The Small Firm Effect and the Entrepreneurial Spawning of Scientists and Engineers

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We document and examine empirically a small firm effect on entrepreneurial spawning, using data from a broad sample of US scientists and engineers. Scientists and engineers in small firms are far more likely than their large-firm counterparts to enter entrepreneurship. We identify four classes of explanations for this small firm effect—preference sorting, ability sorting, opportunity cost, and the possibility that workers in small firms develop entrepreneurial human capital—and explore these empirically, by examining the determinants of entrepreneurial entry and performance. We find that preference sorting plays a role in generating the small firm effect: small firms attract those with prior preferences for autonomy, who are similarly drawn into entrepreneurship. Similarly, ability sorting plays a role: small firms also attract some of the most talented scientists and engineers from larger firms, and high-ability workers are more likely to enter entrepreneurship, where their monetary rewards are highest. Finally, we interpret evidence that prior experience in small firms predicts positive performance outcomes in the early stages of entrepreneurship as suggesting that employment in a small firm also appears to make these workers better entrepreneurs. This effect may be largest among those of high ability.

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1. Introduction

Entrepreneurship has been lauded by numerous observers as a driving force behind economic growth and technological change. Not surprisingly, therefore, a large body of research has focused on the determinants of entrepreneurship. Much of this research examines how individual characteristics predict entrepreneurial activity and explores the role of factors such as gender, race, education, credit constraints, preferences, and cognitive differences on individual decisions to found entrepreneurial ventures (e.g., Evans and Leighton 1989, Borjas and Bronars 1989, Busenitz & Barney 1997, Blanchflower and Oswald 1998, Hamilton 2000, Hurst and Lusardi 2004). A growing literature has also emphasized the role that the broader economic and social context plays in promoting entrepreneurship. Of particular interest is how the characteristics of an entrepreneur's prior employer affect entrepreneurial activity. In this vein, recent research highlights the role of a prior employer's size in the process of entrepreneurial spawning (Gompers, Lerner, and Sharfstein 2005, Dobrev and Barnett 2005, Sorensen, 2007, Klepper and Thompson 2007, Klepper 2009).

We present new data highlighting the important role that small firms play in spawning entrepreneurship among scientists and engineers in the United States. Table 1 documents the relationship between employer size and self-employment entry using panel data on scientists and engineers covering 1995-2001 from the National Science Foundation's Scientist and Engineers Statistical Data System (SESTAT).[1] Nearly half of all entrepreneurial ventures started by members of this group during the period were founded by individuals employed immediately prior in firms of 100 employees or fewer. Moreover, scientists and engineers working in firms with fewer than 25 employees were six times more likely than those working in firms with 5000 or more employees to move to self-employment within the next two years, and those working in firms with 26 to 100 employees were three times more likely to do so. This paper seeks to examine empirically the causes of this small firm effect, i.e., the surprisingly large role that small firms play in spawning entrepreneurs.

The prior literature on the determinants of entrepreneurship provides two categories of explanations for the small firm effect, which map neatly onto the standard distinction between selection and treatment effects. Selection-based explanations must argue that the small firm effect results from sorting by individual attributes. To effectively address the small firm effect, these explanations must identify the individual attributes of those first drawn into small firms and then out into entrepreneurship. Treatment-based explanations, by contrast, argue that some feature of the small firm environment or context uniquely enhances the relative attractiveness of entrepreneurship. Within both categories, we can distinguish between those explanations that simply predict a relationship between prior employer size and transitions to entrepreneurship and those that also predict a relationship between prior employer size and entrepreneurial performance. We label the latter subset "functional" theories, as they yield predictions about productivity in small firms and startups, and the former subset "non-functional," as they make no such statements. In this paper, we develop and empirically explore competing explanations for the small

[1] To our knowledge, reports of this relationship in the literature for the US are limited to Boden (1996), who examines a sample of all workers from the Current Population Survey, and Gompers, Lerner, and Scharfstein (2005), which restricts the sample to spinoffs from publicly traded companies. Wagner (2004) and Sorenson (2007) examine German and Danish workers, respectively, from a broad set of occupations and industries.

firm effect—explanations that differ along the two dimensions described: sorting vs. environmental context and functional vs. non-functional (see Figure 1). The richness of our data enables us to examine each of these four types of explanations which we label: preference sorting, ability sorting, opportunity cost, and entrepreneurial human capital.

We examine these competing explanations using a new dataset of science and engineering graduates from American universities between 1947 and 2001 (SESTAT) that contains extensive information on individuals' education, job experience, and demographic characteristics. The SESTAT is especially suited for our analysis because it has longitudinal information from 1995-2001 for a large number of individuals. The large sample size provides sufficient observations to analyze infrequent transitions such as moving from a large firm to self-employment. The data we examine are distinct from those used in other studies of entrepreneurship and self-employment. Prior studies have examined three types of data: broad national samples which attempt to represent the entire working population (e.g., Evans and Leighton 1989, Sorensen 2007), focused data sets of venture-backed start-ups (e.g., Gompers et al. 2005), or focused data on spin-offs within a particular industry (e.g., Klepper and Sleeper 2005). Studies of the first type may overstate the importance, from an economic standpoint, of small proprietorships such as barbershops, caterers, and convenience stores founded by those with limited education. Studies of the second type, while highly valuable, draw conclusions based on examination of an elite group whose members may not be responsive to the same considerations as those of the broader population. Studies of the third type provide in-depth analysis of a particular industry that may or may not generalize to other industries (or across industries). The data examined in this paper provide important complementary evidence to these studies and yield new insights. The individuals we analyze have all achieved at least a bachelor's degree in a science and engineering field, and in many cases have received PhD's. Our sample embodies those who are most likely to be the targets of policy-makers concerned with entrepreneurship as a force of economic growth—individuals with high levels of human capital in dynamic, knowledge-intensive fields.

Our analysis suggests that multiple factors are at work in generating the small firm effect. Of particular interest are the analyses that suggest that small firms play an important functional role in generating both numerous entrepreneurs and particularly successful ones. This is a key result, as potential entrepreneurs, managers, and policy-makers alike may make different decisions depending on whether they view the dynamics of entry into entrepreneurship as driven primarily by factors that relate directly to productivity or merely by preferences quite unrelated to performance. We find that employees working in small firms engage in a broader range of commercial activities than their large firm counterparts and, consistent with the jack-of-all-trades theory of entrepreneurship (Lazear 2004, 2005), the broader the scope of work in his or her prior job, the more likely a given worker is to become an entrepreneur. Moreover, we find that new entrepreneurs coming from small firms supervise more workers in their entrepreneurial start-ups and earn more in early stages of entrepreneurship than their large firm counterparts, controlling for ability (as measured by their previous wage) and prior activities on the job. We speculate that this may come from better opportunity recognition (Shane 2003), greater access to networks and resources that are valuable in entrepreneurship (Gompers, Lerner, Scharfstein 2005, Stuart and Ding 2006), or better self-assessment of entrepreneurial talent.

The result that entrepreneurs from small firms perform better than those coming from large firms stands in contrast to the existing literature on the performance of spin-offs, which has shown that within-industry spin-offs from more successful, larger, firms exhibit longer survival and better performance than spin-offs from less successful firms in the industry (Klepper and Thompson 2007, Klepper, 2009). Several theoretical mechanisms for this pattern have been posited including heritability of superior routines coming from more successful firms, and better product ideas coming out of large firms (e.g., Hellman 2007). While our performance results are robust to including controls for industry choice, we cannot rule out the possibility that employees from large firms may build new ventures that are more successful in the long run.[2] Although we provide findings that contrast with this prior work on spinoffs,

[2] Similarly, we cannot rule out the possibility that the very best entrepreneurs in an industry are those coming from large firms.

we note that our findings and explanations are not logically inconsistent with the theoretical explanations and evidence from this literature. It is possible, even likely, that *both* large, successful firms and small firms offer benefits to prospective entrepreneurs, albeit of different types.

The plan of the paper is as follows. Section 2 examines the theoretical explanations for the small firm effect. Section 3 describes the data. Section 4 analyzes the transitions of scientists and entrepreneurs from the paid, private-sector workforce into entrepreneurship and examines the performance of new entrepreneurs coming from firms of different sizes. Section 5 concludes.

2. Theory

Scholars have long debated the comparative importance of nature vs. nurture in explanations of entrepreneurship. The basic debate is whether eventual entrepreneurs are simply endowed with preferences or innate abilities that prompt them to select entrepreneurship, or whether eventual entrepreneurs experience environmental conditions that prompt or enable entrepreneurship. Explanations for the small firm effect may reflect arguments from either category. Thus, small firms may simply play a sorting role and differentially attract those with innate attributes that cause them to prefer entrepreneurship, or the small firm context may shape or influence employees in such a way that they more frequently prefer entrepreneurship.

In attempting to differentiate among explanations for the "small firm effect," a key question is whether those entrepreneurs that emerge from small firms enjoy a performance advantage as entrepreneurs. In other words, does prior employment in a small firm play some functional role related to subsequent performance as entrepreneurs, or is prior employment in a small firm unrelated to performance? Explanations relating to both innate and environmental attributes predict relationships that fall in both performance categories. For instance, the "small firm effect" may be due solely to the allure of autonomy in entrepreneurship or to comparatively low pay in small firms, in which case the entrepreneurs who emerge from small firms should not differ in performance from those who emerge from large firms. Alternatively, high ability scientists and engineers may be lured into small firms, or the

environment of small firms may provide valuable skill, knowledge, and connections which enhance the performance of new ventures spawned from small firms.[3] Below we discuss each category of theoretical explanation, beginning first with those theories unrelated to subsequent performance and then shifting to those directly related to entrepreneurial performance.

2.1. Opportunity Cost

One explanation for the small firm effect is that small firms simply pay lower wages (Brown and Medoff 1989, Troske 1999) and thus small firm workers face lower opportunity costs in leaving their present employment. Consequently, entrepreneurs may disproportionately transition from small firms simply because low pay reduces the opportunity cost of choosing entrepreneurship. Moreover, employees in small firms may confront poorly developed internal labor markets, leaving them with limited opportunities for internal promotion or increased pay (Sorensen 2007). A related phenomenon that may explain higher rates of entrepreneurial transitions is the greater frequency with which workers separate from smaller firms. The negative relationship between firm size and labor turnover is well documented (Brown, Hamilton, and Medoff 1990, Davis, Haltiwanger, and Schuh. 1996). The wage differentials described above offer one explanation for increased rates of turnover at smaller firms as do differences in the provision of benefits such as pensions (Even and MacPherson 1996). An additional cause of increased employee separation from smaller firms is the high failure rate of small firms. Evans (1987) provides strong evidence that the failure rate of manufacturing firms is inversely related to firm size. If, conditional on leaving the prior employer, a worker had a constant likelihood of ending up in self-employment, then higher labor turnover at small firms could explain the small firm effect. If high turnover is the cause, however, then the relationship between firm size and entry into entrepreneurship should be identical to the relationship between firm size and turnover more generally. Moreover, if the lower opportunity cost of departing small firms explains the small firm effect, we will not observe those

[3] Another possibility is that employees in small firms receive more accurate signals about their entrepreneurial ability. This, too, might lead the resulting entrepreneurial ventures to be more successful on average.

entering entrepreneurship from small firms experiencing higher subsequent performance in entrepreneurship.

