation techniques to unveil the true trends and patterns. In searching of these powerful computation techniques, many studies have proposed machine learning tools. For example, Varian (2014) described several machine learning tools for analyzing big data, which he believed should be more widely used. Bajar *et al.* (2015) compared the model fit of linear regression, the conditional logit with the model fit of six other machine learning tools. They found that machine learning tools in general produce better out-of-sample fits than linear models without loss of in-sample goodness. However, although

¹ Prior studies have suggested three core elements of big data: volume, velocity and variety (George *et al.*, 2014, 2016; McAfee and Brynjolfsson, 2012). According to George *et al.* (2016), volume means the sheer size of the dataset due to the aggregation of a large number of variables or observations. Velocity reflects the speed at which the data is collected and analyzed. Variety comes from the plurality of structured and unstructured data sources, such as text, videos and among others. Because most management research is *post hoc* analysis, which means a manuscript is drafted months or years after the original data is collected, velocity is a less a concern for management scholars. In this study, we focus on volume, and an interesting future direction about variable selection is also discussed in the final Chapter.

many studies examining entrepreneurial entry have used census data that has features of big data (e.g. Evans and Leighton, 1989; Amaral *et al.*, 2011), few of them have employed these contemporary techniques to handle it, even if these techniques have entered economics (e.g. Varian, 2014; Bajar *et al.* 2015), marketing (e.g. Cui, Wong, and Lui, 2006), operational management (e.g. Carbonneau, Laframboise, and Vahidov, 2008), and other disciplines in business.

To illuminate the above concerns, we re-visit the important relationship between prior entrepreneurial experience and the probability of switching into entrepreneurship from wage employment using two different models: logistic regression – a standard statistical model commonly used by management scholars, and random forests (Breiman, 2001) – a powerful machine learning tool for analyzing big data. Because wage experience may also affect individuals' subsequent financial payoffs in entrepreneurship and wage employment (Evans and Leighton, 1989; Hamilton, 2000), we also investigate its impacts on entrepreneurial entry to develop a richer insight.

Testing from a sample of over 19,000 individuals, our results show that logistic regression and random forests present several different findings. First, logistic regression shows a U-shaped relationship between prior entrepreneurial experience and the probability of switching into entrepreneurship. However, random forests shows that the probability of switching into entrepreneurship decreases as individuals have more experience in entrepreneurship, but soon flattens out. Second, the results of logistic regression show inconsistencies about the effect of wage experience on the probability of switching into entrepreneurship. When prior entrepreneurial experience is controlled, the model shows an inverted U-shaped relationship between wage experience and the

probability of switching into entrepreneurship. When prior entrepreneurial experience is not controlled, the above relationship flips, becoming U-shaped. On the other hand, the results presented by random forests are very consistent – with or without prior entrepreneurial experience – the effect of wage experience on the probability of switching into entrepreneurship flattens out at first, declines after and then increases again. In addition, we also compare the results of interactions between prior entrepreneurial experience and wage experience using these two models as supplementary analyses.

To conclude, our study reveals that the true relationship between prior entrepreneurial experience and the likelihood of again becoming an entrepreneur is not linear in nature. It illustrates that while a larger sample size is always preferred, it has to be handled appropriately. Using the standard statistical models to handle big data is likely to generate misleading conclusions. It also suggests that using contemporary approaches to handle big data might be particularly valuable in re-visiting fundamental questions in entrepreneurship.

In the following, we will describe and compare the features of logistic regression and random forests in a greater detail.

2. Logistic Regression versus Random Forests

Logistic regression is a standard statistical approach for modeling binary outcome variables. The model that postulates the conditional probability of observing a successful event of the dependent variable ($Y = 1$) can be expressed as:

$$P(Y = 1|X) = \left(1 + e^{-(\beta_0 + \beta^T X)}\right)^{-1}$$

The coefficients then can be estimated through maximizing the log-likelihood based on n independent and identically distributed samples $\{x_i, y_i\}_{i=1}^n$:

$$\sum_{i=1}^n -\log\left(1 + e^{\beta_0 + x_i^T \beta}\right) + \sum_{i=1}^n y_i(\beta_0 + x_i^T \beta)$$

Unlike logistic regression that uses a parametric form, i.e. linear combinations of the independent variables, to model the probability of the outcome variables, machine learning models usually take much more complicated forms, hence are oftentimes “nonparametric” in statistical sense. Random forests (Breiman, 2001), support vector machines (Cortes and Vapnik, 1995), neural networks (Haykin, 1994), boosting (Friedman, Hastie, and Tibshirani, 2000), and classification trees (Breiman *et al.*, 1984) are among the most popular machine learning tools. Many efforts have been spent to compare the effectiveness of them, and random forests is generally considered as the most stable and robust one (Goetz *et al.*, 2015; Rodriguez-Galiano *et al.*, 2015; Zhu, Zeng, and Kosorok, 2015). In addition, it provides important information about variable importance, which helps visually interpret the results and increases prediction accuracy. Therefore, we use random forests as our exemplary machine learning tool.

In particular, random forests (Breiman, 2001) is a machine learning algorithm that offers nonparametric model structure for classification and regression. It works by constructing an ensemble of trees and averaging them to obtain the final model. Each tree is an essentially a recursive partitioning algorithm that cuts the space of the independent variables into non-overlapping hyperrectangles. The essence of random forests lies in the greediness of pursuing the signal while preserving randomness. In other words, random forests is capable of detecting the signal and simultaneously preventing overfitting through utilizing random components, such as bootstrapping and random splitting rules. As an alternative to linear regressions, random forests model is extremely flexible in

terms of model structure. It can be used to visualize and graphically interpret the underlying relationship between independent and outcome variables.

Denote this covariate space as A , then each tree defines a collection of mutually exclusive sets $\{A_1, A_2, \dots, A_K\}$, with $A = \bigcup_{k=1}^K A_k$ and k is the number of terminal nodes. The predicted value for any target point x in a single tree can be obtained through averaging the observations within the same terminal node as x . The regression version can be expressed as:

$$\hat{f}(x) = \frac{\sum_i \sum_k y_i I(x \in A_k) I(x_i \in A_k)}{\sum_i \sum_k I(x \in A_k) I(x_i \in A_k)}$$

while the classification version is done by majority voting.

An ensemble of M trees is obtained by repeatedly performing bootstraps samplings and fit one tree to each of the bootstrap samples. Denote each of these tree models as $\hat{f}_m(x)$, the forests model (for regression) is simply done by averaging (more details can be found in Appendix A):

$$\hat{f}_{RF}(x) = \frac{1}{m} \sum_{m=1}^M \hat{f}_m(x)$$

Random forests have several distinctive advantages over logistic regression in handling big data. First, logistic regression provides p -values to establish the significance of a finding, yet such an approach is inappropriate in the context of big data. As mentioned above, when sample size is large enough, almost everything can be significant (Cumming *et al.*, 2017; George *et al.*, 2014). Therefore, the statistical significance that relies on p -values may not imply economic significance.

In addition, logistic regression puts an additional assumption on the logistic link between the probability of observing a successful event and the linear combination of the

independent variables. It requires pre-specifying the linear relationships (i.e. linear, curvilinear, cubic, *etc.*) between the dependent and independent variables using the linear function form $\beta_0 + \beta^T X$. Because more flexible relationships than these simple linear relationships are possible in the context of big data (Varian, 2014), logistic regression may limit the possibility to unveil the true trends and patterns, or even lead to misleading conclusions.

On the other hand, random forests does not rely on p -values to establish the significance of a finding. Instead, it concerns about variable importance, which is defined as to what extent the outcome can be explained by a variable (Zhu and Kosorok, 2012; Zhu *et al.*, 2015). Therefore, its findings are less influenced by the immense volume of data. Furthermore, functioning through a set of decision rules on the independent variables, random forests can easily fit nonparametric relationships and provide more flexible model structures. The trends and patterns it identifies can be any form, even discontinuous.

Second, logistic regression, like many other standard statistical models is built on specific assumptions. If these assumptions are violated, its conclusions are wrong. In the context of big data, the aggregation of a large number of variables or observations for each variable (George *et al.*, 2016) has led to concerns over multicollinearity. If two independent variables are highly correlated, the coefficient estimations may get exaggerated, leading to false correlations and conclusions. Admittedly, problems like multicollinearity may be able to solve through variable transformations. However, these transformations often lead to discrepant results (Lo and Andrews, 2015).

On the other hand, random forests is invariant to variable transformation, and is less sensitive to multicollinearity due to its random sampling mechanisms. Because it randomly selects some variables at each internal node to split, it allows highly correlated variables to explain the effect in turn. The effect is then randomly spread among correlated variables.

In conclusion, random forests is a more appropriate advanced computation technique than logistic regression to analyze big data. Someone may question that a machine learning tool like random forests may limit the theoretical contribution of a study. However, we believe that scholars can still present theoretical conjectures for the topic of interests, but the difference rests on that a hypothesis testing relying on p -values is no longer needed when using machine learning tools. In the following, we will introduce the problem of entrepreneurial entry.

3. Entrepreneurial Entry Problem

Human capital theory (Becker, 1962) suggests that individuals choose an occupation to maximize the expected pecuniary rewards of their investments in skills and knowledge (Gimeno *et al.*, 1997).² Because individuals' prior entrepreneurial and labor

² Many scholars have studied the characteristics of individuals who become entrepreneurs. There are primarily two approaches – trait-based approach and economic models-based approach. A trait-based approach hypothesizes that entrepreneurs are individuals with certain traits and personalities, which determine the emergence of entrepreneurs (e.g. McClelland, 1965; Caird, 1991). However, this approach often fails to provide consistent results because the literature has been unable to report a unique set of traits and personalities that characterize entrepreneurs (Douglas and Shepherd, 2000; Mitchell *et al.*, 2002). As Mitchell *et al.* (2002) commented, “But efforts to isolate psychological or demographic characteristics that are common to all entrepreneurs, or are unique to entrepreneurs, have generally met with failure due to weak, disconfirming, or nonsignificant results.” Alternatively, more recent research has adopted an economic models-based approach to provide a rational perspective that calculates individuals'

market experience can significantly influence their subsequent career choices, it is unsurprising that prior studies have explored the relationship between prior entrepreneurial/ wage experience and the probability of switching into entrepreneurship from wage employment (Amaral *et al.*, 2011; Evans and Leighton, 1989; Hamilton, 2000; Henley, 2004; Hyttinen and Ilmakunnas, 2007a; Stam *et al.*, 2008). Many of these studies have used census data that has features of big data. For example, Evans and Leighton (1989) used the National Longitudinal Survey of Young Men (NLS) for 1966 – 1981 and the Current Population Surveys for 1969 – 1987, and their sample has in total around 154, 000 observations. Amaral *et al.* (2011) used the Quadros de Pessoal, and his final sample includes more than 23,000 observations. However, we believe that there remains uncertainty because the standard statistical models commonly used in these studies are less capable of unveiling the true relationship in the context of big data.

As previously discussed, logistic regression needs to rely on p -values to establish the significance of a finding while random forests does not. In the following, we will deduce from human capital theory (Becker, 1962) to hypothesize the relationship between prior entrepreneurial/ wage experience and the probability of switching into entrepreneurship from wage employment – as a common practice of using logistic regression, and simultaneously, present our theoretical conjectures for the relationships following a random forests approach.

3.1. Entrepreneurial Experience

expected utility determined by payoffs (e.g. Baumol, 1990; Campbell, 1992; Gifford, 1993; Eisenhauer, 1995; Douglas and Shepherd, 2000).

The literature of entrepreneurship suggests that individuals learn about their entrepreneurial abilities through running a business (Jovanovic, 1982). Because prior entrepreneurial experience can shape how individuals discover, evaluate, and exploit opportunities (Shane and Venkataraman, 2000), and also help them identify the most appropriate actions (Minniti and Bygrave, 2001), these with greater prior entrepreneurial experience may expect higher earnings in their next entrepreneurship spell comparing with those with a low level or no prior entrepreneurial experience. Therefore, many studies have supported a positive relationship between prior entrepreneurial experience and the tendency of become an entrepreneur again (Amaral *et al.*, 2011; Evans and Leighton, 1989; Hamilton, 2000; Henley, 2004; Hyytinen and Ilmakunnas, 2007a; Stam *et al.*, 2008).

For example, Stam *et al.* (2008) found that these who had started more than one firm are more likely to return to entrepreneurship. Henley (2004) also showed that individuals who were previously self-employed are much more likely to be self-employed in the future as compared with someone who was previously wage-employed. Hyytinen and Ilmakunnas (2007) used longitudinal, register-based employer-employee data to illustrate that prior entrepreneurial experience significantly increases an individual's aspiration to re-enter entrepreneurship. Amaral *et al.* (2011) studied how soon individuals return to entrepreneurship. They reported that those having more years as entrepreneurs are likely to return to entrepreneurship more quickly.

However, it is paramount to acknowledge that prior entrepreneurial experience may also lead to higher expected financial earnings in wage employment. For example, 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, Campbell (2013) estimated the earnings differentials between the employees who joined startups and their matched counterparts who did not. He reported that relative to a matched control group, employees who joined startups exhibited an initial earnings dip but quickly recovered such that after four quarters, these employees earned more than their matched counterparts. These findings imply that prior entrepreneurial experience can reveal individuals' general human capital, which increases their market value to employers. It then follows that the relationship between prior entrepreneurial experience and the probability of switching into entrepreneurship from wage employment may not be linear.

Therefore, we theoretically conjecture that entrepreneurial experience is an important predictor for entrepreneurial entry. The relationship between entrepreneurial experience and the probability of switching into entrepreneurship from wage employment is not linear.

Theoretical Conjecture 1: entrepreneurial experience is an important predictor of the probability of switching into entrepreneurship from wage employment. The relationship is non-linear in nature.

In particular, we believe that individuals with a moderate level of entrepreneurial experience are less motivated to switch into entrepreneurship from wage employment. On one hand, comparing with individuals having a low level or no prior entrepreneurial experience, those with more experience may compare the options of entrepreneurship versus wage employment more realistically. For example, Ucbasaran *et al.* (2010)

showed that individuals with greater prior entrepreneurial experience may be less likely to report comparative optimism and have more realistic expectations about entrepreneurship. In addition, as mentioned above, prior entrepreneurial experience may provide rewards in the context of wage employment (Campbell, 2013). If these experienced individuals have already obtained higher earnings than their counterparts with similar backgrounds but no prior start-up experience in their current wage jobs, they may not have the incentives to return to entrepreneurship. On the other hand, the earnings effect of prior entrepreneurial experience in the context of wage employment is likely to reach a tipping point if an individual's prior experience is too narrowly focused on entrepreneurship. Although prior entrepreneurial experience can reveal individuals' general human capital, increasing their market value to employers (Campbell, 2013), wage employment also requires individuals to have certain firm – specific human capital, which enhances individuals' productivity in their current firm, but no elsewhere (Lazear, 2009). Individuals who spent most of their time in entrepreneurship before entering their current jobs, clearly, can hardly achieve the balance between these two important components. Therefore, the earnings effect of prior entrepreneurial experience in the context of wage employment can diminish when individuals have a high level of prior entrepreneurial experience. Given that the experience can still help these individuals in their subsequent ventures in many useful ways, they may be more likely to switch into entrepreneurship in which they have more advantages.

Taken together, the above arguments collectively suggest that the relationship between prior entrepreneurial experience and the probability of switching into entrepreneurship from wage employment is U-shaped.

*Hypothesis 1: The relationship between prior entrepreneurial experience and the probability of switching into entrepreneurship from wage employment is U-shaped.*³

3.2. Wage Experience

The experience obtained from wage employment has several distinct features that can influence individuals' choices of entrepreneurship versus wage employment. On one hand, comparing with entrepreneurial experience, experience from wage employment is relatively industry and firm – specific (Lazear, 2009). Unlike entrepreneurs that are often exposed to new tasks and responsibilities, wage employees usually need to perform the same narrow tasks over and over again. In addition, because established firms have a more matured corporate system and are less constrained by resources (Alvarez and Busenitz, 2001), there is no need for wage employees to solve any critical problems individually. Therefore, wage employees are specialists, but not generalists. Given that they have fewer chances to develop a broad set of skills comparing with entrepreneurs, wage employees with greater labor market experience may have lower expected earnings for entrepreneurship. On the other hand, Hamilton (2000) revealed that nonfinancial rewards, just as “being your own boss”, plays an important role in entrepreneurship. These psychological factors may be particularly appealing to individuals with greater labor market experience. As such, the relationship between prior wage experience and the probability of switching into entrepreneurship from wage employment may not be linear.

³ As discussed above, logistic regression pre-specifies the linear relationship between the dependent and independent variables using the linear function form $\beta_0 + \beta^T X$. Although we often regard a curvilinear (e.g. U-shaped) relationship as nonlinear, it is still a linear relationship in statistical sense.

Therefore, we theoretically conjecture that wage experience is an important predictor of entrepreneurial entry. The relationship between wage experience and the probability of switching into entrepreneurship from wage employment is not linear.

Theoretical Conjecture 2: wage experience is an important predictor of the probability of switching into entrepreneurship from wage employment. The relationship is non-linear in nature.

We believe that the relationship between wage experience and the probability of switching into entrepreneurship from wage employment is inverted U-shaped. That is to say, those with a moderate level of labor market experience are more likely to become an entrepreneur. Comparing with individuals with a low level of labor market experience, these with greater wage experience may have higher incentives to “test the water”. These individuals have experienced the constraints of wage employment and may want to explore the alternation. In addition, these individuals are not too limited by their industry and firm-specific human capital as individuals with a high level of labor market experience do. Thus, they may be still optimistic and confident about their ability to run a business.

Taken together, we hypothesize that the relationship between wage experience and the probability of switching into entrepreneurship from wage employment is inverted U-shaped.

Hypothesis 2: The relationship between wage experience and the probability of switching into entrepreneurship from wage employment is inverted U-shaped.

4. Methods

4.1. Sample

The study uses the data drawn from a set of three matched longitudinal data sources on the entire Swedish high-technology labor market. The first source is LOUISE that contains demographic and financial information for all legal residents of Sweden over the age of 16 in 1989. The second source is RAMS that tracks employment flows for all firms having at least one employee or earning a profit. The third source is RSU that provides financial information for each firm. The special abstract that we used is called EPRO (Entrepreneurial Processes Databases) that covers any individuals in high-technology manufacturing or knowledge-intensive service sectors from 1989 to 2002. The original data contains 11,182,628 observations with 482,249 unique individual identifications.

We constructed a sample based on young men between the ages of 20 and 25 in 1989. We focused on men because the self-employment rate differs substantially between sex groups (Evans and Leighton, 1989) and unobserved heterogeneity around issues of family choice will be undermined (Folta, Delmar, and Wennberg, 2010). In addition, a focus on the age range between 20 and 25 in 1989 can eliminate the possibility that an individual was wage-employed or self-employed prior to our ability to observe it. This step led to a total of 429,071 observations with 32,733 unique individual identifications. Noticeably, some individuals have multiple records per year in the datasets because the total number of observations is larger than the unique individual identifications. It happens because some individuals (1) had multiple wage jobs, (2) ran multiple ventures, or (3) worked for wages, but were simultaneously self-employed. We then combined

these multiple records to report one observation per individual per year. If an individual had multiple wage jobs or ran multiple ventures, his annual income was recorded as the highest income he obtained. If an individual worked for wages and self-employment simultaneously, he was identified as an entrepreneur that year.

We then modeled the probability estimates of the determinants of entry into self-employment from wage-employment from 2000 to 2001. Because 2002 is the last year of our sample period, observing individuals' career choice from 2000 to 2001 allows us to mostly collect their information about their wage and entrepreneurial experience, and at the same time avoids the period of 2001 to 2002 when the Swedish economy growth is slightly slackened. Our final sample includes 19,274 individuals who were wage-employed in 2000 and at-risk of switching into self-employment in 2001.

4.2. Employment Status

We identified individuals' employment statuses using the occupational classification information provided by the data sources. In particular, the datasets provide an identifier to distinguish whether an individual was "employed", "self-employed in a proprietorship or partnership", "self-employed in incorporation" or "not employed" for every single year of the entire study period. In addition, the datasets also assign a unique identifier to each firm that the individual was affiliated with. By matching these two identifiers, we were able to observe whether an individual was wage-employed or self-employed.

In particular, individual were identified as an entrepreneur if “self-employed in a proprietorship or partnership” or "self-employed in incorporation". Individuals were identified as wage worker if “employed”. Among 19, 274 sampled individuals were

wage-employed in 2000, 2, 704 (around 14.029%) of them switched into entrepreneurship.

4.3. Variable

Dependent Variable. *Entry* was coded as a dummy for individuals who were wage-employed in 2000 and self-employed in 2001.

Independent Variables. Because we observe individuals' years of experience from 1989 to 2000, *entrepreneurial experience* was defined as individuals' years of experience in entrepreneurship prior to 2000. *Wage experience* was defined as individuals' years of experience in wage employment prior to 2000.

Controls. In addition to individuals' entrepreneurial and wage experience, their entrepreneurial entry decisions might be influenced by their family situations, financial conditions, current employment status, and the industry. We included several variables to account for these possibilities. These variables were calculated based on the information of 2000.

First, a dummy variable to indicate whether an individual was *married* in 2000 was included. Individuals' *age*, *education*, and number of *small children* in 2000 were also controlled.

Second, individuals' *current earnings* was controlled and calculated as the natural log of their wage earnings in 2000. If an individual had multiple wage jobs, his current earnings was calculated as the highest earnings he obtained from these jobs. In addition, a dummy indicating whether an individual had *multiple wage jobs* was also controlled.

The earnings in wage employment₂₀₀₀ = log (the highest wage earnings of all wage jobs₂₀₀₀)

Third, individuals' *household wealth* was calculated as the natural log of their household wealth in 2000. Individuals' years in *unemployment* and the natural log of their *non-salary income* were included.

Furthermore, the natural log of individuals' current *firm sale* and *firm growth* were controlled to describe their current employment. Firm growth was calculated as the difference between the number of employees in 1999 and 2000. A dummy variable indicating whether an individual was a manager of the firm was also included. If an individual's wage earning was higher than the firm's median salary, *managerial* was coded as 1. Otherwise, it was coded as 0.

Dummy variables were used to indicate whether an individual was in *manufacturing industry*, *professional service industry*, *rental industry* or *other service industries*.

Table 1 presents descriptive statistics.

Insert Table 1 about here

5. Results

Table 2 reports summary statistics of individuals' entrepreneurial experience by wage experience in 2000. Because the sample covers any individuals in high-technology manufacturing or knowledge-intensive service sectors from 1989 to 2002, and we observe the probability of switching from wage employment into self-employment from 2000 to 2001, an individual's maximum experience in wage employment is 12 years and maximum experience in self-employment is 11 years. As shown, the data points are

highly concentrated on the top right part of the table, indicating that most individuals in the sample have more experience in wage employment than in self-employment.

Insert Table 2 about here

Table 3 reports entry rate by individuals' entrepreneurial and wage experience. As shown, 38% of individuals who switched into entrepreneurship from 2000 to 2001 had no prior entrepreneurial experience. The entrepreneurial entry rate declines as individuals had more entrepreneurial experience. However, this decline stops when individuals had more than 6 years of entrepreneurial experience. The entrepreneurial entry rate then increases again, and is around 26% when individuals had 11 years of entrepreneurial experience. On the other hand, the entrepreneurial entry rate by individuals' wage experience shows frequent fluctuations. The highest entrepreneurial entry rate is around 16% when individuals have 12 years of wage experience.

Insert Table 3 about here

5.1. Logistic Regression

Table 4 reports the results of logistic model. Model 1 reports the effect of entrepreneurial experience. As shown, the coefficient of entrepreneurial experience is negative and significant ($b = -0.474$, $p < 0.001$). The AIC is 14,324, and the log likelihood ratio is $-7,140.100$. Model 2 reports the quadratic effect of entrepreneurial experience. As shown, the coefficients of entrepreneurial experience ($b = -1.249$, $p < 0.001$) and entrepreneurial experience – square ($b = 0.130$, $p < 0.001$) are significant, indicating a U-shaped relationship between individuals' entrepreneurial experience and

the probability of switching into entrepreneurship. In addition, the AIC is 13,399, and the log likelihood ratio is $-6,674.400$. The chi-square test indicates that adding entrepreneurial experience – square improves the model fit. Therefore, Hypothesis 1 (H1) is supported.

Model 3 reports the effect of wage experience. As shown, the coefficient of wage experience is positive and significant ($b = 0.188, p < 0.001$). The AIC is 15,089, and the log likelihood ratio is $-7,522.600$. Model 4 reports the quadratic effect of wage experience. As shown, the coefficients of wage experience ($b = -0.419, p < 0.001$) and entrepreneurial experience – square ($b = 0.033, p < 0.001$) are significant, indicating a U-shaped relationship between individuals' wage experience and the probability of switching into entrepreneurship. In addition, the AIC is 15,055, and the log likelihood ratio is $-7,504.000$. The chi-square test indicates that adding wage experience – square improves the model fit. However, because the finding contradicts to Hypothesis 2 (H2), Hypothesis 2 (H2) is not supported.

Model 5 reports the quadratic effects of entrepreneurial and wage experience. As shown, the coefficients of entrepreneurial experience ($b = -1.243, p < 0.001$) and entrepreneurial experience – square ($b = 0.133, p < 0.001$) are significant, confirming a U-shaped relationship between individuals' entrepreneurial experience and the probability of switching into entrepreneurship.⁴ The coefficient of wage experience is

⁴ We did a supplementary analysis by excluding entrepreneurial experience – square term from Model 5 to compare the model fit. The results show that the relationship between individuals' entrepreneurial experience and the probability of switching into entrepreneurship is significantly negative ($b = -0.453, p < 0.001$). The log likelihood ratio is $-7,461.300$. The chi-square test indicates that including entrepreneurial experience – square term improves model fit. We determined to include entrepreneurial experience – square term in our model estimation.

positive and significant ($b = 0.237, p < 0.05$), but the coefficient of wage experience – square is not significant ($b = -0.009, p = 0.133$). The AIC is 13,380, and the log likelihood ratio is – 6,665.200. The chi-square test indicates that adding entrepreneurial and wage experience variables together into the model estimation improves the model fit. These findings show that the relationship between individuals’ wage experience and the probability of switching into entrepreneurship is inverted U-shaped, but not significant.

