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

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Scientists and engineers in small firms are far more likely than their large firm counterparts to enter entrepreneurship. We label this phenomenon the small firm effect and explore its origins. In particular, we identify four classes of explanations for the small firm effect—preference sorting, ability sorting, opportunity cost, and the possibility that workers in small firms develop entrepreneurial human capital—and examine the empirical evidence for each. We find that preference sorting does play 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: those who ultimately become entrepreneurs may be drawn first to small firms because they offer tighter pay-for-performance links and can subsequently improve their expected earnings by becoming entrepreneurs, or because the skills required for success in small firms are also valuable in entrepreneurship. Evidence suggests that although those with the very least to lose do enter entrepreneurship with greater frequency, opportunity cost has at best a modest role to play in explaining the small firm effect. Finally, we interpret evidence that prior experience in small firms predicts positive performance outcomes in the early stages of entrepreneurship as suggesting that workers in small firms may develop entrepreneurial human capital that makes them better entrepreneurs. This effect may be largest among those of high ability.

Key words: entrepreneurship; employee mobility; human capital; small firms; spawning
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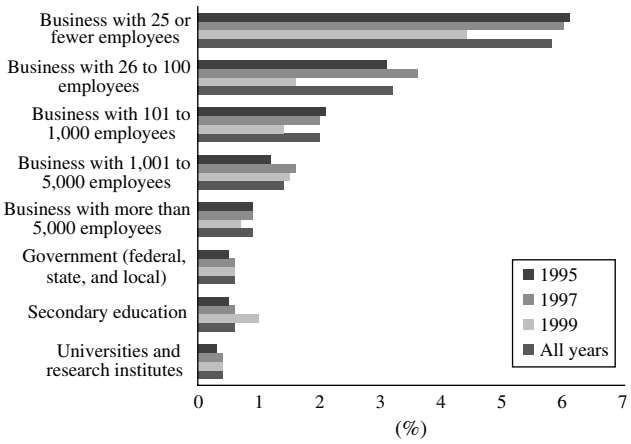
1. Introduction

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 and 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 workplace characteristics, including employer size, affect subsequent entrepreneurial activity. Recent studies in this area identify a robust inverse correlation between firm size and the propensity of employees to become entrepreneurs (Wagner 2004, Gompers et al. 2005, Dobrev and Barnett 2005, Sørensen 2007).[1] We uncover further evidence of the relationship between prior employment in a small firm and entry into self-employment—a phenomenon we label the small firm effect. The aim of this paper is to provide a theory-based structure for understanding the origins of this small firm effect and test these theories empirically. To perform these empirical tests, we use panel data on scientists and engineers covering 1995 to 2001 from the National Science Foundation's Scientist and Engineers Statistical Data System (SESTAT). Figure 1 highlights the differences in transition rates to entrepreneurship by employer size and type within this sample. Nearly half of all new ventures started by individuals in this sample came from respondents who were employed in firms of 100 or fewer employees in the prior period. Moreover, as Figure 1 shows, scientists and engineers working in firms with fewer than 25 employees were six times more likely than those working in firms with 5,000 or more employees to move to self-employment

[1] Earlier evidence of this relationship can be found in Boden (1996), which uses the Current Population Survey to address questions about gender differences in transitions to self-employment.

Figure 1 Transitions into Self-Employment (Two Years Later) by Employer Type



within the next two years, and those working in firms with 26 to 100 employees were three times more likely to do so. We also document a new feature of this small firm effect. Not only do small firms disproportionately spawn new entrepreneurs, but the new ventures they spawn are more successful on average than those spawned from larger firms. This paper seeks to both document and explain the causes of the small firm effect, i.e., the surprisingly large role that small firms play in spawning entrepreneurs.

The prior literature on the determinants of entrepreneurship suggests two categories of explanations for the small firm effect. These map neatly onto the standard distinction between selection and treatment effects. Selection-based explanations suggest that this small firm effect results from processes of sorting by individual attributes. To 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 shapes or alters those within small firms, enhancing their subsequent preferences for entrepreneurship. Moreover, within each of these 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 "performance-related" theories, because they yield predictions about productivity in small firms and start-ups, and the former subset "performance neutral," because they make no such statements. In this paper, we develop and empirically explore competing explanations for the small firm effect—explanations that differ along the two dimensions described: sorting versus environmental context and performance related versus performance neutral. 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 data set of science and engineering (S&E) 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 to 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 that attempt to represent the entire working population (e.g., Evans and Leighton 1989, Sørensen 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, although 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 individuals we analyze have all achieved at least a bachelor's degree in a science and engineering field, and in many cases have received Ph.D.'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 our results suggesting that small firms play an important performance-related role in generating not only numerous entrepreneurs, but also particularly successful ones. This is a key result, because 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 of their prior jobs, the more likely these workers are to become entrepreneurs. 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, even after controlling for ability (as measured by their previous wage) and prior activities on the job. We speculate that this may come from an increased capacity for opportunity recognition (Shane 2003), greater access to networks and resources that are valuable in entrepreneurship (Gompers et al. 2005, Stuart and Ding 2006), or better self-assessment of entrepreneurial talent.

The rest of this 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 versus nurture in explanations of entrepreneurship. The fundamental debate argues 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. Those with preferences for small firms may be precisely those who prefer to ultimately transition to entrepreneurship when the opportunity arises. Alternatively, 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 that enhance the performance of new ventures spawned from small firms.[2] These two dimensions, selection versus treatment explanations, and performance-enhancing versus performance-neutral explanations, suggest define four categories of theoretical explanation for the small firm effect, which we summarize in Figure 2. We develop each in greater detail in our discussion below.

2.1. Preference Sorting

One explanation for the small firm effect revolves around simple preference sorting. Perhaps entrepreneurship is more similar to employment in a small firm than it is to employment in a large firm. Thus, the same preferences that promote transitions to employment in small firms promote transitions to entrepreneurship. Small firms may attract individuals who, as a consequence of their individual preferences, receive greater nonpecuniary 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 2009, Benz and Frey 2008).[3] Alternatively, as suggested by Parker (2006), workers who are less averse to risk may find themselves working in small firms, and these same preferences may lead small firm employees into entrepreneurship when an appropriate opportunity arises. To summarize, these theories predict that individuals with preferences for risk or autonomy will disproportionately migrate into small firms and eventually into entrepreneurship. However, if only these types of preferences are at work, we should find no empirical relationship between prior small firm employment and subsequent entrepreneurial performance. We summarize the main prediction of

[2] 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.

[3] Sørensen's (2007) analysis seeks to demonstrate that the small firm effect is independent of precisely this type of sorting. Astebro and Thompson (2009) argue that entrepreneurs (and by extension individuals joining small firms) have tastes for variety and receive nonpecuniary 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."

Figure 2 Explanations for the Small Firm Effect

	PERFORMANCE NEUTRAL	PERFORMANCE ENHANCING
SORTING ("selection")	**1. Preference sorting** • Individuals with preferences for autonomy (or less risk aversion) transition to small firms and entrepreneurship	**2. Ability sorting** • Small firms more directly link pay to performance • High-ability employees select small firms to improve earnings; high-ability employees in small firms select entrepreneurship to further improve earnings • Labor markets match sector-specific ability to appropriate sectors; high ability in small firms more likely to succeed in entrepreneurship than high ability in large firms
CONTEXT ("treatment")	**3. Opportunity cost** • Employees of small firms receive low pay and are thus more likely to change jobs • Low-paid employees in small firms are more likely to try their luck in entrepreneurship	**4. Developing entrepreneurial human capital** • Small firms provide improved access to networks or valuable entrepreneurial resources • Small firms provide employees with broad skills (jacks-of-all-trades) that enable greater success in entrepreneurship • Individuals in small firms more likely to discover entrepreneurial opportunities

preference-sorting arguments in Quadrant 1 (Q1) of Figure 2: Individuals with preferences for autonomy are more likely to reside in small firms and more likely to transition to entrepreneurship.