2.2. Preference Sorting

A second category of explanations for the small firm effect is preference sorting. Small firms may attract individuals who, as a consequence of their individual preferences, receive greater non-pecuniary benefits from entrepreneurship than others. By offering greater levels of autonomy, small firms may attract those who find the bureaucracy of large firms unappealing; these individuals may also place greater value on the independence that entrepreneurship provides (Hamilton 2000, Halaby 2003, Astebro and Thompson 2007, Benz and Frey 2008).[4] Alternatively, Parker (2006) develops a model in which workers who are less averse to risk may find themselves working in small firms, and these same preferences may lead the worker to become an entrepreneur when an appropriate opportunity arises. These theories suggest individuals' preferences for risk or autonomy explain the disproportionate rate at which workers from small firms become entrepreneurs. However, if only preferences are at work, we should find no empirical relationship between prior small firm employment and subsequent entrepreneurial performance.

2.3. Ability Sorting

Sorting may also occur on a dimension that is directly related to entrepreneurial productivity. In particular, sorting may reflect ability, where ability influences both the decision to enter self-employment and subsequent performance. In exploring the role of ability and prior employment on entrepreneurship decisions, we build on the matching logic of Roy (1951) and Jovanovic (1979), where individuals with differing levels of sector-specific abilities choose the employment or entrepreneurship state that yields the

[4] Sorensen's (2007) analysis seeks to demonstrate that the small firm effect is independent of precisely this type of sorting. Astebro and Thompson (2007) argue that entrepreneurs (and by extension individuals joining small firms) have tastes for variety and receive non-pecuniary benefits from being a "jack of all trades." Benz and Frey (2008) argue that individuals value autonomy and self-determination in the processes that lead to outcomes. Small firms and self-employment offer higher levels of "procedural utility."

highest level of utility.[5] Because of higher measurement costs (Garen 1985; Holmstrom, 1989) or higher costs involved in addressing the perceived inequity that often accompanies performance-based pay (Zenger 1994, Nickerson and Zenger 2008), large bureaucratic firms are less able to directly link pay to performance. Small firms, by more effectively rewarding individual performance, attract the more able employees from large firms (Zenger 1994). Thus, the most talented workers at large firms may choose to migrate to small firms or eventually self-employment where they can more fully capture the returns to their ability.[6]

How might such arguments contribute to explaining the small firm effect? If small firms are disproportionately stocked with stars, then the greater propensity for entrepreneurship among employees of small firms may reflect the abundance of high ability employees in small firms searching for higher compensation.[7] If, by contrast, small firms are disproportionately stocked with low ability individuals, then the small firm effect may simply reflect a lower opportunity cost that encourages individuals to gamble by choosing the higher variance rewards of entrepreneurship. While the latter argument might help explain a greater propensity for self employment among employees of small firms, only the former argument implies that prior employment in small firms should be associated with better entrepreneurial performance.

2.4 Developing Entrepreneurial Human Capital

Employees of small firms may have increased access to skill development opportunities, knowledge, and outside networks and resources critical to entrepreneurial success, as well as broader

[5] Braguinsky and Ohyama (2007) develop a model of job-matching in which workers learn about their ability over time. An attractive feature of their model is that it predicts that entrepreneurs coming from the upper part of the paid wage distribution will differ in the types of firms they found.

[6] A related literature, typified by the work of Zucker, Darby, and Brewer (1998) explores the role of superstar scientists in the genesis of high tech spinoffs. Hellmann (2007) explores the role that firms' innovation policies, namely whether to commit *ex ante* (not) to commercializing innovations not directly related to the firm's core business, play in the decisions by innovative employees to start their own firms.

[7] Hamilton (2000), for example, shows that earnings of the self employed at the 90th percentile and above exceed the earnings of paid employees in the same percentiles.

exposure to more heterogeneous information and contacts outside the firm (Dobrev and Barnett, 2005). The increased diversity of information and broader network access may promote greater capacity for recognizing entrepreneurial opportunities. If the discovery of entrepreneurial opportunities involves combining broad and diverse knowledge, then the broad exposure to various functions, tasks, and external buyers and suppliers provided in small firms may promote individuals' capability in entrepreneurship. Consistent with this logic, Lazear (2005) argues that entrepreneurship demands a diverse set of skills including both application knowledge and a wide range of management skills. Entrepreneurs not only require an entrepreneurial idea, but they require a more balanced, jack-of-all-trades set of skills. Arguably, working in a small firm enables the employee to acquire a range of skills that will be valuable in subsequent entrepreneurial ventures. Sorensen (2007) uses these arguments among others to explain his findings of a small firm entry effect. Similarly, Gompers, Lerner, Scharfstein (2005) suggest that those employed in small entrepreneurial firms gain access to valuable networks critical to entrepreneurship. Finally, Stuart and Ding (2006) find that movement into entrepreneurship is more likely when colleagues and co-authors have prior experience in entrepreneurship. Thus, small firms may provide important context in which workers acquire human capital that will increase their chance of success in entrepreneurship, and thus promote a higher probability of entrepreneurial spawning.

In addition to predicting an increased propensity to enter self-employment from a small firm, these theories imply that entrepreneurs coming from small firms should be more successful than those from large firms, controlling for individual ability as measured, for example, by the paid employment wage. This "treatment effect" reflects the greater accumulation of entrepreneurial human capital that occurs when working for a small firm.

3. Data

We construct a sample of individuals with science and engineering degrees using data from the Scientists and Engineers Statistical Data System (SESTAT). This data file is comprised of responses to three separate surveys—the National Survey of Recent College Graduates (NSRCG), the National Survey

of College Graduates (NSCG), and the Survey of Doctoral Recipients (SDR). All survey responses in the SESTAT are restricted to respondents who earned a science or engineering degree (S&E). The sampling methodologies vary widely across each of these three surveys.[8] For example, the sample population for the 1993 NSCG was chosen by the Bureau of the Census to be representative of all college graduates in all fields as of 1990; SESTAT reports a sub-sample of these respondents who received S&E degrees or were employed in an S&E field. The NSRCG sampled S&E degree recipients from the prior two-year window, and the SDR defined as its sample population all people who had received an S&E doctorate from a U.S. institution by the year preceding the survey. For each of these survey programs, individuals responded to multiple survey episodes, allowing us to track their behavior across time. We combine data from all three surveys in 1995, 1997, and 1999 and augment it with data from the SDR in 2001.[9] We make the following additional restrictions to eliminate sources of undesirable heterogeneity:

- To avoid problems of retirement, full-time education, and other choices about whether to enter or remain in the labor force, we eliminate all of those who are not in the labor force in each year between 1995 and 2001 and further eliminate all of those under age 22 or above age 65 in any year between 1995 and 2001. Together these eliminations reduce the sample by roughly 10%.
- Since we use measures derived from annual salary in our analysis below, we wish to avoid confounding total pay with choices about working part-time vs. full time. Therefore, we eliminate from the sample all those who report working fewer than 30 hours per week and all those who report working fewer than 30 weeks per year (approximately 6% of survey responses).
- Because we want to focus exclusively on scientists and engineers, we eliminate all those whose highest degree was not in a science and engineering field and further, we drop from our analysis

[8] For details, see http://sestat.nsf.gov/.

[9] Although data for 2003 and 2006 are available for the SDR, we do not include these data in the present analysis.

any individual who also holds a professional degree (such as an M.D., J.D., DVM., etc.).[10] This group comprises approximately 8.5% of survey responses.

- To avoid confounds due to currency differences, all respondents working outside the United States are excluded from the sample. This group represents less than .01% of survey responses.

In this paper, we are interested in transitions from paid employment, i.e., working for a private for profit firm in which the individual is not an owner, to self-employment, i.e., a working arrangement in which the individual is both the "boss" and residual claimant of returns to the enterprise. While in the surveys that generated SESTAT these categories were mutually exclusive and appear well defined,[11] we were concerned that individuals might misreport their employment status. In particular, owners or partners in small firms may disproportionately mis-report themselves as working in a for-profit enterprise in one period and as being self-employed the next. If this were the case, we would likely over-report the magnitude of the small firm effect and potentially find performance differences between former employees of small and large firms that stemmed from the difference in average ages of the startups. To address this concern, we corroborated reports of transitions between paid employment and self-employment with questions that indicate either that (a) the individual reported working with a new employer or (b) that the individual's reported tenure on the job indicates that he or she is working in a new enterprise. All other potential entrepreneurial transitions are excluded from the analysis. A possible consequence of this decision is that we eliminate from our empirical analysis those employees who begin entrepreneurial ventures while "on the job," a phenomenon recognized to be of some empirical importance (Haber, Lamas, and Lichtenstein 1987), as well as those who become sub-contractors for their prior employers, and those who become owners in their prior firm. Overall, restricting our attention only to those entrepreneurial transitions that are corroborated with other survey data reduces the magnitude of

[10] Masters in Business Administration (MBA) degrees are not considered by the survey to be professional degrees, so PhDs who hold MBAs are included in the sample.

[11] In fact individuals were asked whether their principal employment relationship was with a for-profit firm, or whether they worked in an incorporated self-employed business or non-incorporated self-employed business.

the small firm effect somewhat. However, virtually all of the tests of theory that we report below have the same signs and similar significance levels when we utilize a more liberal definition of entrepreneurial transition.[12]

We use all survey responses meeting the criteria described above to generate Table 1. As discussed in the Introduction, Table 1 illustrates the likelihood that an individual working for an employer of a given type in year *t-2* has either changed jobs, labeled "turnover" in the table, or has become self-employed by year *t*. The turnover category includes transitions to self-employment, and may include some instances of individuals who have become owners in the firms for which they now work.[13]

Table 2 compares the means (and, for salary, the median) of several of the key explanatory variables across different employer types. In this table, we include all self-employed, not just those who transition into self-employment while under observation. The average entrepreneur is significantly older than the average employee in our sample, is more likely to be white, and have a PhD, but is less likely to be an engineer. Entrepreneurs engage in more commercial activities and are less likely to be engaged in R&D activities. As we are interested primarily in the transition from paid employment to self employment as it relates to firm size, we focus on the differences in individual responses across firm size categories. A handful of notable differences emerge. First, average job tenure is longer in large firms than in small firms. Second, large firm workers are more likely to be engineers, perform a modestly

[12] Results available from the authors upon request.

[13] Table A1 provides summary statistics of individual demographics, such as age, race, and marital status; individual-job characteristics, such as job tenure, reports for hours and weeks worked, salary, and a set of characteristics about the individual's activities on the job; educational attainment and the field of the individual's highest degree; employer characteristics, such as the size[13] or age of the employing firm if the individual is in paid employment, and indicator variables about whether the individual is self-employed; a set of characteristics about the individual's activities on the job; the main industry of the individual in self-employment or the main industry of the employer firm; and location. Salary data is generally top-coded at $150,000 for the NRCG and NSRCG surveys, but not for the SDR survey. We top-code the data from the SDR survey at $150,000 and use only the top-coded salary in the analysis. Data about firm age and industry were collected beginning in 1997, and consequently the number of individual observations with these data is substantially smaller. We report fourteen "activities on the job," which are responses to a series of survey questions asking whether the individual spent more than 10% of a typical work-week on the activity in question. We construct a count of commercial activities (i.e., those that relate to business and management) and R&D activities based on these responses. The precise construction of these variables is detailed in Table A1.

broader set of R&D activities, and are more likely to be primarily engaged in R&D than small firm workers. Third, small firm workers seem to be engaged in a significantly broader set of commercial activities than those who work in large firms. Overall, small firm employees and entrepreneurs appear to engage in similar activities, in contrast to workers at large firms.

In the 1997 survey, individuals were asked the question, "If you could have any type of working arrangement you wanted, would your first choice be?" We construct a dummy variable equal to 1 if the individual responded, "being self-employed" and equal to 0 if the individual responded "a permanent (part-time or full time) job" or "some other working relationship." Table 2 shows that small firm employees are much more likely to report that they wish to be self-employed in the future, suggesting the potential role of preference sorting for the small firm effect.