Noticeably, when we have entrepreneurial experience under control, the U-shaped relationship between individuals’ wage experience and the probability of switching into entrepreneurship flips and becomes inverted U-shaped (not significant, but still an inverted U-shape). One possible explanation is that entrepreneurial and wage experience are highly correlated and entrepreneurial experience is a much more influential factor in determining entrepreneurial entry comparing with wage experience, and thus the effect of wage experience is compensated. A Pearson Correlation test confirms our conjecture. It shows that the correlation between these two variables is -0.442.

Insert Table 4 about here

Table 5 reports the results of two supplementary analyses to test the interaction effects. Model 1 reports the interacting effects of entrepreneurial experience – square and wage experience. As shown, the coefficient of entrepreneurial experience \times wage experience ($b = -0.056, p < 0.001$) and entrepreneurial experience – square \times wage experience ($b = 0.010, p < 0.001$) are significant, indicating that when individuals have more wage experience, the U-shaped relationship between entrepreneurial experience and the probability of switching into self-employment will become more dramatic. The AIC

is 13,319, and the Log likelihood ration is -6,637.100. The chi-square test indicates that including the interaction terms improves the model fit.

Model 2 reports the interacting effects of wage experience – square and entrepreneurial experience. As shown, the coefficients of wage experience \times entrepreneurial experience ($b = -0.001, p = 0.979$) and wage experience – square \times entrepreneurial experience ($b = -0.004, p = 0.065$) are not significant. The coefficient of wage experience – square is now positive and significant ($b = 0.016, p < 0.05$), indicating a U-shaped relationship between wage experience and the probability of switching into entrepreneurship. The AIC is 14,206, and the Log likelihood ration is -7,077.300. The chi-square test indicates that including the interaction terms does not improve the model fit.

Insert Table 5 about here

5.2. Random Forests

The number of trees used to model random forests is 1,000 with node size equaling 5. As discussed above, while logistic regression relies on p -values to determine the significance of a finding, random forests provide visual interpretation of variable importance. Figure 1 plots the variable importance assessment of the random forests. In consistent with the results of logistic regression, entrepreneurial experience renders the most important influence on the probability of switching into entrepreneurship – excluding it from the model will lose the model prediction accuracy by around 14%. In addition to it, current earnings (loss of prediction accuracy by 3%), wage experience (around 0.5%), firm sale (around 0.5%), managerial (around 0.3%) are also influential

factors. Different from logistic regression, random forests also shows that firm growth (around 0.4%) and non-salary income (around 0.4%) have equal important influences as the variables mentioned above on the probability of switching into entrepreneurship.

Insert Figure 1 about here

The following effects plots are used to compare the findings of logistic regression and random forests. Figure 2 compares the effects plots of individuals' entrepreneurial experience using the logistic regression and random forests. As shown, the plot of logistic regression (Model 2, Table 4) shows a U-shaped relationship between entrepreneurial experience and the probability of switching into entrepreneurship. However, the plot of random forests shows that the probability of switching into entrepreneurship declines at first but flattens out when individuals have more entrepreneurial experience.

Insert Figure 2 about here

To investigate whether including a series of binary variables of entrepreneurial experience can help logistic regression detect the nonlinear relationship, we did another supplementary analysis reported in Table 6. In particular, we created two dummy variables to indicate whether individuals' years of entrepreneurial experience equals 1 (dummy = 1 if individuals have one year entrepreneurial experience; otherwise dummy = 0) or is greater than 1 (dummy = 1 if individuals' years of entrepreneurial experience is greater than 1; otherwise dummy = 0). As shown, all the dummy variables are negative related to the probability of entrepreneurial entry ($b = -2.542$, $p < 0.001$ for the dummy variable indicating whether individuals' years of entrepreneurial experience equals 1; $b =$

-2.129, $p < 0.001$ for the dummy variable indicating whether individuals' years of entrepreneurial experience is greater than 1). These results indicate that individuals are less likely to switch into entrepreneurship from wage employment when they have one year experience in entrepreneurship. The negative relationship between prior entrepreneurial experience and the probability of entrepreneurial entry becomes slightly weaker when individuals have more entrepreneurial experience. As shown by Figure 3 the findings of logistic regression now is quite similar to the findings of random forests.

Insert Table 6 and Figure 3 about here

Figure 4 compares the effects plots of individuals' wage experience by excluding entrepreneurial experience (Model 4, Table 4). The logistic regression shows a U-shaped relationship between wage experience and the probability of switching into entrepreneurship. However, the random forests shows that the probability of switching into entrepreneurship flattens out at first, declines after and then increases again.

Insert Figure 4 about here

Figure 5 compares the effects plots of individuals' wage experience by including entrepreneurial experience (Model 5, Table 4). As shown, the plot of logistic regression shows a nonsignificant inverted U-shaped relationship between individuals' wage experience and the probability of switching into entrepreneurship. But random forests shows consistent results as Figure 4 reports.

Insert Figure 5 about here

Figure 6a, 6b, 6c compare the effects plots of the U-shaped relationship between entrepreneurial experience and the probability of switching into entrepreneurship interacting with wage experience (Model 1, Table 5, at minimum, median and maximum). As shown by Figure 6a, the logistic regression shows that the right slope of the U-shaped relationship flattens out when individuals have one year of wage experience. The random forests reports the probability of switching into entrepreneurship is overall lower. As shown by Figure 6b, when individuals have more wage experience, the logistic regression shows that the right slope of the U-shaped relationship slightly bends toward the right side, while the random forests reports the probability of switching into entrepreneurship is lower to a greater degree. As shown in Figure 6c, when individuals are very experienced in wage employment, the effects plots of both models are consistent as reported by Figure 2.

Insert Figure 6a, 6b, 6c about here

Figure 7a, 7b, 7c compare the effects plots of the U-shaped relationship between wage experience and the probability of switching into entrepreneurship interacting with entrepreneurial experience (Model 2, Table 5, at minimum, median and maximum). As shown by Figure 7a, the logistic regression shows that the U-shaped relationship between wage experience and the probability of switching into entrepreneurship is more dramatic when individuals have one year of entrepreneurial experience. The random forest reports the probability of switching into entrepreneurship is overall higher. As shown by Figure 7b, a moderate level of entrepreneurial experience does not seem to affect the U-shaped relationship between wage experience and the probability of switching into entrepreneurship. As shown by Figure 7c, the effect of wage experience on the

probability of switching into entrepreneurship becomes more negative when individuals are very experienced in entrepreneurship. The random forest reports the probability of switching into entrepreneurship is overall higher.

Insert Figure 7a, 7b, 7c about here

5.3. Model Fit

We compared the prediction errors of logistic regression, random forests, and several other advanced linear regression tools on the same models as reported by Table 4. The purpose is to illustrate whether random forests is superior to other computation techniques in terms of model fit and prediction accuracy. Because ridge regression (Hoerl and Kennard, 1970), lasso regression (Tibshirani, 1996) and elastic-net (Zou and Hastie, 2005) are the most popular linear regression tools to prevent the problems such as multicollinearity, we report the prediction errors of these models.

In particular, to assess the model fit and prediction accuracy of each model, we used a bootstrapped cross-validation. We first randomly selected, with replacements, a set of n observations from the original data, and used each model to fit on the selected bootstrapped data. Then, the observations in the original data that were not selected by the bootstrapping were treated as the testing data to assess the model fit and prediction accuracy. The prediction error of each model was then recorded. We repeated this entire procedure for 100 times and took an average of recorded prediction errors. We then used a boxplot to compare the prediction errors across all models.

As shown by Figure 8, random forests has the smallest prediction errors, around 0.136. The other four models have higher prediction errors, roughly around 0.139. The

results illustrate that random forests achieved higher prediction accuracy comparing with logistic regression, lasso regression, ridge regression and elastic-net.

Insert Figure 8 about here

6. Discussion

Our results show that logistic regression and random forests present several different findings. These discrepant findings illustrate random forests is superior to logistic regression in handling big data from several perspectives.

First, as discussed above, the statistical significance relying on p -values may not imply economic significance because the immense volume of data means that almost everything can be significant (Cumming *et al.*, 2017; George *et al.*, 2014). In addition, more flexible relationships than simple linear relationships (i.e. linear, curvilinear, cubic, *etc.*) are possible (Varian, 2014) in the context of big data, and thus logistic regression that pre-specifies the linear relationship between the dependent and independent variables may lead to misleading conclusions. On the other hand, random forests do not rely on p -values. Instead, it provides visualize graphs to illustrate variable importance (Zhu and Kosorok, 2012; Zhu *et al.*, 2015). It also functions through a set of decision rules on the independent variables, helping deduce nonparametric relationship and provide more flexible model structures.

For example, our Hypothesis 1 suggests that the relationship between entrepreneurial experience and the probability of switching into entrepreneurship is U-shaped. As shown by Model 1 in Table 4, this hypothesis is supported by the logistic regression. However, as shown in Figure 2, random forests illustrates the probability of

switching into entrepreneurship declines first and then flattens out. That is to say, the relationship between entrepreneurial experience and the probability of switching into entrepreneurship is not quadratic as suggested by the logistic model. Because we pre-specified this quadratic relationship for the logistic regression model estimation, the right-side slope is over stretched due to the immense volume of data, leading to misleading conclusions.

To investigate whether including a series of binary variables of entrepreneurial experience can help logistic regression detect the nonlinear relationship, we did an additional analysis reported in Table 6 and Figure 3. Our findings confirm that the relationship between entrepreneurial experience and probability of switching into entrepreneurship from wage employment is not linear. The probability of switching into entrepreneurship from wage employment is lowest when individuals have one year experience in entrepreneurship, and then flattens out when individuals have more experience. These findings suggest that when dealing with big data, researchers may use machine learning tools, like random forests, to deduce the true patterns of the relationship, and then including a series of binary variables for the variable of interest to detect the nonlinear relationship. However, it is also worth pointing out that although using a series of binary variables may be able to help detect the nonlinear relationship, it loses the implication of treating it as a continuous variable. In addition, categorizing continuous variables is a subjective and tedious process because cutoffs can have profound effects on the findings. More importantly, if a study has multiple continuous variables of interests and each of them have multiple categories, that means researchers

need to add many extra variables into the model estimation, resulting in an exponential increase of numbers of parameters and serious overfitting problems.

Second, when there are several highly-correlated variables, logistic regression may be subject to multicollinearity (Hoerl and Kennard, 1970). In addition, although variable transformations may help solve the problem, they often lead to discrepant results (Lo and Andrews, 2015). On the other hand, random forests is less sensitive to correlated variables due to their model ensemble. Because different trees in the forests may use a different set of variables to explain the variance in the outcome, the average of them becomes more stable. Hence, adding or removing some highly correlated variables will not likely to change its conclusions. That is to say, the results presented by random forests are more consistent and robust.

For example, the logistic regression shows that the effect of wage experience depends on whether we have entrepreneurial experience under control. When we exclude entrepreneurial experience from model estimation (Model 4 in Table 4), the relationship between wage experience and the probability of switching into entrepreneurship is U-shaped, and thus our Hypothesis 2 is not supported. When we have entrepreneurial experience under control (Model 5 in Table 4), the U-shaped relationship between wage experience and the probability of switching into entrepreneurship flips and becomes inverted U-shaped (insignificant). One possible explanation could be that wage experience is highly correlated with entrepreneurial experience, causing the logistic regression rendering nonsignificant findings. A Pearson Correlation test confirms our conjecture and shows that the correlation between these two variables is -0.442. Because entrepreneurial experience is a much more influential factor in determining

entrepreneurial entry comparing with wage experience as shown by Figure 1, the effect of wage experience is compensated. Given that random forests provide consistent results – with or without entrepreneurial experience under control, the above evidence illuminates that logistic regression may be subject to multicollinearity when there are several highly-correlated variables (Hoerl and Kennard, 1970), while random forests concerns less about it.

Third, comparing with logistic regression, random forests achieves higher prediction accuracy and provides more robust results when dealing with complex interactions. In Table 5, we report the interacting effects between entrepreneurial experience/ wage experience – square with wage experience/ entrepreneurial experience. Comparing with the findings of random forests, logistic regression reports more dramatic interaction effects. For example, Figure 6a shows that the right slope of the U-shaped relationship between entrepreneurial experience and the probability of switching into entrepreneurship flattens out when individuals have one year of wage experience. But random forests reports the probability of switching into entrepreneurship is overall lower – the shape of the plot remains the same. Similarly, as shown by Figure 7a, the logistic regression shows that the relationship between wage experience and the probability of switching into entrepreneurship is more dramatic when individuals have one year of wage experience. But the random forests reports that the shape of the plot remains the same as reported by Figure 4 and Figure 5.

To conclude, our findings illustrate that using the standard statistical models to analyze big data can lead to misleading conclusions. We need more powerful computation techniques, such as random forests, to handle it. Our model fit analysis also

proves that random forests is superior to logistic regression and other advanced linear regression tools (i.e. ridge regression, lasso regression and elastic-net) about the prediction accuracy. It is worth pointing out that logistic regression, like other standard statistical models, has its advantages. As a famous statistician George Box (1919-2013) once said, “All models are wrong, but some are useful”. When dealing with a small sample size, logistic regression is surely a more sensible choice. Because it provides p -values, its findings are easier to interpret than the findings of these machine learning tools. But again, the statistical significance relying on p -values to confirm or disconfirm hypotheses are not likely to be effective in the context of big data (George *et al.*, 2014).

Our study makes contributions to the literature from several perspectives. First, although the relationship between entrepreneurial experience and the probability of switching into entrepreneurship from wage employment has been well studied (Amaral and Baptista, 2007; Amaral *et al.*, 2011; Evans and Leighton, 1989; Hamilton, 2000; Hessels *et al.*, 2011; Metzger, 2008; Stam *et al.*, 2008), it remains theoretical and empirical uncertainty as an alternative possibility that prior entrepreneurial experience can also generate and reveal general human capital, which is valuable to wage employers (Campbell, 2013), has been ignored. We argue and illustrate that this theoretical and empirical uncertainty may can be solved through using more powerful computation techniques, such as machine learning tools. By doing so, we also invite more attention from management scholars to these contemporary computation techniques, which might be particularly valuable in re-visiting these fundamental questions in entrepreneurship.

Second, although prior studies have stressed the importance of analyzing big data using more advanced computation techniques, such as machine learning tools (Bajari *et*

al., 2015; George *et al.*, 2014; George *et al.*, 2016; Sivarajah *et al.*, 2017; Varian, 2014), they have not empirically illustrated the advantage of these advanced machine learning tools over the standard statistical models. Our study uses a commonly studied problem – entrepreneurial entry as an example and empirically compares the findings of logistic regression – a standard statistical model and random forests – a power machine learning tool. The results show that these two models present several different findings, and random forests is obviously superior to logistic regression in handling big data. Our conclusions and findings then can be used as empirical evidence to confirm the advantages of these machine learning tools over the standard statistical models.

Third, although several studies have proposed machine learning tools to management scholars (Bajari *et al.*, 2015; George *et al.*, 2016; Varian, 2014), our study illuminates the features of random forests, which is believed to be one of the most effective machine learning tool (Zhu and Kosorok, 2012; Zhu *et al.*, 2015), in a greater detail.

Fourth, our study attempts to achieve a balance between theory and method. Although there is likely a trade-off between theoretical and empirical contribution (George *et al.*, 2014), our study shows that scholars can still deduce from theories to present their theoretical conjectures while simultaneously running a statistical test correctly. Perhaps, a fruitful future direction for studies using big data is to emphasize more on theoretical interpretation of the empirical findings, instead of pre-specifying the hypotheses.

7. Conclusion

In this study, we re-visit the important relationship between prior entrepreneurial experience and the probability of switching into entrepreneurship from wage employment using two models: logistic regression – a standard statistical model commonly used by management scholars and random forests – a powerful machine learning tool for analyzing big data. Through comparing the findings of these two models, this study resolves the theoretical and empirical uncertainty on this topic and also illuminates the importance of appropriately handling big data.

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Table 1 Descriptive Statistics (n = 19,274, year = 2000)

	Mean	Median	Min	Max
Entrepreneurial experience	1.864	1.000	0.000	11.000
Wage experience	10.860	12.000	1.000	12.000
Age	33.730	34.000	31.000	36.000
Current earnings	256,788.000	234,000.000	105.000	15,124,679.000
Education	4.222	4.000	0.000	7.000
Firm growth	0.205	0.000	-9.075	8.502
Firm sale	1,219,603,324.000	0.000	-15.000	92,364,652,472.000
Kids 0-3	0.393	0.000	0.000	3.000
Kids 4-6	0.269	0.000	0.000	3.000
Kids 7-10	0.248	0.000	0.000	4.000
Kids 11-15	0.085	0.000	0.000	4.000
Kids 16-17	0.008	0.000	0.000	2.000
Non-salary income	725.800	-58.000	-20,160.000	2,909,440.000
Household wealth	0.452	0.000	0.000	19.472
Time unemployed	0.507	0.000	0.000	5.905
Frequency/Percentage				
Managerial	76.100%			
Marriage	39.737%			
Multiple wage jobs	44.189%			
Manufacturing industry	17.830%			
Professional service industry	32.178%			
Rental industry	2.843%			
Other service industry	12.473%			
Other industry	34.674%			

Table 2 Entrepreneurial Experience by Wage Experience in Years (n = 19,274, year = 2000)

Entrepreneurial Experience in Years	Wage Experience in Years												Total
	1	2	3	4	5	6	7	8	9	10	11	12	
0	0	0	1	9	16	32	38	78	143	273	618	3,698	4,906
1	1	4	4	15	34	65	103	167	272	465	964	3,761	5,855
2	1	3	8	6	20	45	71	133	206	400	667	1,813	3,373
3	0	1	1	12	15	39	59	101	208	331	344	809	1,920
4	0	0	2	9	17	31	56	108	192	187	172	428	1,202
5	1	2	3	8	18	25	66	133	120	86	95	216	773
6	1	1	4	3	18	44	75	69	68	47	47	142	519
7	0	0	5	5	41	46	39	42	30	18	29	71	326
8	0	2	8	17	21	26	17	19	13	12	9	51	195
9	2	0	7	19	19	14	17	8	7	7	7	27	134
10	1	0	8	4	6	5	3	4	2	3	7	5	48
11	1	3	3	4	3	1	3	0	0	2	0	3	23
Total	8	16	54	111	228	373	547	862	1,261	1,831	2,959	11,024	19,274

Table 3 Self-employment Entry Rate by Entrepreneurial/Wage Experience (n = 19,274, year = 2000)

Entrepreneurial Experience in Years	Switch into Entrepreneurship			Wage Experience in Years	Switch into Entrepreneurship		
	Entry	Remain in Wage Employment	Entry Percentage		Entry	Remain in Wage Employment	Entry Percentage
0	1,851	3,055	37.729%	1	0	8	0.000%
1	280	5,575	4.782%	2	2	14	12.500%
2	185	3,188	5.485%	3	5	49	9.259%
3	145	1,775	7.552%	4	11	100	9.910%
4	82	1,120	6.822%	5	20	208	8.772%
5	45	728	5.821%	6	42	331	11.260%
6	34	485	6.551%	7	56	491	10.238%
7	33	293	10.123%	8	82	780	9.513%
8	22	173	11.282%	9	122	1,139	9.675%
9	16	118	11.940%	10	195	1,636	10.650%
10	5	43	10.417%	11	365	2,594	12.335%
11	6	17	26.087%	12	1804	9,220	16.364%

Table 4 Logistic Regression on Entrepreneurial/Wage Experience (n = 19,274, y = 2000)

	Model 1			Model 2			Model 3			Model 4			Model 5		
	p.a.	s.e.	p-value	p.a.	s.e.	p-value	p.a.	s.e.	p-value	p.a.	s.e.	p-value	p.a.	s.e.	p-value
Intercept	4.184	1.703	0.014*	5.269	1.747	0.003**	2.921	1.579	0.064	5.838	1.636	< 0.001***	3.935	1.828	0.031*
Age	-0.022	0.03	0.097	-0.016	0.014	0.242	-0.048	0.013	< 0.001***	-0.050	0.013	< 0.001***	-0.016	0.014	0.238
Current earnings (log)	-0.307	0.023	< 0.001***	-0.313	0.234	< 0.001***	-0.324	0.022	< 0.001***	-0.329	0.022	< 0.001***	-0.327	0.024	< 0.001***
Education	0.006	0.017	0.722	0.004	0.018	0.803	0.023	0.017	0.162	0.023	0.017	0.167	0.001	0.018	0.943
Firm growth (log)	-0.041	0.026	0.110	-0.036	0.027	0.177	-0.035	0.026	0.176	-0.034	0.026	0.187	-0.033	0.027	0.222
Firm sale (log)	-0.011	0.003	< 0.001***	-0.013	0.003	< 0.001***	-0.012	0.003	< 0.001***	-0.012	0.003	< 0.001***	-0.013	0.003	< 0.001***
Kids 0-3	-0.008	0.039	0.826	0.000	0.040	0.990	-0.021	0.038	0.584	-0.021	0.038	0.571	-0.004	0.040	0.929
Kids 4-6	-0.052	0.047	0.259	-0.052	0.048	0.279	-0.055	0.046	0.230	-0.060	0.046	0.188	-0.052	0.048	0.028
Kids 7-10	0.071	0.043	0.098	0.061	0.044	0.164	0.069	0.042	0.100	0.067	0.042	0.107	0.057	0.044	0.198
Kids 11-15	0.023	0.070	0.739	0.038	0.072	0.593	0.035	0.068	0.608	0.038	0.068	0.576	0.047	0.072	0.515
Kids 16-17	0.106	0.225	0.636	0.084	0.234	0.719	0.179	0.216	0.409	0.203	0.217	0.349	0.080	0.235	0.733
Non-salary income (log)	-0.091	0.165	0.582	-0.173	0.169	0.306	-0.123	0.151	0.416	-0.138	0.150	0.359	-0.167	0.169	0.324
Household wealth (log)	-0.010	0.010	0.330	-0.011	0.015	0.323	-0.015	0.010	0.131	-0.016	0.010	0.127	-0.010	0.011	0.345
Time unemployed	0.012	0.015	0.401	0.015	0.015	0.323	0.047	0.014	0.001**	0.050	0.014	< 0.001***	0.022	0.015	0.145
Managerial	-0.099	0.054	0.070	-0.127	0.056	0.024*	-0.122	0.053	0.022*	-0.118	0.054	0.028*	-0.134	0.056	0.017*
Marriage	0.048	0.052	0.349	0.062	0.053	0.245	-0.006	0.050	0.908	-0.010	0.051	0.847	0.058	0.053	0.273
Multiple wage jobs	0.008	0.044	0.861	-0.030	0.045	0.504	-0.000	0.043	0.996	-0.006	0.043	0.882	-0.050	0.045	0.270
Manufacturing industry	0.077	0.065	0.238	0.141	0.067	0.035*	0.004	0.064	0.949	0.002	0.064	0.972	0.141	0.067	0.036*
Professional service industry	0.107	0.054	0.049*	0.109	0.056	0.052	0.092	0.053	0.085	0.088	0.053	0.097	0.111	0.056	0.048*
Rental industry	0.043	0.135	0.750	0.052	0.139	0.710	-0.012	0.132	0.929	-0.008	0.132	0.953	0.052	0.139	0.708
Other service industries	0.150	0.070	0.033*	0.176	0.073	0.016*	0.152	0.069	0.028*	0.149	0.069	0.031*	0.184	0.073	0.011*
<i>Main effect</i>															
Entrepreneurial experience	-0.474	0.018	< 0.001***	-1.249	0.323	< 0.001***							-1.243	0.034	< 0.001***

Entrepreneurial experience ² (H1)				0.130	0.033	< 0.001***							0.133	0.004	< 0.001***
Wage experience							0.188	0.015	< 0.001***	-0.419	0.094	< 0.001***	0.237	0.112	0.035*
Wage experience ² (H2)										0.033	0.005	< 0.001***	-0.009	0.006	0.133
AIC	14,324			13,399			15,089			15,055			13,380		
Log likelihood ratio	-7,140.100			-6,676.400			-7,522.600			-7,504.000			-6,665.200		
Chi-square	< 0.001						<0.001						<0.001		
*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$															

Table 5 Supplementary Analyses on Entrepreneurial/Wage Experience Interactions (n = 19,274, year = 2000)

	Model 1			Model 2		
	p.a.	s.e.	p-value	p.a.	s.e.	p-value
Intercept	4.658	1.778	0.009**	4.01	1.842	0.030*
Age	-0.015	0.014	0.284	-0.023	0.013	0.085
Current earnings (log)	-0.317	0.234	< 0.001***	-0.325	0.023	< 0.001***
Education	-0.002	0.018	0.893	0.010	0.017	0.607
Firm growth (log)	-0.035	0.027	0.191	-0.036	0.026	0.164
Firm sale (log)	-0.013	0.003	< 0.001***	-0.012	0.003	< 0.001***
Kids 0-3	-0.002	0.04	0.953	-0.017	0.039	0.662
Kids 4-6	-0.046	0.048	0.334	-0.059	0.047	0.207
Kids 7-10	0.054	0.044	0.213	0.060	0.043	0.159
Kids 11-15	0.043	0.072	0.552	0.026	0.07	0.71
Kids 16-17	0.062	0.235	0.793	0.122	0.225	0.588
Non-salary income (log)	-0.17	0.171	0.319	-0.102	0.165	0.539
Household wealth (log)	-0.011	0.011	0.319	-0.010	-0.010	0.333
Time unemployed	0.020	0.015	0.184	0.020	0.015	0.099
Managerial	-0.138	0.057	0.015*	-0.105	0.055	0.055
Marriage	0.060	0.053	0.263	0.045	0.052	0.383
Multiple wage jobs	-0.049	0.046	0.288	-0.015	0.044	0.728
Manufacturing industry	0.151	0.067	0.025*	0.090	0.065	0.167
Professional service industry	0.118	0.056	0.035*	0.111	0.055	0.042
Rental industry	0.038	0.140	0.788	0.051	0.135	0.708
Other service industries	0.182	0.073	0.012*	0.167	0.071	0.018
<i>Main effect</i>						
Entrepreneurial experience	-0.716	0.184	< 0.001***	-0.022	0.141	0.878

Entrepreneurial experience ² (H1)	0.048	0.019	0.011*			
Wage experience	0.062	0.023	0.007**	-0.127	0.146	0.383
Wage experience ² (H2)				0.016*	0.01	0.041*
<i>Supplementary analyses - Interaction</i>						
Entrepreneurial experience * Wage experience	-0.056	0.017	< 0.001***	-0.001	0.036	0.979
Entrepreneurial experience ² * Wage experience	0.010	0.002	< 0.001***			
Wage experience ² * Entrepreneurial experience				-0.004	0.002	0.065
AIC	13,319			14,206		
Log likelihood ratio	-6,637.100			-7,077.300		
Chi-square	<0.001			0.387		
*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$						