2.2. Ability Sorting

Sorting may also occur on dimensions directly related to entrepreneurial performance. In particular, sorting may reflect innate ability, where ability influences the decisions to enter both small firms and self-employment, and is thus correlated with the subsequent performance of an entrepreneurial venture. Two ability-sorting arguments are relevant here. One argument suggests that those with generically high ability migrate to employment settings that tightly link pay and performance. By seeking settings that link pay and performance more closely, those with higher ability receive greater income. Small firms tend to link pay and performance more tightly than large firms (Garen 1985) and as a result may attract those of higher ability from large firms, especially in high-tech settings (Zenger 1994).[4] Entrepreneurship provides a setting that even more directly links pay to individual performance. The greater capacity of small firms to link pay and performance may reflect either lower measurement costs (Garen 1985, Holmstrom 1989) or lower costs of addressing social comparison concerns that arise as firms seek to differentially reward performance (Zenger 1994, Nickerson and Zenger 2008). Consequently, small firms may simply be stocked with a greater abundance of high-ability scientists and engineers lured by pay for performance, who then ultimately transition to self-employment where pay for performance reaches its limits.[5]

An alternative argument suggests that ability in an entrepreneurial venture is more highly correlated with demonstrated ability in a small firm than demonstrated ability in a large firm. This argument builds on the matching logic of Roy (1951) and Jovanovic (1979), where individuals with differing levels of sector-specific ability choose the employment or entrepreneurship state that yields the highest level of expected utility.[6] When an entrepreneurial opportunity emerges, those in small firms have greater entrepreneurial ability, and thus are more likely to migrate into entrepreneurship. Note that this argument, unlike the argument above, requires no assumption about the different compensation structures of small and large firms. Thus, we observe a disproportionate number of entrepreneurs emerging from employment in small firms merely because these firms are disproportionately stocked with those possessing the ability to succeed both in small firms and

[4] A related literature, typified by the work of Zucker et al. (1998), explores the role of superstar scientists in the genesis of high-tech spin-offs. Hellmann (2007) explores the role that firms' innovation policies—namely, ex ante commitments about whether to commercialize innovations not directly related to the firm's core business—play in the decisions by innovative employees to start their own firms.

[5] 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.

[6] 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.

in self-employment. Note, however, that this argument does not predict the migration of those with high ability in large firms into self-employment.

In Quadrant 2 (Q2) of Figure 2, we summarize the main predictions of ability sorting arguments: ability will predict sorting into small firms and into entrepreneurship, and the pattern of ability sorting into entrepreneurship may be more defined among those employed in small firms than those employed in large firms. Moreover, those of high ability who sort into self-employment will perform better in self-employment than those of low ability.

2.3. Opportunity Cost

Another category of explanation for the small firm effect is that small firms simply pay lower wages (Brown and Medoff 1989, Troske 1999), and thus small firm employees 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.[7] If this opportunity cost explanation is accurate, we expect transitions from small firms (or large firms) into entrepreneurship to be most prevalent among those who receive particularly low pay.

A related phenomenon that may explain higher rates of entrepreneurial transitions is the greater frequency with which workers from smaller firms change jobs. The negative relationship between firm size and labor turnover is well documented (Brown et al. 1990, Davis et al. 1996). Lower average wages at small firms offer one explanation for the 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 entering entrepreneurship from small firms experiencing higher subsequent performance in entrepreneurship.

The opportunity cost predictions, captured in Quadrant 3 (Q3) of Figure 2, are that generally higher turnover rates and low pay in small firms predict transitions to entrepreneurship.

2.4. Developing Entrepreneurial Human Capital

Our final explanatory category focuses on attributes of the small firm setting that may contribute not merely to entrepreneurial transitions, but to particularly successful transitions, i.e., to successful new ventures. Thus, relative to employees of large firms, 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 exposure to more heterogeneous information and contacts outside the firm (Dobrev and Barnett 2005, Shane 2003). The increased diversity of information and broader network access may promote greater capacity among those in small firms 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, and thereby explain the small firm effect.

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. Thus, entrepreneurship not only requires an entrepreneurial idea, but a more balanced, jack-of-all-trades set of skills. Working in a small firm may enable the employee to acquire a range of skills that is broader than that typically acquired in a large firm where tasks are more narrowly defined. This broader set of skills will be valuable in subsequent entrepreneurial ventures. Sørensen (2007) uses these arguments among others to explain his findings of a small firm entry effect. Similarly, Gompers et al. (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 coauthors 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.

Thus, our predictions captured in Quadrant 4 (Q4) of Figure 2 are that employees of small firms will have an increased propensity to enter self-employment

[7] Employees in small firms may also confront poorly developed internal labor markets, leaving them with limited opportunities for internal promotion or increased pay (Sørensen 2007).

and that entrepreneurs coming from small firms will be more successful than those from large firms, even after controlling for individual ability. This "treatment effect" reflects the greater accumulation of entrepreneurial human capital that occurs when working for a small firm.

3. Data

3.1. Constructing the Sample

We construct a sample of individuals with science and engineering degrees using data from 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. 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; the SESTAT reports a subsample 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 those who are not in the labor force in each year between 1995 and 2001 and further eliminate all those under age 22 or above age 65 in any year between 1995 and 2001. Together, these eliminations reduce the sample by roughly 10%.
- Because we use measures derived from annual salary in our analysis below, we wish to avoid confounding total pay with choices about working part-time versus 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 any individual who also holds a professional degree (such as an MD, JD, 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 0.01% 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. Although in the surveys that generated the 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 misreport 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 overreport 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 start-ups. 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 et al. 1987), as well as those who become subcontractors for their prior employers, and those who become owners in their prior firm. Overall, restricting our attention to only those entrepreneurial transitions that are corroborated with other survey data reduces the magnitude of the small firm effect somewhat. However, virtually all of the tests of theory

[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.

[10] Masters in Business Administration (MBA) degrees are not considered by the survey to be professional degrees, so Ph.D.'s 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 nonincorporated self-employed business.

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								
Business: 1–25 employees	29.3	6.1	31.6	6.0	23.1	4.4	29.4	5.8
Business: 26–100 employees	29.6	3.1	33.2	3.6	25.9	1.6	30.7	3.2
Business: 101–1,000 employees	26.0	2.1	30.3	2.0	26.1	1.4	27.8	2.0
Business: 1,001–5,000 employees	21.0	1.2	24.5	1.6	23.2	1.5	22.7	1.4
Business: 5,000 + employees	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 education	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. The 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, and 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.

that we report below have the same signs and similar significance levels when we utilize a more liberal definition of entrepreneurial transition.

3.2. Describing the Sample and the Small Firm Effect

We use all survey responses meeting the criteria described above to generate Table 1. Table 1 expands upon Figure 1 in the Introduction, illustrating both 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, and the likelihood that he or she 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.[12] The table shows that although turnover falls with firm size, the decline in the propensity to become an entrepreneur is much more dramatic. The rate of turnover at firms with 1–25 employees is almost double that at firms with more than 5,000 workers, but the propensity to become an entrepreneur is six times higher.

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, and is more likely to be white and have a Ph.D., but is less likely to be an engineer. Entrepreneurs engage in more commercial activities and are less likely to be engaged in research and development (R&D) activities. Because 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 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.

[12] Table A.1 in the appendix provides summary statistics of individual demographic, 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 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 are 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 14 "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 A.1. in the appendix.