The bottom row of Table 2 highlights the potential role of pay in explaining the relationship between firm size and entrepreneurship observed in Table 1. The median worker in firms with 1-25 employees earns $17,000 less than the median employee in firms with 5000+ employees, suggesting substantial differences in the opportunity cost of self-employment. However, these median differences hide substantial differences in the distributions of pay. Figure 2a plots the pay distributions of small and large firm employees, as well as entrepreneurs. To simplify the figures, we define small firms as firms with 100 or fewer employees and larger firms as firms with 100 or more employees. The figure illustrates that the distributions of pay differ significantly in large firms, small firms, and self-employment in ways that are consistent with the prior literature on the relationship between pay and firm size (Garen, 1985; Rasmusen and Zenger, 1990). Figure 2b compares the wages at time t of large firm employees who move to a small firm by time $t+2$ and those who remain at the large firms. The figure helps explain the differences in the pay dispersion at large and small firms observed in Figure 2a: Small firms disproportionately attract workers from the extremes of the ability distribution from large firms. Lower ability scientists and engineers may be screened out of large firms. On the other hand, higher ability employees may choose to join small firms to capture a greater share of returns to their ability. Moreover, if these star employees also tend to be high potential entrepreneurs, the sorting of these individuals into

small firms may partly explain the relationship between firm size and entrepreneurial entry found in Table 1. Our empirical focus in this paper is not on explaining transitions into small firms. However, in unreported regressions, we do confirm a pattern of small firms disproportionately attracting those of higher ability (as measured by prior pay) from large firms.

Figures 2c and 2d compare the paid employment wages at time *t* of employees who become self-employed by time *t+2* and those who remain in paid employment for small and large firms, respectively. Consistent with the theory that suggests that stars (and slugs) are more likely to leave paid employment to become self employed, we see greater density at high (and low) pay levels in paid employment of the future self-employed relative to those who remain in paid employment. Surprisingly, both small and large firms appear to be losing their best (and worst) employees to entrepreneurship.

4. Analysis

In the sample we construct above, nearly one third of all movement into self-employment comes from firms of fewer than 25 employees and just less than one half comes from firms with fewer than 100 employees. Given that such a disproportionate share of all movement into self-employment comes from small firms, a critical empirical question is explaining this simple fact. We examine each of the four categories of potential explanations outlined in Figure 1 by investigating: (1) factors that predict the likelihood that a worker in a for-profit firm in a given period will move into self employment in the subsequent period; and (2) factors that predict initial performance of those who make the transition into entrepreneurship.

4.1. Probit Models of Transitions into Self Employment

We begin by examining factors correlated with individuals' transitions from paid employment to self-employment. In particular, we examine whether the strong relationship we observe between firm size at time *t* and the likelihood of being self-employed at time *t+2* can be explained by: (a) heterogeneity across individuals on observables such as education, race, and location, that could be correlated with firm

size; (b) opportunity cost differences in leaving self-employment for paid employment, which could be relevant if small firms pay less than large firms; (c) differences in paid-employment ability as reflected in pay, which may explain the firm size effect if large and small firms are populated by workers of different abilities; (d) differences in activities on the job across small and large firms; (e) differences in preferences for autonomy or self-employment, which may be stronger among workers in smaller firms; or (f) differences in the frequency with which employees of small and large firms change jobs. To explore these issues, we estimate the following model:

$$PR(SE_{i,t+2} = 1 \mid SE_{it} = 0) = \alpha + \beta \mathbf{X}_i + \gamma \mathbf{Z}_{it} + \mu_{d(i)t} + \varepsilon_{it+2} \qquad (1)$$

In equation (1), SE_{it} equals 1 if individual i is self employed in year t and 0 otherwise. The vector $\mathbf{X}_i$ is a set of time-invariant individual characteristics (e.g., race, gender, and the type and field of highest degree), and $\mathbf{Z}_{it}$ is a vector of potentially time-varying individual characteristics (marital status, number of children in the household, and location), as well as all characteristics of the individual's employer and employment conditions. Employer characteristics within $\mathbf{Z}_{it}$ include firm size and location (generally region). Employment characteristics potentially included in $\mathbf{Z}_{it}$ are the worker's job tenure and pay at the employer at time t, and job activity variables which consist of measures of the diversity of activities pursued on the job, and fourteen dummy variables reflecting the activities on which the individual reported spending 10% or more of his or her time in a given week. Differences in the average rate of transitioning into self-employment over time are captured by $\mu_{d(i),t}$, which we allow to vary by the type of highest degree held by the individual ($d(i)$), and ε_{it} represents the idiosyncratic error. We estimate equation (1) only for those who are paid employees at time t; i.e., self-employed individuals are excluded from the estimation. The estimated coefficients can be interpreted as the likelihood of transitioning into self employment at $t+2$ as functions of $\mathbf{X}_i$ and $\mathbf{Z}_{it}$, rather than the likelihood of being self employed given $\mathbf{X}_i$ and $\mathbf{Z}_{it}$.

Table 3 reports probit estimates of equation (1). To facilitate interpretation, we report the marginal effects associated with the estimated coefficients. Column (1) serves as a baseline for

considering the importance of employer size at time *t* in explaining self-employment at *t+2*, controlling only for year effects. The results reflect the patterns evident in Table 1. Employees of smaller firms transition into self-employment much more frequently than those working in larger firms. The likelihood of transition declines monotonically with our firm size categories. The differences in transition rates across firms are economically significant, with individuals in firms of size 1 – 25 employees transitioning into self-employment at a rate that is more than three times the average rate in the sample. Individual and joint tests of equality across the firm size coefficients reject at the $p < .001$ level.

Column (2) adds a number of individual characteristics, location, and the individual's tenure in the current job. In the table, we focus on the variables of theoretical interest and suppress coefficients for race, gender, marital status, spouse's employment status, number of children, year-degree dummies, and location dummies. This wide range of individual observables reduces the estimated marginal effects of the firm size dummy variables by 18 to 22 percent, but they remain economically and statistically significant and continue to decrease monotonically with firm size. Column (2) also shows that older workers are more likely to make the transition to self employment, while longer tenured employees are less likely to move into self employment. While statistically significant, these coefficients are small in impact when compared to the firm size effect.

We next explore opportunity cost explanations for the differences in transitions into entrepreneurship. The summary statistics in Table 2 (and Figure 2a) show that small firm employees receive, on average, lower wages than those in larger firms. The discussion in Section 2.1 argued that because small firms pay less, they may spawn more entrepreneurs due to the lower opportunity cost of self-employment entry for these employees. If the small firm effect reflects differential opportunity costs, then including the (log of) weekly paid employment wages in equation (1) should both enter with a significantly negative coefficient and reduce the impact of the firm size variables.[14] Comparison of the firm size coefficients in column (3) with those in column (2) indicate that differences in pay by firm size

[14] To avoid estimating a supply response to wage rates, we employ the respondent's (log of) weekly wage (reported annual salary divided by reported weeks worked) as the measure of pay.

cannot explain the small firm effect. Moreover, the coefficient on log(weekly wage$_{it}$) is positive rather than negative, although it is not significantly different from zero. These findings are inconsistent with the view that the small firm effect is generated solely by simple differences in average pay, and hence a lower opportunity cost of self-employment, for workers in small firms.[15]

Column (4) of Table 3 provides a test of ability sorting explanations by further examining the relationship between compensation in paid employment and the transition to self employment. In Section 2 we hypothesized that—for different reasons—the highest and lowest ability workers would be the most likely to transition into self-employment. We test these hypotheses using a crude measure of relative ability—the position of a given worker within the pay distribution[16] in a given year among individuals with the same highest degree. Thus, we construct a percentile rank in the pay distribution separately for BAs, MAs, and PhDs in each year and include dummy variables reflecting membership in one of the top two and bottom two deciles in this wage distribution in the transition model. The omitted category is membership in the middle 60 percent of the wage distribution. Employees in the highest decile are 30 percent more likely to enter entrepreneurship than those in the middle of the wage distribution. Similarly, workers in the bottom two deciles are 22 and 24 percent more likely to enter self-employment in the subsequent period, although these differences are only marginally statistically significant ($p < .1$).

The relatively high rate of entrepreneurial entry among workers in the lowest quintile of the wage distribution is consistent with the view that lower ability workers are either forced into self-employment because of low productivity or have the lowest opportunity cost of becoming self-employed. However, this argument cannot explain why employees at the top of the pay distribution also are more likely to

[15] We also estimated the model in column (3) including the expected weekly wage in $t+2$, rather than the actual wage in period t, and an estimate of expected self-employment earnings in $t+2$ using the approach of Willis and Rosen (1979). We find that larger expected pay differentials between self-employment and paid employment are associated with a higher rate of self-employment entry, but the effect is not statistically significant at the 10% level. Moreover, the coefficient estimates for the firm size indicators are virtually identical to those presented in column (3). Results available from the authors upon request.

[16] Thus, those whose highest degree is a BA are compared with other BAs, MAs are compared with other MAs, and PhDs are compared to PhDs.

become entrepreneurs. These higher ability individuals may be drawn into entrepreneurship by the relatively higher returns to ability which entrepreneurship provides.

Although position in the top or bottom end of the wage distribution does have an economically meaningful impact on the likelihood of transitioning into entrepreneurship, Figures 2c and 2d showed that the relationship appeared similar among those employed in large and small firms. Not surprisingly therefore, the inclusion of these variables provides only modest explanation for the small firm effect. Including wage decile dummies reduces the magnitude of the firm size coefficients by less than 3 percent.

We next examine the degree to which the small firm effect can be explained by the "jack of all trades" hypothesis, i.e., that small firms provide a greater opportunity to accumulate the broad array of skills that are valuable in self-employment. Table 2 indicates that in this sample, workers in small firms are engaged in a wider array of commercial (business-related) activities, but are engaged in a narrower array of R&D activities than their counterparts in larger firms. We introduce measures of the breadth of activities of the individual in the firm: a count of the number of commercial activities that the individual reported engaging in and a count of the number of research activities. Column (5) shows that the coefficient on the count of commercial activities is positive and significantly different from zero, consistent with the idea that those with a broader range of skills are more likely to become entrepreneurs. The coefficient on the count of R&D activities is negative, but not significant at conventional levels. Column (6) allows the count of commercial and R&D activities to vary non-monotonically; the estimates in these regressions show that those who engage in the broadest range of commercial activities (i.e., four or more) are most likely to transition into self-employment in the subsequent period, while those whose jobs involve any R&D activity are less likely to move into self-employment, suggesting that R&D workers require the complementary resources provided by firms in order to be productive. Column (7) includes dummy variables for each of the 14 activities reported. Incorporating these significantly improves the fit of the model and reduces the magnitude of the small firm coefficients by an additional 10 to 12 percent. In sum, this analysis has two main implications: First, similar to the theory of Lazear (2005), we find that performing a broader range of commercial activities in one's current job increases the

likelihood of subsequently becoming an entrepreneur, although the same cannot be said for R&D activities. Second, a portion of the small firm effect can be explained by the fact that small firm employees perform a broader set of commercial activities than employees in large firms and the fact that they perform somewhat different activities than their large firm counterparts.