Figure 1 Random Forests Model – Variable Importance

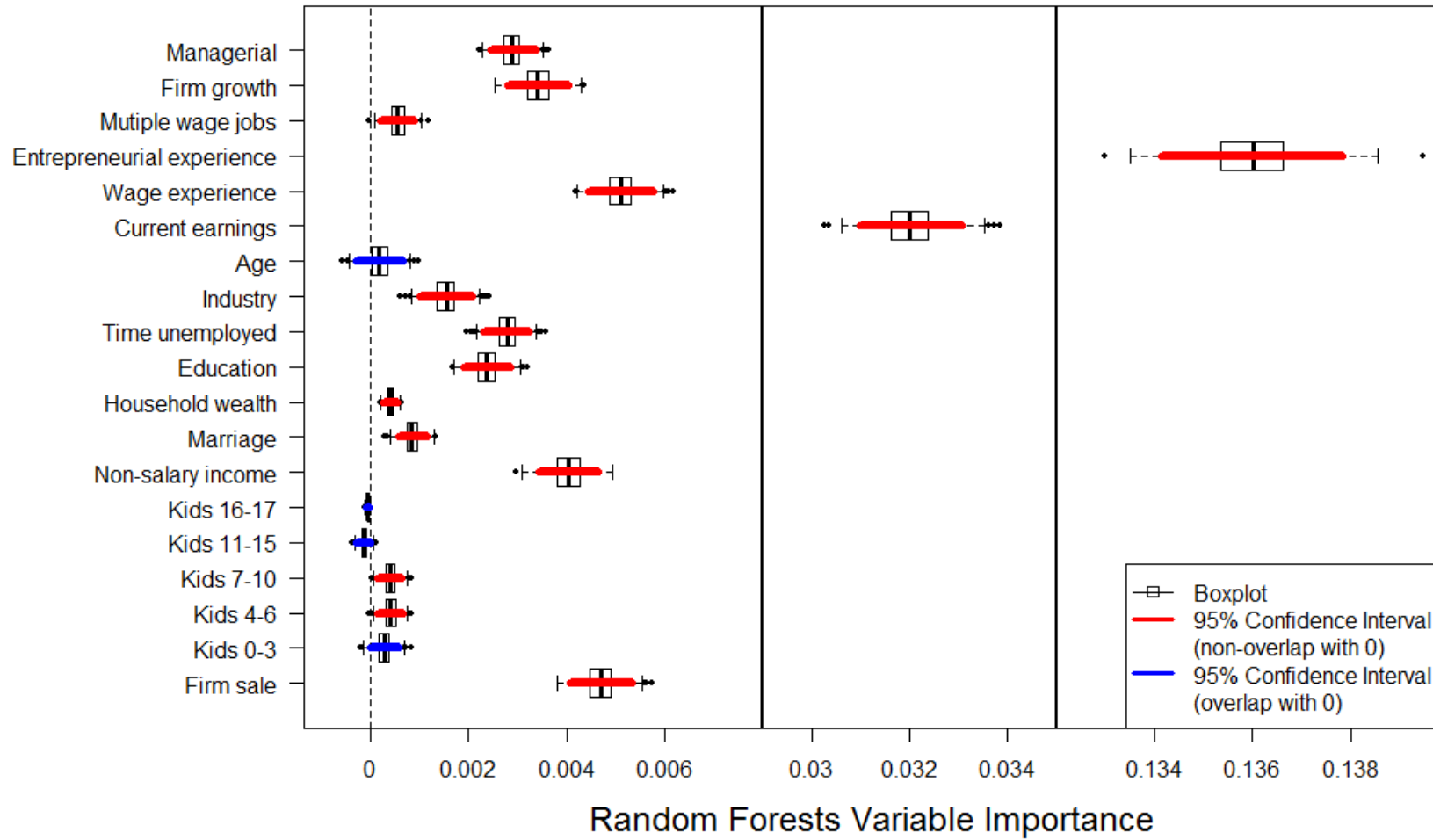


Figure 2 Comparative plots – The relationship between prior entrepreneurial experience and the probability of switching into entrepreneurship

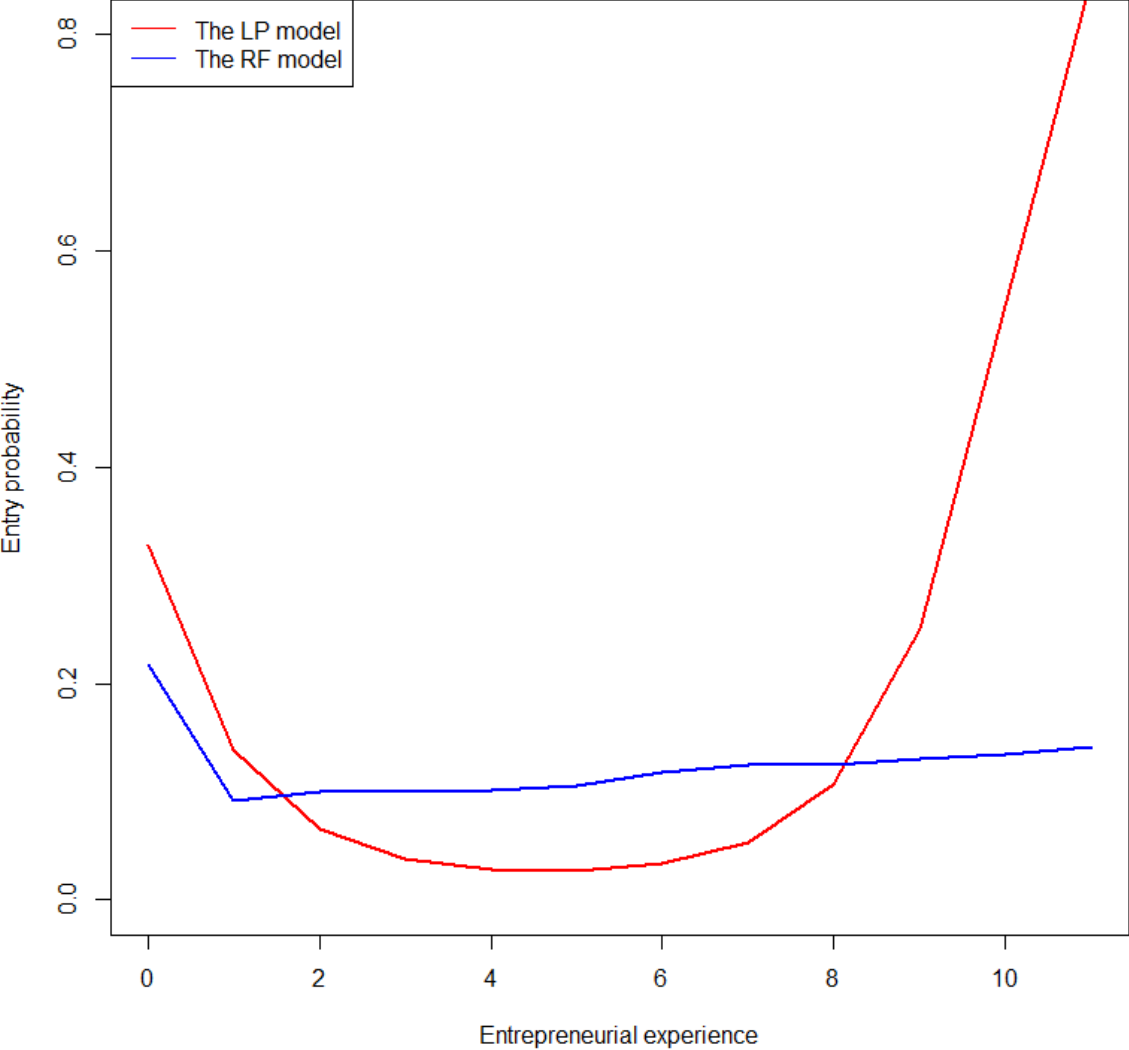


Table 6 Additional Analyses on the Effect of Entrepreneurial Experience (n = 19,274, year = 2000)

	Model 1		
	p.a.	s.e.	p-value
Intercept	5.674	1.811	0.002***
Age	-0.003	0.014	0.813
Current earnings (log)	-0.330	0.025	< 0.001***
Education	0.000	0.018	0.985
Firm growth (log)	-0.031	0.028	0.272
Firm sale (log)	-0.015	0.003	< 0.001***
Kids 0-3	-0.014	0.041	0.733
Kids 4-6	-0.061	0.050	0.215
Kids 7-10	0.058	0.046	0.199
Kids 11-15	0.036	0.074	0.630
Kids 16-17	-0.024	0.243	0.920
Non-salary income (log)	-0.157	0.167	0.348
Household wealth (log)	-0.011	0.011	0.298
Time unemployed	0.027	0.016	0.094
Managerial	-0.189	0.059	0.001**
Marriage	0.078	0.055	0.160
Multiple wage jobs	-0.071	0.047	0.135
Manufacturing industry	0.228	0.070	0.001**
Professional service industry	0.119	0.058	0.041*
Rental industry	0.091	0.143	0.524
Other service industries	0.227	0.076	0.003**
Main effect			
Entrepreneurial experience = 1 year	-2.542	0.070	< 0.001***
Entrepreneurial experience > 1 year	-2.129	0.057	< 0.001***
Wage experience	-0.168	0.104	0.107
Wage experience ²	0.011	0.006	0.044*
AIC	12,591		
Log likelihood Ratio	-6,272.500		
*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$; † $p < 0.1$.			

Figure 3 Additional Analyses on the Effect of Entrepreneurial Experience

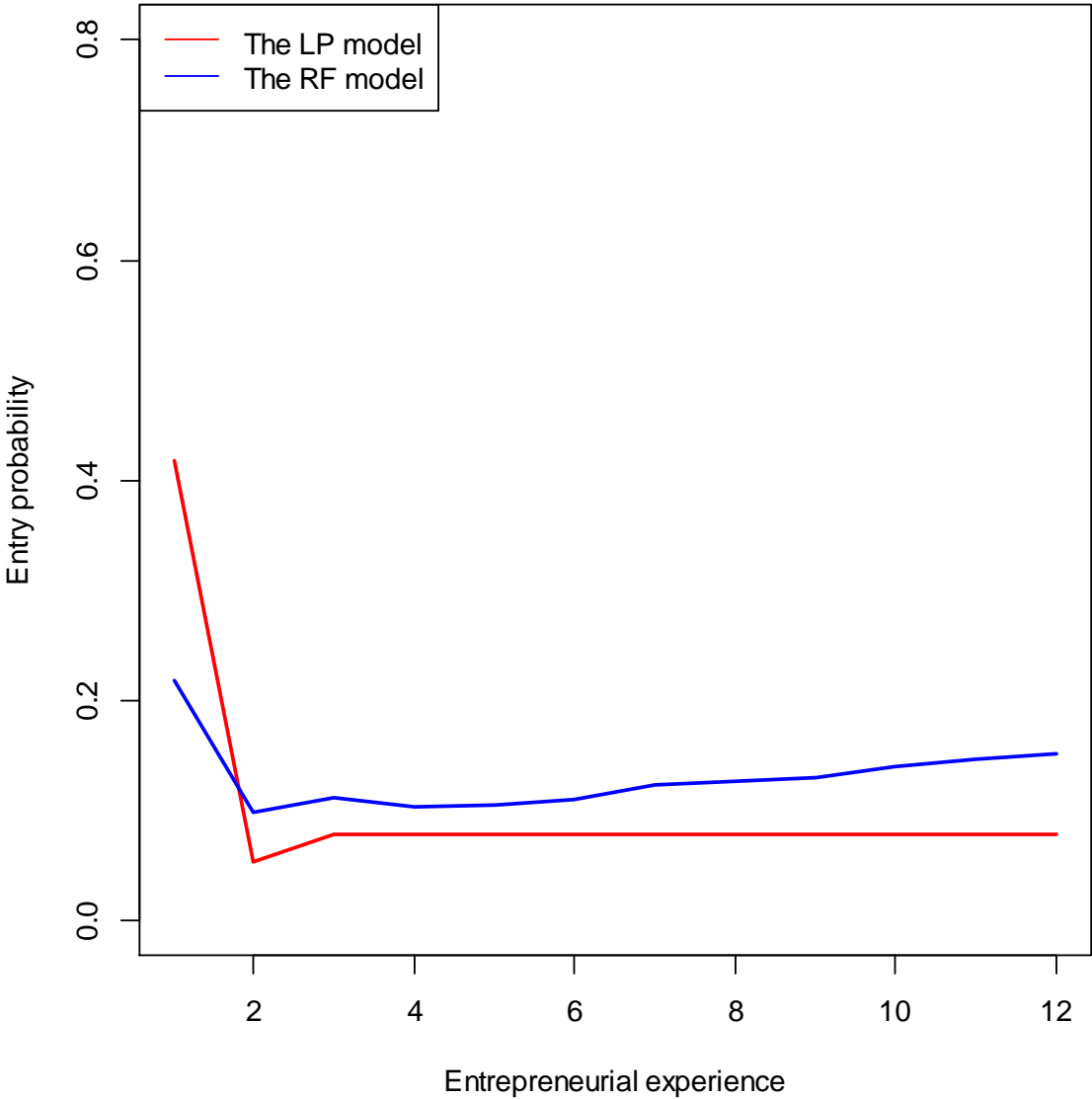


Figure 4 Comparative plots – The relationship between wage experience and the probability of switching into entrepreneurship when taking out entrepreneurial experience

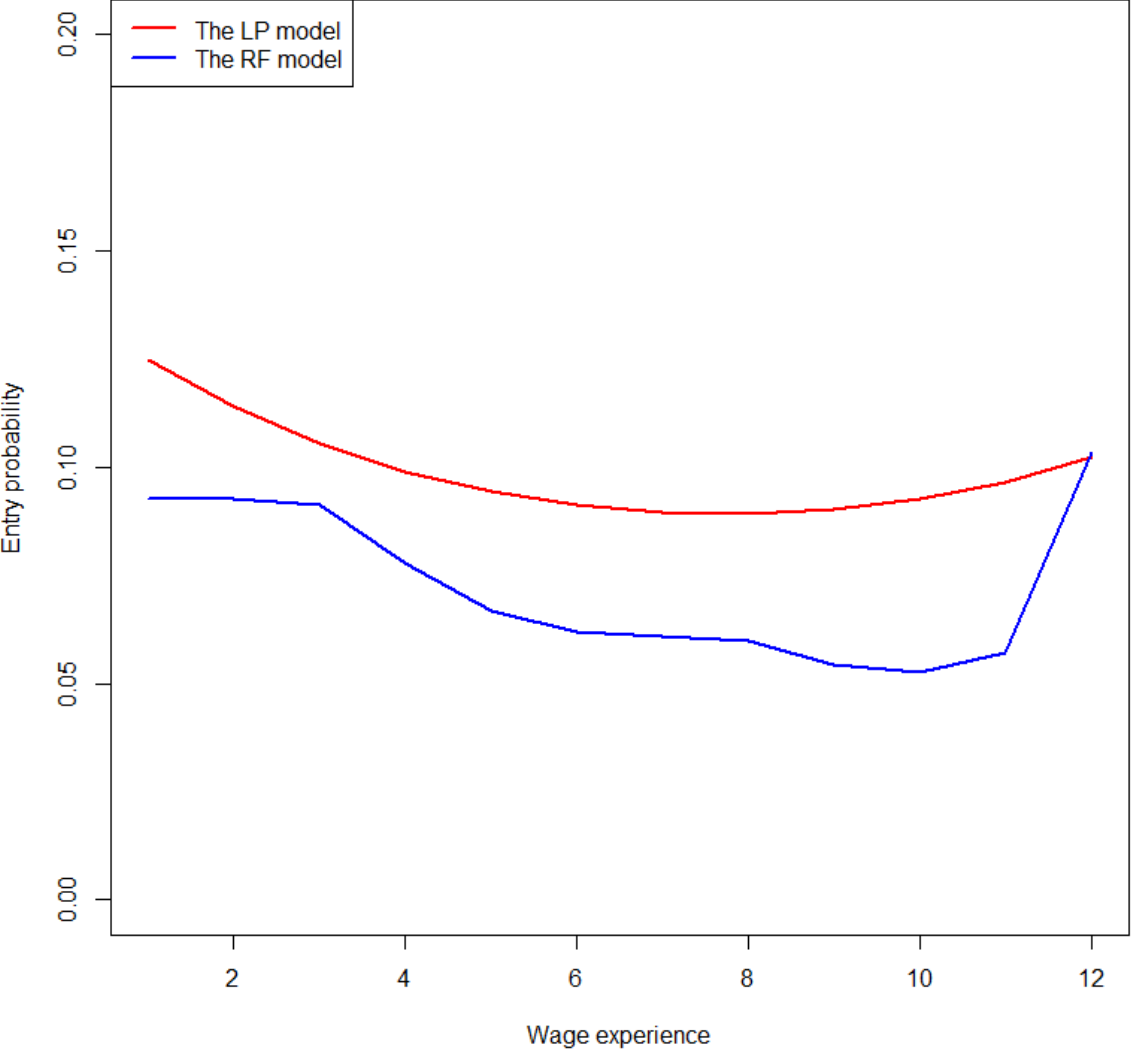


Figure 5 Comparative plots – The relationship between wage experience and the probability of switching into entrepreneurship when controlling entrepreneurial experience

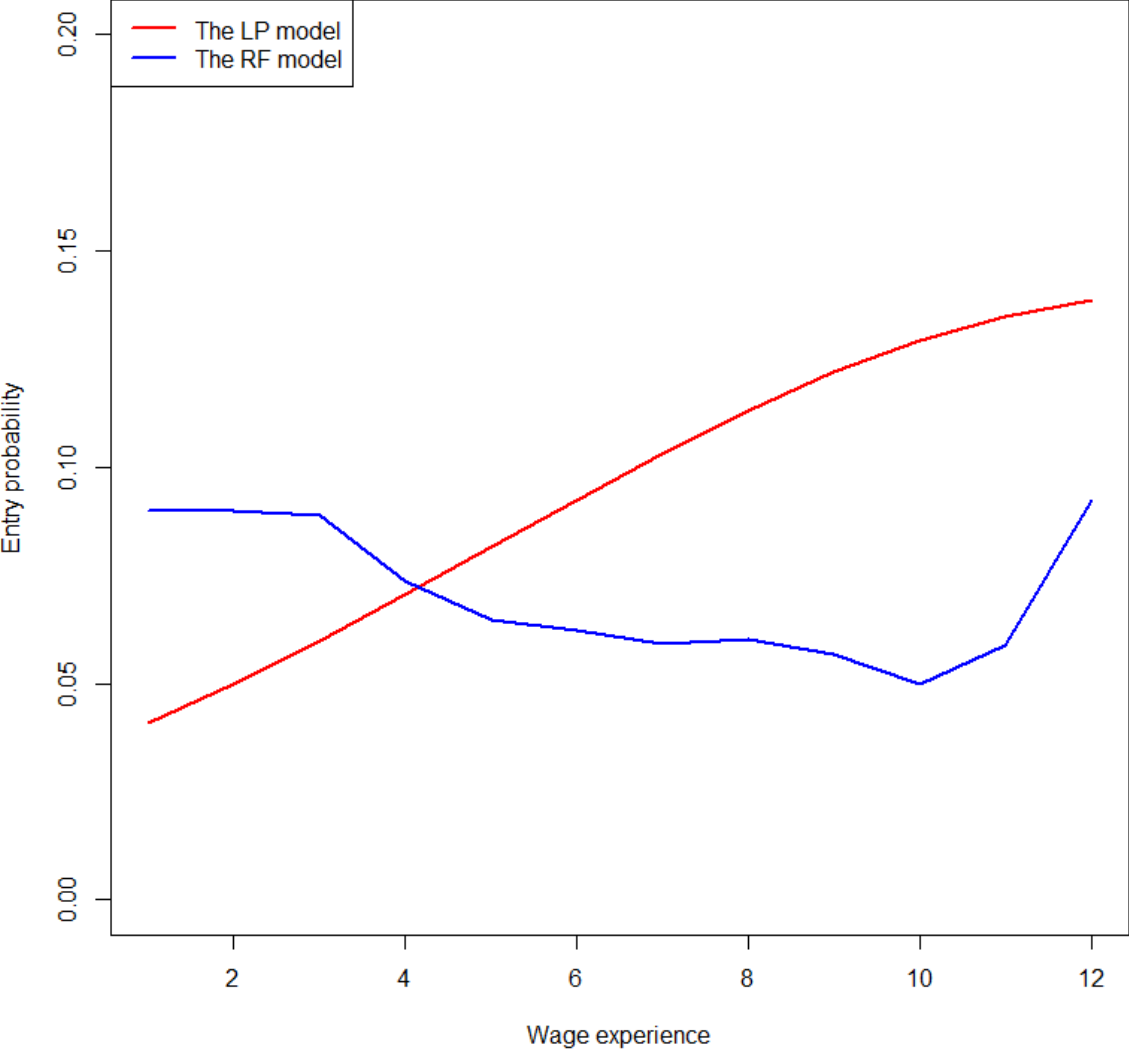


Figure 6a b c Comparative plots – The moderating effect of wage experience on the relationship between prior entrepreneurial experience and the probability of switching into entrepreneurship (at min, median, max)

Figure 6a

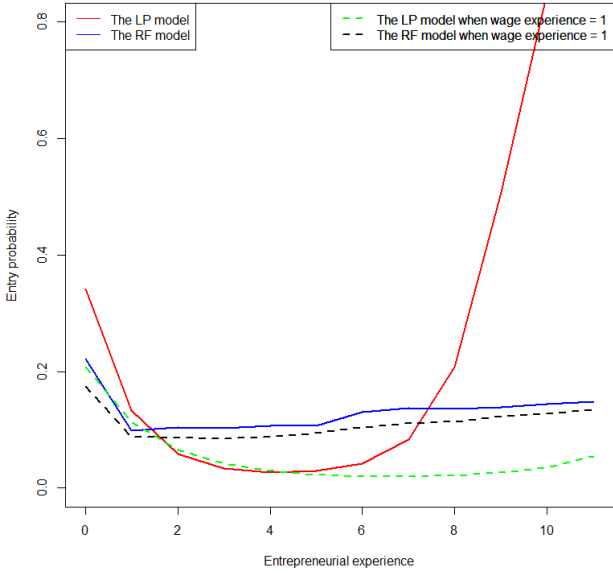


Figure 6b

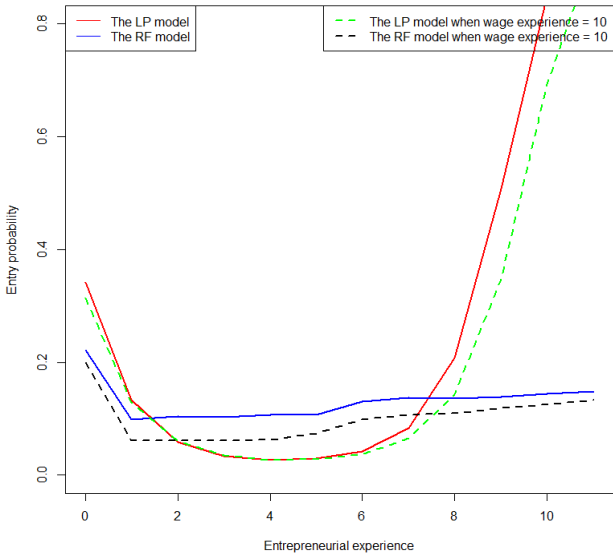


Figure 6c

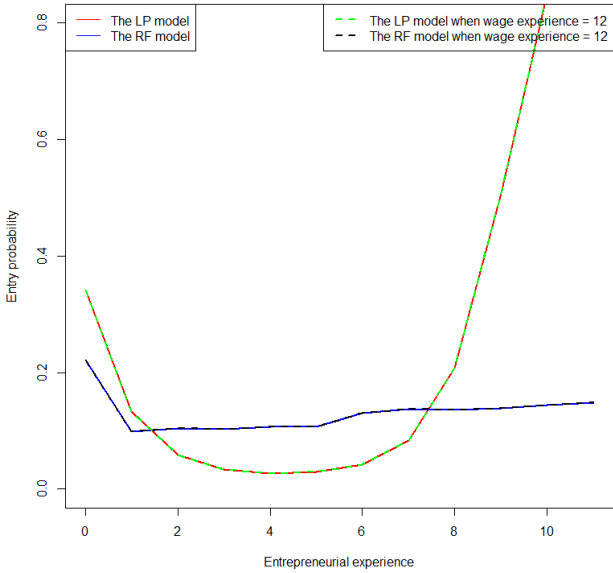


Figure 7a b c Comparative plots – The moderating effect of prior entrepreneurial experience on the relationship between wage experience and the probability of switching into entrepreneurship (at min, median, max)