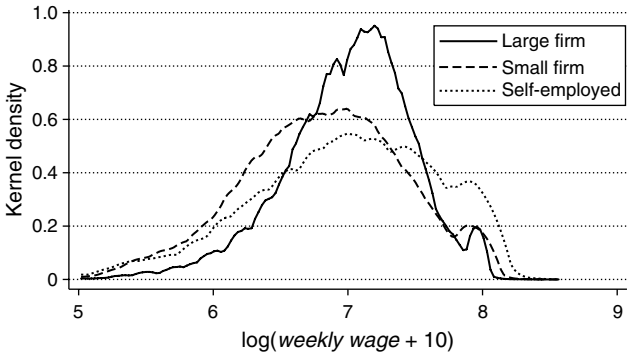
Table 2 Summary Statistics by Self-Employment Status and Firm Size

	Self-employed	1–25	26–100	100–1,000	1,000–5,000	5,000+
Age	46.0	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: Bachelor's	0.396	0.501	0.520	0.521	0.507	0.430
Highest degree: Master's	0.139	0.169	0.187	0.201	0.201	0.206
Highest degree: Ph.D.	0.464	0.329	0.293	0.278	0.291	0.364
HD field: Computer	0.075	0.101	0.112	0.122	0.140	0.144
HD field: Life science	0.200	0.181	0.166	0.155	0.140	0.108
HD field: Physical science	0.102	0.130	0.146	0.143	0.154	0.161
HD field: Social science	0.393	0.252	0.191	0.169	0.141	0.112
HD field: Engineering	0.231	0.336	0.384	0.411	0.424	0.479
White	0.816	0.772	0.747	0.723	0.727	0.714
Male	0.743	0.764	0.776	0.761	0.765	0.781
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	0.149	0.251	0.299	0.323	0.345	0.411
Want to be SE_{1997}	0.818	0.472	0.343	0.318	0.281	0.251
N	11,896	11,127	10,273	20,193	15,193	43,631

Notes. The sample consists of individuals whose responses are included in the SESTAT restricted file in 1995, 1997, and 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. HD, Highest degree.

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.

Figure 3 Distributions of Weekly Wages in Large Firms, Small Firms, and Self-Employed



Notes. Large firms are for-profit enterprises with more than 100 employees. Small firms are for-profit enterprises with 100 or fewer employees. Yearly salaries, top coded at $150,000, are used to compute the log of *weekly wage*. *Weekly wage* is computed as total salary divided by number of weeks worked.

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 5,000 + employees, suggesting substantial differences in the opportunity cost of self-employment. However, these median differences hide substantial differences in the distributions of pay. Figure 3 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).

4. Analysis

In this section, we look for empirical support for each of the four categories of explanation for the small firm effect. Figure 4 summarizes the empirical predictions from the theory that we are able to test. We begin

Figure 4 Empirical Predictions by Quadrant

	PERFORMANCE NEUTRAL	PERFORMANCE ENHANCING
SORTING ("selection")	**1. Preference sorting** • Individuals with preferences for autonomy will transition from paid employment to self-employment • Transitioning to entrepreneurship from a small firm rather than a large firm will not influence performance in entrepreneurship	**2. Ability sorting** • Employees of high ability are likely to transition from large firms to small firms • Employees of high ability are particularly likely to transition from paid employment to entrepreneurship • High performance in small firms is more likely to predict transitions to self-employment than high performance in large firms • High-ability employees will enjoy better performance in entrepreneurship than low-ability employees
CONTEXT ("treatment")	**3. Opportunity cost** • The higher rate of transitions from small firms to entrepreneurship reflects the higher rate of job changing (of any form) among employees of small firms • Controlling for the higher rate of job changing among employees of small firms, low pay will predict transitions to entrepreneurship • Transitioning to entrepreneurship from a small firm rather than a large firm will not influence performance in entrepreneurship	**4. Developing entrepreneurial human capital** • Employees in small firms will perform a wider range of commercial activities than employees of large firms • Performing a broader range of activities in paid employment will predict transitions to entrepreneurship • Controlling for ability as measured by prior pay, prior employment in a small firm will lead to higher performance in entrepreneurship

by examining the determinants of individual transitions into self-employment and transitions into self-employment and other employment states using probit and multinomial logit frameworks, respectively. This analysis sheds light on the predictions in each of the four quadrants in Figures 2 and 4. Next we examine the wages of workers in paid employment to further explore the ability sorting predictions in Q2 of Figures 2 and 4. Third, we explore the performance of new entrepreneurs to examine the predictions in Q2 and Q4. We conclude the analysis section by attempting to control for selection effects that might explain the differential performance results.

4.1. Examining 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) differences in preferences for autonomy or self-employment, which may be stronger among workers in smaller firms (Q1); (b) opportunity cost differences in leaving self-employment for paid employment, which could be relevant if small firms pay less than large firms (Q3); (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 (Q2); (d) differences in activities on the job across small and large firms (Q4); or (e) differences in the frequency with which employees of small and large firms change jobs (Q3). To explore these issues, we estimate the following model:

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

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, job activity variables that consist of measures of the diversity of activities pursued on the job, and 14 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 $p < 0.001$ level. This analysis also shows that older workers are more likely to make the transition to self-employment, whereas longer tenured employees are less likely to move into self-employment. Although statistically significant, these coefficients are small in impact when compared to the firm size effect.

We now turn to examining our four categories of hypotheses. We first explore opportunity cost explanations for the differences in transitions into entrepreneurship. The summary statistics in Table 2 (and Figure 3) show that small firm employees receive, on average, lower wages than those in larger firms. The discussion in §2.3 argued that because small firms pay less, they may spawn more entrepreneurs due to the lower opportunity cost of self-employment entry for employees of small firms. If this argument is correct, then transitions to entrepreneurship should be particularly prevalent among those who earn low wages. Thus, 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.[13] Comparison of the firm size coefficients in column (2) with those in column (1) of Table 3 indicates that differences in pay by firm size 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.[14]

It is possible, however, that ability sorting is confounding our efforts to examine the opportunity cost explanation. In particular, highly paid, high-ability employees *and* very low-paid, low-ability workers may both disproportionately transition to self-employment, but for different reasons. Column (3) of Table 3 provides an initial attempt at jointly testing theses hypotheses. As a proxy for ability, we use a given worker's position within the pay distribution 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 Ph.D.'s 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% of the wage distribution. Our results show that employees in the highest decile are 30% 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% more likely to enter self-employment in the subsequent period, although these differences are only marginally statistically significant ($p < 0.1$).

The relatively high rate of entrepreneurial entry among workers in the lowest quintile of the wage distribution is consistent with the opportunity cost explanation—low-paid, lower-ability workers 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 become entrepreneurs. Consistent with Q3 arguments of ability sorting, these higher-ability individuals may be drawn into entrepreneurship by the relatively higher returns to ability that entrepreneurship provides. Note, however, that the inclusion of the wage decile indicators cannot explain the small firm effect, suggesting that other factors associated with firm size (such as human capital accumulation) remain important.

[13] 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.

[14] 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 are available from the authors upon request.