The estimates in column (8) address the issue of preference sorting as an explanation for the small firm effect. We include a dummy variable indicating the worker chose self-employment as their most desired type of working arrangement in the model. Since this question was only asked in 1997, we limit the analysis to respondents who answered the survey in that year. Not surprisingly, this variable is highly significant, both economically and statistically, in explaining subsequent transitions into self-employment. Workers claiming that their preferred working arrangement was self-employment were more than twice as likely as others to transition into self-employment. While this provides strong support for preference sorting, it cannot fully explain the small firm effect: Incorporating this variable into the transition regressions reduced coefficients on the firm size dummies by 22 to 35 percent. However, the coefficient on the smallest firm category remains larger (economically and statistically) than the coefficient on preferred working relationship, suggesting that *ceteris paribus* working in a small firm (rather than a very large one) makes an individual more likely to become self-employed in the subsequent period than the individual's stated preference to be self-employed. Of course, the question remains within this dataset as to whether individuals go to work in small firms because they have preferences for self-employment or whether they develop preferences for self-employment as a result of working in small firms. Moreover, while we have tried to control for ability, stated preferences for self-employment may also reflect employees' assessment of their ability and the returns that self-employment provides.

4.2. Multinomial Logit Models of Transitions into Self Employment

The probit models of entry into self-employment above allow us to examine the importance of preferences for self-employment, breadth of activities on the job, relative ability, and opportunity cost as reflected by current pay, in explaining the small firm effect. To investigate if the observed relationship

between firm size and entry into self-employment is a function of the increased rate at which employees from smaller businesses change employers, we employ an estimation strategy that allows individuals to choose among multiple options. If all employees who separate from a given employer are equally likely to become self-employed, the higher rates of transition we observe when we estimate equation (1) may result from the fact that employees at small firms are simply more likely to leave their jobs than those leaving larger firms. To examine this possibility we estimate a multinomial logit model for those who are not self-employed at time *t* with the following choices between period *t* and *t+2*: (1) remain with current employer in both periods, (2) change jobs, but do not become self-employed, and (3) become self employed in *t+2*. If employees changing jobs have a constant rate of entering self-employment, then we expect the ratio of the estimated coefficients on firm size for choice (2) and (3) to be approximately equal.

Table 4 presents the estimates for three variants of this model. The omitted decision in these estimations is choice 1, remaining with the current employer. Comparison of the firm size coefficients in columns (1a) and (1b) shows that the relationship between firm size and changing jobs is quite different than the relationship between firm size and subsequent entry into self-employment. The likelihood that an individual in this sample will change jobs (without becoming self-employed) does not decrease monotonically with firm size. In fact, it remains at similar levels for all categories of firm size with fewer than 5000 employees. By contrast, the estimated coefficients on firm size decrease monotonically (and quite dramatically) in predicting transitions into self-employment, displaying a pattern that is very consistent with the results presented in Table 3 above. Additionally noteworthy is the relationship between pay in period *t* and the likelihood of changing jobs vs. entering into self-employment. In this estimation, pay is inversely (and strongly) correlated with the likelihood of changing jobs, whereas the estimates suggest that it is unrelated to the likelihood of moving into self-employment. In Model B, we further explore ability sorting explanations, incorporating dummy variables for membership in the top and bottom two pay deciles, respectively. This model reveals that while only those in the bottom of the pay distribution are more likely to change jobs, those in both the top and bottom of the pay distribution are more likely to enter into self-employment, providing further support for the ability sorting explanation. In

Model C, we incorporate individuals' preferred employment arrangement. As above, the small firm effect remains robust to incorporating this additional variable. Those who state preferences for self-employment are generally more likely to change jobs, however they are particularly likely to choose self-employment. Thus, the relationship between preferring self-employment and entering into self-employment in the subsequent period is an order of magnitude larger than the relationship between preferring self-employment and changing jobs but staying in paid employment.

As a robustness check, we examine the possibility that the small firm effect may result from industry characteristics and / or sample selection. For example, if in our sample information technology workers industry are more likely to work in small firms—and the rate of entrepreneurial entry by workers in information technology firms is higher—then our observed small firm effect would, in reality, be an industry effect. Additionally, as we are interested in the degree to which employees in small firms differentially acquire entrepreneurial skill, we explore whether firm size is related to the industry in which an entrepreneur starts his / her new business. Similar to Braguinsky, Klepper, and Ohyama (2009), we contend that entrepreneurial transitions made within the same industry reflect an individual's use of different types of human capital than entrepreneurial transitions across industries. Specifically, transitions made within an industry are more likely to be the result of better opportunity recognition or access to networks or resources acquired in the prior job than transitions made into a new industry, which may only utilize general management skill acquired in the prior job. Thus, we expand the choice set examined in Table 4 to include (1) remaining in the same job at $t+2$ as in t, (2) changing employers, but remaining in paid employment in the same industry as in t, (3) changing employers, remaining in paid employment, but moving to a different industry than in t, (4) becoming self-employed in the same industry as in t, and (5) becoming self-employed in a different industry than in t. Choice (1) is the omitted choice. As we incorporate industry dummies in this regression, we are restricted to examining 1997 through 2001, since industry questions were not asked on the 1995 survey.

Table 5 presents the results of this estimation. The small firm effect remains robust after incorporating industry controls and within industry and cross industry choices. Indeed, the small firm

effect appears most strong in explaining within industry transitions to self-employment. Working in smaller firms has the largest impact on an individual's likelihood of moving into self-employment within the same industry. The results on ability, as measured by prior pay, also suggest intriguing conclusions. Thus, those of high ability, as reflected in prior pay, are significantly more likely to start a new venture within the same industry, but significantly less likely to start a business in a different industry. By contrast, low ability workers are more likely to enter different industries, either in paid or self-employment, or to enter self employment in the same industry. As in Table 4, the rate of job changes cannot explain the small firm effect in this sample. Overall, this analysis suggests that the small firm effect is not merely an industry effect. Moreover, the fact that firm size relates most strongly to within-industry transitions (and that these transitions tend to be favored among high ability workers), suggest some support for the contextual explanations for the small firm effect. We investigate these more fully below.

4.3. Performance in Early Stages of Self-Employment

Two categories of explanation for the small firm effect suggest a positive relationship between prior employment in a small firm and the performance of the newly-founded venture. In this section, we investigate whether those with experience working in smaller firms perform better in self-employment. If the entry effect described above reflects the greater opportunity that small firms provide to accumulate human capital that is valuable in entrepreneurship, or that small firms attract higher quality "latent" entrepreneurs, then small firms should spawn better performing entrepreneurs. If, on the other hand, small firms simply attract individuals with preferences for independence who then become entrepreneurs, we should not observe a positive relationship between prior employment in small firms and performance. To explore theories espousing a functional role for small firms, we estimate entrepreneurial performance relationships of the form:

$$PERF_{it} = \alpha + \beta \mathbf{X}_i + \gamma \mathbf{Z}_{i,t-2} + \rho \mathbf{FSIZE}_{i,t-2} + \theta \log(wage_{i,t-2}) + \nu_{it}, \qquad (2)$$

where $PERF_{it}$ is the measure of entrepreneurial performance, $\boldsymbol{X}_i$ and $\boldsymbol{Z}_{it-2}$ are as defined above, and $\boldsymbol{FSIZE}_{i,t-2}$ is a vector indicating the size of the firm employing individual *i* in period *t-2*, prior to self-employment entry. The inclusion of the weekly wage in period *t-2* in equation (2) accounts for the role of ability (in paid employment) for initial entrepreneurial success.

Our primary measure of initial entrepreneurial performance ($PERF_{it}$) is total pay in the first period of self-employment. In addition, we also consider two alternative performance metrics: (a) whether or not the self-employed individual incorporates the new venture; (b) the number of direct reports in the first period of self-employment. Prior research indicates that unincorporated business owners may be less innovative and less likely to undertake risks, and often have slower growth trajectories than incorporated ventures (Ribstein 2004). Incorporated businesses are also more likely to be able to attract outside capital (Mackie-Mason and Gordon 1997). Similarly, we interpret the number of direct reports for the self-employed individual as proxies for the size of the new venture.

Table 6 reports estimates of equation (2) in which $PERF_{it}$ is the (log of) annualized pay in the entrepreneurial venture in period *t*. We employ a censored-normal regression to account for the top-coding of pay for some sample members (and limited bottom coding as well). Controls for the industry in which the new venture is established are incorporated in all specifications. The estimates in column (1) exclude the lagged (log) weekly wage from the regression and indicate that initial pecuniary return in entrepreneurship is unrelated to the size the of previous employer. However, this finding appears to reflect positive correlation between ability and firm size. When the lagged wage is incorporated into the regression, column (2) shows that new entrepreneurs coming from firms with 25 or fewer employees earn 23 percent more than those entering entrepreneurship from firms of size 5000 or more. The firm size effect, however, is non-monotonic. Workers coming from firms of 101 to 1000 employees have a similar wage differential as those coming from the smallest firms.[17] Column (3) explores whether the small firm

[17] We speculate that firms in this size category that spawn entrepreneurs may disproportionately consist of entrepreneurial ventures that have already grown successfully, and that opportunities to develop entrepreneurial human capital in these firms may be rife.

effect on performance can be explained by jack-of-all-trades hypotheses by adding measures of the breadth of activities on the job. Surprisingly, these measures have little impact on the relative pay of workers in firms of different sizes.[18] A possible interpretation, addressing the puzzle posed by the empirical work of Lazear (2005), is that "latent" entrepreneurs choose to be jacks-of-all-trades, rather than jacks-of-all-trades transforming themselves into entrepreneurs. Another possibility is that the jack of all trades effect is fully captured in the prior pay these new entrepreneurs received. Finally, we also examined the sensitivity of the findings to the inclusion of an indicator variable that equals 1 if the entrepreneur locates his venture in the same industry as the 1 in which he was previously employed and 0 otherwise. Although the sample size falls by 47 percent, these additional unreported regressions show the same patterns with respect to pay and prior firm size as those reported in columns (2) and (3); the coefficient on the same industry dummy is not statistically significant.

The analysis in Sections 4.1 and 4.2 suggested that entrepreneurship attracts both high and low performers from paid employment. To investigate the possibility that small firm experience has a different impact on high ability versus low ability workers, we divide the sample into two groups—those earning more than the median for their education type in year *t-2* and those earning less than the median—and repeat the analyses on these subsamples. The contrast between the estimates produced by the two subsamples is striking. As illustrated in columns (4) through (6), for those entrepreneurs who were among the top-half of wage earners, prior experience in small firms is associated with significantly higher pay than prior experience in large firms, controlling for a variety of characteristics. In addition, the coefficient on the lagged wage suggests that individuals who were stars in paid employment are also star entrepreneurs, at least in terms of initial returns. By contrast, columns (7) through (9) show that for those coming from the bottom half of the wage distribution, initial pecuniary returns in entrepreneurship are unrelated to firm experience. Additionally, there is a much weaker relationship between these employees'

[18]In unreported regressions, we interact firm size dummies with these activity scope measures. We find no evidence that activity scope in small versus large firms differentially affects performance in the early stages of entrepreneurship.

prior earnings in paid employment and their earnings in self-employment. This pattern in the data suggests two interpretations. First, low-earning small firm employees may be constrained either by their position in the firm or by their ability from acquiring the benefits of small firm experience. Second, low-pay workers who become entrepreneurs may be doing so because their current pay is weakly correlated with their ability.

Table 7 reports the results of analyses for the remaining performance measures. In columns (1) - (4) we investigate the decision to enter self-employment as an incorporated entity using a probit analysis. $PERF_{it}$ in this case equals 1 if the self-employed individual reported being incorporated in period *t*, and 0 otherwise. We employ the identical sample and controls as in Table 6 above. As above, column (1) excludes the lagged wage, column (2) incorporates the lagged wage as a measure of ability,, and column (3) additionally adds the worker's activities on the prior job. In column (4) we restrict the sample to include only those observations in which we know the respondent's industry at *t-2* and *t* and add an indicator variable if worker became self-employed in the same industry he or she worked in at time *t-2*. Across the specifications, the industry controls are significant in predicting whether new entrepreneurs choose to incorporate. Although the estimate on the small firm coefficient in column (1) is approaching significance, no clear relationship emerges between firm size and the decision to incorporate. We find no evidence that a broader set of commercial activities on the job leads to higher rates of incorporation; however, those involved in R&D at their prior employer do incorporate at a higher rate. R&D intensive businesses may incorporate as part of the patent protection process.