Figure 7a

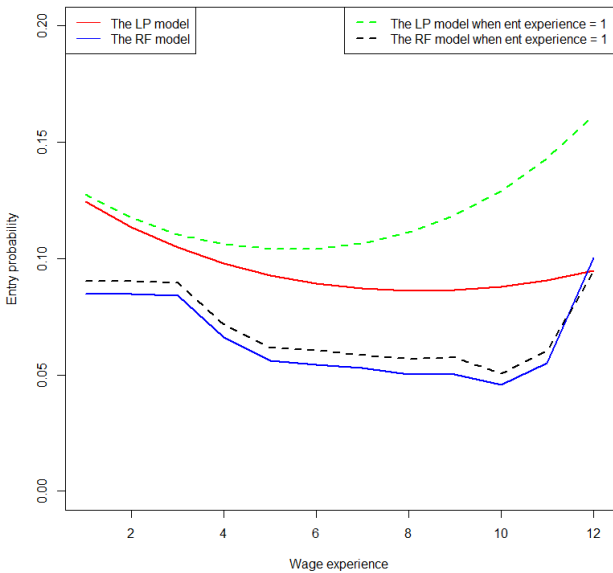


Figure 7b

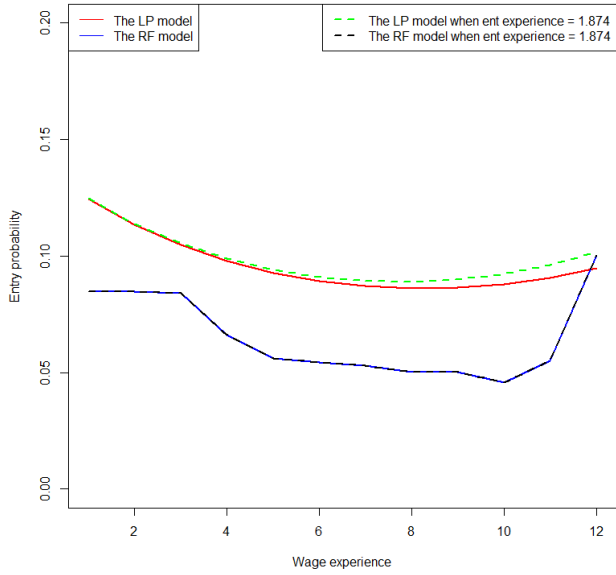


Figure 7c

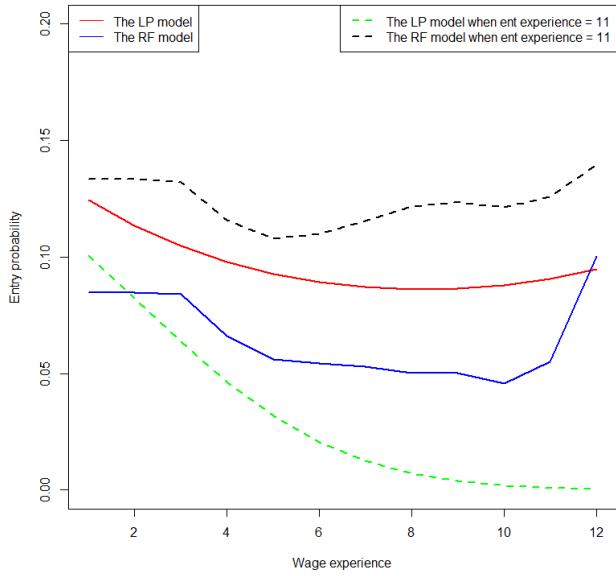
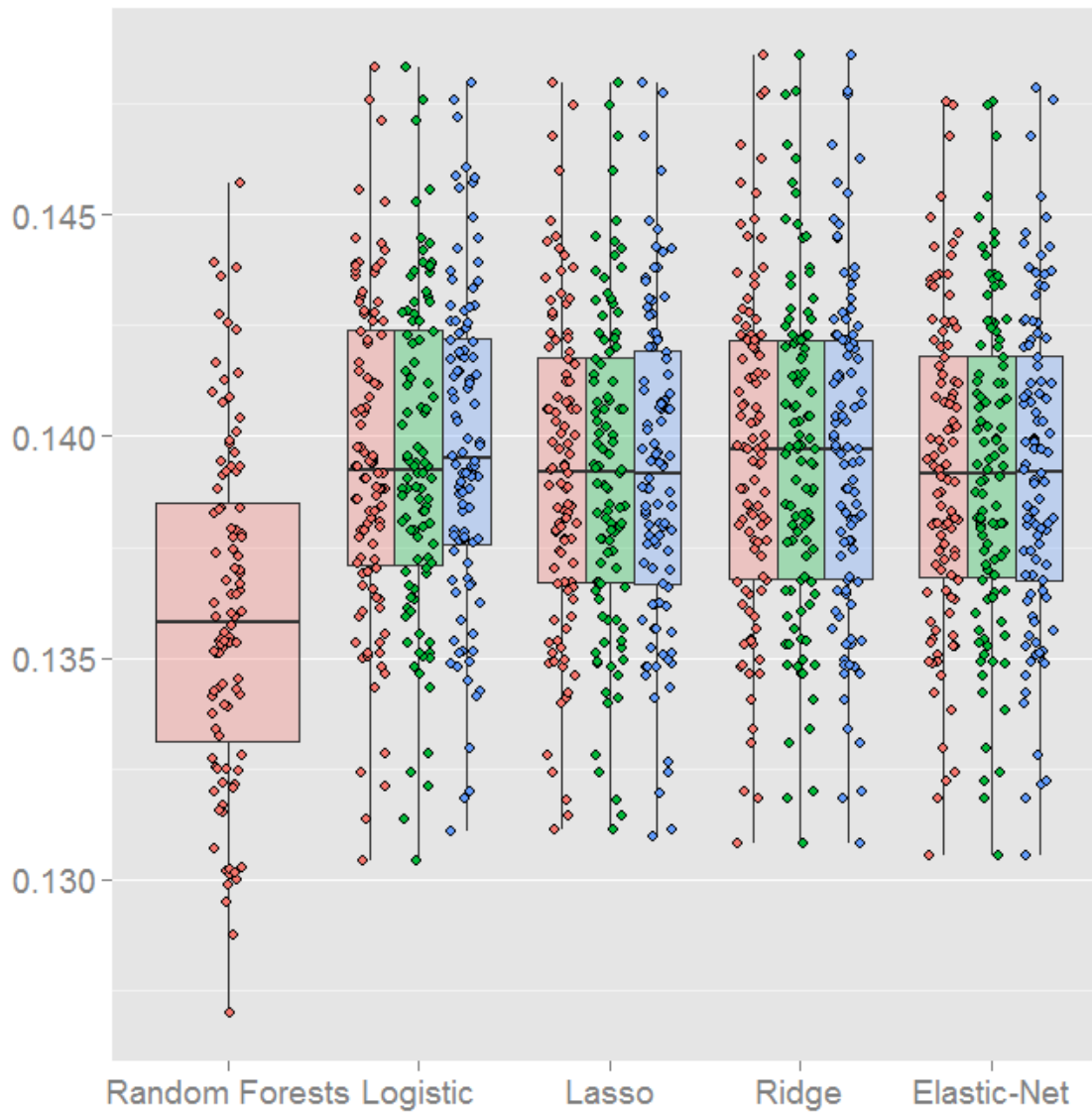


Figure 8 Prediction Errors of Random Forests, Logistic, Lasso, Ridge and Elastic-Net



APPENDIX A

Random forests is introduced by Breiman (2001). Assume that a set of observations $\{x_i, y_i\}_{i=1}^n$ are collected as the training data, a random forest model fits many independent single tree models, where each tree is constructed in the following way:

At the initiation step, a bootstrap sample is randomly drawn from the training data. As a default in the “randomForest” R package, $0.632 \times n$ numbers of observations are drawn. The collection of these samples is treated as the root node, where a splitting is performed. In particular, a splitting is done by separating the observations in the current node. It is usually in the form of an indicator function $I(x_i^{(j)} \leq c)$ where $x_i^{(j)}$ is the j th variable of subject i , and c is a cutting point within the range of variable j . It is then possible to split the current node into two groups by evaluating this indicator function for all subjects. A score that evaluates the benefit of such a split can be calculated based on the two groups: the gini index is commonly used for calculating the score for classification model, and variance reduction is used for regression model. Next, we search through possible indices of j and cutting points c such that the resulting score is maximized. After obtaining the best combination, we proceed to actually splitting the node into two child nodes. The algorithm then recursively applies such a splitting mechanism to each of the child nodes until the node sample size is sufficiently small. Such a node is called a terminal node where no splitting is further done. Now we can obtain a fitted value for a terminal node by averaging the y values (for regression) or obtaining the most prevalent class (for classification) of the within-node observations.

The forest model is obtained by pooling or averaging all such single trees. For classification model, if we are interested in predicting a future subject with covariate value x , the subject can be dropped into each individual tree, and follow the splitting rules to reach a terminal node. We then obtain the fitted value of that terminal node as the single tree prediction of this subject. To pool all such single tree predictions, we again perform averaging or looking at the most prevalent prediction class.

ESSAY TWO
THE RELATIVE FINANCIAL PAYOFFS TO PRIOR ENTREPRENEURIAL
EXPERIENCE: INSIDE VERSUS OUTSIDE THE ENTREPRENEURIAL CONTEXT

ABSTRACT

Building from human capital theory, we investigate the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. Testing from the sample of 26,235 entrepreneurs who were at risk of making a career choice between serial entrepreneurship or wage employment, we find that greater prior entrepreneurial experience leads to a higher financial payoff in wage employment than in serial entrepreneurship, implying that the financial payoffs to prior entrepreneurial experience can be extended, and much higher, outside the entrepreneurial context. Our findings hold a host of novel implications for understanding the motivation of entrepreneurship and also add to the research of serial entrepreneurship.

Keywords: Prior Entrepreneurial Experience, Financial Payoffs, Serial Entrepreneurship, Wage Employment, Human Capital Theory

1. Introduction

Although many studies have examined the role that prior entrepreneurial experience plays in influencing individuals' subsequent entrepreneurial performance (Cope, 2005; Davidsson and Honig, 2003; Gompers *et al.*, 2010; Parker, 2013; Rerup, 2005; Stuart and Abetti, 1990; Santarelli and Tran, 2013; Wright, Robbie and Ennew, 1997b), they hardly give us a complete view of the earnings effect of prior entrepreneurial experience because the recent development in the literature reminds us an alternative possibility – prior entrepreneurial experience can also develop and reveal general human capital, the value of which may be able to extend outside the entrepreneurship context (Campbell, 2013). Therefore, what became fundamental is an investigation of the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. Such an investigation will make contributions to the literature particularly from two perspectives.

First, it will contribute to our understanding of the motivation of entrepreneurship. Hamilton (2000) suggested that the reason why most individuals enter and persist in entrepreneurship despite the fact that they have both lower initial earnings and lower earnings growth than in wage employment is because of the desirable attributes of entrepreneurship, such as “being your own boss”. Yet his study did not compare the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. Because the experience gained from involvement in a start-up can be general in nature, it may be transferrable and valuable to outside employers. Individuals with a greater level of general human capital then can bargain for higher compensations from their current or future employers by threatening mobility (Campbell, 2013). It then follows that individuals may enter entrepreneurship because it provides more career mobility and persistent rewards even after

leaving entrepreneurship. Therefore, investigating the relative financial payoffs to prior entrepreneurial experience outside the entrepreneurial context may present an alternative explanation for the findings of Hamilton (2000).

Second, it will add to the research of serial entrepreneurship. In particular, upon exiting from their previous ventures, individuals need to make a career choice between serial entrepreneurship and wage employment. As Westhead, Ucbasaran, and Wright (2005, pp. 393-417) defined, “serial entrepreneurs can be viewed as individuals who have sold/closed a business in which they had a minority or majority ownership stake, and they currently have a minority or majority ownership stake in a single independent business that is either new, purchased or inherited.” Speaking of the factors that influence the return decision, the literature has generally agreed that individuals with greater prior entrepreneurial experience have a higher preference to become a serial entrepreneur than become wage-employed (Amaral and Baptista, 2007; Amaral, Baptista, and Lima, 2011; Evans and Leighton, 1989; Hamilton, 2000; Hessels *et al.*, 2011; Metzger, 2008; Stam, Audretsch, and Meijaard, 2008). One implied premise of these studies is that because prior entrepreneurial experience influences how individuals seek resources (Cooper, Folta, and Woo, 1995), create or identify entrepreneurial opportunities (Shane, 2000; Shane, 2003), individuals with greater prior entrepreneurial experience may be better prepared for another entrepreneurial spell (Amaral *et al.*, 2011) and likely to perform better than those with less experience. However, this implied premise renders an incomplete view as the financial payoffs associated with prior entrepreneurial experience may be able to extend outside the entrepreneurial context (Campbell, 2013). If individuals with greater prior entrepreneurial experience can obtain higher earnings in wage employment than in serial entrepreneurship, there must be some alternative explanations of serial entrepreneurship awaiting us to explore.

For these reasons, it is critical to empirically investigate the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. Although several studies have explored the financial payoffs to prior entrepreneurial experience in entrepreneurship or wage employment (e.g. Evans and Leighton, 1989; Hamilton, 2000; Campbell, 2013), they have not fully illuminated this problem mainly because of the limitation of their sample design. For example, Evans and Leighton (1989) used cross-sectional data to estimate the effects of prior entrepreneurial experience on entrepreneurship or wage earnings. However, their findings are limited by the cross-sectional nature of the design. Because the benefits of prior entrepreneurial experience may depreciate over time (Parker, 2013), their findings lack the important information regarding the long-term earnings effect of prior entrepreneurial experience. Even though the sample used by Campbell (2013) allowed him to study the career and earnings trajectories of individuals over a long time period, his study compared the earnings of employees who joined start-up with a matched control group of comparable wage employees without start-up experience. Therefore, his findings can only be used to conclude whether the financial payoffs to prior entrepreneurial experience can be extended outside the entrepreneurial context, but does not imply anything about the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. In addition, his study lacks data on important control variables, such as age and education.

Therefore, the objective of this study is to empirically investigate the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. We achieve this objective through examining individuals' subsequent earnings in wage employment or serial entrepreneurship upon exiting from their previous ventures using the data drawn from a

set of three matched longitudinal data sources on the entire Swedish high-technology labor market to test the above agreements. The strength of this data is that it universally covers any individuals in high-technology manufacturing or knowledge-intensive service sectors from 1989 to 2002, and thus permits a close examination of individuals' career and earnings trajectories over a long time period. Testing from the sample of 26,235 entrepreneurs who were at risk of making a career choice between serial entrepreneurship or wage employment, the results show that the relative financial payoffs to prior entrepreneurial experience are much higher in wage employment than in serial entrepreneurship, implying that the financial payoffs to prior entrepreneurial experience can be extended, and much higher, outside the entrepreneurial context.

In the following sections, we will discuss why prior entrepreneurial experience can affect individuals' level of general human capital and thus the relative financial payoffs inside versus outside the entrepreneurial context.

2. Theory and Hypotheses

Entrepreneurs accumulate human capital over time (Jovanovic, 1982). According to human capital theory (Becker, 1962), while some human capital is more specific to entrepreneurship, some is more general and valuable to both inside and outside the entrepreneurial context. We believe that individuals' prior entrepreneurial experience can help develop their level of general human capital for two reasons.

First, when creating something from nothing, entrepreneurs are exposed a variety of new responsibility and tasks, and thus need to develop a broad range of skills. As Lazear (2004) described, for example, to open a restaurant, the founder must choose a good location and décor, find reliable food suppliers and negotiate costs, obtain external funding if necessary, being a good cook and be able to manage and monitor other employees' behavior, *etc.* Entrepreneurs

may not have the complete set of these skills at first, but they have to acquire them over time so that their ventures won't fail (Lazear, 2004). Therefore, individuals with greater prior entrepreneurial experience are generalists who will not be easily devastated by new responsibilities and tasks.

Second, almost all new ventures suffer from resource constraints. To overcome this difficulty, entrepreneurs need to combine resources at hand to meet their needs (Baker and Nelson, 2005) and actively establish inter-firm networks to support venture growth (Lechner and Dowling, 2003). Through solving the problem of resource constraints, entrepreneurs become more capable at deploying resources to attempt for a desirable result and acquire critical problem-solving skills.

To conclude, prior entrepreneurial experience affects individuals' level of general human capital through exposure them to new responsibilities, tasks and resource constraints. It then follows that merely exploring the financial payoff to prior entrepreneurial experience inside the entrepreneurial context renders an incomplete view, and what became fundamental is the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. Although several studies have explored the financial payoffs to prior entrepreneurial experience in entrepreneurship or wage employment (e.g. Evans and Leighton, 1989; Hamilton, 2000; Campbell, 2013), they have not illuminated the relative financial payoffs between these two career choices.

First, the findings of prior studies are limited by the cross-section nature of the design. For example, Evans and Leighton (1989) estimated the earnings for individuals who were entrepreneurs or wage workers in 1981 using data from the National Longitudinal Survey of Young Men for 1966 – 1981 and the Current Population Surveys for 1968 – 1987. They reported

a positive impact of prior entrepreneurial experience on both wage and entrepreneurial earnings. However, they investigated the earnings effects of prior entrepreneurial experience using cross-sectional data, and thus could not tell whether the positive effects of prior entrepreneurial experience can be persistent over time. Given that the benefits of prior entrepreneurial experience may depreciate over time (Parker, 2013), it is important to know the long-term earnings effect of prior entrepreneurial experience.

Second, the findings of prior studies are limited by their sample design. For example, using the 1984 panel of the Survey of Income and Program Participation, Hamilton (2000) explored the possible explanations for the earnings differentials in entrepreneurship and wage employment. To evaluate whether self-employment carries a stigma that causes the earnings differentials, he examined whether individuals having been self-employed in the previous year are associated with lower wage earnings in the future. The results showed that entrepreneurs returning to wage employment actually obtain higher earnings than employees with the same observed characteristics. Furthermore, he also found that each additional year of prior entrepreneurial experience increases mean wages. Although Hamilton (2000) contributed by disentangling factors motivating an individual to become an entrepreneur, his matched control group included individuals with no prior entrepreneurial experience, suggesting that he did not compare the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context.

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, Campbell (2013) estimated the earnings differentials between the employees who joined startups and their matched counterparts who did not. He reported that relative to a matched

control group, employees who joined startups exhibited an initial earnings dip but quickly recovered such that after four quarters, these employees earned more than their matched counterparts. He believed that this empirical evidence implies that entrepreneurial experience can reveal an individual's general human capital, which increases that individual's market value. Although Campbell (2013) contributed by proposing prior entrepreneurial experience can increase earnings that are independent of the entrepreneurial context, like Hamilton (2000), his matched control group included individuals who never entered entrepreneurship. Thus, its findings can be used to conclude whether the financial payoffs to prior entrepreneurial experience can be extended outside the entrepreneurial context, but does not illuminate the question regarding the relative financial payoffs to prior entrepreneurial experience in wage employment versus entrepreneurship. In addition, his study lacks data on important control variables, such as age and education.

To conclude, while prior studies have attempted to test the earnings effects of prior entrepreneurial experience in wage employment or entrepreneurship (e.g. Evans and Leighton, 1989; Hamilton, 2000; Campbell, 2013), they have not empirically compared its relative financial payoffs inside versus outside the entrepreneurial context. In order to test it, we need to construct a sample of individuals with prior entrepreneurial experience and observe their subsequent career and earnings trajectories. In this study, we test this objective through examining individuals who are at the risk of making a career choice between serial entrepreneurship or wage employment.

2.1. Serial Entrepreneurship or Wage Employment

Prior studies have proposed to calculate individuals' expected utility, which is determined by payoffs, to examine what motivates one to become an entrepreneur. For example, Baumol

(1990), Campbell (1992) and Gifford (1993) suggested that entrepreneurial actions and decisions are heavily influenced by the relative expected payoffs in wealth, power and prestige. Campbell (1992) proposed that the payoffs can be evaluated using an expected net present value that includes a monetary evaluation of psychic costs and benefits. Eisenhauer (1995) modeled one type of entrepreneurial decision – entry – as an expected utility calculation, considering that both expected income and working conditions are compared with alternative occupations. Douglas and Shepherd (2000) further considered the choice of an entrepreneurial career path is a result of utility-maximizing decision and assumed that utility is a function of earnings, working conditions, risk exposure, work effort required, independence, and other work conditions. In their model, whether individuals choose to become an entrepreneur depends on their preference for each of these job attributes. For example, individuals with greater entrepreneurial ability are more motivated to be self-employed because they have higher expected earnings in entrepreneurship. Later studies have categorized the bundles of job attributes that influences the expected utility categorized by financial payoffs, such as earnings (e.g. Hartog, Van Praag, and Van Der Sluis, 2010), and nonfinancial payoffs, such as job satisfaction (e.g. Benz and Frey, 2008; Shane, Locke, and Collins, 2003). Prior studies about the role of human capital on the emergence of serial entrepreneurs have largely followed the utility-maximizing logic described above.

In particular, upon exiting from their previous ventures, individuals need to make a career choice between wage employment or serial entrepreneurship. Prior studies have generally supported that individuals with greater prior entrepreneurial experience are more likely to become a serial entrepreneur than become wage-employed (Amaral and Baptista, 2007; Amaral *et al.*, 2011; Evans and Leighton, 1989; Hamilton, 2000; Hessels *et al.*, 2011; Metzger, 2008;

Stam *et al.*, 2008). For example, by investigating individuals who closed their previous businesses, Stam *et al.* (2008) found that those who had started more than one firm are more likely to return to entrepreneurship. Henley (2004) also showed that individuals who were previously self-employed are much more likely to be self-employed in the future as compared with someone who was previously wage-employed. Hyytinen and Ilmakunnas (2007) used longitudinal, register-based employer-employee data to illustrate that prior entrepreneurial experience significantly increases an individual's aspiration to become an entrepreneur again. Amaral *et al.* (2011) considered how soon individuals return to entrepreneurship and found that those having more years as entrepreneurs are likely to return to entrepreneurship more quickly.

An implicit premise of these studies is that individuals with greater prior entrepreneurial experience should perform better in their next entrepreneurial spell as prior entrepreneurial experience can shape how individuals discover, evaluate, and exploit opportunities (Shane and Venkataraman, 2000), and also help them identify the most appropriate actions (Minniti and Bygrave, 2001). However, what has been ignored is the possibility that the financial payoffs to prior entrepreneurial experience can be extended outside the entrepreneurial context.

Following Gimeno *et al.* (1997), we would expect that individuals prefer to again become an entrepreneur than become wage employed if the expected utility of entrepreneurship exceeds the expected utility of wage employment minus the switching cost. Denote the expected utility of entrepreneurship and wage employment as U_E and U_W , the financial payoffs to entrepreneurship and wage employment as F_E and F_W , the nonfinancial payoffs to entrepreneurship and wage employment as P_E and P_W , and the switching cost as SC , the re-entry formula is:

$$\text{Re-entry if : } U_E(F_E + P_E) > U_W(F_W + P_W - SC)$$

That is to say, if prior entrepreneurial experience can lead to higher financial payoffs in wage employment than in serial entrepreneurship, there must be some alternative explanations of the motivation of serial entrepreneurship. These explanations could be: (a) entrepreneurship provides much higher nonfinancial payoffs, and thus its expected utility exceeds the expected utility of wage employment; (b) the switching cost from entrepreneurship to wage employment is very high, and thus the expected utility of wage employment is lower than the expected utility of entrepreneurship. Therefore, examining these ex-entrepreneurs' subsequent career and earnings trajectories will not only help us compare the relative financial payoffs to prior entrepreneurial experience, but also adds to the research of serial entrepreneurship.

We believe that the relative financial payoffs to prior entrepreneurial experience are likely to be higher in wage employment than in serial entrepreneurship. First, as discussed above, prior entrepreneurial experience affects individuals' level of general human capital through exposure them to new responsibilities, tasks and resource constraints. Comparing with entrepreneurs, wage employees need to be more focused on narrow duties. In addition, established firms usually have a more matured corporate governance system so that there is no need for wage employees to solve any critical problem individually. As such, wage employees can hardly develop a broad set of skills as entrepreneurs do. Individuals who acquired greater general human capital through entrepreneurship then may look quite attractive to wage employers, and thus with more chances to obtain higher wage earnings.

On the other hand, prior studies on the relationship between prior entrepreneurial experience and individuals' subsequent entrepreneurial performance have provided mixed findings. For example, Cope (2005) believed that entrepreneurs develop their skills and knowledge through learning, and thus individuals with greater prior entrepreneurial experience

should have better future performance. Stuart and Abetti (1990) suggested that investors have traditionally attached a high importance to founders' entrepreneurial experience in their evaluation of firm potential, and thus more experienced entrepreneurs are more likely to obtain external investments. Davidsson and Honig (2003) also claimed that entrepreneurs usually collect long-term benefits from the resources they acquired through entrepreneurship. However, Rerup (2005) suggested that learning can be hampered by entrepreneurs' cognitive heuristics, and thus the relationship between entrepreneurial experience and venture performance may not always be positive. Santarelli and Tran (2013) also reported a negative association between entrepreneurial experience and firm profitability. As they explained, this could be due to that experienced entrepreneurs are more risk-averse and less willing to invest in risky but potentially profitable opportunities. The above evidence suggests that it is quite debatable whether prior entrepreneurial experience is always beneficial to individuals' subsequent entrepreneurial performance.

As Kihlstrom and Laffont (1979) commented, while wage earnings are relatively riskless, entrepreneurial earnings may be affected by a more variety of factors. Therefore, the financial payoffs to prior entrepreneurial experience are likely to be higher in wage employment than in serial entrepreneurship because they are more guaranteed there.

Second, individuals may be willing to accept lower earnings for nonfinancial benefits, such as "being as being your own boss" (Hamilton, 2000). As Hamilton (2000) described, the median level of nonfinancial rewards of self-employment and wage employment may lead to the earnings differentials between these two career choices. Evans and Leighton (1989) also argued that entrepreneurial firms are with higher nonfinancial rewards because of their liquidity constraints. However, entrepreneurs' tolerance of lower earnings will not persist if they leave

entrepreneurship for wage employment (Campbell, 2013). Consequently, they may ask for higher earnings to compensate their lost nonfinancial benefits.

Taken together, we expect that:

Hypothesis 1: Entrepreneurial experience will have a higher financial payoff in wage employment than in serial entrepreneurship.

3. Methods

3.1. Sample

As discussed above, the data was drawn from a set of three matched longitudinal data sources – LOUISE, RAMS, and RSU on the entire Swedish labor market. The special abstract we used is called EPRO that specializes in high-technology manufacturing or knowledge-intensive service sectors and covers any individual who was active in these sectors from 1989 to 2002. The original data contains 11,182,628 observations with 482,249 unique individual identifiers.

We sampled young men aged between 20 and 25 in 1989 to eliminate the unobserved heterogeneity caused by gender (Evans and Leighton, 1989; Folta, Delmar, Wennberg, 2010) and the possibility of an individual was self-employed prior to 1989. This step led to a total of 32,733 unique individual identifiers. Because we are interested in analyzing experienced entrepreneurs and their subsequent career, earnings trajectories, we then required all sampled individuals to have engaged in entrepreneurship at least once. This step led to a total of 21,959 unique individual identifiers. We further excluded portfolio entrepreneurs, which are defined as entrepreneurs holding multiple businesses at the same time, because these entrepreneurs are different from serial entrepreneurs in terms of resources at hand, experience, and performance

(Westhead *et al.*, 2005a, 2005b, 2005c), and it is technically difficult to identify their exit, return. This step led to a total of 113,827 observations with 21,229 unique individual identifiers.