Table 3 Analysis of Transitions into Self-Employment from Paid Employment

Description:	Baseline	Opportunity cost: Wages	Ability sorting and opportunity cost: Low wages	Jack-of-all-trades	Jack-of-all-trades: Nonlinear	Jack-of-all-trades: Full activity vector	Preference sorting: Desire to be SE	Opportunity cost: High turnover	Robustness
Specification:	Probit (marginal effects)							Multinomial logit	
Dependent variable:	SE_{t+2} (1)	SE_{t+2} (2)	SE_{t+2} (3)	SE_{t+2} (4)	SE_{t+2} (5)	SE_{t+2} (6)	SE_{t+2} (7)	*New employer*$_{t+2}$ (8a)	SE_{t+2} (8b)
Firm size: 1–25$_t$	0.0507***	0.0513***	0.0493***	0.0469***	0.0468***	0.0428***	0.0288***	0.3718***	1.4309***
	(0.0045)	(0.0045)	(0.0045)	(0.0044)	(0.0044)	(0.0042)	(0.0034)	(0.0440)	(0.1116)
Firm size: 26–100$_t$	0.0262***	0.0263***	0.0256***	0.0244***	0.0244***	0.0229***	0.0183***	0.5933***	1.1659***
	(0.0036)	(0.0036)	(0.0036)	(0.0035)	(0.0035)	(0.0034)	(0.0030)	(0.0416)	(0.1210)
Firm size: 101–1,000$_t$	0.0119***	0.0120***	0.0118***	0.0113***	0.0113***	0.0107***	0.0084***	0.5000***	0.7356***
	(0.0022)	(0.0022)	(0.0022)	(0.0021)	(0.0021)	(0.0021)	(0.0018)	(0.0334)	(0.1125)
Firm size: 1,001–5,000$_t$	0.0066***	0.0066***	0.0065***	0.0062**	0.0062**	0.0057**	0.0049**	0.3346***	0.4449***
	(0.0022)	(0.0022)	(0.0022)	(0.0022)	(0.0022)	(0.0021)	(0.0018)	(0.0371)	(0.1304)
Age$_{t+2}$	0.0006*	0.0005†	0.0005†	0.0005†	0.0005†	0.0004†	0.0005*	−0.0399***	0.0277
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0065)	(0.0179)
Age$^2_{t+2}$ ∗ 100	−0.0004	−0.0003	−0.0004	−0.0004	−0.0004	−0.0004	−0.0005	0.0298*	−0.0338
	(0.0005)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0005)	(0.0148)	(0.0389)
Job tenure$_t$	−0.0010***	−0.0010***	−0.0010***	−0.0010***	−0.0010***	−0.0010***	−0.0009***	−0.1255***	−0.0948***
	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0063)	(0.0155)
Job tenure$_t^2$ ∗ 100	0.0031***	0.0031***	0.0029***	0.0030***	0.0030***	0.0030***	0.0026***	0.2882***	0.2846***
	(0.0008)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0008)	(0.0276)	(0.0598)
log *weekly wage*$_t$		0.0009							
		(0.0011)							
Weekly wage decile$_t$ = 1 (lowest)			0.0047†	0.0045†	0.0040†	0.0043†	0.0037†	0.5825***	0.4658***
			(0.0028)	(0.0027)	(0.0027)	(0.0027)	(0.0023)	(0.0552)	(0.1427)
Weekly wage decile$_t$ = 2			0.0043†	0.0040†	0.0038†	0.0038†	0.0038†	0.3319***	0.3864**
			(0.0025)	(0.0025)	(0.0025)	(0.0024)	(0.0022)	(0.0503)	(0.1382)
Weekly wage decile$_t$ = 9			0.0021	0.0018	0.0018	0.0019	0.0018	−0.0130	0.1459
			(0.0018)	(0.0018)	(0.0018)	(0.0017)	(0.0015)	(0.0415)	(0.1123)
Weekly wage decile$_t$ = 10 (highest)			0.0059***	0.0049**	0.0049**	0.0051**	0.0037**	−0.0523	0.2653*
			(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0015)	(0.0442)	(0.1025)
No. of commercial activities$_t$				0.0009**					
				(0.0003)					
No. of research activities$_t$				−0.0006					
				(0.0004)					
Commercial activities = 1					0.0008				
					(0.0017)				
Commercial activities = 2					0.0027				
					(0.0019)				
Commercial activities = 3					0.0018				
					(0.0020)				
Commercial activities = 4 or more					0.0046*				
					(0.0021)				
R&D activities = 1					−0.0030*				
					(0.0014)				
R&D activities = 2					−0.0033*				
					(0.0015)				
R&D activities = 3					−0.0028†				
					(0.0015)				
R&D activities = 4 or more					−0.0030†				
					(0.0017)				
Commercial activity dummies$_t$						Y***	Y*	Y**	Y†
Research activity dummies$_t$						Y*	Y†	Y***	Y*
Want to be SE$_{1997}$							0.0261***	0.1886***	1.5255***
							(0.0016)	(0.0275)	(0.0774)
Observed P.	0.0192	0.0192	0.0192	0.0192	0.0192	0.0192	0.0193	0.2131	0.0193
N	47,106	47,106	47,106	47,106	47,106	47,106	45,176	45,232	
log pseudolikelihood	−4,157.4	−4,157.1	−4,149.5	−4,144.5	−41,270.0	−41,270.0	−3,764.6	−24,316.2	
Pseudo-R^2	0.0705	0.0706	0.0723	0.0734	0.0739	0.0768	0.1241	0.0898	

Notes. 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 5,000 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*. Additionally, regressions 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, Ph.D.), and for the *region in which the respondent worked* in year t. "Observed P." is the frequency with which the dependent variable takes on the value 1 in the sample under analysis. This corresponds to the probability that any individual in paid employment in the sample will become self-employed in the next period. "Y" designates where the full set of commercial activity dummy variables and research dummy variables were included in the regression analysis. The significance levels reported for these sets of dummy variables are from joint tests that all coefficients are equal to 0.

†Significant at $p \leq 0.1$; *significant at $p \leq 0.05$; **significant at $p \leq 0.01$; ***significant at $p \leq 0.001$ (two-sided tests).

We next examine whether the small firm effect can be explained by greater human capital accumulation (Q4). Specifically, we examine a "jack-of-all-trades" hypothesis, i.e., small firms provide greater opportunity to accumulate the broad array of skills that are valuable in self-employment. Table 2 clearly indicates that in this sample, workers in small firms are engaged in a wider array of commercial (business-related) activities, and a narrower array of specialized 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 (4) of Table 3 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 (5) allows the *count of commercial and R&D activities* to vary nonmonotonically; 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, whereas 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 to be productive. Column (6) of Table 3 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%. In sum, this analysis has two main implications: First, consistent with Lazear's (2005) theory, 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.[15] 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 (7) of Table 3 address the issue of preference sorting as an explanation (Q1 in Figure 2) for the small firm effect. We include in this specification variables that account for all of the effects for which we tested above. Thus, our question here is whether simple preferences for self-employment influence future transitions into self-employment above and beyond these other factors. We include a dummy variable indicating that the worker chose self-employment as their most desired type of working arrangement in the model. Because this question was asked only 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. Although 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%. 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 data set 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, although 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.