In columns (5) through (8) of Table 7, we examine the relationship between the size of the entrepreneur's prior employer and the initial size of new ventures. We specifically examine responses to a survey question in which individuals were asked the number of direct reports they had in their current job. Because the number of employees supervised is reported as free response (i.e., 0, 1, 2, 3, etc), this measure allows us to distinguish between entrepreneurs who have employees and those who do not.[19] For

[19] We could not infer this from the firm size category responses since "1" is included in the smallest category of firm size, 1-10 employees.

first-period self employed, the median and mean of the number of direct reports are 0 and 2.5, respectively. Given the preponderance of zeros in the distribution of the dependent variable and the skewness of the distribution, we estimate equation (2) as an ordered logit, in which the ordered choices reflect the number of direct reports. The results are similar to the findings for the relationship between prior firm size and pay from Table 6: Prior employment in small firms is associated with an increasing number of direct reports in the new firm. In contrast to the findings above, those engaged in a broader set of activities in the prior job are more likely to have (more) employees in their present endeavor, and this result is particularly pronounced for the range of commercial activities performed in the prior job. Similarly, those who start new enterprises in the same industry that they left are more likely to found larger ventures than those who found ventures in new industries. Finally, we note that, unlike the evidence reported in Table 6 on pay, the firm size effect on the number of direct reports seems to be monotonically decreasing in firm size.

4.4. Accounting for Selection on Observables in Early Stage Performance

The results in Tables 6 and 7 imply that firms with 1-25 employees spawn new ventures that initially larger and generate higher pecuniary returns for their owners. Consequently, part of the reason for the high rates of transition from small firms into entrepreneurship is that these individuals (rationally) expect better performance and higher initial returns in their new ventures. We now attempt to distinguish between two alternative explanations for the observed positive effect of small firm experience on entrepreneurial performance: (a) individuals acquire human capital by working in small firms that make them more successful entrepreneurs; (b) small firms attract individuals with higher levels of "latent" entrepreneurial ability (i.e., higher values of ν_{it}, in equation (2)).[20] To account for the potential non-random selection into small firms implied by explanation (b), we re-estimate the performance equation (2) adopting the inverse propensity score weighting methods discussed in Hirano and Imbens (2002) and

[20] Explanation (b) implies cov($\boldsymbol{FSIZE}_{i,t-2}, \nu_{it}$,) > 0 in equation (2).

Wooldridge (2007).[21] These methods allow us to more fully capture non-random selection based on observed characteristics. While an obvious instrument is not available that would allow us to account for selection on unobservables, we are able to condition on the lagged wage. If entrepreneurial ability is strongly correlated with ability in paid employment (as appears to be the case from the strongly positive estimates of θ in Table 6, at least for above-median workers), the lagged wage variable should incorporate some of the effect implied by explanation (b). Considering the "treatment" as having worked in a small firm (1-25 employees) in *t-2*, we construct both the average treatment effect and the treatment effect for the treated. The former measures the impact of having worked in a small firm on entrepreneurial success for the average entrepreneur; the latter measures the treatment effect for the set of entrepreneurs who actually worked in a small firm prior to starting their venture.

The results from our treatment effect estimates for various measures of performance are reported in Table 8. In rows (1)–(3) we examine self-employment pay for the entire sample and for the subsample of those coming from the top and bottom halves of their respective salary distributions at *t-2*, respectively, using OLS.[22] In row (4) we examine the choice to enter as an incorporated entity also using a weighted linear probability model, and in row (5) we report the propensity score adjusted coefficients on entry size using weighted OLS. Adjusting for the non-random selection based on observed characteristics, we find a positive, but not significant relationship between prior small firm employment and earnings in entrepreneurship for the entire sample. However, we do find a positive and significant relationship between prior small firm employment and earnings for those who were in the top half of wage earners in their prior job. When controlling for selection on observables in the equation that estimates the decision to found an incorporated entity, the estimated small firm coefficient continues to be positive and becomes

[21] The propensity score weighting approach is very similar to matching on propensity scores. In the first step, we estimate a logit model for the probability that an individual worked in a small firm in *t-2*, including $\boldsymbol{X}_i$ and $\boldsymbol{Z}_{it-2}$ as covariates. In the second step, equation (2) is re-estimated via weighted least squares (or logit) using the inverse of the predicted propensity scores from step 1 as weights. The form of the weights depends on whether the average treatment effect or treatment effect for the treated is being estimated. Hirano and Imbens (2002) provide a clear introduction to these methods.

[22] Unfortunately, the appropriate weighted regressions that incorporated censoring were not available.

significant at $p < .1$ and $p < .05$ for the average treatment effect and the effect of the treatment on the treated, respectively. Finally, controlling for selection on observables in the analysis of the size of the newly founded firms continues to yield positive and significant coefficient estimates on the small firm dummy. Although we cannot completely rule out explanation (b) in the absence of instrumental variables accounting for selection on unobservables, the findings in Table 8 support the view that there remains an important positive impact of skills accumulated while working in a small firm that extends beyond any form of sorting explanation, based on either observed or unobserved individual attributes.

Together, the results of sections 4.3 and 4.4 suggest that small firms spawn larger, more stable ventures, and that small firm experience is associated with higher initial entrepreneurial returns, especially for high ability workers. Some of the small firm effect on performance appears to reflect the accumulation of human capital that is valuable once the individual starts his business, although sorting explanations cannot be ruled out. Small firms spawn more entrepreneurs in part because workers from these firms earn higher returns in self-employment.

5. Conclusion

Small firms play a disproportionate role in the genesis of new entrepreneurial ventures. We document this "small firm effect" in a population of U.S.-trained scientists and engineers—individuals who play a key role in industrial growth and technological change—and explore the potential explanations for this small firm effect. Our results suggest that the small firm effect is the result of a number of factors, including both "selection" and "treatment" effects. By examining not only determinants of transitions into entrepreneurship, but also the performance of new entrepreneurs, we are able to distinguish between "functional" and "non-functional" explanations as well. We are particularly interested in explanations for the small firm effect that include a "functional" role for small firms, and we are among the first to demonstrate evidence of just such a role. While individuals may receive utility from working in small firms and / or being their own boss, these considerations may be secondary to those that suggest that small firms help generate more productive entrepreneurs. This distinction is

important for policy-makers who design institutions such as the Small Business Administration, non-profits and others that seek to promote entrepreneurship, and educators and mentors who advise those who seek to become entrepreneurs.

We identify and examine four categories of explanation for the small firm effect—preference sorting, ability sorting, opportunity cost, and development of entrepreneurial human capital. We find evidence that preference sorting is responsible for some of the small firm effect that we observe. Scientists and engineers in small firms are more likely to state a preference for self-employment, and those who state a preference for self-employment are more likely to become entrepreneurs. Presumably, this stated preference for self-employment reflects an interest in independence, autonomy, or procedural utility (Benz and Frey, 2008). We also find evidence of ability sorting: those scientists and engineers who move to smaller firms are more likely to be positioned at the extremes: either of high or low ability. High-ability scientists and engineers in general select into entrepreneurship more frequently, presumably to maximize their expected earnings—consistent with the findings of Gort and Lee (2007) and Braguinsky and Ohyama (2007). While the lowest paid workers also enter self-employment more frequently, yielding some support for opportunity cost explanations, we find no evidence that overall differences in the level of pay between small and large firms explains the small firm effect, or that differences in job turnover explain the small firm effect.

We present a series of findings that are consistent with the proposition that workers in small firms develop entrepreneurial human capital. Small firm employees engage in a broader range of business-related activities than large firm workers, and these "jacks of all trades" are more likely to select entrepreneurship. Although workers with broad capabilities could be selecting into small firms prior to entering entrepreneurship, we speculate that necessity and or opportunity may transform some workers into jacks of all trades.[23] Additionally, we find that the relationship between firm size and entrepreneurial entry is more pronounced with respect to within-industry entrepreneurial transitions as compared to those

[23] Indeed, in regressions of activity scope on firm size with individual fixed effects, we find that the same individual performs a broader set of business-related tasks in smaller firms. Results available from the authors upon request.

that occur across industries. The fact that the small firm effect is more pronounced for "related" opportunities supports, if indirectly, the notion that small firm workers may acquire specific skills, potentially related to opportunity recognition. Finally, we offer evidence that workers with prior experience in small firms start firms that are larger in size and generate higher initial economic returns than those coming from large firms. This result is clearly consistent with the greater development of entrepreneurial skill in small firms. We cannot, however, rule out the possibility that differences in the latent entrepreneurial ability of those who select into small firms drive this result.

Some results in this paper may be viewed as presenting contrasting evidence to prior work on entrepreneurial spawning. Gompers, Lerner and Scharfstein (2005), for example, find that firms of 10,000 or more employees account for the lion's share of venture-backed startups. That result, however, reflects spawning only from publicly traded companies, so small firms are likely to be dramatically under-represented. Citing evidence from a number of industry studies, Klepper and Thompson (2007), argue that better-performing firms have better spinoffs and that better performing firms spawn spinoffs at a higher rate. They also argue that the rate of spawning falls with firm age. If firm performance correlates highly with size, then this seems to stand in contrast with our results, to the contrary, however, if firm size instead correlates highly with firm age. Unfortunately, aside from size, we have little information about the relative performance of the firms in which the employees in our sample work. It could be the case that better measures of relative firm performance would bring our results closer to those of these previous industry studies. On the other hand, we find it quite plausible that large, successful firm and small firms could *both* offer benefits to potential entrepreneurs, albeit of different types. We see a significant contribution of this paper as highlighting this possibility.

In summary, our results suggest that small firms may play several important roles in promoting successful entrepreneurship. We find some evidence that small firms provide opportunities to develop the broad skills necessary for entrepreneurship. More work is necessary to show that employment in small firms leads individuals to develop better networks that facilitate entrepreneurship and/or improved skill at locating opportunities. We speculate the small firms may also provide an arena in which individuals self-

discover their capacity for entrepreneurship. In part, this self-recognition could reflect the knowledge accumulated while employed within small firms, and it may enable potential entrepreneurs in small firms to make more accurate assessments of their likely performance when making the leap to entrepreneurship. While our study has made important headway in documenting and explaining the small firm effect, there is clearly much that remains unexplored.

7. References

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Figure 1. Explanations for the Small Firm Effect

	NON-FUNCTIONAL	FUNCTIONAL*
SORTING ("selection")	**Preference Sorting** • Individuals with preferences for autonomy (or less risk aversion) go to work for small firms	**Ability Sorting** • Labor market sorts those "best suited" to become entrepreneurs into small firms o High ability workers select entrepreneurship to maximize earnings
CONTEXT ("treatment")	**Opportunity Cost** • Small-firm workers paid less o Low ability workers in small firms paid considerably less, have low opportunity cost of becoming self-employed • High turnover: small firms fail more frequently, small firm workers change jobs more	**Developing Entrepreneurial Human Capital** • Improved access to networks or valuable entrepreneurial resources • Better discovery of entrepreneurial opportunities • Become jacks-of-all trades

*i.e., small firms play a valuable, productivity-related role.