3.2. Employment Status

We identified individuals' employment statuses using the occupational classification information provided by the data sources. In particular, the datasets provide an identifier to distinguish whether an individual was "employed", "self-employed in a proprietorship or partnership", "self-employed in incorporation" or "not employed" for every single year of the entire study period. In addition, the datasets also assign a unique identifier to each firm that the individual was affiliated with. By matching these two identifiers, we were able to observe an individual's career trajectories.

Individuals were identified as an entrepreneur if "self-employed in a proprietorship or partnership" or "self-employed in incorporation". When individuals were no longer associated with their original ventures, they were identified as ex-entrepreneur. Serial entrepreneurs were then identified when ex-entrepreneurs returned to "self-employed in a proprietorship or partnership" or "self-employed in incorporation" with a different firm identifier. If ex-entrepreneurs became "employed", they were identified as wage workers.

As shown in Figure 1, for the 21,229 sampled individuals who had engaged in entrepreneurship at least once from 1989 to 2002, 66.31% ($n = 14,076$) left their first ventures and became ex-entrepreneurs while 33.69% ($n = 7,153$) remained in it. These first-time exiters then were at risk to make a career choice - either serial entrepreneurship or wage employment. For these sampled first-time exiters, 35.56% ($n = 5,006$) returned to entrepreneurship while the rest of them 64.44% ($n = 9,070$) became wage-employed.

We then observed whether these serial entrepreneurs left their second ventures. As illustrated, 56.17% of these serial entrepreneurs exited their second ventures and became ex-entrepreneurs for the second time (n = 2,812) and 43.83% remained in it (n = 2,194). These second-time exiters, once again, were at risk of making a career choice; yet they are different from first-time exiters because they had multiple ventures experience. For these second-time exiters, 34.07% of them (n = 958) returned to entrepreneurship and 65.93% of them became wage-employed (n = 1,854). We then considered the career choice confronted by individuals at these two time points – first time and second time exit – as two independent incidents. Combining these two incidents, we have a total of 16,888 individuals (14,076 first-time exiters and 2,812 second-time exiters) were at risk of making a career choice between serial entrepreneurship and wage employment.

Insert Figure 1 about here

3.3. Time to Return

Individuals may choose to return to entrepreneurship immediately upon exiting from their previous ventures or become wage-employed first as a transition to fully return. Consistent with prior studies (e.g. Amaral *et al.*, 2011) that have advanced these two types of return are different, we labeled the first type of return as direct return and the latter as indirect return. Although Amaral *et al.* (2011) found that prior entrepreneurial experience increases the likelihood of direct return but not indirect return, they did not explore the financial payoffs. As the relative financial payoffs to prior entrepreneurial experience may be varied for these two types of return, we took these uncertainties into account.

Table 1 summarizes the employment statuses of sampled individuals. As shown, for the 26,235 sampled individuals, 35.63% didn't exit their current venture (n = 9,347). As for the 16,888 sampled individuals who left their current ventures, 41.64% (n = 10,924) of them became wage-employed and remained in wage employment till 2002. 4.08% of them (n = 1,070) directly returned to entrepreneurship and 18.65% of them (n = 4, 894) indirectly returned to entrepreneurship. For individuals who chose to indirectly return to entrepreneurship, the average time in transition is 3.68 years.

Insert Table 1 about here

Table 2 presents the employment transition frequencies by years. As shown in Panel A, there are in total 14,076 sampled first-time exiters who were at risk of making a career choice between wage employment or serial entrepreneurship. In 1989, 3.10% of sampled first-time exiters (n = 437) became wage-employed. This percentage generally increases over years with the highest percentage appeared in 2000 – 6.27% of first-time exiters left and never returned to entrepreneurship. The percentage of sampled individuals who directly returned to entrepreneurship upon exiting from entrepreneurship also presents a consistent pattern. Each year, no more than 0.70% of sampled individuals chose to return to entrepreneurship directly. Meanwhile, more individuals, if returned, chose to return indirectly. Around 2.50% of sample individuals indirectly returned to entrepreneurship each year.

Panel B presents the employment transition frequencies by years for second-time exiters. In total, 2,812 sampled second-time exiters were at risk of making a career choice between wage employment or serial entrepreneurship. The earliest year to observe their career choice is 1990 because these individuals had engaged in entrepreneurship once prior to their second

entrepreneurial episode. In 1990, 0.75% of sampled second-time exiters became wage workers, and this percentage consistently increases over time. Only a small percentage of these individuals – no more than 1.50% chose to directly return to entrepreneurship. Like what is observed for first-time exiters, more individuals chose to return indirectly if they preferred to become serial entrepreneurs. A total of 741 sampled individuals (26.35%) returned to entrepreneurship indirectly.

The exit and career choice patterns are consistent across first-time and second-time exiters.

Insert Tables 2 about here

3.4. Variables

Dependent variables. We calculated individuals' post-exit earnings starting from the year they left entrepreneurship till the year their employment status changed again (time = $t + n$, $1 \leq n \leq 10$) in order to isolate the financial payoffs to prior entrepreneurial experience specific to serial entrepreneurship or wage employment. If an individual returned to entrepreneurship, *the earning in serial entrepreneurship* was calculated as the natural log of the total earnings from an individual's active and passive businesses, deduct business deficit and plus wage earning from these businesses because (a) entrepreneurial earnings may be withdrawn from the business in the form of salary; (b) entrepreneurs may understate the true earnings for tax purposes, wage earnings from their businesses then may provide an alternative measures of entrepreneurial earnings (Hamilton, 2000). In addition, Hamilton (2000) employed equity-adjusted earnings as another alternative measure of entrepreneurial earnings to account for the possibility that the earnings were reinvested in the business. However, he also commented that business equity and

wealth are typically imprecisely measured and likely to be noisy in survey data. Given that the information of business equity is not available in our datasets and this measure is possibly limited, we did not include this measure in our study.

The earnings in serial entrepreneurship $_{t+n} = \log$ (the total earnings from active and passive businesses $_{t+n} -$ businesses deficit $_{t+n} +$ wage earnings from these businesses $_{t+n}$)

If an individual became wage-employed, *the earning in wage employment* was calculated as the natural log of an individual's wage salary. If an individual had multiple wage jobs, we took an average of these earnings.

The earnings in wage employment $_{t+n} = \log$ (the average wage earnings of all wage jobs $_{t+n}$)

Independent Variables. The independent variables were calculated at the time when they left entrepreneurship (time = t). Following Hamilton (2000), we employed two measures to evaluate prior entrepreneurial experience. One measure is the natural log of an individual's *prior entrepreneurial experience in years*. The other measure gauges whether an individual *had founded multiple ventures*. If an individual had founded more than one venture, it was coded as 1. Otherwise, it was coded as 0.

Controls. The controls were calculated at the time when they left entrepreneurship (time = t). Several important control variables were added to exclude the influences of alternative explanations. First, it is possible that the earnings of individuals will be influenced by family-related factors and life changing events, such as a birth of child. Thus, we included a dummy variable to indicate whether an individual was *married*. We also controlled the number of *small children*, which was defined as how many children (< 18 years old) an individual had during the year. Second, we controlled *hybrid status* that was coded as 1 if an individual was self-employed

and simultaneously job-employed (Folta *et al.*, 2010). In addition, an individual's pre-entrepreneurship experience and overall ability were controlled. We included *unemployment* as an individual's years in unemployment, *prior wage salary* as the natural log of average prior wage earnings, and *education* as the highest education level an individual obtained at the year of leaving entrepreneurship. We also took industrial influence into account by indicating whether the firm was in *manufacturing industry*, *professional industry* or *wholesale industry*. Furthermore, it is possible that the earnings will be influenced by the *current business experience*. Thus, we controlled an individual's years in their current businesses. Individuals' *age* that may influence their switching costs (Gimeno *et al.*, 1997) was also included. Table 3 presents a summary of variables definition.

Insert Table 3 about here

4. Results

Table 4 reports the means and standard deviations of independent and control variables across different types of employment statuses. Noticeably, entrepreneurs who didn't exit their current ventures had greater entrepreneurial experience. The mean of prior entrepreneurial experience in years (log) is 1.743, and 20.50% of them had multiple ventures. It is worth pointing out that those non-exiters who had multiple ventures represent individuals who exited their first ventures, returned to entrepreneurship, and remained in their second ventures. Upon exiting from entrepreneurship, individuals who directly returned to entrepreneurship were more experienced. They had greater prior entrepreneurial experience in years (log) (mean = 0.810), and 20.7% of them founded multiple ventures. In addition, the mean of prior entrepreneurial in years (log) for those who became wage-employed and indirectly returned to entrepreneurship is

0.598 and 0.597 respectively. 12.90% of individuals who became wage-employed had multiple ventures, while 13.00% of indirectly returners had multiple ventures.

In addition, there are several other noticeable mean differences for control variables. For example, the majority of individuals who were hybrid entrepreneurs, if exited, chose to become wage-employed or at least wait for a while before returning to entrepreneurship.

Insert Tables 4 about here

Table 5 reports the (log) means of earnings across different types of employment statuses by years. As shown, individuals who became wage-employed had the highest mean earnings and higher earnings growth as comparing with the rest of the sample. Individuals in the rest of the sample had an initial earnings growth, but their earnings immediately flattened out. We also report the average means of earnings across different types of employment statuses before log transformation in Swedish Krona and U.S. Dollar. As shown, the average means of earnings for individuals who became wage-employed was kr. 293,946.040, equivalent to \$33,894.410. Those numbers are very consistent with the report of Organization for Economic Co-Operation and Development.⁵ According to them, the means of wage earnings in Sweden was kr. 247,245.000 in 2000 and kr. 254,923.000 in 2001. Our reported average means of wage earnings is slightly higher because the sampled individuals were from high-technology manufacturing or knowledge-intensive service sectors. The average means of earnings for individuals for the other three types of employment statuses was substantially lower.

Figure 3 plots the mean earnings growth in Swedish Krona across employment statuses. Table 6 presents the correlation of all variables.

⁵ https://stats.oecd.org/Index.aspx?DataSetCode=AV_AN_WAGE

Insert Figure 3, Tables 5 and Table 6 about here

Because the effects of prior entrepreneurial experience on earnings may vary across individuals, we used the generalized linear mixed model with a random intercept to account for the randomness. It is a useful approach particularly for longitudinal data that subjects may contribute multiple responses (Cnaan, Laird, and Slasor, 1997). By incorporating the dependence among repeated observations of the same subject, it provides unbiased estimates and valid statistical inference (Seltman, 2009).

As shown in Model 1 in Table 7, comparing with individuals who didn't exit their current ventures, individuals who exited have overall higher future earnings ($b = 0.273$, $p < 0.001$ for individuals who became wage-employed; $b = 0.037$, $p < 0.001$ for individuals who directly returned to entrepreneurship; $b = 0.031$, $p < 0.001$ for individuals who indirectly returned to entrepreneurship). That means the natural log of earnings for individuals who became wage-employed is about 0.273 higher than the natural log of earnings for individuals who didn't exit their current ventures, and around 0.240 higher than the natural log of earnings for individuals who exited their current ventures and subsequently returned to entrepreneurship.

We further estimated the financial payoffs to prior entrepreneurial experience for each type of employment statuses. As shown in Table 8, prior entrepreneurial experience in years (log) is positively related to wage earnings while negative related to entrepreneurial earnings ($b = 0.048$, $p < 0.001$ for individuals who became wage-employed; $b = -0.014$, $p < 0.01$ for individuals who directly returned to entrepreneurship; $b = -0.008$, $p < 0.01$ for individuals who indirectly returned to entrepreneurship; $b = -0.040$, $p < 0.001$ for individuals who didn't exit). That means each additional year of prior entrepreneurial experience (log) increases the natural

log of earnings for individuals who became wage-employed by 0.048, decreases the natural log of earnings for individuals who become serial entrepreneurs by around 0.010, and decreases the natural log of earnings for individuals who didn't exit their current ventures by around 0.040.

Multiple ventures experience is positive related to wage earnings, entrepreneurial earnings of individuals who indirectly returned to entrepreneurship, while negative related to entrepreneurial earnings of the other two employment statuses ($b = 0.051$, $p < 0.001$ for individuals who became wage-employed; $b = -0.010$, *n.s.* for individuals who directly returned to entrepreneurship; $b = 0.010$, $p < 0.10$ for individuals who indirectly returned to entrepreneurship; $b = -0.008$, $p < 0.05$ for individuals who didn't exit). That means having multiple ventures experience increases the natural log of earnings for individuals who became wage-employed by 0.051, decreases the natural log of earnings for individuals who indirectly returned to entrepreneurship by 0.010, and decreases the natural log of earnings for individuals who didn't exit their current ventures by around 0.008.

These findings support that the relative financial payoffs to prior entrepreneurial experience are higher in wage employment than in serial entrepreneurship, rendering support for H1. To rule out the possibility that the results were driven by the performance of several superstars, we conducted a robustness check using the quantile regression to study the effects of prior entrepreneurial experience on the earnings of fifth year at 0.25, 0.5, 0.75 quantiles. The results are consistent as reported above.

Insert Tables 7 and Table 8 about here

5. Discussion

In this study, we investigate the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context through observing entrepreneurs' subsequent career and earnings trajectories after leaving their current ventures. This study provides several intriguing findings.

First, as shown in Figure 3, individuals who became wage-employed had the highest mean earnings and higher earnings growth as comparing with the rest of the sample. The biggest difference appears when individuals spent ten years in their current job, and the difference is around kr. 260,000.000 (approximately \$29,979.800 in U.S. Dollar). Our hypotheses testing results also show that the natural log of earnings for individuals who became wage-employed is about 0.273 higher than the natural log of earnings for individuals who didn't exit their current ventures, and around 0.240 higher than the natural log of earnings for individuals who exited their current ventures and subsequently returned to entrepreneurship. In addition, we also find that the natural log of earnings for individuals who left and subsequently returned to entrepreneurship are about 0.300 higher than the natural log of earnings for individuals who didn't exit their current ventures. These findings reveal that the earnings differentials between wage employment and self-employment exist, even in the context of serial entrepreneurship. That is to say, serial entrepreneurs have substantially lower earnings comparing to their counterparts who left entrepreneurship and become wage-employed. These findings also illustrate that serial entrepreneurs' new ventures generally perform better than their previous ventures.

Second, the results show that individuals with greater prior entrepreneurial experience and multiple ventures experience are likely to have higher wage earnings if became wage-employed. However, prior entrepreneurial experience in years is negatively related to

entrepreneurial earnings. In addition, although multiple ventures experience increases earnings if individuals indirectly returned to entrepreneurship, it is negatively related to entrepreneurial earnings if individuals didn't exit their current ventures or directly returned to entrepreneurship. These findings suggest that the relative financial payoffs to prior entrepreneurial experience are much higher in wage employment than in serial entrepreneurship.

It is worth pointing out that according to Figure 3, the means of earnings in Swedish Krona increases over years for all types of employment statuses. However, prior entrepreneurial experience only seems to contribute to wage earnings while is negatively related entrepreneurial earnings. Therefore, there must be some other factors, instead of prior entrepreneurial experience, causing the increase. As shown in Table 8, prior wage salary, additional income, age and years in current businesses are positively related to entrepreneurial earnings and may help explain the increase. In particular, prior wage salary and additional income may relate to individuals' important initial financial capital. Age may explain individuals' maturity to deal with new challenges, and years in current businesses may relate to individuals' understand of their current businesses.

It is also worth pointing out that although prior entrepreneurial experience is negatively related to entrepreneurial earnings, this negative effect is stronger for individuals who didn't exit their current ventures. That is to say, experienced entrepreneurs who didn't exit their current ventures tend to perform worse than their counterparts who left their current ventures and started over. One possible explanation is that prior entrepreneurial experience is more helpful when dealing with new challenges while less helpful when refining existing ideas.

Additionally, an examination on the effects of control variables also renders some interesting results. First, although years in current businesses increase earnings for all

employment statuses, this positive effect is stronger for individuals who became wage-employed. This finding echoes Kihlstrom and Laffont (1979)'s comment that comparing to entrepreneurial earnings, wage earnings are relatively riskless. Individuals' wage earnings increase persistently, if employed by the same firm. Second, although many people have considered entrepreneurship as a way of achieving work-life balance, our study shows that being married and having small children are positively related to earnings in wage employment, while negatively related to or have no effects on entrepreneurial earnings. One possible explanation is that our sample exclusively focuses on men, and men with family responsibilities look more reliable to wage employers than those with no family responsibilities. Thus, wage workers can also have work-life balance, at least for those wage workers who left entrepreneurship and became wage-employed. Third, individuals who were hybrid entrepreneurs tend to earn more if became wage-employed. One possible explanation is that these individuals have developed knowledge both in entrepreneurship and in wage-employment, and thus can better transit from one to the other. Noticeably that being a hybrid entrepreneur is negatively related to earnings for individuals' didn't exit their current ventures. That may because these individuals have to devote their time and efforts to wage employment at the same time, and thus pay less attention to their ventures.

Our study contributes to the literature from two perspectives. First, although the literature has recognized the possibility that prior entrepreneurial experience can reveal and generate valuable general human capital, which is valuable to wage employers (Campbell, 2013), it has not illuminated the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. Our study empirically illustrates that the financial payoffs to prior entrepreneurial experience are much higher in wage employment than in serial entrepreneurship, implying that the financial payoffs to prior entrepreneurial experience can be

extended, and much higher, outside the entrepreneurial context. By doing so, our study renders an alternative explanation of the motivation of entrepreneurship – individuals may be motivated enough to enter entrepreneurship because it provides them with career mobility and persistent rewards inside or outside the entrepreneurial context.

Second, prior studies have left us with a mixed insight on the role that prior entrepreneurial experience plays in influencing subsequent entrepreneurial performance. Our study shows that although entrepreneurs generally perform better in their subsequent entrepreneurial spells, prior entrepreneurial experience does not help increase their earnings. The relationship is more negative for individuals who didn't exit their current ventures. These findings contradict other studies of serial entrepreneurship that assumes the financial payoffs to prior entrepreneurial experience are higher in wage employment than in serial entrepreneurship. Given that entrepreneurship is a utility-maximizing decision (Douglas and Shepherd, 2000, 2002; Levesque, Shepherd, and Douglas, 2002), an interesting future direction would be to explore the alternative explanations for the motivation of serial entrepreneurship.

6. Conclusion

To conclude, our study investigates the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context through observing entrepreneurs' subsequent career and earnings trajectories after leaving their current ventures. Testing from the sample of 26,235 entrepreneurs who were at risk of making a career choice between serial entrepreneurship or wage employment, we find that the financial payoffs to prior entrepreneurial experience are much higher in wage employment than in serial entrepreneurship. By doing so, our study holds a host of novel implications for understanding the motivation of entrepreneurship and also adds to the research of serial entrepreneurship.

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Figure 1 Employment Statuses of Sampled Entrepreneurs

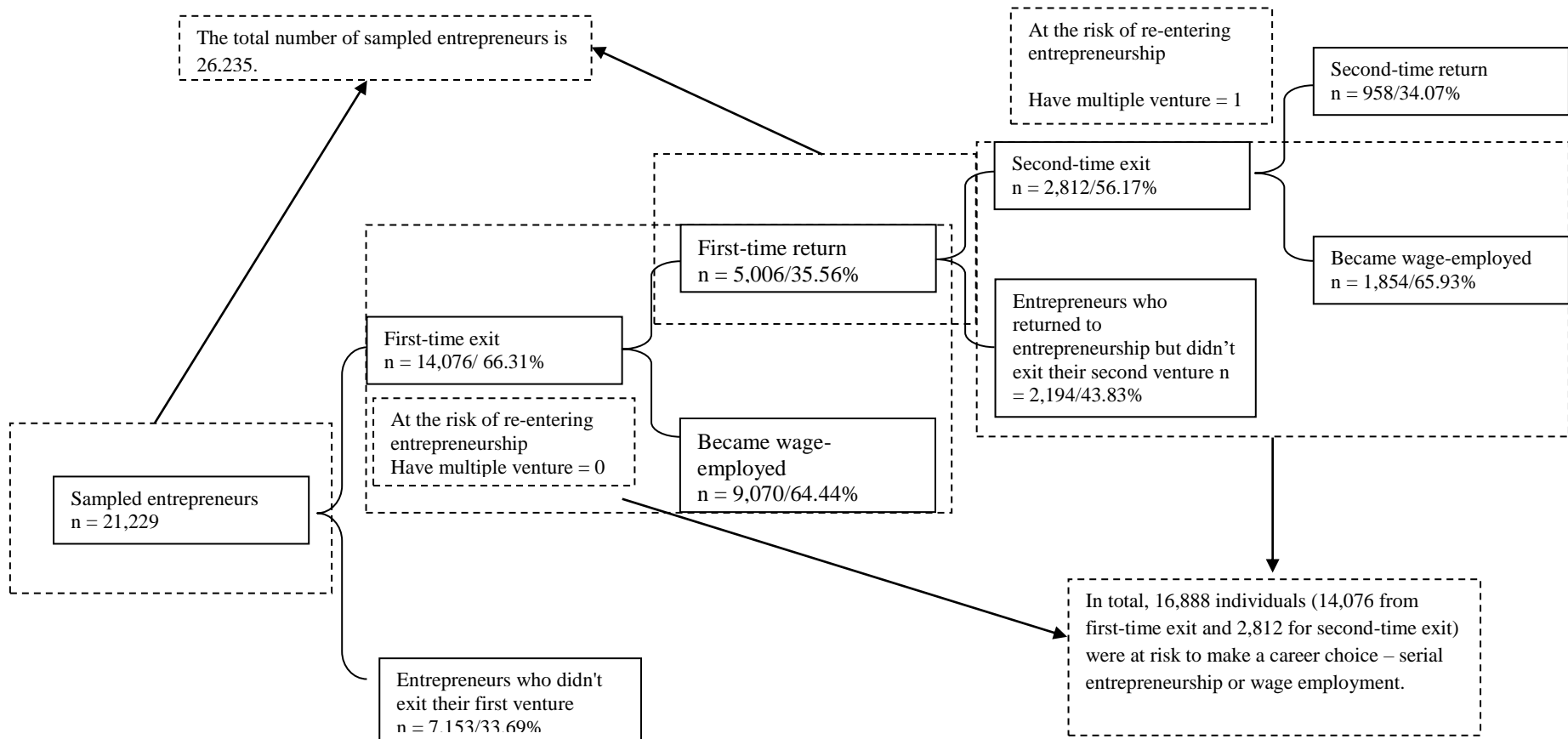


Table 1 Employment Statuses of Sampled Entrepreneurs

Employment Status	Frequency	Percent
Didn't exit	9,347	35.63%
Became wage-employed and remained in wage employment till 2002	10,924	41.64%
Directly returned to entrepreneurship	1,070	4.08%
Indirectly returned to entrepreneurship	4,894	18.65%
Total	26,235	100%

Table 2 Employment Transition Frequencies by Years (1989 to 2001)^a

		(From Their Current Venture) Exit Year												
(Into) Employment Statuses	Total	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
<i>Panel A First-time exiters</i>														
Became wage-employed and remained in wage employment till 2002	9,070	437	821	621	560	553	655	728	679	722	700	740	992	972
%	64.44	3.10	5.83	4.41	3.98	3.93	4.65	5.17	4.82	5.13	4.97	5.26	6.27	6.91
Directly returned to entrepreneurship	853	60	94	96	66	80	64	99	67	46	54	39	37	51
%	6.06	0.43	0.67	0.68	0.47	0.57	0.45	0.70	0.48	0.33	0.38	0.28	0.26	0.36
Indirectly returned to entrepreneurship	4,153	273	469	475	422	358	341	384	340	322	312	241	216	0
%	29.50	1.94	3.33	3.37	3.00	2.54	2.42	2.73	2.42	2.29	2.22	1.71	1.53	0
Total sampled individuals	14,076	770	1,384	1,192	1,048	991	1,060	1,211	1,086	1,090	1,066	1,020	1,135	1,023
<i>Panel B Second-time exiters</i>														
Became wage-employed and remained in wage employment till 2002	1,854	-	21	36	65	89	124	145	145	178	199	232	280	340
%	65.93	-	0.75	1.28	2.31	3.17	4.41	5.16	5.16	6.33	7.08	8.25	9.96	12.09
Directly returned to entrepreneurship	217	-	4	8	19	16	28	42	22	14	20	15	11	18
%	7.72	-	0.14	0.28	0.68	0.57	1.00	1.49	0.78	0.50	0.71	0.53	0.39	0.64
Indirectly returned to entrepreneurship	741	-	10	24	53	70	69	77	104	98	92	83	61	0
%	26.35	-	0.36	0.85	1.88	2.49	2.45	2.74	3.70	3.49	3.27	2.95	2.17	0
Total sampled individuals	2,812	-	35	68	137	175	221	264	271	290	311	330	352	358
a. The observation of exit year ends in 2001 because 2002 is the last year of observation.														