In the last two columns, we explore the robustness of the prior findings to incorporating an individual's decision to change jobs as well as to enter into self-employment. This analysis also allows us to compare the degree to which differential rates of turnover or job switching may explain the small firm effect Q3 of Figures 2 and 4. 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 choices (2) and (3) to be approximately equal. Columns (8a) and (8b) of Table 3 present the results of this specification. Comparison of the firm size coefficients in these columns shows that the relationship between firm size and

[15] This finding is also consistent with Astebro and Thompson's (2009) argument that an individual who prefers a diversity of tasks (and hence is a "jack-of-all-trades") is more likely to become an entrepreneur.

changing employers 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 5,000 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 columns (2)–(7) in Table 3. Also noteworthy is the relationship between pay in period t and the likelihood of subsequently changing jobs versus subsequently entering into self-employment. We see that whereas only those in the bottom of the pay distribution are more likely to change employers, 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. We also test for the effect of *preferences for self-employment*. 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.[16]

[16] As a further robustness check, we examined the possibility that the small firm effect reflects the correlation between firm size and industry that may arise if small firms are concentrated in industries (such as information technology) that also experience substantial entry. Additionally, because 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. Entrepreneurial transitions made within the same industry may reflect the use of different types of human capital than entrepreneurial transitions across industries (Braguinsky et al. 2009). For example, within-industry transitions are more likely to reflect opportunity recognition or access to networks or resources acquired in the prior job than are transitions to a new industry that may only utilize general management skill acquired in the prior job. Thus, we reestimate the multinomial logit model in Table 4, expanding the choice set to include transitions in period $t+2$ where the individual remains in the same industry as in period t versus transitions in which the individual also changes industries. The results in the appendix, Table A.2, show that the small firm effect remains robust after incorporating industry controls and distinguishing between within- and across-industry transitions. 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. Low-ability workers (those in the lowest pay decile) are more likely to enter self-employment either in the same or different industry compared to those in the middle. By contrast, high-ability workers (those in the top pay decile) are significantly more likely to start a new venture within the same industry; this effect, though positive, is not significant for the decision to start a business in a different industry. Individuals appear to recognize their industry-specific ability and make informed choices regarding whether to remain with or leave their current employer and industry. More importantly, this analysis suggests that the small firm effect is not merely an industry effect. The fact that firm size relates most strongly to within-industry transitions (and that these transitions tend to be favored among high-ability workers) provides some support for the contextual explanations for the small firm effect.

4.2. Examining Ability Sorting by Investigating Differences in Paid Employment Wages

In Table 3 above, we find preliminary evidence that both high- and low-ability workers are more likely to transition into self-employment. In this section, we further investigate the predictions of the ability sorting models (summarized in Q2 of Figure 2) that high-ability workers in large firms will move to small firms, and that these high-ability workers subsequently are more likely to become entrepreneurs. We test these predictions by estimating "preprogram" regressions (Heckman and Hotz 1989) that compare the period t wages of "movers," individuals who change sectors in $t+2$, with those of "stayers," individuals who do not change sectors. These regressions take the form

$$PAY_{it} = \alpha + \beta \mathbf{X}_i + \gamma \mathbf{Z}_{it} + \delta MOVER_{i,t+2} + \mu_{d(i)t} + \zeta_{it}, \quad (2)$$

where PAY_{it} is individual i's pay at time t, measured by the log of the weekly wage, $MOVER_{i,t+2}$ indicates whether worker i changes sectors between period t and $t+2$, and $\mathbf{X}_i$, $\mathbf{Z}_{it}$, and $\mu_{d(i)t}$ are defined as in §4.1. Because we are particularly interested in behavior at the top and bottom of the pay distribution, we estimate Equation (2) via simultaneous quantile regression for the 10th, 25th, 50th, 75th, and 90th percentiles. We interpret an individual's pay in the present period as a reflection of the ability of the worker in paid employment. Therefore, a positive and significant δ in the 90th percentile regression, for example, indicates that the 90th percentile of the current pay distribution for future movers is higher than that for stayers, controlling for other factors. This would imply positive selection of high- ability workers into entrepreneurship.

We estimate two sets of quantile regressions using Equation (2). First, we limit the sample to workers in large firms and examine whether high-ability workers in these firms systematically sort into small firms. To simplify the analysis, we define small firms as firms with 100 or fewer employees and larger firms as firms

Table 4 Simultaneous Quantile Regression of log(*Weekly Wage*) **on Determinants of Pay Among Stayers and Movers**

	Percentile				
	10th	25th	50th	75th	90th
Model 1					
Moves to small firm in next period (dummy)	−0.0258	−0.0369**	−0.0068	0.0040	0.0501*
	(0.0164)	(0.0107)	(0.0080)	(0.0102)	(0.0221)
N			37,489		
Pseudo-R^2	0.2979	0.3199	0.3122	0.2818	0.2542
Model 2					
Small firm (dummy)	−0.2345***	−0.1697***	−0.1102***	−0.0640***	−0.0052
	(0.0102)	(0.0074)	(0.0050)	(0.0059)	(0.0106)
Moves to SE in next period (dummy)	−0.1485**	−0.0459*	0.0098	0.0473**	0.0726*
	(0.0460)	(0.0189)	(0.0213)	(0.0160)	(0.0318)
N			46,319		
Pseudo-R^2	0.2941	0.3190	0.3092	0.2767	0.2485
Model 3					
Small firm (dummy)	−0.2311***	−0.1677***	−0.1102***	−0.0647***	0.0070
	(0.0098)	(0.0075)	(0.0050)	(0.0062)	(0.0116)
Moves to SE in next period (dummy)	−0.0912**	−0.0296	0.0117	0.0322†	0.0386
	(0.0425)	(0.0189)	(0.0179)	(0.0181)	(0.0304)
Small firm (dummy) × moves to SE in next period (dummy)	−0.1675*	−0.0678	−0.0018	0.0339	0.0940†
	(0.0842)	(0.0481)	(0.0326)	(0.0357)	(0.0521)
N			46,319		
Pseudo-R^2	0.2943	0.3191	0.3092	0.2767	0.2486

Notes. In Model 1, the sample consists of all members of the sample employed in a large firm (100 or more employees) at time t. In Models 2 and 3, the sample consists of all members of the pooled sample in paid employment in a for-profit business in period t except those who reported transitions that are not corroborated by other survey data (as discussed in §3.1). The dependent variable is the log of *weekly wage* (salary divided by number of weeks worked). 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), year-degree dummies, 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. Bootstrap standard errors are in parentheses.

†Significant at $p < 0.1$; *significant at $p < 0.05$; **significant at $p < 0.01$; ***significant at $p < 0.001$ (two-sided tests).

with 100 or more employees. In the first specification, the variable $MOVER_{i,t+2}$ equals 1 if worker i joins a small firm in period $t+2$, and 0 if the worker remains in a large firm. The coefficient estimates in Model 1 of Table 4 confirm the prediction that "stars" in large firms move to small firms: At the 90th percentile, workers in large firms who subsequently move to small firms earn 5.0% ($p < 0.05$) more than their counterparts who remain at large firms. The negative and significant estimate at the 25th percentile suggests that individuals moving from large to small firms are also more likely to be low-ability workers.

Having established that high-ability workers in large firms sort into small firms, we next examine the prediction that high-ability workers systematically sort into entrepreneurship. For this analysis, we use the full sample of paid employees in small and large firms at period t, and define $MOVER_{i,t+2}$ to equal SE_{it+2} (i.e., worker i enters self-employment in period $t+2$). To control for firm-size wage effects, we also include an indicator for employment in a small firm in period t. Model 2 in Table 4 confirms that individuals entering self-employment tend to come from the top and bottom of the paid-employment wage distribution. For example, at the 90th percentile, movers earned 7.3% more ($p < 0.05$) than stayers, whereas at the 10th percentile movers earned 14.9% less ($p < 0.05$). However, Model 3 in Table 4 suggests that this pattern of selection into entrepreneurship may vary by firm size. We include an interaction between employment in a small firm at period t and SE_{it+2} to test for differences in sorting into entrepreneurship between small and large firms. Although there is moderate evidence of positive selection from large firms into entrepreneurship (e.g., workers leaving large firms earn 3.2% ($p < 0.1$) more at the 75th percentile than their counterparts remaining in paid employment), the sorting of both high- and low-ability workers from small firms is much more pronounced. For example, future entrepreneurs from small firms earned 9.4% more ($p < 0.1$) at the 90th percentile than future entrepreneurs from large firms, implying small firm "stars" are more likely to become self-employed. On the other hand, small firm employees leaving for self-employment earn 16.8%

($p < 0.05$) less at the 10th percentile of the pay distribution compared to workers leaving large firms.