Figure 2a. Distributions of Weekly Wages in Large Firms, Small Firms, and Self-Employed, Pooled Sample

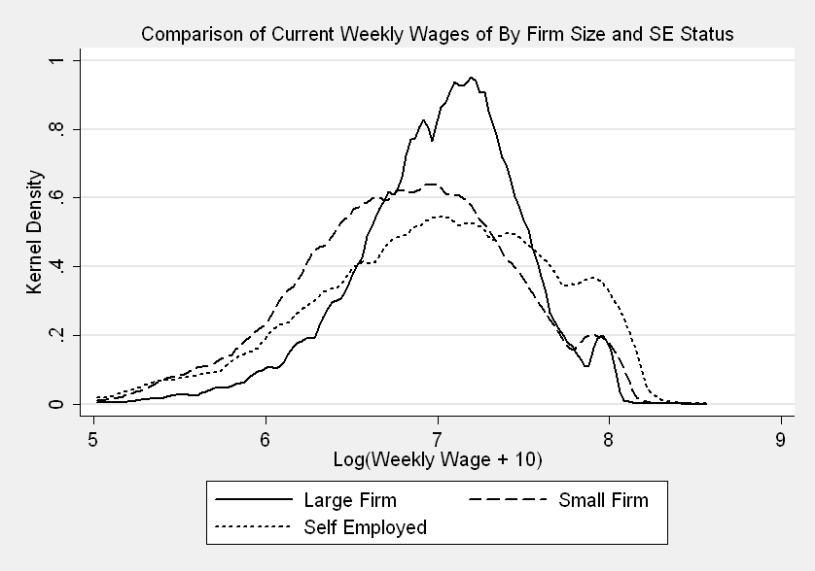

Figure 2b. Distribution Of Weekly Wages In Large Firms, Among Those Who Remain In Large Firm Employment And Those Who Move To Small Firms

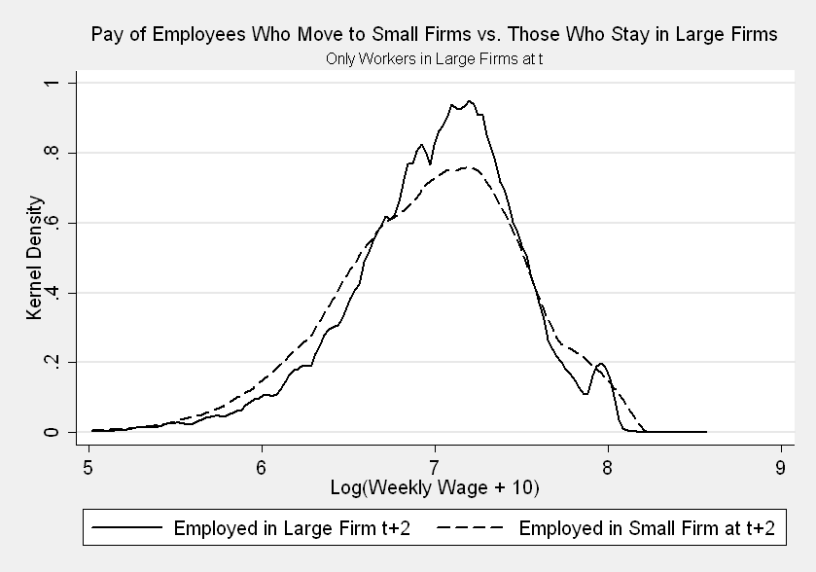

Figure 2c. Distribution of Weekly Wages for Future Self-Employed, Compared with Distribution of Those Remaining in Paid Employment in Small Firms, Pooled Sample

Figure 2d. Distribution of Weekly Wages for Future Self-Employed, Compared with Distribution of Those Remaining in Paid Employment in Large Firms, Pooled Sample

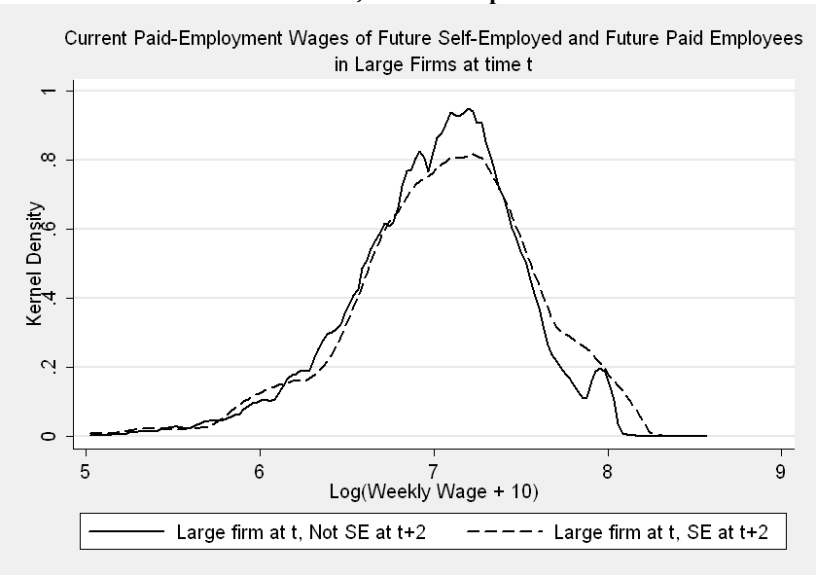

Table 1. Comparison of job separation and transitions into self employment by type of employment in prior survey period.

	Fraction of Employees in:							
	1997		1999		2001		All Years	
	Turnover	Self-Employed	Turnover	Self-Employed	Turnover	Self-Employed	Turnover	Self-Employed
Employer Type in Prior Survey Episode								
Bus: 1 – 25	29.3%	6.1%	31.6%	6.0%	23.1%	4.4%	29.4%	5.8%
Bus: 26 – 100	29.6%	3.1%	33.2%	3.6%	25.9%	1.6%	30.7%	3.2%
Bus: 101 – 1000	26.0%	2.1%	30.3%	2.0%	26.1%	1.4%	27.8%	2.0%
Bus: 1001 – 5000	21.0%	1.2%	24.5%	1.6%	23.2%	1.5%	22.7%	1.4%
Bus: 5000 +	14.9%	0.9%	16.1%	0.9%	17.5%	0.7%	16.0%	0.9%
Government	8.8%	0.5%	10.1%	0.6%	11.3%	0.6%	9.7%	0.6%
Secondary Ed.	11.1%	0.5%	13.6%	0.6%	9.6%	1.0%	12.0%	0.6%
University / Research Institute	10.4%	0.3%	12.2%	0.4%	11.5%	0.4%	11.3%	0.4%

Notes: Prior survey episode occurred two years earlier, e.g., for 1997 the prior survey episode was in 1995. The sample consists of individuals whose responses are included in the SESTAT restricted file in 1995, 1997, 1999, and the SDR in 2001 and who were at least 22 in 1995 and not more than 65 in 2001. Individuals who were not in the labor force in all relevant periods are eliminated from the sample. Individuals whose highest degrees were not in a science or engineering field or were professional degrees (such as MD, JD, or DDS) are also eliminated from the sample, as are all individuals who reported working fewer than 30 hours per week on average and fewer than 30 weeks per year.

Table 2. Summary statistics by self employment status and firm size.

	Self-Employed	1-25	26-100	100-1000	1000-5000	5000+
Age	46.	39.4	37.6	37.4	38.0	38.7
Year	1997.3	1997.2	1997.2	1997.2	1997.1	1997.3
Years in Current Job	8.4	4.8	4.0	4.2	5.2	6.5
Hours worked	47.9	46.7	46.7	46.3	46.1	46.6
Weeks Worked	50.4	51.3	51.7	51.7	51.7	51.8
Salary (median)	58,345	48,000	52,000	54,600	59,290	65,000
Highest Degree: Bachelors'	.396	.501	.520	.521	.507	.430
Highest Degree: Masters'	.139	.169	.187	.201	.201	.206
Highest Degree: PhD.	.464	.329	.293	.278	.291	.364
HD Field: Computer	.075	.101	.112	.122	.140	.144
HD Field Life Science	.200	.181	.166	.155	.140	.108
HD Field Phys Science	.102	.130	.146	.143	.154	.161
HD Field Soc Science	.393	.252	.191	.169	.141	.112
HD Field Engineering	.231	.336	.384	.411	.424	.479
White	.816	.772	.747	.723	.727	.714
Male	.743	.764	.776	.761	.765	.781
Commercial Activity Count	2.64	2.44	2.19	1.98	1.83	1.66
Research Activity Count	1.14	1.58	1.67	1.82	1.89	2.10
Primary Activity is R&D	.149	.251	.299	.323	.345	.411
Want to be SE_{1997}	.818	.472	.343	.318	.281	.251
N	11,896	11,127	10,273	20,193	15,193	43,631

Note: The sample consists of individuals whose responses are included in the SESTAT restricted file in 1995, 1997, 1999, and the SDR in 2001 and who were at least 22 in 1995 and not more than 65 in 2001. Individuals who were not in the labor force in all relevant periods are eliminated from the sample. Individuals whose highest degrees were not in a science or engineering field or were professional degrees (such as MD, JD, or DDS) are also eliminated from the sample, as are all individuals who reported working fewer than 30 hours per week on average and fewer than 30 weeks per year. Data for "Want to be SE" are based on responses from 1997 only, and are based on a smaller sample. All other responses are contemporaneous and may represent multiple responses from a single individual..

Table 3. Probit analysis of transition into self-employment from paid employment at for-profit firms (marginal effects).

Description:	Baseline	Individual Observables	Opportunity Cost	High & Low Ability?	Activity Count	Activity Count-Non-linear	Full activity vector	Desire to be Self-employed
Column:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm Size: 1 – 25$_t$	.0634***	.0507***	.0513***	.0493***	.0469***	.0468***	.0428***	.0288***
	(.0048)	(.0045)	(.0045)	(.0045)	(.0044)	(.0044)	(.0042)	(.0034)
Firm Size: 26 – 100$_t$	.0320***	.0262***	.0263***	.0256***	.0244***	.0244***	.0229***	.0183***
	(.0039)	(.0036)	(.0036)	(.0036)	(.0035)	(.0035)	(.0034)	(.0030)
Firm Size: 101 – 1000$_t$	.0151***	.0119***	.0120***	.0118***	.0113***	.0113***	.0107***	.0084***
	(.0023)	(.0022)	(.0022)	(.0022)	(.0021)	(.0021)	(.0021)	(.0018)
Firm Size: 1001 – 5000$_t$	.0081***	.0066***	.0066***	.0065***	.0062**	.0062**	.0057**	.0049**
	(.0024)	(.0022)	(.0022)	(.0022)	(.0022)	(.0022)	(.0021)	(.0018)
Age$_{t+2}$		.0006*	.0005†	.0005†	.0005†	.0005†	.0004†	.0005*
		(.0003)	(.0003)	(.0003)	(.0003)	(.0003)	(.0003)	(.0002)
Age $_{t+2}^2$ * 100		-.0004	-.0003	-.0004	-.0004	-.0004	-.0004	-.0005
		(.0005)	(.0006)	(.0006)	(.0006)	(.0006)	(.0006)	(.0005)
Job Tenure $_t$		-.0010***	-.0010***	-.0010***	-.0010***	-.0010***	-.0010***	-.0009***
		(.0003)	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)
Job Tenure $_t^2$* 100		.0031***	.0031***	.0029***	.0030***	.0030***	.0030***	.0026***
		(.0008)	(.0009)	(.0009)	(.0009)	(.0009)	(.0009)	(.0008)
Log Weekly Wage$_t$			.0009					
			(.0011)					
Weekly Wage Decile$_t$ = 1 (lowest)				.0047†	.0045†	.0040†	.0043†	.0037†
				(.0028)	(.0027)	(.0027)	(.0027)	(.0023)
Weekly Wage Decile$_t$ = 2				.0043†	.0040†	.0038†	.0038†	.0038†
				(.0025)	(.0025)	(.0025)	(.0024)	(.0022)
Weekly Wage$_t$ Decile $_t$ = 9				.0021	.0018	.0018	.0019	.0018
				(.0018)	(.0018)	(.0018)	(.0017)	(.0015)
Weekly Wage Decile$_t$ = 10 (highest)				.0059***	.0049**	.0049**	.0051**	.0037**
				(.0019)	(.0019)	(.0019)	(.0019)	(.0015)
# of Commercial Activities $_t$					.0009**			
					(.0003)			
# of Research Activities $_t$					-.0006			
					(.0004)			
Commercial Activities = 1						.0008		
						(.0017)		
Commercial Activities = 2						.0027		
						(.0019)		
Commercial Activities = 3						.0018		
						(.0020)		
Commercial Activities = 4 or more						.0046*		
						(.0021)		
R&D Activities = 1						-.0030*		
						(.0014)		
R&D Activities = 2						-.0033*		
						(.0015)		
R&D Activities = 3						-.0028†		
						(.0015)		
R&D Activities = 4 or more						-.0030†		
						(.0017)		
Comm. Act. Dummies $_t$							Y***	Y*
Res. Activity Dummies $_t$							Y*	Y†
Want to be SE$_{1997}$								.0261***
								(.0016)
Obs P.	.0192	.0192	.0192	.0192	.0192	.0192	.0192	.0193
N	47,129	47,106	47,106	47,106	47,106	47,106	47,106	45,176
Log Pseudolikelihood	-4232.2	-4157.4	-4157.1	-4149.5	-4144.5	-4127.0	-4127.0	-3764.6
Pseudo-R^2	.0539	.0705	.0706	.0723	.0734	.0739	.0768	.1241