Table 3 Variable Definition

Variables	Definitions
Self-employed	Identified as self-employed if an individual's primary classification is either "self-employed in a proprietorship or partnership" or "self-employed in incorporation"
Wage-employed	Identified as wage workers if an individual's primary classification is "employed"
Entrepreneurial earnings	Earnings from active/passive businesses, deduct business deficit, plus wage earnings from businesses (log transferred)
Wage earnings	Wage earnings (log transferred)
Years in current businesses	Years in an individual's current business
Prior entrepreneurial experience in years	Years of prior business ownership experience (log transferred)
Had founded multiple ventures	Dummy (=1) for individuals who had established more than one venture at the year of exit
Education	The highest education individuals obtained at the year of exit
Married	Dummy (=1) for individuals who were married at the year of exit
Unemployment	Individuals' unemployment duration in years at the year of exit
Previous wage salary	The average of individuals' previous wage earnings per wage job before entering entrepreneurship (log transferred)
Hybrid	Whether an individual was an entrepreneur and simultaneously had a wage job at the year of exit
Additional income	The amount of additional income (other than earnings from entrepreneurship) individuals had at the year of exit (log transferred)
Small children	The number of small children (<18 years old) individuals had at the year of exit
Age	Individuals' age at the year of exit (log transferred)
Manufacturing industry	Dummy (=1) if individuals' venture was in manufacturing industry at the year of exit
Professional industry	Dummy (=1) if individuals' venture was in professional industry at the year of exit
Wholesale industry	Dummy (=1) if individuals' venture was in whole sale industry at the year of exit

Table 4 Descriptive Statistics of Independent and Control Variables by Employment Statuses

	Didn't exit		Exited					
	Stayed in current businesses (n = 35,026)		Became wage-employed and remained in wage employment till 2002 (n = 63,323)		Directly returned to entrepreneurship (n = 3,508)		Indirectly returned to entrepreneurship (n = 11,970)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Prior entrepreneurial experiences in years (log)	1.743	0.693	0.598	0.636	0.810	0.688	0.597	0.619
Had founded multiple ventures	0.205	0.403	0.129	0.335	0.207	0.405	0.130	0.337
Education	4.056	1.333	3.764	1.333	3.717	1.328	3.726	1.446
Married	0.439	0.496	0.240	0.427	0.293	0.455	0.240	0.427
Unemployment	0.176	0.855	0.794	1.746	0.492	1.422	0.626	1.595
Prior wage salary (log)	10.898	2.936	8.944	4.752	8.551	4.963	8.888	4.751
Hybrid	0.491	0.500	0.629	0.483	0.393	0.489	0.660	0.474
Additional income (log)	11.258	1.778	9.206	2.097	10.317	1.852	9.040	2.098
Small children	1.277	1.152	0.552	0.904	0.698	0.978	0.525	0.882
Age (log)	3.601	0.161	3.365	0.171	3.381	0.107	3.358	0.150
Manufacturing industry	0.219	0.413	0.123	0.328	0.114	0.318	0.132	0.338
Professional industry	0.338	0.473	0.124	0.330	0.176	0.381	0.128	0.335
Wholesale industry	0.043	0.203	0.035	0.184	0.034	0.183	0.024	0.152

Table 5 Descriptive Statistics of Dependent Variables (Log Earnings) by Employment Statuses

Years in current business	Didn't exit		Exited					
	Stayed in current businesses (n = 35,026)		Became wage-employed and remained in wage employment till 2002 (n = 63,323)		Directly returned to entrepreneurship (n = 3,508)		Indirectly returned to entrepreneurship (n = 11,970)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
1	13.561	0.159	13.702	0.183	13.523	0.115	13.499	0.243
2	13.573	0.137	13.723	0.182	13.550	0.126	13.515	0.123
3	13.589	0.143	13.734	0.180	13.557	0.123	13.537	0.142
4	13.602	0.149	13.751	0.183	13.571	0.131	13.555	0.150
5	13.608	0.149	13.768	0.189	13.570	0.129	13.574	0.156
6	13.612	0.142	13.787	0.199	13.590	0.159	13.577	0.144
7	13.620	0.144	13.805	0.204	13.590	0.126	13.582	0.144
8	13.625	0.147	13.829	0.225	13.589	0.141	13.590	0.158
9	13.623	0.154	13.836	0.222	13.600	0.161	13.596	0.155
10	13.627	0.157	13.856	0.238	13.602	0.171	13.615	0.171
Swedish Krona (average)	101,314.500		293,946.040		106,471.210		86,672.040	
U.S. Dollar at 2018	11,682.400		33,894.410		12,277.010		9,994.010	

Figure 3 Compare the Means of Earnings (in Swedish Krona) across Different Employment Statuses

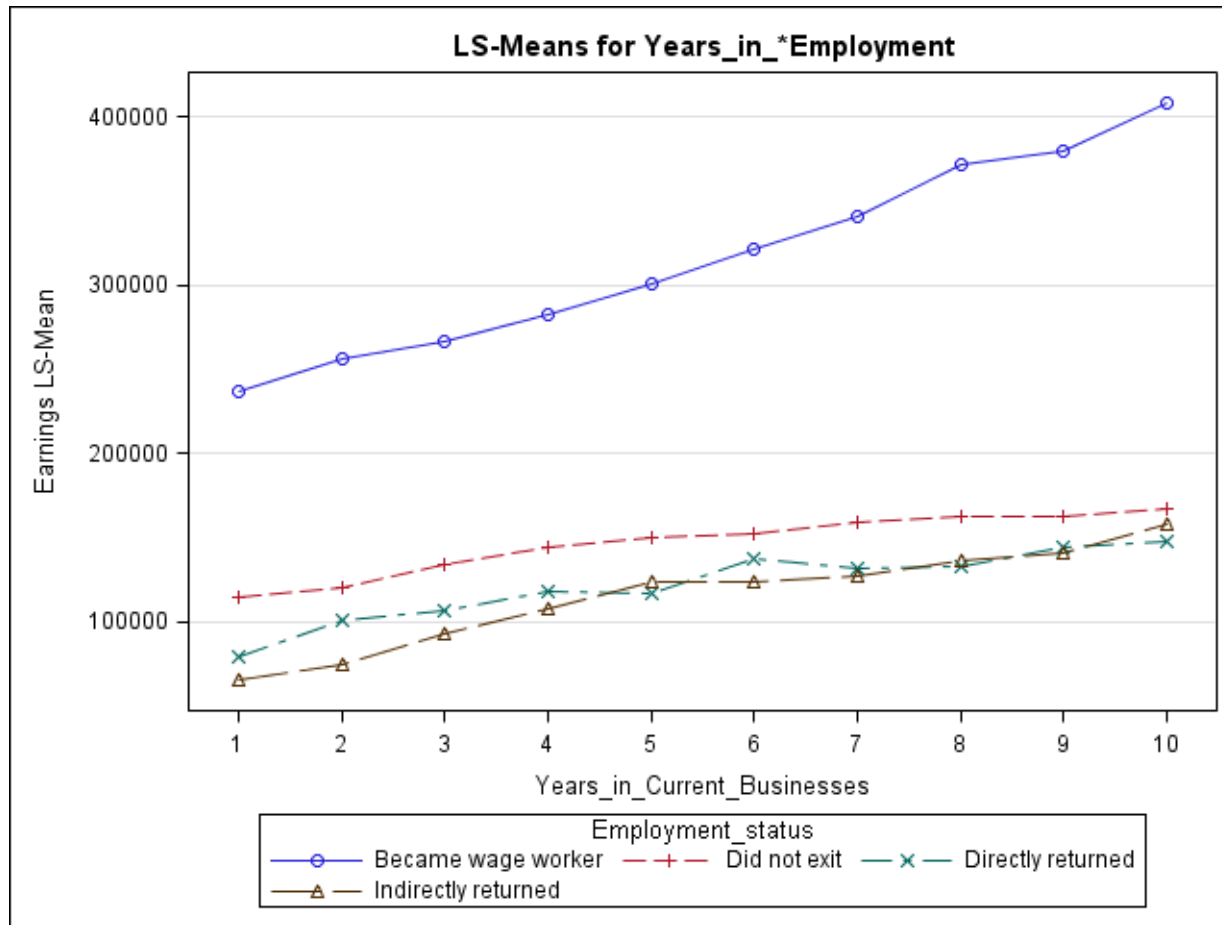


Table 6 Correlations (n = 113,827)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Earnings (log)	1														
2. Years in current businesses	0.264	1													
3. Prior entrepreneurial experiences in years (log)	-0.136	0.001	1												
4. Had founded multiple ventures	-0.000	-0.070	0.281	1											
5. Education	-0.010	-0.044	0.024	0.012	1										
6. Married	0.001	-0.089	0.183	0.082	0.065	1									
7. Unemployment	-0.032	0.021	-0.112	-0.010	-0.041	-0.042	1								
8. Prior wage salary (log)	0.031	-0.176	-0.006	-0.096	0.063	0.131	0.059	1							
9. Hybrid	-0.043	-0.009	-0.144	0.004	0.054	-0.022	0.024	-0.008	1						
10. Additional income (log)	-0.016	-0.034	0.371	-0.005	-0.014	0.091	-0.046	0.073	-0.290	1					
11. Small children	-0.049	-0.100	0.276	0.078	0.027	0.517	-0.048	0.165	-0.067	0.171	1				
12. Age (log)	-0.064	-0.191	0.465	0.135	0.146	0.249	-0.069	0.283	-0.095	0.273	0.334	1			
13. Manufacturing industry	0.011	-0.051	0.121	0.037	0.050	0.049	-0.054	0.039	-0.009	0.070	0.056	0.119	1		
14. Professional industry	-0.009	-0.121	0.169	0.038	0.112	0.089	-0.040	0.141	-0.019	0.172	0.078	0.232	-0.207	1	
15. Wholesale industry	-0.016	-0.022	0.061	0.019	-0.028	0.016	0.027	0.040	-0.029	0.032	0.042	0.054	-0.083	-0.095	1

*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$; † $p < 0.1$. Correlations greater than |0.006| are significant at $p < 0.05$

Table 7 Results of the Random Intercept, Mixed Model Analysis (n = 113,827)^{ab}

DV: Entrepreneurial / Wage earnings	Model 1	
	p.a.	s.e.
Intercept	12.870***	0.019
Controls		
Education	0.007***	0.001
Married	0.012***	0.002
Unemployment	-0.014***	0.001
Prior wage salary (log)	0.009***	0.000
Hybrid	-0.015***	0.002
Additional income (log)	0.007***	0.000
Small children	0.005***	0.001
Age (log)	0.114***	0.005
Years in current businesses	0.026***	0.000
Manufacturing industry	0.036***	0.002
Professional industry	0.029***	0.002
Wholesale industry	-0.017***	0.004
Main effects		
Became wage-worker (dummy)	0.273***	0.002
Directly returned to entrepreneurship (dummy)	0.037***	0.003
Indirectly returned to entrepreneurship (dummy)	0.031***	0.002
-2 log likelihood	-123,294	
AIC	-123,258	
Chi-Square	43,114.120***	
a. Reference group = didn't exit b. We used a random intercept mixed model for model estimation. *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$; † $p < 0.1$.		

Table 8 Results of the Random Intercept, Mixed Model Analysis (n = 113,827) ^a

DV: Entrepreneurial / Wage earnings	Became Wage-worker		Directly Returned to Entrepreneurship		Indirectly Returned to Entrepreneurship		Didn't Exit	
	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.
Intercept	13.052***	0.018	13.052***	0.018	13.052***	0.018	13.052***	0.018
<i>Controls</i>								
Education	0.011***	0.001	0.003	0.002	0.002*	0.001	0.007***	0.001
Married	0.033***	0.003	-0.017*	0.007	-0.017***	0.004	0.002	0.003
Unemployment	-0.024***	0.001	-0.004†	0.002	0.003**	0.001	-0.003*	0.001
Prior wage salary (log)	0.010***	0.000	0.003**	0.001	0.003***	0.000	0.004***	0.000
Hybrid	0.018***	0.002	0.011†	0.006	0.002	0.003	-0.048***	0.003
Additional income (log)	-0.009***	0.001	0.014***	0.002	0.011***	0.001	0.029***	0.001
Small children	0.009***	0.001	0.003	0.003	0.001	0.002	0.001	0.001
Age (log)	0.143***	0.005	0.093***	0.008	0.089***	0.006	0.047***	0.006
Years in current businesses	0.034***	0.000	0.008***	0.001	0.016***	0.001	0.015***	0.000
Manufacturing industry	0.053***	0.003	0.014	0.010	0.013**	0.004	0.019***	0.003
Professional industry	0.070***	0.003	-0.010	0.008	-0.003	0.005	-0.002	0.003
Wholesale industry	-0.013*	0.006	-0.021	0.015	0.010	0.010	-0.010	0.001
<i>Main effects (H1)</i>								
Prior entrepreneurial experience in years (log)	0.048***	0.002	-0.014**	0.005	-0.008**	0.003	-0.040***	0.002
Had founded multiple ventures	0.051***	0.003	-0.010	0.010	0.010†	0.004	-0.008*	0.003
-2 log likelihood	-133,301							
AIC	-133,183							
Chi-Square	39,568.900***							
*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$; † $p < 0.1$.								
a. We used a random intercept mixed model for model estimation.								

ESSAY THREE

WHO BECOMES A SERIAL ENTREPRENEUR: DEVELOPING A MULTI-DIMENSIONAL DEFINITION OF PRIOR ENTREPRENEURIAL EXPERIENCE

ABSTRACT

We argue that the matching model, which suggests individuals self-select themselves into a career in which they have relative advantages, may explain serial entrepreneurship. To test this theoretical argument, we propose to investigate the qualitative differences of prior entrepreneurial experience. In particular, we believe that prior entrepreneurial experience can be decomposed into three dimensions: (1) venture success experience (i.e. the extent to which an individuals' previous venture was financially successful), (2) venture managerial experience (i.e. managerial expertise individuals have developed through leadership experience in their previous entrepreneurial spell) and (3) venture industry experience (i.e. venture industry expertise individuals have developed specific to the target industry in their previous entrepreneurial spell). While some experience dimensions are more transferrable to wage employment (i.e. venture industry experience), leading to higher financial payoffs, some are more specific and useful in entrepreneurship (i.e. venture success experience and venture managerial experience). Individuals with more transferrable experience may prefer to become wage-employed, but those with more specific experience may self-select to return to entrepreneurship. Testing from the sample of 16,888 entrepreneurs who were at risk of making a career choice between serial entrepreneurship or wage employment partially confirms this conjecture. Our study then provides a fine-grained view for the motivation of serial entrepreneurship.

Keywords: Serial Entrepreneurship, Wage Employment, the Matching Model, Prior Entrepreneurial Experience, Experience Dimensions

1. Introduction

Owning a business involves a lot of challenges, but a serial entrepreneur takes on these challenges repeatedly. Serial entrepreneurs are defined as “individuals who have sold/closed a business in which they had a minority or majority ownership stake, and they currently have a minority or majority ownership stake in a single independent business that is either new, purchased or inherited” (Westhead, Ucbasaran, and Wright, 2005, pp. 393-417). One distinct difference of serial entrepreneurs from first-time entrepreneurs is that they are repeat business owners with prior entrepreneurial experience. Unsurprisingly, many studies have used human capital theory (Becker, 1962) to deduce the role that prior entrepreneurial experience plays in influencing subsequent entrepreneurial performance (Cope, 2005; Davidsson and Honig, 2003; Gompers *et al.*, 2010; Parker, 2013; Rerup, 2005; Santarelli and Tran, 2013; Stuart and Abetti, 1990; Wright, Roobie, Ennew, 1997). Yet the motivation of serial entrepreneurship is under-explored.

We argue that serial entrepreneurship may be explained by the matching model (Jovanovic, 1982; Roy, 1951), which suggests individuals self-select themselves into a career in which they have relative advantages. In particular, the matching model states that individuals have imperfect information about their abilities and learn about their true abilities over time. Individuals who experience bad outcomes then may quit and choose alternative occupations if the financial payoffs to their abilities are greater there (Jovanovic, 1982; Roy, 1951). Since prior entrepreneurial experience can reflect individuals’ knowledge and abilities that are specific to entrepreneurship, and may also develop and reveal their general human capital that is valuable to wage employers (Campbell, 2013), individuals with greater prior entrepreneurial experience should have a lower level of uncertainties about their ability. Therefore, associating prior

entrepreneurial experience with the matching model (Jovanovic, 1982; Roy, 1951) may help explain their subsequent career choices between serial entrepreneurship and wage employment. It then follows that in order to test this theoretical argument, we need to define prior entrepreneurial experience in a greater detail and thus be able to examine individuals' sector-specific skills.

Although this theoretical argument is of significant importance for us to understand the motivation of serial entrepreneurship, prior studies have not fully investigated it, primarily because their definition of prior entrepreneurial experience is limited. For example, Hamilton (2000) rejected the theoretical conjecture that self-selection explains the earnings differentials between entrepreneurship and wage employment. He believed that the reason why most individuals enter and persist in entrepreneurship despite the fact that they have both lower initial earnings and lower earnings growth in wage employment is because of the desirable attributes of entrepreneurship, such as "being your own boss". However, he defined prior entrepreneurial experience using whether the individual had been self-employed before or how long the individual had stayed in entrepreneurship, which merely gauge the quantitative differences of prior entrepreneurial experience. Intuitively, even spending the same amount of time in entrepreneurship, individuals can learn differently. Therefore, to fully investigate whether the matching model (Jovanovic, 1982; Roy, 1951) can help explain serial entrepreneurship and individuals' sector-specific skills, we need to further study the qualitative differences of prior entrepreneurial experience.

As such, the objective of this study is to investigate whether the matching model (Jovanovic, 1982; Roy, 1951) helps explain the motivation of serial entrepreneurship by developing a multi-dimensional definition of prior entrepreneurial experience. We propose that

in addition to its quantitative differences, prior entrepreneurial experience can also be decomposed into three dimensions to reflect its qualitative differences: (1) venture success experience (i.e. the extent to which an individual's previous venture was financially successful), (2) venture managerial experience (i.e. managerial expertise individuals have developed through leadership experience in their previous entrepreneurial spell) and (3) venture industry experience (i.e. venture industry expertise individuals have developed specific to the target industry in their previous entrepreneurial spell). The former two can help define expert entrepreneurs (Ucbasaran, *et al.* 2010), and the latter can help detect different learning outcomes resulted from context-domain differences (Toft-Kehler, Wennberg, Kim, 2013). In particular, we argue that while some experience dimensions are more transferrable to wage employment (i.e. venture industry experience), leading to higher payoffs, some are more specific and useful in entrepreneurship (i.e. venture success experience and venture managerial experience). Individuals with more transferrable experience prefer to become wage-employed, but those with more specific experience dimensions tend to self-select to become serial entrepreneurs.

We test the above arguments using the data drawn from a set of three matched longitudinal data sources on the entire Swedish high-technology labor market. The final sample includes 16,888 sampled individuals who were at risk of making a career choice between serial entrepreneurship or wage employment. Because this dataset tracks individuals' employment flow and financial payoffs over thirteen years based on an annual mandatory survey for all firms having at least one employee or earnings profit, it provides us with sufficient information to examine the qualitative differences of individuals' prior entrepreneurial experience. We used a two-stage modeling approach for model estimation. The first stage probit model models the probability of entrepreneurial entry and calculates the inverse Mills ratio. The inverse Mills ratio

is then used in the second stage model to account for potential nonrandom selection (Heckman, 1976) of earnings.

Our results show that these different experience dimensions influence individuals' subsequent career choices and financial payoffs in different ways. Individuals whose previous ventures were financially successful tend to self-select themselves to serial entrepreneurship while those with greater venture industry experience prefer to become wage-employed because the career choice they choose is with higher financial payoffs. In addition, while venture managerial experience is positively associated with both wage and entrepreneurial earnings, it does not influence individuals' subsequent career choices. This may be because the financial payoffs to venture managerial experience are equally high in wage employment and serial entrepreneurship, and thus individuals are more inclined to consider other factors when determining a career choice. Furthermore, our results also show that the estimated self-selection coefficient is generally positive and significant, indicating that individuals positively self-select into their current career. In other words, had they chose the other career choice, they should have earned less.

The above evidence echoes our theoretical argument based on the matching model (Jovanovic, 1982; Roy, 1951) – individuals self-select themselves into wage employment or serial entrepreneurship in which they have relative advantages. By doing so, our study provides a fine-grained view for the motivation of serial entrepreneurship and also invites more attention from entrepreneurship scholars regarding the definition of prior entrepreneurial experience.

In the following, we will firstly discuss the matching model (Jovanovic, 1982; Roy, 1951), and then develop a multi-dimensional definition of prior entrepreneurial experience.

2. Theory and Hypotheses

The matching model (Jovanovic, 1982; Roy, 1951) indicates that individuals self-select themselves into a career in which they have relative advantages according to an income maximizing procedure. In particular, in the Roy model (Roy, 1951), income maximizing individuals possess two skills, denoted as S_1 and S_2 with associated positive financial payoffs denoted as F_1 and F_2 . These individuals are differed in their skills but understand their own endowments. Assuming there are no mobility costs and individuals' sector-specific skills cannot be augmented by personal investment decisions, individuals will self-select into sector one if their financial payoffs are greater there ($F_1 S_1 > F_2 S_2$). Otherwise, they will choose sector two ($F_2 S_2 > F_1 S_1$). In other words, individuals tend to choose a career with the highest expected financial payoffs given their sector-specific skills. Jovanovic (1982) further elaborated the Roy model (Roy, 1951) by assuming individuals have imperfect information about their abilities. In his model, individuals choose a career based on their beliefs about their abilities, but their belief is imprecisely estimated. Through observing the outcome of the choice, individuals learn about their true abilities and revise the initial estimates. Individuals who experience bad outcomes then may quit and choose alternative occupations. Since prior entrepreneurial experience can reflect individuals' knowledge and abilities that are specific to entrepreneurship, and may also develop and reveal their general human capital that is valuable to wage employers (Campbell, 2013), individuals with greater prior entrepreneurial experience should have a lower level of uncertainties about their ability. Associating it with the matching model (Jovanovic, 1982; Roy, 1951) then may help explain who becomes a serial entrepreneur.

In order to test this theoretical argument, we suggest that prior entrepreneurial experience can be decomposed into three dimensions to reflect its qualitative differences: (1) venture success experience (i.e. the extent to which an individuals' previous venture was financially

successful), (2) venture managerial experience (i.e. managerial expertise individuals have developed through leadership experience in their previous entrepreneurial spell) and (3) venture industry experience (i.e. venture industry expertise individuals have developed specific to the target industry in their previous entrepreneurial spell). The former two can help define expert entrepreneurs (Ucbasaran, *et al.* 2010), and the latter can help detect different learning outcomes resulted from context-domain differences (Toft-Kehler, Wennberg, Kim, 2013). We believe that while some experience dimensions are more transferrable and valuable to wage employment (i.e. venture industry experience), leading to higher payoffs, some are more specific and useful in entrepreneurship (i.e. venture success experience and venture managerial experience). Individuals with more transferrable experience may prefer to become wage-employed, but those with more specific experience tend to self-select to return to entrepreneurship. In the following, we will define these three dimensions, discuss whether they are more transferrable to wage employment or more specific and useful in entrepreneurship, and how it may affect their subsequent career choices.

2.1. Venture Success Experience

Venture success experience is defined by the extent to which an individuals' previous venture was financially successful. Entrepreneurial firms have a greater risk of financial failure than established firm due to the liability of newness (Stinchcombe, 1965). Individuals' previous ventures' performance is then a strong signal for the quality of their prior entrepreneurial experience (Campbell, 2013). Therefore, this experience dimension is likely to influence individuals' subsequent financial payoffs and career choices. We argue that venture success experience is more specific and useful in entrepreneurship than in wage employment.

First, individuals whose previous venture was financially successful are more likely to get access to important future resources in form of financial capital or social capital. As Hayward *et al.* (2010) suggested, performance in previous ventures can provide resources for future ventures, especially if previous ventures were financially successful. On one hand, individuals with venture success experience have established their reputation as an entrepreneur and thus are more likely to attract external investments (MacMillan, Siegel, and Narasimha, 1986). They also have higher chances to get access to debt and equity financing (Gompers, *et al.* 2010). Using data from a survey of 149 early stage technology-based start-up firms, Hsu (2007) found empirical evidence showing that prior financially successful experience increases both the likelihood of VC funding via a direct tie and venture valuation. He commented that entrepreneurs with prior successful experience send a clearer signal of entrepreneurial quality. As such, like Gottschalk *et al.* (2014) concluded, comparing with first-time entrepreneurs, those with prior successful experience have lower start-up costs and higher likelihood of raising start-up capital. Because financial capital can help new ventures against random shocks and pursue more capital-intensive strategies (Cooper, Gimeno-Gascon, and Woo, 1994; Rujoub, Cook, and Hay, 1995), those entrepreneurs' new ventures are more likely to grow and succeed.

On the other hand, venture success experience helps individuals build credibility and thus link them to a network of important stakeholders, such as employees, suppliers, investors, and customers (Delmar and Shane, 2006; Gottschalk *et al.*, 2014; Hsu, 2007). These network contacts are useful in recruiting talented managers and technical staff (Bygrave and Timmons, 1992), determine what roles are necessary in ventures and who should fill these roles (Delmar and Shane, 2006), develop long-term relationships with suppliers and customers (Ostgaard and Birley, 1994), facilitate the process of obtaining resources and organizing new venture operations

(Aldrich, 1990). As a result, venture success experience may reduce the level of uncertainties and risks that exist in entrepreneurship.

Second, although entrepreneurial learning occurs in activities, such as identify and exploit opportunities (Shane and Venkataraman, 2000), launch a product (Schoonhoven, Eisenhardt, and Lyman, 1990), seek for external investments and work on the relationship with important stakeholders (De Clercq and Rangarajan, 2008; Sapienza, 1992), adapt to environmental jolts (Meyer, 1982; Sine and David, 2003), and so forth, the learning will be leveraged if individuals' previous venture was successful. This is because through appropriately reflecting and acting upon the feedback from the market as they set up the ventures, their knowledge and skills of entrepreneurship improve (Alvarez and Parker, 2009; Nystrom and Starbuck, 1984). Individuals then can use their successful prior entrepreneurial experience to develop a better market entry strategy (Gompers, *et al.* 2010), increase comprehension of the entrepreneurial tasks (Dimov, 2010), and consequently shorten the time and resources required to meet important development milestones (Capelleras and Greene, 2008).

Although venture success experience is also valuable to wage employers as it reflects individuals' prior entrepreneurial experience quality, such experience is more specific and useful in entrepreneurship because established firms and startups need to deal with different business environments. Given that the financial payoffs to venture success experience are higher in entrepreneurship than in wage-employment, individuals whose previous venture was financially successful may self-select to become a serial entrepreneur than become wage-employed.

Taken together, we expect that:

Hypothesis 1a: Venture success experience will lead to higher financial payoffs in serial entrepreneurship than in wage employment.

Hypothesis 1b: Venture success experience will increase the likelihood of entrepreneurial re-entry.

2.2. Venture Managerial Experience

Venture managerial experience is defined as managerial expertise (i.e. manage employees, handle difficult tasks, allocate resources) that individuals have accumulated and developed through leadership experience in their previous entrepreneurial spells. Given that the majority of startups have a relatively flat organization structure, they are usually managed by founders who also act as the general manager, perform multiple tasks and make the most decisions (Papastathopoulos and Beneki, 2010). Because individuals who need to perform more managerial duties tend to have more chances to learn and practice (Arrow, 1971; Cope and Watts, 2000; Minniti and Bygrave, 2001), this experience dimension is likely to influence their subsequent financial payoffs and career choices. We argue that venture managerial experience is more specific and useful in entrepreneurship than in wage employment.