Our analysis thus suggests that large firms play a role in "feeding" high-ability workers into small firms where higher rewards for ability are present. High-ability workers are also generally more likely to migrate from paid employment into entrepreneurship, where rewards for high ability are greatest. However, this effect is considerably more pronounced among those departing small firms. This latter finding provides some evidence of a process of matching in regard to ability sorting (Roy 1951, Jovanovic 1979). Thus, high-ability workers in small firms are matched to entrepreneurship with greater frequency than high-ability workers in large firms.

4.3. Performance in Early Stages of Self-Employment

We now turn to an analysis of the performance implications of the small firm effect. Two of our categories of explanations (Q2 and Q4) suggest a positive relationship between prior employment in a small firm and the performance of the resulting venture. 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

$$PERF_{it} = \alpha + \beta \mathbf{X}_i + \gamma \mathbf{Z}_{i,\,t-2} + \rho \mathbf{FSIZE}_{i,\,t-2} + \theta \log(wage_{i,\,t-2}) + \nu_{it}, \quad (3)$$

where $PERF_{it}$ is the measure of entrepreneurial performance, $\mathbf{X}_i$ and $\mathbf{Z}_{it-2}$ are as defined above, and $\mathbf{FSIZE}_{i,\,t-2}$ 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 (3) 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 and (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 5 reports estimates of Equation (3) 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 the initial pecuniary return in entrepreneurship is unrelated to the size of the previous employer. This is not surprising given our finding that employees from both the top and bottom of the pay distribution in small firms sort into self-employment. 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% more than those entering entrepreneurship from firms of size 5,000 or more. The firm size effect, however, is nonmonotonic. Workers coming from firms of 101 to 1,000 employees have a similar wage differential as those coming from the smallest firms.[17] Because we control for ability with prior pay, these results suggest that some firm-specific transformation occurs in small firms that promotes higher performance in self-employment.

Column (3) explores whether the small firm effect on performance can be explained by the jack-of-all-trades logic. We add measures of the breadth of activities on the job, but surprisingly, these measures have little impact on the relative pay of workers from 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 become jacks-of-all-trades, rather than jacks-of-all-trades transforming themselves into entrepreneurs (Astebro and Thompson 2009). Another possibility is that the jack-of-all-trades effect is fully captured by

[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.

[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.

Table 5 Censored-Normal Regression Analysis of First Period Self-Employment Earnings by Size of Previous Employer

	Subset								
	Entire sample			Top half of wage earners$_{t-2}$			Bottom half of wage earners$_{t-2}$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Firm size: 1–25$_{t-2}$	−0.0146	0.2307*	0.2354*	0.3982**	0.3973**	0.4234**	−0.0504	0.0594	0.0351
	(0.1097)	(0.1051)	(0.1061)	(0.1442)	(0.1423)	(0.1428)	(0.1644)	(0.1600)	(0.1618)
Firm size: 26–100$_{t-2}$	−0.0948	0.0363	0.0379	0.1057	0.0803	0.1143	−0.0958	−0.0354	−0.0583
	(0.1295)	(0.1220)	(0.1231)	(0.1611)	(0.1592)	(0.1602)	(0.1952)	(0.1887)	(0.1895)
Firm size: 101–1,000$_{t-2}$	0.1421	0.2688*	0.2685*	0.2494	0.2786†	0.3173*	0.1922	0.2386	0.2155
	(0.1213)	(0.1144)	(0.1150)	(0.1516)	(0.1509)	(0.1505)	(0.1863)	(0.1800)	(0.1808)
Firm size: 1,001–5,000$_{t-2}$	−0.0197	−0.0128	−0.0179	−0.0026	0.0059	0.0144	−0.1582	−0.1542	−0.1815
	(0.1375)	(0.1302)	(0.1297)	(0.1589)	(0.1567)	(0.1569)	(0.2398)	(0.2315)	(0.2322)
log(*weekly wage*) $_{t-2}$		0.6640***	0.6663***		0.9192***	0.9414***		0.4210***	0.4263***
		(0.0549)	(0.0550)		(0.1731)	(0.1728)		(0.0737)	(0.0744)
No. of comm. activities$_{t-2}$			−0.0209			−0.0658†			0.0233
			(0.0261)			(0.0341)			(0.0400)
No. of res. activities$_{t-2}$			−0.0220			0.0037			−0.0490
			(0.0305)			(0.0409)			(0.0443)
Industry dummies$_t$	Y**	Y**	Y**	Y†	Y†	Y†	Y**	Y**	Y**
N	1,152	1,152	1,152	665	665	665	487	487	487
log likelihood	−1,801.2	−17,31.0	−1,730.4	−989.0	−974.8	−972.9	−696.2	−694.0	−693.2
Pseudo-R^2	0.0568	0.0936	0.0939	0.0594	0.0729	0.0746	0.1097	0.1126	0.1135

Notes. The sample consists of all members of the sample who moved from employment in a for-profit business to self-employment. The dependent variable is the log of pay 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. "Y" designates that dummy variables were included for the 13 "employer main business" classifications reported in Table A.1. The significance levels reported for this set of dummy variables are from a joint test that all coefficients are equal to 0.

†Significant at $p \leq 0.1$; *significant at $p \leq 0.05$; **significant at $p \leq 0.01$; ***significant at $p \leq 0.001$ (two-sided tests).

the prior pay measure. In other words, large and small firms pay for these broader skills.

Our previous results suggested that entrepreneurship attracts both high and low performers from paid employment. To investigate the possibility that small firm experience has a differential impact on high-ability versus low-ability workers, we divide the sample into two groups—those who earned more than the median for their education type in year $t-2$ and those who earned 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)–(6), for those entrepreneurs who were among the top half of wage earners in paid employment, prior experience in small firms is associated with significantly higher initial returns in self-employment compared to prior experience in a large firm. 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. Therefore, stars in paid employment appear to gain particularly valuable human capital from employment in small firms. By contrast, columns (7)–(9) show that for those coming from the bottom half of the wage distribution, initial pecuniary returns in entrepreneurship are unrelated to prior firm size. Additionally, there is a much weaker relationship between these employees' 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 human capital 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. Our analysis thus supports both ability sorting (Q2) and human capital accumulation (Q4) as explanations for the small firm effect.

Table 6 reports the results of analyses for the remaining performance measures. In columns (1)–(3), we investigate the decision to enter self-employment as an incorporated entity using a probit analysis. In this case, $PERF_{it}$ 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 5. As above, column (1)

Table 6 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		
	(1)	(2)	(3)	(4)	(5)	(6)
Firm size: 1–25$_{t-2}$	−0.0015	0.0272	0.0450	0.3624***	0.4608***	0.3844***
	(0.0430)	(0.0439)	(0.0447)	(0.1066)	(0.1089)	(0.1117)
Firm size: 26–100$_{t-2}$	−0.0523	−0.0372	−0.0143	0.3078*	0.3456**	0.2951*
	(0.0506)	(0.0512)	(0.0522)	(0.1250)	(0.1259)	(0.1285)
Firm size: 101–1,000$_{t-2}$	−0.0623	−0.0479	−0.0299	0.2074†	0.2546*	0.2257†
	(0.0474)	(0.0479)	(0.0486)	(0.1192)	(0.1198)	(0.1219)
Firm size: 1,001–5,000$_{t-2}$	−0.0132	−0.0104	0.0071	0.1569	0.1578	0.1604
	(0.0547)	(0.0549)	(0.0555)	(0.1367)	(0.1372)	(0.1392)
log(*weekly wage*)$_{t-2}$		0.0759***	0.0631**		0.2681***	0.2116***
		(0.0234)	(0.0238)		(0.0577)	(0.0589)
No. of comm. activities$_{t-2}$			−0.0030			0.1791***
			(0.0112)			(0.0267)
No. of res. activities$_{t-2}$			0.0544***			0.0771*
			(0.0127)			(0.0302)
Industry dummies$_t$	Y***	Y***	Y**	Y**	Y***	Y**
N	1,155	1,155	1,155	1,155	1,155	1,155
Observed P.	0.4736	0.4736	0.4736			
log likelihood	−766.5	−761.1	−751.1	−1,019.8	−1,008.7	−982.0
Pseudo-R^2	0.0407	0.0474	0.0589	0.0436	0.0540	0.0790