*** = significant at $p \leq 0.001$; ** = significant at $p \leq 0.01$; * = significant at $p \leq 0.05$; † = significant at $p \leq 0.1$ (two-sided test)

Note: The dependent variable is *SELF-EMPLOYED*$_{t+2}$. All regressions include only those who were not self employed at time *t*. Standard errors, clustered on individuals are in parentheses. For firm size category variables, the omitted variable is more than 5000 employees. Regressions also include additional control variables for race, gender, marital status, employment status of spouse (full-time, part-time, not employed), and the number of children under 18 in the household. Models (2) through (10) include dummy variables for year interacted with field of highest degree as well as year interacted with level of highest degree (e.g., BA, MA, PhD), and for the region in which the respondent worked in year *t*.

Table 4. Multinomial logit analysis of likelihood of entering self-employment or changing jobs in paid employment.

Model:	A		B		C	
Choice:	Change Jobs, Not Self Employed	Self-Employed	Change Jobs, Not Self Employed	Self-Employed	Change Jobs, Not Self Employed	Self-Employed
Column:	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)
Firm Size: $1 - 25_t$	.4048***	1.6980***	.3907***	1.6706***	.3718***	1.4309***
	(.0424)	(.1064)	(.0426)	(.1072)	(.0440)	(.1116)
Firm Size: $26 - 100_t$	.5918***	1.2261***	.5879***	1.2207***	.5933***	1.1659***
	(.0405)	(.1180)	(.0406)	(.1179)	(.0416)	(.1210)
Firm Size: $101 - 1000_t$	.4898***	.7684***	.4889***	.7691***	.5000***	.7356***
	(.0326)	(.1096)	(.0326)	(.1098)	(.0334)	(.1125)
Firm Size: $1001 - 5000_t$	.3248***	.4433***	.3244***	.4430***	.3346***	.4449***
	(.0362)	(.1269)	(.0362)	(.1271)	(.0371)	(.1304)
Age_{t+2}	-.0358***	.0195	-.0328***	.0191	-.0399***	.0277
	(.0063)	(.0176)	(.0064)	(.0174)	(.0065)	(.0179)
Age_{t+2} Squared * 100	.0236	-.0129	.0243†	-.0168	.0298*	-.0338
	(.0145)	(.0320)	(.0145)	(.0375)	(.0148)	(.0389)
Job $Tenure_t$	-.1285***	-.0947***	-.1270***	-.0916***	-.1255***	-.0948***
	(.0061)	(.0146)	(.0062)	(.0148)	(.0063)	(.0155)
Job $Tenure\ Squared_t$* 100	.2999***	.2822***	.2925***	.2704***	.2882***	.2846***
	(.0269)	(.0549)	(.0271)	(.0555)	(.0276)	(.0598)
Log Weekly $Wage_t$	-.2198***	-.0245				
	(.0249)	(.0710)				
WW_t Decile = 1 (lowest)			.5420***	.4377**	.5825***	.4658***
			(.0538)	(.1413)	(.0552)	(.1427)
WW_t Decile = 2			.3085***	.3328**	.3319***	.3864**
			(.0490)	(.1333)	(.0503)	(.1382)
WW_t Decile = 9			-.0090	.1341	-.0130	.1459
			(.0406)	(.1102)	(.0415)	(.1123)
WW_t Decile = 10 (highest)			-.0586	.3067**	-.0523	.2653*
			(.0433)	(.1025)	(.0442)	(.1025)
Want to be SE_{1997}					.1886***	1.5255***
					(.0275)	(.0774)
Commercial Activity $Dummies_t$	Y***	Y*	Y**	Y***	Y**	Y†
Research Activity $Dummies_t$	Y**	Y***	Y***	Y*	Y***	Y*
N	47,162		47,162		45,232	
Log pseudo-likelihood	-25,747.0		-25,715.7		-24,316.2	
Pseudo R^2	.0781		.0793		.0898	

*** = significant at $p \leq 0.001$; ** = significant at $p \leq 0.01$; * = significant at $p \leq 0.05$; † = significant at $p \leq 0.1$ (two-sided test)

Note: The dependent variable consists of three choices, (1) the individual does not change employers, (2) the individual changes employer but does not become self employed, and (3) the individual leaves paid employment and becomes self employed. In the results reported above, (1) is the omitted choice. All regressions include only those who were not self employed at time *t*. For firm size category variables, the omitted variable is more than 5000 employees. Regressions also include dummy variables indicating race, gender, marital status, employment status of spouse (full-time, part-time, not employed), and the number of children under 18 in the household. All models include dummy variables for year interacted with field of highest degree as well as year interacted with level of highest degree (e.g., BA, MA, PhD), and for the region in which the respondent worked in year *t*. Standard errors, clustered on individuals are in parentheses.

Table 5. Multinomial logit analysis of likelihood of entering self-employment in the same industry or different industry.

Choice:	Change Employer, Same Industry	Change Employer, Different Industry	Become Self Employed, Same Industry	Become Self-Employed, Different Industry
Column:	(1a)	(1b)	(1c)	(2b)
Firm Size: $1 - 25_t$	.4682***	.2386**	2.1039***	1.1105***
	(.0804)	(.0712)	(.2215)	(.1988)
Firm Size: $26 - 100_t$	.6523***	.4789***	1.7059***	.7667***
	(.0768)	(.0687)	(.2375)	(.2274)
Firm Size: $101 - 1000_t$	.6119***	.4045***	.9093***	.5594**
	(.0609)	(.0558)	(.2383)	(.1953)
Firm Size: $1001 - 5000_t$	.4943***	.1973***	.9151***	.2726
	(.0674)	(.0627)	(.2543)	(.2263)
Age_{t+2}	-.0080	-.0516***	.0207	.0039
	(.0127)	(.0103)	(.0333)	(.0333)
Age Squared $_{t+2}$ * 100	-.0445	.0697**	-.0415	.0247
	(.0283)	(.0234)	(.0702)	(.0713)
Job $Tenure_t$	-.1114***	-.1316***	-.0824**	-.1038***
	(.0121)	(.0102)	(.0288)	(.0271)
Job Tenure $Squared_t$* 100	.1734**	.3248***	.2751*	.2755**
	(.0581)	(.0430)	(.1077)	(.1060)
WW_t Decile = 1 (lowest)	.0529	.6845***	.5654*	.6419**
	(.1195)	(.0821)	(.2554)	(.2502)
WW_t Decile = 2	.1018	.3717***	.3567	.3758
	(.0958)	(.0761)	(.2472)	(.2504)
WW_t Decile = 9	.0621	-.0904	.2021	.00663
	(.0737)	(.0704)	(.2113)	(.2153)
WW_t Decile = 10 (highest)	.0972	-.2990***	.4225*	.2863
	(.0735)	(.0773)	(.1906)	(.1928)
Industry $Controls_t$	Y***	Y***	Y***	Y*
N	25,416			
Log pseudo-likelihood	-17814.7			
Pseudo R^2	.0806			

*** = significant at $p \leq 0.001$; ** = significant at $p \leq 0.01$; * = significant at $p \leq 0.05$ (two-sided test)

Note: The dependent variable consists of five choices, (1) the individual does not change employers, (2) the individual changes employers, but stays in the same industry, not self employed (3) the individual changes employers, but moves to a different industry, not self employed (3) the individual becomes self-employed in the same industry, and (4) the individual becomes self-employed in a new industry. In the results reported above, (1) is the omitted choice. All regressions include only those who were not self employed at time *t*. All covariates are at time *t+2*, unless otherwise specified. For firm size category variables, the omitted variable is more than 5000 employees. Regressions also include dummy variables indicating race, gender, marital status, employment status of spouse (full-time, part-time, not employed), and the number of children under 18 in the household. All models include dummy variables for year interacted with field of highest degree as well as year interacted with level of highest degree (e.g., BA, MA, PhD), and for the region in which the respondent worked in year *t*. Standard errors, clustered on individuals are in parentheses.

Table 6. Censored normal regression analysis of first period self-employment earnings by size of previous employer. (revised 02/03/2009)

Subset:	Entire Sample			Top Half of Wage Earners$_{t-2}$			Bottom Half of Wage Earners$_{t-2}$		
Column:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Firm Size: 1 – 25$_{t-2}$	-.0146	.2307*	.2354*	.3982**	.3973**	.4234**	-.0504	.0594	.0351
	(.1097)	(.1051)	(.1061)	(.1442)	(.1423)	(.1428)	(.1644)	(.1600)	(.1618)
Firm Size: 26 – 100$_{t-2}$	-.0948	.0363	.0379	.1057	.0803	.1143	-.0958	-.0354	-.0583
	(.1295)	(.1220)	(.1231)	(.1611)	(.1592)	(.1602)	(.1952)	(.1887)	(.1895)
Firm Size: 101 – 1000$_{t-2}$	.1421	.2688*	.2685*	.2494	.2786†	.3173*	.1922	.2386	.2155
	(.1213)	(.1144)	(.1150)	(.1516)	(.1509)	(.1505)	(.1863)	(.1800)	(.1808)
Firm Size: 1001 – 5000$_{t-2}$	-.0197	-.0128	-.0179	-.0026	.0059	.0144	-.1582	-.1542	-.1815
	(.1375)	(.1302)	(.1297)	(.1589)	(.1567)	(.1569)	(.2398)	(.2315)	(.2322)
Log Weekly Wage$_{t-2}$		.6640***	.6663***		.9192***	.9414***		.4210***	.4263***
		(.0549)	(.0550)		(.1731)	(.1728)		(.0737)	(.0744)
# Comm. Activities $_{t-2}$			-.0209			-.0658†			.0233
			(.0261)			(.0341)			(.0400)
# Res. Activities $_{t-2}$			-.0220			.0037			-.0490
			(.0305)			(.0409)			(.0443)
Industry Dummies$_t$	Y**	Y**	Y**	Y†	Y†	Y†	Y**	Y**	Y**
N	1152	1152	1152	665	665	665	487	487	487
Log Likelihood	-1801.2	-1731.0	-1730.4	-989.0	-974.8	-972.9	-696.2	-694.0	-693.2
Pseudo R^2	.0568	.0936	.0939	.0594	.0729	.0746	.1097	.1126	.1135

*** = significant at $p \leq 0.001$; ** = significant at $p \leq 0.01$; * = significant at $p \leq 0.05$; † = significant at $p \leq 0.1$ (two-sided test)

Note: The sample consists of all members of the pooled sample who moved from employment in a for-profit business to self-employment. The dependent variable is the log of salary in the first period of self-employment. The dependent variable is considered top-censored if salary is greater than or equal to 150,000, and it is considered bottom-censored if salary equals 0. Firm size and salary variables refer to the individual's employer immediately prior to transitioning into self-employment and are measured at *t-2*. State dummy variables (e.g., AK, AR, AZ, etc.), and regional dummy variables where state dummies are unavailable, gender and race dummy variables (African-American, Asian, and Hispanic), dummy variables for the field of the individual's highest degree (computer science, physical science, life science, social science, and engineering), and other demographic characteristics are included in the regressions below but are not reported. Standard errors are in parentheses.