First, individuals' ability of adopting managerial traits is important for new ventures to succeed and grow. On one hand, individuals with greater entrepreneurial managerial experience should have better knowledge of how to set up, manage a firm, and handle managerial tasks involved in organizing and controlling the work of employees (Colombo and Grilli, 2005). Hence, their leadership should be more effective, leading to higher subordinate performance and commitment. For example, Gupta and MacMillan (2004) asserted that experienced entrepreneurial leaders are capable of breaking down self-imposed perceptual barriers of the

individuals and let them understand what they can, or cannot, accomplish together. Anyanwu and Oad (2016) also proposed that individuals with greater venture managerial experience also have a higher level of entrepreneurial leaders' emotional intelligence, which plays an important role in managing team relationship to create an enabling environment for creativity. On the other hand, entrepreneurial managerial behaviors are also closely related to entrepreneurial style and performance (Sadler-Smith *et al.*, 2003). For example, the success of important entrepreneurial firms' cooperative arrangements (McGee, Dowling, and Megginson, 1995) and resource productivity (Holcomb, Holmes Jr and Connelly, 2009) strongly depend on entrepreneurs' managerial experience (McGee, Dowling, and Megginson, 1995). A lack of managerial experience will also lead to a greater liability of newness and a greater risk of failure (Shepherd, Douglas, and Shanley, 2000).

Second, individuals with greater venture managerial experience should have a better access to important financial capital. As Stuart and Abetti (1990) reported, venture capitalists heavily rely on entrepreneurs' prior experience, such as managerial experience, to evaluate the attractiveness of new ventures. Ajzen (1991) also pointed out that, investors often have a strong believe that individuals with relevant entrepreneurial managerial experience have a greater sense of behavior control and greater ability to discover, exploit opportunities. Because financial capital is believed to be the most important factor for entrepreneurial growth, (Cooper *et al.*, 1994; Rujoub *et al.*, 1995), the new ventures founded by individuals with greater entrepreneurial managerial experience are likely to grow faster.

Although entrepreneurial managerial experience is also valuable to wage employers as some managerial tasks (e.g. giving directions to employees, monitoring, *etc.*) are general in nature, it is more specific and useful in entrepreneurship. In particular, venture managerial

experience is still different from general managerial experience because entrepreneurial leaders need to manage their ventures in a highly unpredictable and uncertain environment. Instead of developing detailed plans based on accurate predictions, entrepreneurial leaders need to constantly reposition themselves to capture fast-changing opportunities (Gupta and MacMillan, 2004). In addition, entrepreneurial and established firms have totally different governance structures and thus may prefer different leadership styles. Therefore, even though venture managerial experience can directly apply to individuals' entrepreneurial job in their newly created firms (Colombo and Grilli, 2005), it may need to reshape in order to be useful in wage employment. As such, the financial payoffs to venture managerial experience should be higher in serial entrepreneurship than in wage employment. Therefore, individuals with greater entrepreneurial managerial experience should prefer to become a serial entrepreneur than become wage-employed.

Taken together, we expect that:

Hypothesis 2a: Venture managerial experience will lead to higher financial payoffs in wage employment than in serial entrepreneurship.

Hypothesis 2b: Venture managerial experience will increase the likelihood of entrepreneurial re-entry.

2.3. Venture Industry Experience

Venture industry experience is defined as individuals' venture industry expertise specific to the target industry in their previous entrepreneurial spells. Individuals who have spent many years in the same industry as an owner should have greater information on the requirements of customers (Delmar and Shane, 2006), established relationships with important stakeholders

(Gimeno *et al.*, 1997; Hsu, 2007) and a better understanding of the norms, practices as well as routines in that industry (Kotha and George, 2012). Therefore, this experience dimension may influence their subsequent financial payoffs and career choices. We argue that, probably counterintuitive, the financial payoffs to venture industry experience are higher in wage employment than in serial entrepreneurship if individuals enter the same industry in which their venture competed.

First, although mounting evidence has shown that venture industry experience may contribute to venture growth and succeed (e.g. Cooper and Bruno, 1977; Cooper *et al.* 1994; Siegel, Siegel and Macmillan, 1993), the other side of story tells that the impact of venture industry experience on venture performance is not always positive. This is because if individuals choose to start a new venture in the same industry in which their previous ventures were formerly operated, their new ventures may fall into the familiarity trap (Ahuja and Lampert, 2001). Because their knowledge and social network are too specific to that specific industry, they may have a stronger preference to refine existing ideas where be reluctant to experiment alternative directions (Ahuja and Lampert, 2001). They are also likely to have limited ability to conceptualize and solve new problems, leading to rigidities in their decision makings (Sorensen and Stuart, 2001). This is particularly destructive to startups, which strive for innovations and quicker movements.

On the other hand, if individuals choose to become wage-employed in the same industry in which their previous ventures were formerly operated, the benefits of venture industry experience are not likely to be offset by the familiarity trap mentioned above. This is because in contrast to startups that founders need to perform multiple tasks and make the most decisions (Papastathopoulos and Beneki, 2010), established firms usually have employees or managers

work in teams, break down tasks and hold compatible or complementary knowledge (Klimoski and Mohammed, 1994). Because most important decisions are made jointly by a group of people experienced in a variety of ways, firms then can take advantage of individual's venture industry experience without limiting by it. Individuals with greater venture industry experience then may be quite valuable to wage employers.

As such, the financial payoffs to venture industry experience should be higher in wage employment than in serial entrepreneurship. Therefore, individuals with greater venture industry experience should prefer to become wage-employed than become a serial entrepreneur.

Taken together, we expect that:

Hypothesis 3a: Venture industry experience will lead to higher financial payoffs in wage employment than in serial entrepreneurship.

Hypothesis 3b: Venture industry experience will decrease the likelihood of entrepreneurial re-entry.

3. Methods

3.1. Sample

We use the data drawn from a set of three matched longitudinal data sources – LOUISE, RAMS, and RSU on the entire Swedish labor market. The special abstract we used is called EPRO that specializes in high-technology manufacturing or knowledge-intensive service sectors and covers any individual who was active in these sectors from 1989 to 2002. The original data contains 11,182,628 observations with 482,249 unique individual identifiers.

We used the same sampling procedure as in essay two. In particular, we sampled young men aged between 20 and 25 in 1989 to eliminate the unobserved heterogeneity caused by

gender (Evans and Leighton, 1989; Folta, Delmar, Wennberg, 2010) and the possibility of an individual was self-employed prior to 1989. This step led to a total of 32,733 unique individual identifiers. We then required all sampled individuals to have engaged in entrepreneurship at least once in order to investigate the details of their prior entrepreneurial experience. This step led to a total of 21,959 unique individual identifiers. We further excluded portfolio entrepreneurs who are different from serial entrepreneurs in terms of resources at hand, experience, and performance (Westhead *et al.*, 2005a, 2005b, 2005c). This step led to a total of 113,827 observations with 21,229 unique individual identifiers.

In consistent with essay two, we identified individuals' employment statusrd using the occupational classification information provided by the data sources. Individual were identified as an entrepreneur if "self-employed in a proprietorship or partnership" or "self-employed in incorporation". When individuals were no longer associated with their original ventures, they were identified as ex-entrepreneur. Serial entrepreneurs were then identified when ex-entrepreneurs returned to "self-employed in a proprietorship or partnership" or "self-employed in incorporation" with a different firm identifier. If ex-entrepreneurs became "employed", they were identified as wage workers. Because individuals may choose to return to entrepreneurship immediately upon exiting from their previous ventures or become wage-employed first as a transition to fully return (Amaral *et al.*, 2011), we labeled the first type of return as direct return and the latter as indirect return.

For the 21,229 sampled individuals who had engaged in entrepreneurship at least once from 1989 to 2002, 66.31% (n = 14,076) left their first ventures and became ex-entrepreneurs. These first-time exiters then were at risk to make a career choice - either serial entrepreneurship or wage employment. For these sampled first-time exiters, 35.56% (n = 5,006) returned to

entrepreneurship while the rest of them 64.44% (n = 9,070) became wage-employed. We then observed whether these serial entrepreneurs left their second ventures. For these individuals, 56.17% of these serial entrepreneurs exited their second ventures and became ex-entrepreneurs for the second time (n = 2,812), and once again were at risk of making a career choice. For these second-time exiters, 34.07% of them (n = 958) returned to entrepreneurship and 65.93% of them became wage-employed (n = 1,854). In addition, for these returners, 4.08% of them (n = 1,070) directly returned to entrepreneurship and 18.65% of them (n = 4, 894) indirectly returned to entrepreneurship.

Therefore, we have a total of 16,888 individuals (14,076 first-time exiters and 2,812 second-time exiters) were at risk of making a career choice between serial entrepreneurship and wage employment. A total of 10,924 of them became wage-employed and remained in wage employment till 2002. A total of 1,070 of them directly returned to entrepreneurship, and 4,894 of them indirectly returned to entrepreneurship.

3.2. Variables

Dependent variables. If an individual returned to entrepreneurship immediately upon exiting from their previous ventures, *directly returned to entrepreneurship* was coded as 1. Otherwise, it was coded as 0. If an individual became wage-employed first as a transition to fully return, *indirectly returned to entrepreneurship* was coded as 1. Otherwise, it was coded as 0. If an individual left entrepreneurship, became wage-employed and never returned, *became wage-employed* was coded as 1. Otherwise, it was coded as 0.

Individuals' post-exit earnings were then calculated by taking an average of the earnings starting from the year they left entrepreneurship till the year their employment statuses changed again. If individuals returned to entrepreneurship, the earnings in *in serial entrepreneurship* was

calculated as the average of the natural log of the total earnings from an individual's active and passive businesses, deduct business deficit and plus wage earning from these businesses because (a) entrepreneurial earnings may be withdrawn from the business in the form of salary; (b) entrepreneurs may understate the true earnings for tax purposes, wage earnings from their businesses then may provide an alternative measures of entrepreneurial earnings (Hamilton, 2000).

The average earnings per year in serial entrepreneurship = \log (the sum of the total earnings from active and passive businesses – businesses deficit + wage earnings from these businesses)/ years in this venture

If individuals became wage-employed, *the earning in wage employment* was calculated as the average of the natural log of an individual's wage salary.

The average earnings per year in wage employment = \log (the sum of the total wage earnings)/ years in this job

Independent Variables. The independent variables were calculated at the time when they left entrepreneurship. Following Hamilton (2000), individuals' prior entrepreneurial experience was measured by their *prior entrepreneurial experience in years* and whether an individual *had founded multiple ventures*. If an individual had founded more than one venture, it was coded as 1. Otherwise, it was coded as 0.

Venture success experience was measured by the natural log of individuals' last year entrepreneurial earnings of their previous venture. Because individuals who need to perform more managerial duties tend to have more chances to practice managerial ability (Arrow, 1971; Cope and Watts, 2000; Minniti and Bygrave, 2001), we measured *venture managerial experience* by the natural log of number of employees in individuals' previous venture. *Venture*

industry experience was measured by individuals' years of entrepreneurial experience in the same industry of their new firm.

Controls. The control variables were calculated at the time when they left entrepreneurship. In consistent with the second essay, we controlled family-related factors and life changing events. We included a dummy variable to indicate whether an individual was *married*. We also controlled the number of *small children*, which was defined as how many children (< 18 years old) an individual had during the year. We also controlled *hybrid status* that was coded as 1 if an individual was self-employed and simultaneously job-employed (Folta *et al.*, 2010). In addition, we included *unemployment* as an individual's years in unemployment, *prior wage salary* as the natural log of average prior wage earnings, and *education* as the highest education level an individual obtained at the year of leaving entrepreneurship. We also took industrial influence into account by indicating whether the firm was in *manufacturing industry*, *professional industry* or *wholesale industry*. Individuals' *age* that may influence their switching costs (Gimeno *et al.*, 1997) was also included.

3.3. Analytical Approach

We used a two-stage modeling approach (Heckman, 1976) to test whether individuals self-select themselves to the career with relative higher financial payoffs. Heckman (1976) studied the wage earnings of working women. He recognized that the sample of working women is likely not random because the career decision is an outcome of observed factors, such as family reasons. Therefore, he proposed to estimate a first-stage probit model to specify a selection equation and then calculate the inverse Mills ratio, which then can be used to account for potential nonrandom selection in a second stage performance model. Following his approach, in this study, the first stage probit model estimates the probability of entrepreneurial entry and

calculates the inverse Mills ratio. The inverse Mills ratio is then used in the second stage to estimate the entrepreneurial/ wage earnings. We added the natural log of household wealth as an instrumental variable in the first stage as it may significantly influence individuals' return decision.

4. Results

Table 1 reports the definition, means, and standard deviations of prior entrepreneurial experience and its three dimensions. Table 2 reports the correlation of the independent variables.

Insert Tables 1 and Table 2 about here

Table 3 reports the probit estimates for first-stage entrepreneurial re-entry model. Model 1 and 2 investigate individuals' directly return decision. As shown in Model 1, individuals with greater prior entrepreneurial experience in years are less likely to directly return to entrepreneurship ($b = -0.055, p < 0.05$), while multiple ventures experience is positive related to the direct return decision ($b = 0.150, p < 0.05$). We added three prior entrepreneurial experience dimensions in the Model 2. As shown, prior entrepreneurial experience in years is no longer significantly related to the direct return decision, while the effect of multiple ventures experience is significant positive ($b = 0.113, p < 0.05$). In addition, individuals with venture success experience are more likely to directly return ($b = 2.052, p < 0.001$), but those with venture industry experience are less likely to directly return ($b = -0.116, p < 0.01$). Venture managerial experience does not seem to influence the return decision.

Model 3 and 4 investigate individuals' indirectly return decision. As shown in Model 3, individuals with greater prior entrepreneurial experience in years are less likely to indirectly return to entrepreneurship ($b = -0.079, p < 0.001$), while multiple ventures experience does not

influence the indirect return decision. We added three prior entrepreneurial experience dimensions in the Model 4. As shown, prior entrepreneurial experience in years is still negatively related to the indirect return decision ($b = -0.066, p < 0.001$). In addition, individuals with venture success experience are more likely to indirectly return ($b = 0.553, p < 0.01$), but those with venture industry experience are less likely to indirectly return ($b = -0.084, p < 0.01$). Again, venture managerial experience does not seem to influence the return decision.

Model 5 and 6 test on the overall return decision. As shown in Model 5, individuals with greater prior entrepreneurial experience in years are less likely to return to entrepreneurship ($b = -0.069, p < 0.001$), while multiple ventures experience does not influence the return decision. We added three prior entrepreneurial experience dimensions in the Model 6. As shown, prior entrepreneurial experience in years is still negatively related to the return decision ($b = -0.056, p < 0.01$). In addition, individuals with venture success experience are more likely to return ($b = 1.167, p < 0.001$), but those with venture industry experience are less likely to return ($b = -0.097, p < 0.001$). Venture managerial experience does not seem to influence the return decision.

To conclude, the above evidence suggests that individuals with greater prior entrepreneurial experience in years and venture industry experience are less likely to return to entrepreneurship. Instead, they have a stronger preference to become wage-employed upon exiting from entrepreneurship. In addition, individuals whose previous ventures were financially successful are more likely to become a serial entrepreneur than become wage-employed.

Insert Tables 3 about here

Table 4 reports the results of the second-stage earnings (log) model. Model 1 and 2 report the results based on the sample of individuals who became wage-employed. Model 1 shows that

greater prior entrepreneurial experience in years is associated with higher financial payoffs in wage employment ($b = 0.048, p < 0.001$), while multiple ventures experience render no effects. That means each additional year of prior entrepreneurial experience (log) increase the natural log of wage earnings by 0.048. The inverse Mills ratio that accounts for nonrandom selection is positive and significant ($b = 0.686, p < 0.01$), indicating that individuals positively self-select into their current career. In other words, had they chosen the other career choice, they should have experienced worse performance. We added three prior entrepreneurial experience dimensions in the Model 2. As shown, prior entrepreneurial experience in years is still positively related to the financial payoffs in wage-employment ($b = 0.022, p < 0.001$), and multiple ventures experience becomes significantly positive ($b = 0.032, p < 0.001$). In addition, individuals with greater venture managerial experience ($b = 0.024, p < 0.001$) or venture industry experience ($b = 0.027, p < 0.001$) tend to earn more in wage-employment, but venture success experience does not seem to influence the financial payoffs in wage employment. That means one unit increase of the natural log of venture managerial experience will increase the natural log of wage earnings by 0.024. One unit increase of the natural log of venture industry experience will increase the natural log of wage earnings by 0.027. The inverse Mills ratio is still positive and significant ($b = 0.144, p < 0.01$), indicating that individuals positively self-select into their current career.

Model 3 and 4 report the results based on the sample of individuals who directly returned to entrepreneurship. Model 1 shows that prior entrepreneurial experience in years and multiple ventures experience do not influence the financial payoffs in serial entrepreneurship. But the inverse Mills ratio is surprisingly positive ($b = 0.284, p < 0.05$), indicating that some unobserved characteristics may increase the financial payoffs associated with this career choice. We added

three prior entrepreneurial experience dimensions in the Model 4. As shown, prior entrepreneurial experience in years and multiple ventures experience still do not influence the financial payoffs in serial entrepreneurship. In addition, individuals whose previous venture was financially successful ($b = 0.677, p < 0.001$) or with greater venture managerial experience ($b = 0.022, p < 0.05$) tend to earn more if they directly return to entrepreneurship, but venture industry experience does not seem to influence their financial payoffs. That means one unit increase of the natural log of venture success experience will increase the natural log of entrepreneurial earnings by 0.677. One unit increase of the natural log of venture managerial experience will increase the natural log of entrepreneurial earnings by 0.022. The inverse Mills ratio is still positive and significant ($b = 0.204, p < 0.10$), indicating that individuals positively self-select into their current career.

Model 5 and 6 report the results based on the sample of individuals who indirectly returned to entrepreneurship. As shown, all the main explanatory variables render no effects on individuals' financial payoffs. The inverse Mills ratio is also insignificant.

It is possible that as the three dimensions are correlated with each other, their true effect is then obscured. We did an additional analysis to test their effects separately. As shown by Table 5, the findings are consistent.

Insert Tables 5 about here

To conclude, the above evidence suggests that individuals with greater prior entrepreneurial experience or venture industry experience will earn more in wage employment. Individuals whose previous ventures were financially successful will earn more if they directly

return to entrepreneurship and become a serial entrepreneur. Venture managerial experience leads to higher financial payoffs in both wage employment and directly return.

Table 6 summarizes our findings. Because venture success experience leads to higher financial payoffs in directly return than in wage employment, and individuals with venture success experience are also more likely to return to entrepreneurship, Hypothesis 1a and 1b (H1a and H1b) are partially supported. In addition, because venture industry experience leads to higher financial payoffs in wage employment than in serial entrepreneurship, and individuals with venture industry experience are also more likely to become wage-employed, Hypothesis 3a and 3b (H3a and H3b) are supported. We do not find supports for Hypothesis 2a and 2b (H2a and H2b).

Insert Tables 6 about here

5. Discussion

In this study, we investigate whether the matching model (Jovanovic, 1982; Roy, 1951), which suggests that individuals self-select themselves into a career with relative advantages, can help explain serial entrepreneurship. We argue that prior entrepreneurial experience can be decomposed into three dimensions to reflect its qualitative differences: (1) venture success experience (i.e. the extent to which an individuals' previous venture was financially successful), (2) venture managerial experience (i.e. managerial expertise individuals have developed through leadership experience in their previous entrepreneurial spell) and (3) venture industry experience (i.e. venture industry expertise individuals have developed specific to the target industry in their previous entrepreneurial spell). The former two can help define expert entrepreneurs (Ucbasaran, *et al.* 2010), and the latter can help detect different learning outcomes resulted from context-

domain differences (Toft-Kehler, Wennberg, Kim, 2013). We believe that while some experience dimensions are more transferrable to wage employment (i.e. venture industry experience), leading to higher financial payoffs, some are more specific and useful in entrepreneurship (i.e. venture success experience and venture managerial experience).

Through examining the sample of 16,888 individuals who were at risk of making a career choice between serial entrepreneurship and wage employment, our results show that venture success experience leads to higher financial payoffs in serial entrepreneurship than in wage employment, and individuals whose previous ventures were financially successful are also more likely to directly return to entrepreneurship than become wage-employed. In addition, venture industry experience leads to higher financial payoffs in wage employment than in serial entrepreneurship, and individuals with greater venture industry experience are also more likely to become wage-employed in the same industry in which their previous ventures were formerly operated. These findings partially support our theoretical conjecture based on the matching model (Jovanovic, 1982; Roy, 1951) – individuals self-select themselves into wage employment or serial entrepreneurship in which they have relative advantages.

Our study yields several intriguing implications. First, although prior entrepreneurial experience is one of the most important explanatory variables in entrepreneurship research, many studies measured it by either (a) a dummy variable to indicate whether an individual is with multiple ventures experience, or (b) an individual's prior entrepreneurial experience in years. For example, Henley (2004) found that once an individual have made an initial transition into entrepreneurship, the likelihood of remaining in entrepreneurship is much higher. Using a longitudinal matched employer-employee data set covered from 1996 to 2003, Amaral, *et al.* (2011) measured prior entrepreneurial experience using the number of ventures founded by an

individual. They found that individuals with greater prior entrepreneurial experience have a higher likelihood to become a serial entrepreneur. However, these two measures merely gauge the quantitative differences of prior entrepreneurial experience, while the important qualitative differences have been ignored. Our results show that venture success experience, venture managerial experience and venture industry experience tend to influence individuals' subsequent career choices and financial payoffs in different ways. By doing so, our study emphasizes the importance of understand the qualitative differences of prior entrepreneurial experience and invites more attention from entrepreneurship scholars regarding its definition. Table 7 reports selected examples of how prior entrepreneurial experience was measured. It is worth pointing out that although several studies examined the effects of professional managerial experience (e.g. Chatterji, 2009; Toft-Kehler, Wennberf and Kim, 2014), they did not measure venture managerial experience. As discussed above, these two experiences are different in terms of the leadership style and the nature of the tasks they need to perform. Thus, we only report the experience that is pertinent to entrepreneurship in Table 7.

Insert Tables 7 about here

Second, by decomposing prior entrepreneurial experience into three dimensions, our study investigates whether the matching model (Jovanovic, 1982; Roy, 1951) can help explain serial entrepreneurship in a greater detail. Although Hamilton (2000) empirically rejected this conjecture, his study merely measures the quantitative differences of prior entrepreneurial experience. Our results show that the individuals whose previous ventures were financially successful tend to self-select themselves to serial entrepreneurship while those with greater venture industry experience prefer to become wage-employed because the career choice they

choose is with higher financial payoffs. Our results then provide a fine-grained view for the motivation of serial entrepreneurship.

Third, our results show that venture managerial experience does not influence individuals' subsequent career choice, but it is positively related to the financial payoffs in wage employment and directly return. One possible explanation is that because venture managerial experience is valuable to both wage employment and entrepreneurship, it is then not the determinant factor for individuals' career choice. In addition, our results show that the self-selection explanation does not seem to explain individuals' career choice of indirectly return. One possible explanation is that what individuals learn during the transition time may influence their subsequent financial payoffs and career choices. Therefore, one interesting future direction is to further investigate these nuanced details.

It is worth pointing out that probit model estimates the probability of entrepreneurial entry by the cumulative distribution function of the normal distribution. Yet the link function that describes the mean of the normal distribution shares the same drawbacks as the logistic regression (discussed in essay one) because they all assume a linear function of the independent variables. Although we use two-stage model for a theoretical purpose, our findings need to be interpreted with cautions.

6. Conclusion

In this study, we test whether the matching model (Jovanovic, 1982; Roy, 1951), which suggests that individuals self-select themselves into a career with relative advantages, can help explain serial entrepreneurship. We argue that prior entrepreneurial experience can be decomposed into three dimensions: (1) venture success experience (i.e. the extent to which an individuals' previous venture was financially successful), (2) venture managerial experience (i.e.

managerial expertise individuals have developed through leadership experience in their previous entrepreneurial spells) and (3) venture industry experience (i.e. venture industry expertise individuals have developed specific to the target industry in their previous entrepreneurial spells). We believe that while some experience dimensions are more transferrable to wage employment (i.e. venture industry experience), leading to higher financial payoffs, some are more specific and useful in entrepreneurship (i.e. venture success experience and venture managerial experience). Our results find that individuals whose previous ventures were financially successful tend to self-select themselves to serial entrepreneurship while those with greater venture industry experience prefer to become wage-employed because the career choice they choose is with higher financial payoffs. Therefore, our theoretical argument is partially supported. Our study then enhances our understanding of the motivation of serial entrepreneurship.

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Table 1 Descriptive Statistics of Prior Entrepreneurial Experience Dimensions (n = 16, 888)

	Definitions	Mean	S.D.
Prior entrepreneurial experience in years (log)	The natural log of individuals' years in entrepreneurship	0.713	0.686
Have multiple ventures	Whether individuals had founded multiple ventures	0.166	0.372
Venture success Experience (Log)	The natural log of individuals' last year entrepreneurial earnings of their previous venture	13.453	0.127
Venture managerial experience (Log)	The natural log of number of employees in individuals' previous venture	0.185	0.508
Venture industry experience (Log)	Individuals' years of experience in the same industry of their new firm	0.270	0.550

Table 2 Correlations (n = 16, 888)

	1	2	3	4	5
1. Prior entrepreneurial experience in years (log)	1				
2. Have multiple ventures	0.368	1			
3. Venture success Experience (Log)	0.067	-0.020	1		
4. Venture managerial experience (Log)	0.155	0.006	0.012	1	
5. Venture industry experience (Log)	0.286	-0.052	0.042	0.256	1
*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$; † $p < 0.1$. Correlations greater than $ 0.020 $ are significant at $p < 0.05$					

Table 3 Probit Estimates for First-Stage Return Decision Model^a

	Directly Returned to Entrepreneurship (n = 11,994)				Indirectly Returned to Entrepreneurship (n = 15,818)				Returned to Entrepreneurship (n = 16,888)			
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.
Intercept	-0.805**	0.275	-27.837***	2.851	1.548***	0.200	-5.775*	2.367	1.632***	0.196	-13.802***	2.088
<i>Controls</i>												
Education	-0.031*	0.013	-0.031*	0.013	-0.024**	0.007	-0.023**	0.008	-0.025***	0.007	-0.025***	0.007
Married	0.055	0.043	0.053	0.043	0.029	0.027	0.030	0.027	0.035	0.026	0.037	0.026
Unemployment	-0.052***	0.011	-0.048***	0.011	-0.024***	0.007	-0.024***	0.007	-0.031***	0.006	-0.031***	0.006
Prior wage salary (log)	-0.021***	0.004	-0.024***	0.004	-0.010***	0.003	-0.010***	0.003	-0.012***	0.002	-0.014***	0.002
Hybrid	-0.411***	0.034	-0.404***	0.034	0.076***	0.022	0.077***	0.022	-0.038†	0.021	-0.032	0.021
Additional income (log)	0.100***	0.009	0.054***	0.010	-0.021***	0.005	-0.030***	0.006	0.002	0.005	-0.018**	0.006
Small children	0.023	0.019	0.027	0.020	-0.065***	0.013	-0.064***	0.013	-0.044***	0.012	-0.043***	0.012
Age (log)	-0.266**	0.081	-0.311***	0.080	-0.464***	0.060	-0.476***	0.060	-0.491***	0.059	-0.516***	0.059
Manufacturing industry	-0.021***	0.053	-0.136*	0.060	-0.062*	0.031	-0.014	0.036	-0.093**	0.030	-0.036	0.034
Professional industry	-0.029	0.046	0.061	0.056	-0.045	0.029	0.009	0.036	-0.042	0.028	0.023	0.034
Wholesale industry	-0.079	0.085	0.034	0.091	-0.200***	0.059	-0.138*	0.062	-0.185***	0.055	-0.105†	0.058
Household wealth (log)	-0.138*	0.045	-0.136*	0.059	-0.034	0.033	-0.031	0.033	-0.060†	0.031	-0.054†	0.032
<i>Main effects</i>												
Prior entrepreneurial experience in years (log)	-0.055*	0.028	-0.037	0.029	-0.079***	0.018	-0.066***	0.019	-0.069***	0.017	-0.056**	0.018
Have multiple ventures	0.150*	0.047	0.113*	0.049	-0.001	0.031	-0.020	0.032	0.036	0.029	0.012	0.030
Venture success experience (log) (H1a)			2.052***	0.216			0.553**	0.178			1.167***	0.157
Venture managerial experience (log) (H2a)			0.018	0.035			0.024	0.023			0.026	0.022
Venture industry experience (log) (H3a)			-0.116**	0.044			-0.084**	0.028			-0.097***	0.027
Log Likelihood Ratio	-2,269.252		-2180.527		-9,381.837		-9,377.053		-10,066.510		-10,016.020	

a. Reference group = become wage-employed
 *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$; † $p < 0.1$.