Notes. 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 *no. of comm. activities* is the count of commercial activities performed by the individual in his job prior to entering self-employment, and *no. of 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. "Observed P." is the frequency with which the dependent variable takes on the value 1 in the sample under analysis. This corresponds to the probability that an entrant into self-employment begins an incorporated venture. "Y" designates that dummy variables were included for the 13 "employer main business" classifications reported in Table A.1. The significance levels reported for this set of dummy variables are from a joint test that all coefficients are equal to 0.

†Significant at $p \leq 0.1$; *significant at $p \leq 0.05$; **significant at $p \leq 0.01$; ***significant at $p \leq 0.001$ (two-sided tests).

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. Across the specifications, the industry controls are significant in predicting whether new entrepreneurs choose to incorporate. We find no clear relationship emerging between firm size and the decision to incorporate, nor do we find 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 (4)–(6) of Table 6, 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] In the first period of self-employment, 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 (3) 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 current business, and this result is particularly pronounced for the range of commercial activities performed in the prior job. Finally, we note that,

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

unlike the evidence reported in Table 5, the firm size effect on the number of direct reports is monotonically decreasing in firm size. These results are thus consistent with the Q4 hypothesis that small firms provide forms of human capital that are critical in self-employment. We find those previously employed in small firms found more successful ventures as measured by pay and number of employees. We also find that success is a function of prior ability as measured by prior pay.

4.4. Accounting for Selection on Observables in Early Stage Performance

The results in Tables 5 and 6 imply that firms with 1–25 employees spawn new ventures that initially are 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. 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 (3)).[20] To account for the potential nonrandom selection into small firms implied by explanation (b), we reestimate the performance Equation (3) adopting the inverse propensity score weighting methods discussed in Hirano and Imbens (2001) and Wooldridge (2007).[21] These methods allow us to more fully capture nonrandom selection based on observed characteristics. Although 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 5, 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 7. 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 ordinary least squares (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 nonrandom 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 significant at $p < 0.1$ and $p < 0.05$ 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 7 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 §§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. Although sorting may be an important explanation, some of the small firm effect on performance appears to reflect the accumulation

[20] Explanation (b) implies $\text{cov}(\mathbf{FSIZE}_{i,t-2}, \nu_{it}) > 0$ in Equation (3).

[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 $\mathbf{X}_i$ and $\mathbf{Z}_{it-2}$ as covariates. In the second step, Equation (2) is reestimated 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 (2001) provide a clear introduction to these methods.

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

Table 7 Inverse Propensity Score Weighted Analysis of Initial Entrepreneurial Performance

Row	Dependent variable	Baseline (no selection correction) (1)	Average treatment (2)	Treatment on treated (3)	*N*
(1)	$\log(Pay_t)$ *Entire sample* (OLS)	0.1239†	0.1090	0.0949	1,152
		(0.0738)	(0.0741)	(0.0846)	
(2)	$\log(Pay_t)$ *Top half of wage earners*$_{t-2}$ (OLS)	0.2751*	0.2155*	0.2278**	665
		(0.1060)	(0.0709)	(0.0882)	
(3)	$\log(Pay_t)$ *Bottom half of wage earners*$_{t-2}$ (OLS)	0.0043	0.0828	0.0864	487
		(0.1108)	(0.1037)	(0.1218)	
(4)	*Entry as incorporated entity* (linear probability)	0.0504	0.0637†	0.0718*	1,155
		(0.0317)	(0.0334)	(0.0341)	
(5)	*Entry size* (OLS)	0.1335**	0.1066*	0.1152*	1,155
		(0.0425)	(0.0471)	(0.0504)	

Notes. Figures in the table represent the coefficients and standard errors (in parentheses) associated with prior employment in a firm with 25 or fewer employees. 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 pay 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, or 5 if the respondent had 5–16, 17–64, or 65 or more direct reports, respectively. Coefficients are reported on a dummy variable indicating whether the entrepreneur came from a firm of 25 employees or fewer. Propensity scores for being in this small firm category (25 or fewer employees) are estimated using variables from $t-2$ including age, education, gender, job tenure, salary, and location variables.

†Significant at $p \leq 0.1$; *significant at $p \leq 0.05$; **significant at $p \leq 0.01$ (two-sided tests).

of human capital that is valuable once the individual starts a new venture. Small firms spawn more entrepreneurs in part because workers from small firms recognize that they can simply earn higher returns in self-employment.[23]

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 "performance-enhancing" and "performance-neutral" explanations as well. Of course, we are particularly interested in explanations for the small firm effect that include a "performance-enhancing" role for prior employment in small firms, because we are among the first to demonstrate evidence of just such a role. Although individuals may receive utility from working in small firms or being their own boss, or both, these considerations may be secondary to those that suggest that small firms help generate more productive entrepreneurs. Hence, the small firm effect may reflect the increased expectation of success in self-employment that those employed in small firms accurately perceive. This distinction is important for policy makers who design institutions such as the Small Business Administration, nonprofits and others that seek to promote entrepreneurship, and educators and mentors who advise those who seek to become entrepreneurs.

We identified and examined four categories of explanation for the small firm effect—preference sorting (Q1), ability sorting (Q2), opportunity cost (Q3), and development of entrepreneurial human capital (Q4). We find evidence consistent with each of these. Thus, consistent with preference sorting (Q1), scientists and engineers in small firms are more

[23] In the preceding analysis, we focus on entry into self-employment as the entrepreneurial transition of interest. When we expand the definition of entrepreneurial entry to include transitions to newly founded (or to focus entirely on these transitions) small firms of 25 employees or fewer, the results that we find are largely unchanged. We continue to find evidence of a small firm affect using these definitions of entrepreneurial transitions, and we continue to find evidence strongly consistent with preference sorting and ability sorting explanations. When we examine only transitions to these small, new firms, we find that theories of developing entrepreneurial human capital are weakly supported.

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 (Q2): 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). Although the lowest paid workers also enter self-employment more frequently, yielding some support for opportunity cost explanations (Q3), we find no consistent 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 (Q4). 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. Indeed, in unreported 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 small firms.[24] Finally, we offer evidence that workers with prior experience in small firms found 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 (Q4), although we cannot entirely 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 et al. (2005), for example, find that firms of 10,000 or more employees account for the lion's share of venture-backed start-ups. That result, however, reflects spawning only from publicly traded companies, so small firms are likely to be dramatically underrepresented. Citing evidence from a number of industry studies, Klepper and Thompson (2007) argue that better-performing firms have better spin-offs, and that better performing firms spawn spin-offs 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. However, if firm size instead correlates highly with firm age (i.e., old firms are large), then our results are consistent. 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 firms 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 not only entrepreneurship, but 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 or improved skill at locating opportunities, or both. We speculate that small firms may also provide an arena in which individuals self-discover their capacity for entrepreneurship. In part, this self-recognition may 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. Although our study has made important headway in documenting and explaining the small firm effect, there is clearly much that remains underexplored.