Table 7. Performance in self employment among newly self-employed by size of previous employer.

Dependent Variable:	Enter as Incorporated Business				Number of Direct Reports			
Specification:	Probit (marginal effects)				Ordered Probit			
Column:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm Size: $1 - 25_{t-2}$	-.0015	.0272	.0450	-.0137	.3624***	.4608***	.3844***	.4232**
	(.0430)	(.0439)	(.0447)	(.0634)	(.1066)	(.1089)	(.1117)	(.1542)
Firm Size: $26 - 100_{t-2}$	-.0523	-.0372	-.0143	-.0914	.3078*	.3456**	.2951*	.2016
	(.0506)	(.0512)	(.0522)	(.0725)	(.1250)	(.1259)	(.1285)	(.1784)
Firm Size: $101 - 1000_{t-2}$	-.0623	-.0479	-.0299	-.1655*	.2074†	.2546*	.2257†	.1318
	(.0474)	(.0479)	(.0486)	(.0648)	(.1192)	(.1198)	(.1219)	(.1699)
Firm Size: $1001 - 5000_{t-2}$	-.0132	-.0104	.0071	-.1263	.1569	.1578	.1604	.1307
	(.0547)	(.0549)	(.0555)	(.0744)	(.1367)	(.1372)	(.1392)	(.1924)
Log Weekly $Wage_{t-2}$		.0759***	.0631**	.0581		.2681***	.2116***	.3443***
		(.0234)	(.0238)	(.0356)		(.0577)	(.0589)	(.0916)
# Comm. $Activities_{t-2}$			-.0030	-.0032			.1791***	.1717***
			(.0112)	(.0164)			(.0267)	(.0381)
# Res. $Activities_{t-2}$			.0544***	.0567**			.0771*	.0537
			(.0127)	(.0182)			(.0302)	(.0423)
Same Industry				.0278				.2146*
				(.0454)				(.1078)
Industry $Dummies_t$	Y***	Y***	Y**	Y†	Y**	Y***	Y**	Y†
N	1155	1155	1155	617	1155	1155	1155	617
Observed P.	.4736	.4736	.4736	.4716				
Log Likelihood	-766.5	-761.1	-751.1	-389.0	-1019.8	-1008.7	-982.0	-523.6
Pseudo R^2	.0407	.0474	.0589	.0882	.0436	.0540	.0790	.1015

*** = significant at $p \leq 0.001$; ** = significant at $p \leq 0.01$; * = significant at $p \leq 0.05$; † = significant at $p \leq 0.1$ (two-sided test)

Note: The sample consists of all members of the pooled sample who moved from employment in a for-profit business to self-employment. For the probit analysis, the coefficients presented are marginal effects. The independent variable "# Comm. Activities" is the count of commercial activities performed by the individual in his job prior to entering self-employment, and "# Res. Activities," similarly is the count of research activities in the prior job. Coefficients on year dummy variables and demographic characteristics are suppressed. The categories for the ordered probit analysis are (1) 0 employees, (2) 1-4 direct reports, (3) 5-16 direct reports, (4) 17-64 direct reports, and (5) 65 or more direct reports. Standard errors are in parentheses.

Table 8. Inverse propensity score weighted analysis of initial entrepreneurial performance.

Row	Dependent Variable	Column:	Baseline (no selection correction)	Average Treatment (2)	Treatment on Treated (3)	N
(1)	$Log(Salary_t)$	Coeff:	.1239†	.1090	.0949	1152
	Entire Sample	Std. Error:	(.0738)	(.0741)	(.0846)	
	(OLS)	F-statistic	n.m.	2.16	1.20	
(2)	$Log(Salary_t)$	Coeff:	.2751*	.2155*	.2278**	665
	Top Half of Wage Earners$_{t-2}$	Std. Error:	(.1060)	(.0709)	(.0882)	
	(OLS)	F-statistic	n.m.	5.98*	6.68*	
(3)	$Log(Salary_t)$	Coeff:	.0043	.0828	.0864	487
	Bottom Half of Wage Earners$_{t-2}$	Std. Error:	(.1108)	(.1037)	(.1218)	
	(OLS)	F-statistic	n.m.	0.64	0.50	
(4)	Entry as Incorporated Entity	Coeff:	.0504	.0637†	.0718*	1155
	(Linear Probability)	Std. Error:	(.0317)	(.0334)	(.0341)	
		F-statistic	n.m.	3.58†	4.51*	
(5)	Entry Size	Coeff:	.1335**	.1066*	.1152*	1155
	(OLS)	Std. Error:	(.0425)	(.0471)	(.0504)	
		F-statistic	n.m.	5.12*	6.29	

*** = significant at $p \leq 0.001$; ** = significant at $p \leq 0.01$; * = significant at $p \leq 0.05$; † = significant at $p \leq 0.1$ (two-sided test)

Note: The sample consists of all respondents who moved from for-profit business employment to self-employment. In rows (1)-(3), the dependent variable is the log of the salary reported in the first period of self employment, top-coded at 150,000. Firm size and salary variables refer to the individual's employer immediately prior to transitioning into self-employment and are measured at *t-2*. In row (4), the dependent variable is equal to 1 if the individual entered self employment as an incorporated entity and 0 otherwise. In row (5) , the dependent variable is equal to 1 if the respondent had 0 direct reports, 2 if the respondent had 1-4 direct reports, and 3, 4, and 5 if the respondent had 5-16, 17-64, or 65 or more direct reports, respectively. Propensity scores (for being in the Firm Size: $1\text{-}25_{t-2}$ category) are estimated using variables from *t-2* including age, education, gender, job tenure, salary, and location variables.

Table A1. Summary Statistics for Scientists and Engineers Working in For-Profit Enterprise.

	Obs	*Mean*	*Median*	*Std Dev*	*Min*	*Max*
Age	112,313	39.1	38	10.4	22	65
Year	112,313	1997.2	1997	1.92	1995	2001
Years in Current Job	112,313	5.7	2.9	6.6	0	44.9
Hours worked in primary job	112,313	46.6	45	8.2	30	80
Weeks worked in primary job	112,313	51.6	52	1.8	30	52
Salary	112,313	65,869	60,000	44,859	0	999,996
Salary, top-coded as 150,000	112,313	63,933	60,000	32,616	0	150,000
Highest Degree: Bachelor's	112,313	.468	0	.499	0	1
Highest Degree: Master's	112,313	.192	0	.393	0	1
Highest Degree: Ph.D.	112,313	.339	0	.473	0	1
Highest Degree Field: Computer	112,313	.125	0	.331	0	1
Highest Degree Field: Life Science	112,313	.143	0	.350	0	1
Highest Degree Field: Physical Science	112,313	.146	0	.353	0	1
Highest Degree Field: Social Science	112,313	.177	0	.381	0	1
Highest Degree Field: Engineering	112,313	.409	0	.492	0	1
Male	112,313	.769	1	.421		
White	112,313	.737	1	.440	0	1
Married	112,313	.727	1	.445	0	1
Has spouse who works full time	112,313	.363	0	.481	0	1
Has spouse who works part-time	112,313	.118	0	.322	0	1
Has spouse who does not work	112,313	.217	0	.408	0	1
Children Living in Household	112,313	.89	0	1.15	0	*
Employer:						
Self-Employed	112,313	.106	0	.307	0	1
Self-Employed, Incorporated	112,313	.045	0	.207	0	1
Self-Employed, Not Inc.	112,313	.061	0	.239	0	1
Business, 1-25 employees	112,313	.099	0	.298	0	1
Business, 26-100 employees	112,313	.091	0	.289	0	1
Business, 101-1000 employees	112,313	.180	0	.384	0	1
Business, 1000 – 5000 emp.	112,313	.179	0	.384	0	1
Business, 5000+ emp.	112,313	.342	0	.342	0	1
Turnover	112,313	.186	0	.390	0	1
Activities on the Job:						
Accounting, Finance, Contracts[a]	112,313	.264	0	.441	0	1
Applied Research[b]	112,313	.391	0	.488	0	1
Basic Research[b]	112,313	.161	0	.368	0	1
Computer Applications[b]	112,313	.483	0	.500	0	1
Development[b]	112,313	.393	0	.488	0	1
Design[b]	112,313	.408	0	.491	0	1
Employee Relations[a]	112,313	.316	0	.464	0	1
Managing or Supervising People[a]	112,313	.515	1	.500	0	1
Other	112,313	.056	0	.230	0	1
Production, Operations, and Maintenance[a]	112,313	.101	0	.301	0	1
Quality or Productivity Management[a]	112,313	.279	0	.448	0	1
Sales, Purchasing, or Marketing[a]	112,313	.321	0	.467	0	1
Professional Services[a]	112,313	.174	0	.379	0	1
Teaching	112,313	.094	0	.292	0	1
Employer Main Business						
Agriculture, Forestry, or Fishing	76,123	.020	0	.139	0	1
Biotechnology	76,123	.036	0	.187	0	1
Construction or Mining	76,123	.034	0	.182	0	1
Education / Public Admin. / Gov't	76,123	.004	0	.060	0	1
Finance, insurance or real estate	76,123	.059	0	.236	0	1
Health Services	76,123	.069	0	.253	0	1
Information technology	76,123	.167	0	.374	0	1
All other services	76,123	.062	0	.241	0	1
Manufacturing	76,123	.230	0	.421	0	1
Research	76,123	.092	0	.289	0	1
Transportation Services, Utilities, etc.	76,123	.056	0	.230	0	1
Wholesale or retail trade	76,123	.042	0	.200	0	1
Other	76,123	.124	0	.330	0	1

	Obs	*Mean*	*Median*	*Std Dev*	*Min*	*Max*
Location:						
New England	112,235	.074	0	.262	0	1
Mid Atlantic	112,235	.163	0	.368	0	1
South Atlantic	112,235	.160	0	.366	0	1
East North Central	112,235	.144	0	.351	0	1
West North Central	112,235	.061	0	.239	0	1
East South Central	112,235	.031	0	.173	0	1
West South Central	112,235	.096	0	.294	0	1
Mountain	112,235	.063	0	.243	0	1
Pacific	112,235	.209	0	.406	0	1

[a]These variables used to construct "commercial" activities measure.
[b]These variables used to construct "research" activities measure.

Note: The sample consists of individuals whose responses are included in the SESTAT restricted file in 1995, 1997, 1999, and the SDR in 2001 and who were at least 22 in 1995 and not more than 65 in 2001. Individuals who were not in the labor force in all relevant periods are eliminated from the sample. Individuals whose highest degrees were not in a science or engineering field are also eliminated from the sample, as are all individuals who reported working fewer than 30 hours per week on average and fewer than 30 weeks per year. Workers in government, university / research institutes, secondary or primary education, defense, and other non-profits are excluded.