Table 4 Estimates for Second-Stage Earnings (log) Model

	Became Wage-employed (n = 16,888)				Directly Returned to Entrepreneurship (n = 11,994)				Indirectly Returned to Entrepreneurship (n = 15,818)			
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.
Intercept	11.975***	0.485	13.101***	0.172	12.255***	0.224	3.558	2.593	13.366***	0.115	12.012***	1.936
<i>Controls</i>												
Education	0.022***	0.004	0.015***	0.001	-0.006	0.005	-0.004	0.004	-0.001	0.006	0.001	0.006
Married	0.017	0.011	0.028***	0.004	-0.005	0.014	-0.013	0.011	-0.019	0.011	-0.022†	0.012
Unemployment	-0.011*	0.005	-0.020***	0.001	-0.020**	0.007	-0.014*	0.005	-0.004	0.006	-0.001	0.006
Prior wage salary (log)	0.011***	0.002	0.008***	0.001	-0.004	0.003	-0.004	0.002	-0.000	0.003	0.001	0.003
Hybrid	0.031**	0.010	0.022***	0.004	-0.074	0.048	-0.041	0.039	-0.002	0.020	-0.011	0.021
Additional income (log)	-0.002	0.002	-0.004***	0.001	0.046***	0.012	0.021***	0.006	0.014**	0.005	0.015*	0.008
Small children	0.017*	0.007	0.005*	0.002	0.007	0.007	0.009	0.006	-0.004	0.017	0.004	0.017
Age (log)	0.341**	0.089	0.162***	0.019	0.125*	0.051	0.102*	0.047	-0.017	0.104	0.026	0.107
Manufacturing industry	0.077***	0.017	0.027***	0.006	-0.031	0.029	-0.012	0.020	0.009	0.019	0.010	0.012
Professional industry	0.061***	0.012	0.023***	0.006	-0.006	0.014	0.005	0.015	0.000	0.016	-0.002	0.012
Wholesale industry	0.039	0.032	-0.028**	0.010	-0.048†	0.027	-0.022	0.022	-0.025	0.056	-0.005	0.043
<i>Main effects</i>												
Prior entrepreneurial experience in years (log)	0.048***	0.011	0.022***	0.003	-0.007	0.011	-0.002	0.008	0.010	0.021	0.017	0.019
Have multiple ventures	0.013	0.013	0.032***	0.005	0.022	0.022	0.008	0.016	-0.011	0.010	-0.007	0.012
Venture success experience (log) (H1b)			-0.007	0.015			0.677***	0.186			0.101	0.151
Venture managerial experience (log) (H2b)			0.024***	0.004			0.022*	0.009			0.004	0.010
Venture industry experience (log) (H3b)			0.027***	0.005			-0.012	0.016			0.011	0.024
Inverse Mills Ratio (λ)	0.686**	0.252	0.144**	0.048	0.284*	0.137	0.204†	0.113	0.080	0.339	-0.084	0.347
R-square	0.199		0.204		0.245		0.329		0.026		0.028	
Adjusted R-square	0.198		0.203		0.235		0.318		0.024		0.024	

*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$; † $p < 0.1$.

Table 5 Additional Analyses for the Two-Stage Model

First-stage Return Decision Model ^a																		
	Directly returned to entrepreneurship (n = 11,994)						Indirectly returned to entrepreneurship (n = 15,818)						Returned to entrepreneurship (n = 16,888)					
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8		Model 9	
	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.
Prior entrepreneurial experience in years (log)	-0.059*	0.028	-0.052†	0.028	-0.028	0.029	-0.081***	0.018	-0.079***	0.018	-0.062***	0.013	-0.074***	0.017	-0.068***	0.017	-0.048**	0.018
Have multiple ventures	0.146**	0.047	0.148**	0.047	0.112*	0.049	-0.001	0.031	-0.001	0.031	-0.022	0.032	0.036	0.029	0.036	0.029		
Venture successful experience (log) (H1a)	2.051***	0.212					0.543**	0.176					1.159***	0.156				
Venture managerial experience (log) (H2a)			-0.048	0.034					0.006	0.023					-0.006	0.022		
Venture industry experience (log) (H3a)					-0.129**	0.044					-0.084**	0.028					-0.101***	0.027
Log Likelihood Ratio	-2,186.532		-2,268.003		-2,263.086		-9,374.060		-9,381.678		-9,377.152		-10,024.620		-10,066.000		-10,058.800	
Second-stage Earnings (log) Model																		
	Became wage-employed (n = 16,888)						Directly returned to entrepreneurship (n = 11,994)						Indirectly returned to entrepreneurship (n = 15,818)					
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8		Model 9	
	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.	p.a.	s.e.
Prior entrepreneurial experience in years (log)	0.028***	0.003	0.050***	0.012	0.037***	0.010	-0.005	0.010	-0.008	0.011	0.011	0.018	0.012	0.023	0.012	0.021		
Have multiple ventures	0.025***	0.005	0.012	0.014	0.028*	0.012	0.012	0.018	0.024	0.023	-0.010	0.012	-0.010	0.010	-0.010	0.010		
Venture successful experience (log) (H1a)	-0.007	0.014					0.697***	0.192					0.144	0.149				
Venture managerial experience (log) (H2a)			0.030**	0.010					0.003	0.013					0.004	0.008		

Venture industry experience (log) (H3a)					0.058***	0.017						-0.025	0.021					0.002	0.024
Inverse Mills Ratio (λ)	0.091*	0.045	0.799**	0.285			0.222†	0.116	0.298*	0.146	0.301*	0.144	0.038	0.350	0.054	0.332	0.059	0.345	
R-square	0.197		0.205		0.202		0.323		0.249		0.246		0.027		0.026		0.026		
Adjusted R-square	0.195		0.203		0.200		0.314		0.238		0.236		0.024		0.023		0.023		
a. Reference group = become wage-employed *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$; † $p < 0.1$.																			

Table 6 Summary of Findings

	Became Wage-employed (n = 16,888)		Directly Returned to Entrepreneurship (n = 11,994)		Indirectly Returned to Entrepreneurship (n = 15,818)	
	Probability	Financial payoffs	Probability	Financial payoffs	Probability	Financial payoffs
Prior entrepreneurial experience in years (log)	0.056***	0.022***	n.a.	n.a.	-0.056**	n.a.
Have multiple ventures	n.a.	n.a.	0.113*	n.a.	n.a.	n.a.
Venture success experience (log) (H1a, H1b)	-1.167***	n.a.	2.052***	0.677***	1.167***	n.a.
Venture managerial experience (log) (H2a, H2b)	n.a.	0.024***	n.a.	0.022*	n.a.	n.a.
Venture industry experience (log) (H3a, H3b)	0.097***	0.027***	-0.116**	n.a.	-0.097***	n.a.
Inverse Mills Ratio (λ)	Positively select		Positively select		n.a.	

Table 7 Selected Examples of How Prior Entrepreneurial Experience was Measured

Study	Prior Entrepreneurial Experience (in Years or Dummy)	Venture Success Experience	Venture Managerial Experience	Venture Industry Experience	Findings
Amaral <i>et al.</i> , 2011	Self-employment experience dummy; Years of entrepreneurial experience	None	Number of workers in the firm	None	(1) The impact of entrepreneurial-specific human capital on the hazard of re-entering is generally positive; (2) Number of workers in the firm is positively related to re-enter.
Amaral and Baptista, 2007	Self-employment experience dummy; The length of experience as a business owner	Dummy if first firm remains in business when entrepreneur exits	Log of firm size	None	(1) The length of experience as a business owner plays a positive role in indirect return; (2) Individuals who close their first firm are more likely to directly return; (3) Firm size plays a positive role on directly return
Chatterji, 2009	Founder type – spawn or serial founder	None	None	None	Spawns (ventures started by former employees) perform better than other new entrants (e.g. serial entrepreneurs).
Clarysse, Tartari and Salter, 2011	Number of ventures founded	None	None	None	Entrepreneurial experience is one of the most important predictors of academic entrepreneurship
Evans and Leighton, 1989	Self-employment duration in years	None	None	None	(1) Self-employment experience is positively related to the probability of entering self-employment from wage work; (2) Self-employment experience is positively related to entrepreneurial earnings and wage earnings
DeTienne and Cardon, 2012	Years of entrepreneurial experience	None	None	Environmental similarity	Entrepreneurial experience is positively related to IPO, acquisition, but negatively related to independent sale and liquidation. Industry experience is positively related to employee buyout.
Dobrev and Barnett, 2005	Number of ventures founded; founder role dummy; prior family business experience	None	None	None	(1) Number of ventures founded/ founder role are positively related to the likelihood of leaving current organization to build a new organization; (2) family business experience is

					negatively related to the likelihood of leaving current organization to build a new organization
Henley, 2004	Self-employment experience dummy; Years of entrepreneurial experience	None	None	None	Someone self-employed last year is more likely to be self-employed this year than someone who was in wage employment a year ago.
Hmieleski and Baron, 2009	Number of previous ventures founded	Revenue growth and employment growth	Revenue and employment totals for that year	None	(1) Past business experience strengthens the negative relationship between entrepreneurs' optimism and venture performance; (2) Prior growth is positively related to venture performance, while firm size renders no effects
Hsu, 2007	Number of startups founded	Higher prior start-up return (dummy)	None	None	Prior entrepreneurial experience/ successful prior entrepreneurial experience increases both the likelihood of VC founding
Hsu and Ziedonis, 2013	None	Founding team with prior IPO experience	None	None	Patents will be more valuable and important for ventures with low initial reputation endowments (founding teams have no prior IPO experience)
Toft-Kehler, Wennberf and Kim, 2014	Number of ventures founded	Past performance as serial entrepreneurs	None	Industry similarity	The positive experience – performance relationship only appears to expert entrepreneurs while novice entrepreneurs may perform increasingly worse. Industry similarity may alleviate the negative relationship for novice entrepreneurs
Ucbasaran <i>et al.</i> 2010	None	Total number of failed businesses they had owned	None	None	Experience with business failure was associated with entrepreneurs who are less likely to report comparative optimism.
Zhang, 2011	Firm founded by repeat/ experienced/ novice entrepreneurs	None	None	None	When the analysis takes into account later rounds of financing, all entrepreneur with prior founding experience tend to raise more venture capital.

CHAPTER 5 CONCLUSION

In conclusion, my dissertation includes three essays with an attempt to fully understand the role of prior entrepreneurial experience in entrepreneurial entry decision and the financial payoffs. It answers three important questions: (1) Will individuals with greater prior entrepreneurial experience prefer to return to entrepreneurship? (2) Can the financial payoffs to prior entrepreneurial experience be extended to outside entrepreneurial context? (3) Does self-selection explain serial entrepreneurship? In the following, we will discuss how each of the three essays answers these questions and their theoretical implications, and then conclude future directions and limitations.

1. Theoretical implications

Question one: Will individuals with greater prior entrepreneurial experience prefer to return to entrepreneurship?

Our essay one re-visits this important relationship using two different models: logistic regression – a standard statistical model commonly used by management scholars and random forests – a powerful machine learning tool for analyzing big data. Testing from a sample of over 19,000 individuals, our results show that logistic regression and random forests present different findings. In particular, logistic regression shows a U-shaped relationship between prior entrepreneurial experience and the probability of switching into entrepreneurship. However, random forests shows that the probability of switching into entrepreneurship decreases as individuals have more experience in entrepreneurship, but soon flattens out. As such, the relationship between prior entrepreneurial experience and the likelihood of again becoming entrepreneurs is not linear in nature and far more complicated than previous suggested. By answering this important question, we contribute to the literature from several perspectives.

First, prior studies have generally agreed that individuals with greater prior entrepreneurial experience are more likely to again become an entrepreneur (e.g. Amaral and Baptista, 2007; Amaral, Baptista, and Lima, 2011; Evans and Leighton, 1989; Hamilton, 2000; Hessels *et al.*, 2011; Metzger, 2008; Stam, Audretsch, and Meijaard, 2008). One implied premise of these studies is that individuals with greater prior entrepreneurial experience may perform better in their next entrepreneurial spell than those with less experience. However, this premise renders an incomplete view because prior entrepreneurial experience can also develop and reveal individuals' general human capital (Campbell, 2013), which is valuable to wage employers. As Gimeno *et al.* (1997) explained, entrepreneurial entry occurs if the expected payoffs of entrepreneurship exceed the expected payoffs of alternative employment (e.g. wage employment) minus the cost inherent in switching. If the relative financial payoffs to prior entrepreneurial experience are higher in wage employment, it is possible that the nature of the relationship between prior entrepreneurial experience and the likelihood of again becoming entrepreneurs may be more complicated than previously suggested.

We argue and illustrate that one possible explanation for this theoretical and empirical uncertainty is that the standard statistical models commonly used by management scholars are less capable of unveiling the true relationship, especially in the context of big data. On one hand, the immense volume of data means that everything can be significant (Cumming *et al.*, 2017; George, Haas, and Pentland, 2014), the statistical significance relying on *p*-values may not imply economic significance. On the other hand, in the context of big data, more flexible relationships than simple linear relationships (i.e. linear, curvilinear, cubic, *etc.*) are possible (Varian, 2014). Therefore, examining big data requires the use of more powerful computation techniques, such as machine learning tools. However, although many studies have used census data that has

features of big data to examine this relationship between prior entrepreneurial experience and the likelihood of again becoming an entrepreneur (i.e. Evans and Leighton, 1989; Amaral *et al.*, 2011), none of them appropriately handle it.

Through re-visiting this important relationship using logistic regression and random forests and comparing their findings, we unveil the true relationship between prior entrepreneurial experience and the likelihood of again becoming entrepreneurs. By doing so, we also invite more attention from management scholars to these contemporary computation techniques, which might be particularly valuable in re-visiting these fundamental questions in entrepreneurship.

Second, although more attention has been paid to the importance of appropriately handling big data in management research (e.g. George *et al.*, 2014, 2016), few studies so far have empirically illustrated why it is important. Our study used the problem of entrepreneurial entry as an example to illustrate that mishandling big data may lead to misleading conclusions. For example, although the logistic regression reports that the relationship between entrepreneurial experience and the probability of switching into entrepreneurship is U-shaped. Random forests shows that the probability of switching into entrepreneurship declines first and then flattens out. That is to say, the relationship between entrepreneurial experience and the probability of switching into entrepreneurship is not quadratic as suggested by the logistic regression. One possible explanation is that more flexible relationships than simple linear relationships (i.e. linear, curvilinear, cubic, *etc.*) are possible (Varian, 2014) in the context of big data, however, logistic regression that pre-specifies the linear relationship between the dependent and independent variables lack the capability of detecting such relationships. Despite we may use a series of binary variables of entrepreneurial experience to help detect the nonlinear

relationship, categorizing continuous variables is a subjective and tedious process because cutoffs can have profound effects on the findings. More importantly, if a study has multiple continuous variables of interests and each of them have multiple categories, researchers then need to add many extra variables into the model estimation, leading to an exponential increase of numbers of parameters and serious overfitting problems. As such, our conclusions and findings can be used as empirical evidence to illustrate that the importance of appropriately handling big data.

Question two: Can the financial payoffs to prior entrepreneurial experience be extended to outside entrepreneurial context?

Our essay two investigates the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. Testing from the sample of 26,235 individuals who were at risk of making a career choice between serial entrepreneurship or wage employment, we find that greater prior entrepreneurial experience leads to a higher financial payoff in wage employment than in serial entrepreneurship, implying that the financial payoffs to prior entrepreneurial experience can be extended, and much higher, outside the entrepreneurial context. This study then contributes to the literature from several perspectives.

First, our study enhances our understanding of the motivation of entrepreneurship. Hamilton (2000) suggested that the reason why most individuals enter and persist in entrepreneurship despite the fact that they have both lower initial earnings and lower earnings growth than in wage employment is because of the desirable attributes of entrepreneurship, such as “being your own boss”. Yet his study did not compare the relative financial payoffs to prior entrepreneurial experience inside versus outside the entrepreneurial context. Given prior entrepreneurial experience can reveal and generate valuable general human capital, which is

valuable to wage employers, individuals with greater prior entrepreneurial experience may be able to bargain for higher compensations from their current or future employers by threatening mobility (Campbell, 2013). It then follows that individuals may enter entrepreneurship because it provides more career mobility and persistent rewards even after leaving entrepreneurship. Our findings confirm this conjecture. In particular, we find that the financial payoffs to prior entrepreneurial experience are much higher in wage employment than in serial entrepreneurship, implying that the financial payoffs to prior entrepreneurial experience can be extended, and much higher, outside the entrepreneurial context. Therefore, our study renders an alternative explanation for the findings of Hamilton (2000).

Second, our study adds to the research of serial entrepreneurship. In particular, upon exiting from their previous ventures, individuals need to make a career choice between wage employment or serial entrepreneurship. As discussed above, prior studies have generally supported that individuals with greater prior entrepreneurial experience are more likely to become a serial entrepreneur than become wage-employed (Amaral and Baptista, 2007; Amaral *et al.*, 2011; Evans and Leighton, 1989; Hamilton, 2000; Hessels *et al.*, 2011; Metzger, 2008; Stam *et al.*, 2008). One implicit premise of these studies is that individuals with greater prior entrepreneurial experience should perform better in their next entrepreneurial spell as prior entrepreneurial experience can shape how individuals discover, evaluate, and exploit opportunities (Shane and Venkataraman, 2000), and also help them identify the most appropriate actions (Minniti and Bygrave, 2001). However, what has been ignored is the possibility that the financial payoffs to prior entrepreneurial experience can be extended outside the entrepreneurial context. If prior entrepreneurial experience can lead to higher financial payoffs in wage employment than in serial entrepreneurship, these must be some alternative explanations of serial

entrepreneurship awaiting us to explore. Given individuals prefer to again become an entrepreneur than become wage employed when the expected utility of entrepreneurship exceeds the expected utility of wage employment minus the switching cost (Gimeno, *et al.* 1997), these explanations could be: (a) entrepreneurship provides much higher nonfinancial payoffs, and thus its expected utility exceeds the expected utility of wage employment; (b) the switching cost from entrepreneurship to wage employment is very high, and thus the expected utility of wage employment is lower than the expected utility of entrepreneurship. Therefore, an investigation of the relative financial payoffs to prior entrepreneurial experience between wage employment and serial entrepreneurship can help open new insights for understanding serial entrepreneurship.

Question Three: Does self-selection explain serial entrepreneurship?

Our essay three examines whether the matching model (Jovanovic, 1982; Roy, 1951), which suggests individuals self-select themselves into a career in which they have relative advantages, may explain serial entrepreneurship. We particularly propose to prior entrepreneurial experience can be decomposed into three dimensions to reflect its qualitative differences: (1) venture success experience (i.e. the extent to which an individuals' previous venture was financially successful), (2) venture managerial experience (i.e. managerial expertise individuals have developed through leadership experience in their previous entrepreneurial spells) and (3) venture industry experience (i.e. venture industry expertise individuals have developed specific to the target industry in their previous entrepreneurial spells). The former two can help define expert entrepreneurs (Ucbasaran, *et al.* 2010), and the latter can help detect different learning outcomes resulted from context-domain differences (Toft-Kehler, Wennberg, Kim, 2013). We argue that while some experience dimensions are more transferrable to wage employment (i.e. venture industry experience), leading to higher financial payoffs, some are more specific and

useful in entrepreneurship (i.e. venture success experience and venture managerial experience). Individuals with more transferrable experience may prefer to become wage-employed, but those with more specific experience may self-select to return to entrepreneurship.

Testing from the sample of 16,888 entrepreneurs who were at risk of making a career choice between serial entrepreneurship or wage employment partially confirms this conjecture. Our results show that these different experience dimensions influence individuals' subsequent career choices and financial payoffs in different ways. Individuals whose previous ventures were financially successful tend to self-select themselves to serial entrepreneurship while those with greater venture industry experience prefer to become wage-employed because the career choice they choose is with higher financial payoffs. In addition, while venture managerial experience is positively associated with both wage and entrepreneurial earnings, it does not influence individuals' subsequent career choices. This may be because the financial payoffs to venture managerial experience are equally high in wage employment and serial entrepreneurship, and thus individuals are more inclined to consider other factors when determining a career choice. Furthermore, our results also show that the estimated self-selection coefficient is generally positive and significant, indicating that individuals positively self-select into their current career. In other words, had they chose the other career choice, they should have earned less. The above evidence echoes our theoretical conjecture based on the matching model (Jovanovic, 1982; Roy, 1951) – individuals self-select themselves into wage employment or serial entrepreneurship in which they have relative advantages. By doing so, our study contributes to the literature from several perspectives.

First, although prior entrepreneurial experience is one of the most important explanatory variables in entrepreneurship research, many studies measured it by either (a) a dummy variable

to indicate whether an individual is with multiple ventures experience, or (b) an individual's prior entrepreneurial experience in years. Although these measures reflect quantitative differences of individuals' prior entrepreneurial experience, the important qualitative differences have been ignored. Our study shows that venture success experience, venture managerial experience and venture industry experience influence individuals' subsequent earnings and career choices in different ways. By doing so, our study emphasizes the importance of understand the qualitative differences of prior entrepreneurial experience and invites more attention from entrepreneurship scholars regarding its definition.

Second, although Hamilton (2000) empirically disconfirmed that self-selection explains serial entrepreneurship, his study merely measured the quantitative differences of prior entrepreneurial experience. Intuitively, even spending the same amount of time in entrepreneurship, individuals can learn differently. Whether individuals' previous venture was financially successful, whether they have developed venture managerial experience or venture industry expertise may significantly influence their subsequent earnings and career choices. Therefore, in order to fully investigate this conjecture, we need to further examine prior entrepreneurial experience in a greater detail. By decomposing prior entrepreneurial experience into venture success experience, venture managerial experience and venture industry experience, our result show that individuals whose previous ventures were financially successful tend to self-select themselves to serial entrepreneurship while those with greater venture industry experience prefer to become wage-employed because the career choice they choose is with higher financial payoffs. By doing so, our study provides a fine-grained view for the motivation of serial entrepreneurship.

2. Future Directions and Limitations

There are several future directions to extend our work.

First, in addition to deal with the difficulty caused by the aggregation of a large number of observations, we may also need to solve other problems of big data, such as variable selection. In the context of big data, we may have more potential predictors than appropriate for estimation (Varian, 2004), variable selection then plays an important role to reduce overfitting, detect the true theoretical relationship and improve computational efficiency. Although many standard statistical models perform well for moderated sample size, variable selection in big data requires using more powerful computation techniques (Fan, Han, Liu, 2014; Varian, 2004). Mishandling variable selection in big data may lead to misleading conclusions. Given many entrepreneurship studies have used census data that includes numerous potential predictors, one future direction is to introduce these contemporary variable selection approaches to management scholars and illustrate their advantages over standard statistical models in handling variable selection.

Second, management researchers may question that using contemporary approaches, such as machine learning tools, may limit the theoretical contribution of a study. Our study attempts to illustrate that researchers can still present theoretical conjectures for the topic of interests. Perhaps, one future direction is to further extend our study by setting up procedures for using these contemporary approaches and illuminating how to achieve a balance between theoretical, empirical implications.

Third, our study reports that individuals' subsequent career choices and financial payoffs are different among two types of return strategies – directly return and indirectly return. For example, essay three shows that venture success experience leads to higher financial payoffs for individuals who directly returned to entrepreneurship, but does not explain the financial payoffs for those who indirectly returned. One possible explanation is that what individuals learn during

the transition time may influence their subsequent career choices and financial payoffs. Therefore, one future direction is to further investigate these nuanced details.

My dissertation has several limitations.

First, we focus on young men for an empirical purpose, but it may limit our conclusions. For example, senior people may have totally different motivations for entrepreneurship. Comparing with young people, senior people may have accumulated more personal wealth and then have a stronger desire for work independence or freedom. In addition, women may perform more family duties and thus have a stronger need to work-life balance. As such, these people may be less influenced by the financial payoffs.

Second, my dissertation uses the Swedish data, and thus the generalization of the findings may be limited. In particular, Sweden is a developed country with a well-established social welfare system. Thus, people in Sweden may have a higher tolerance of entrepreneurial failures than people in those developing countries. Therefore, the results of my dissertation should be interpreted with caution by considering the geographic context.

To conclude, I hope my dissertation will enrich our understanding of how prior entrepreneurial experience influences entrepreneurial entry and financial payoffs in both entrepreneurship and wage employment.

3. Reference

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