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[24] Results are available from the authors upon request.

Appendix

Table A.1 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	18.7[a]
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	0.468	0	0.499	0	1
Highest degree: Master's	112,313	0.192	0	0.393	0	1
Highest degree: Ph.D.	112,313	0.339	0	0.473	0	1
Highest degree field: Computer	112,313	0.125	0	0.331	0	1
Highest degree field: Life science	112,313	0.143	0	0.350	0	1
Highest degree field: Physical science	112,313	0.146	0	0.353	0	1
Highest degree field: Social science	112,313	0.177	0	0.381	0	1
Highest degree field: Engineering	112,313	0.409	0	0.492	0	1
Male	112,313	0.769	1	0.421		
White	112,313	0.737	1	0.440	0	1
Married	112,313	0.727	1	0.445	0	1
Has spouse who works full time	112,313	0.363	0	0.481	0	1
Has spouse who works part time	112,313	0.118	0	0.322	0	1
Has spouse who does not work	112,313	0.217	0	0.408	0	1
Children living in household	112,313	0.89	0	1.15	0	2[a]
Employer						
Self-employed	112,313	0.106	0	0.307	0	1
Self-employed, incorporated	112,313	0.045	0	0.207	0	1
Self-employed, not incorporated	112,313	0.061	0	0.239	0	1
Employer						
Business: 1–25 employees	112,313	0.099	0	0.298	0	1
Business: 26–100 employees	112,313	0.091	0	0.289	0	1
Business: 101–1,000 employees	112,313	0.180	0	0.384	0	1
Business: 1,000–5,000 employees	112,313	0.179	0	0.384	0	1
Business: 5,000+ employees	112,313	0.342	0	0.342	0	1
Turnover	112,313	0.186	0	0.390	0	1
Activities on the job						
Accounting, finance, contracts[b]	112,313	0.264	0	0.441	0	1
Applied research[c]	112,313	0.391	0	0.488	0	1
Basic research[c]	112,313	0.161	0	0.368	0	1
Computer applications[c]	112,313	0.483	0	0.500	0	1
Development[c]	112,313	0.393	0	0.488	0	1
Design[c]	112,313	0.408	0	0.491	0	1
Employee relations[b]	112,313	0.316	0	0.464	0	1
Managing or supervising people[b]	112,313	0.515	1	0.500	0	1
Other	112,313	0.056	0	0.230	0	1
Production, operations, and maintenance[b]	112,313	0.101	0	0.301	0	1
Quality or productivity management[b]	112,313	0.279	0	0.448	0	1
Sales, purchasing, or marketing[b]	112,313	0.321	0	0.467	0	1
Professional services[b]	112,313	0.174	0	0.379	0	1
Teaching	112,313	0.094	0	0.292	0	1
Employer main business						
Agriculture, forestry, or fishing	76,123	0.020	0	0.139	0	1
Biotechnology	76,123	0.036	0	0.187	0	1
Construction or mining	76,123	0.034	0	0.182	0	1
Education/public admin./gov't.	76,123	0.004	0	0.060	0	1
Finance, insurance, or real estate	76,123	0.059	0	0.236	0	1
Health services	76,123	0.069	0	0.253	0	1
Information technology	76,123	0.167	0	0.374	0	1
All other services	76,123	0.062	0	0.241	0	1
Manufacturing	76,123	0.230	0	0.421	0	1
Research	76,123	0.092	0	0.289	0	1
Transportation services, utilities, etc.	76,123	0.056	0	0.230	0	1
Wholesale or retail trade	76,123	0.042	0	0.200	0	1
Other	76,123	0.124	0	0.330	0	1

Table A.1 (Continued)

	Obs.	Mean	Median	Std. dev.	Min	Max
Location						
New England	112,235	0.074	0	0.262	0	1
Mid-Atlantic	112,235	0.163	0	0.368	0	1
South Atlantic	112,235	0.160	0	0.366	0	1
East North Central	112,235	0.144	0	0.351	0	1
West North Central	112,235	0.061	0	0.239	0	1
East South Central	112,235	0.031	0	0.173	0	1
West South Central	112,235	0.096	0	0.294	0	1
Mountain	112,235	0.063	0	0.243	0	1
Pacific	112,235	0.209	0	0.406	0	1

Notes. The sample consists of individuals whose responses are included in the SESTAT restricted file in 1995, 1997, and 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 nonprofits are excluded.

[a] To protect confidentiality, we present the 90th percentile for this figure.

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

[c] These variables used to construct "research" activities measure.

Table A.2 Multinomial Logit Analysis of Likelihood of Entering Self-Employment in the Same Industry or Different Industry

	Choice			
	Change employer, same industry (1a)	Change employer, different industry (1b)	Become self-employed, same industry (1c)	Become self-employed, different industry (1d)
Firm size: 1–25$_t$	0.4682***	0.2386**	2.1039***	1.1105***
	(0.0804)	(0.0712)	(0.2215)	(0.1988)
Firm size: 26–100$_t$	0.6523***	0.4789***	1.7059***	0.7667***
	(0.0768)	(0.0687)	(0.2375)	(0.2274)
Firm size: 101–1,000$_t$	0.6119***	0.4045***	0.9093***	0.5594**
	(0.0609)	(0.0558)	(0.2383)	(0.1953)
Firm size: 1,001–5,000$_t$	0.4943***	0.1973***	0.9151***	0.2726
	(0.0674)	(0.0627)	(0.2543)	(0.2263)
Age$_{t+2}$	−0.0080	−0.0516***	0.0207	0.0039
	(0.0127)	(0.0103)	(0.0333)	(0.0333)
Age squared$_{t+2} * 100$	−0.0445	0.0697**	−0.0415	0.0247
	(0.0283)	(0.0234)	(0.0702)	(0.0713)
Job tenure$_t$	−0.1114***	−0.1316***	−0.0824**	−0.1038***
	(0.0121)	(0.0102)	(0.0288)	(0.0271)
Job tenure squared$_t * 100$	0.1734**	0.3248***	0.2751*	0.2755**
	(0.0581)	(0.0430)	(0.1077)	(0.1060)
Weekly wage$_t$ *decile* = 1 (lowest)	0.0529	0.6845***	0.5654*	0.6419**
	(0.1195)	(0.0821)	(0.2554)	(0.2502)
Weekly wage$_t$ *decile* = 2	0.1018	0.3717***	0.3567	0.3758
	(0.0958)	(0.0761)	(0.2472)	(0.2504)
Weekly wage$_t$ *decile* = 9	0.0621	−0.0904	0.2021	0.00663
	(0.0737)	(0.0704)	(0.2113)	(0.2153)
Weekly wage$_t$ *decile* = 10 (highest)	0.0972	−0.2990***	0.4225*	0.2863
	(0.0735)	(0.0773)	(0.1906)	(0.1928)
Industry controls$_t$	Y***	Y***	Y***	Y*
N	25,416			
log pseudolikelihood	−17,814.7			
Pseudo-R^2	0.0806			

Notes. 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; (4) the individual becomes self-employed in the same industry; and (5) 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 5,000 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, Ph.D.), and for the region in which the respondent *worked* in year t. Standard errors, clustered on individuals, are in parentheses. "Y" designates that dummy variables were included for the 13 "employer main business" classifications reported in Table A.1. The significance levels for this set of dummy variables are from a joint test that all coefficients are equal to 0.

*Significant at $p \leq 0.05$; **significant at $p \leq 0.01$; ***significant at $p \leq 0.001$ (two-sided tests).

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