Entrepreneurship

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The theory below is that entrepreneurs must be jacks-of-all-trades who need not excel in any one skill but are competent in many. A model of the choice to become an entrepreneur is presented. The primary implication is that individuals with balanced skills are more likely than others to become entrepreneurs. Using data on Stanford alumni, the predictions are tested and found to hold. Those who have varied work and educational backgrounds are much more likely to start their own businesses than those who have focused on one role at work or concentrated in one subject at school.

What is entrepreneurship? Economic growth may be related to the formation of new businesses, but what is it exactly that entrepreneurs do?[1] The view of entrepreneurship taken here is that it is the process of assembling necessary factors of production consisting of human, physical, and information resources and doing so in an efficient manner. Entrepreneurs put people together in particular ways and combine them with physical capital and ideas to create a new product or to produce an existing

I thank first Boyan Jovanovic for a useful derivation that is used in this article. Comments from Anat Admati, Uschi Backes-Gellner, George Baker, Gary Becker, Lanier Benkard, Jennifer Hunt, Andrea Ichino, Stephen Jones, Kenneth Judd, David Kreps, Robert Lucas, John McMillan, Paul Oyer, Canice Prendergast, Korok Ray, John Roberts, Kathryn Shaw, Steven Tadelis, Robert Wilson, Justin Wolfers, and Jeffery Zwiebel are gratefully acknowledged. Able research assistance was provided by Yuliy Sannikov on theoretical issues and Eugene Kwok and Zeynep Emre on data compilation.

[1] Lazear (1995) found that those Eastern European economies that grew the fastest during the transition from communism to market economies were those for which new business formation was most rapid.

[*Journal of Labor Economics,* 2005, vol. 23, no. 4]

0734-306X/2005/2304-0001$10.00

one at a lower or competitive cost. Because the entrepreneur must bring together many different resources, he or she must have knowledge, at least at a basic level, of a large number of business areas. An entrepreneur must possess the ability to combine talents and manage those of others. Why do some choose to become entrepreneurs, and what characteristics create successful ones? Most of the past work on entrepreneurship has been empirical,[2] but it is useful to have theory to guide the empirics and to assist in interpretation of the results.[3]

It is tempting to argue that the most talented people become entrepreneurs because they have the skills required to engage in creative activity. Perhaps so, but this flies in the face of some facts. The man who opens up a small dry-cleaning shop with two employees might be termed an entrepreneur, whereas the half-million-dollar-per-year executive whose suit he cleans is someone else's employee. It is unlikely that the shop owner is more able than the typical executive.

The reverse might be true. As necessity is the mother of invention, perhaps entrepreneurs are created when a worker has no alternatives. Rather than coming from the top of the ability distribution, they are what is left over.[4] This argument also flies in the face of some facts. Any ability measure that classifies John D. Rockefeller, Andrew Carnegie, or, more recently, Bill Gates near the bottom of the distribution needs to be questioned.

The idea explored below is that entrepreneurs differ from specialists in that entrepreneurs have a comparative disadvantage in a single skill but have more balanced talents that span a number of different skills. Specialists can work for others who have the talent to spot and combine a variety of skills, but an entrepreneur must possess that talent. Although entrepreneurs can hire others, the entrepreneur must be sufficiently well versed in a variety of fields to judge the quality of applicants.

How shall we define *entrepreneur*? There are a number of possible definitions. In keeping with the empirical analysis to be performed below, an entrepreneur is defined for this study as someone who responds af-

[2] See, e.g., the early paper by Evans and Leighton (1989) and the more recent one by Hamilton (2000), who examines the returns to self-employment.

[3] The theoretical papers on the subject rarely speak to the issue that is central to this article. For example, Otani (1996) examines the theoretical relation of firm size to entrepreneurial ability. Perhaps the closest to this study in terms of discussing specialization (although from a very different point of view) is Holmes and Schmitz (1990), where it is argued that certain agents specialize in entrepreneurial skills. This differs from the approach here, where entrepreneurial skills are implicitly defined to be a cross section of all possible skills. De Meza and Southey (1996) build a model where new entrants are excessively optimistic.

[4] Landier (2002) argues that the part of the ability distribution from which entrepreneurs are drawn may differ across countries and provides a multiple equilibrium approach in an information framework to discuss the differences.

firmatively to the question "I am among those who initially established the business." Such individuals, even if they leave the business early, are usually responsible for the conception of the basic product, hiring the initial team, and obtaining at least some early financing. Other definitions are possible. For example, CEOs who "reinvent" a company might also consider themselves entrepreneurs. Conceptually, the model is consistent with including this latter group in the collection of entrepreneurs, but they will be excluded (with one exception) in the empirical analysis. The definition is conceptually distinct from "self-employed." A self-employed person need not have any other employees, and the kinds and combinations of skills that are necessary for real entrepreneurship are less important for, say, a self-employed handyman who works alone. At the empirical level, self-employed individuals are entrepreneurs if they view themselves as having started a business.

The model presented below is one where an individual can decide to become an entrepreneur using a variety of skills or to specialize using only one. The model is tested using data on graduates from the Stanford Graduate School of Business. The data combine information on postgraduate work experience and incomes with courses taken and grades obtained when the individuals were attending the Stanford Graduate School of Business.

The primary theoretical predictions are:

1. Individuals with more balanced skill sets are more likely to become entrepreneurs.
2. The supply of entrepreneurs is smaller for production processes that require a higher number of independent skills.
3. Individuals who become entrepreneurs should have a more balanced human capital investment strategy on average than those who become specialists.

A number of the predictions are tested empirically using data on Stanford alumni and are borne out. Specifically, those who end up being entrepreneurs are more likely to have varied backgrounds, both in school and on the job. The probability of being an entrepreneur in an employment spell is positively related to the number of different roles that an individual has had over his or her career and with the generality of the curriculum followed when at school. Some of this reflects balanced skills that the individual possesses before entering the labor market and some reflects the balance that is acquired after entering the workforce. There is also some evidence that risk tolerance enters into the decision to become an entrepreneur. Specifically, those individuals who have displayed willingness to choose risky occupations in the past are more likely to become entrepreneurs.

A Model of the Choice to Become an Entrepreneur

Initially, let there be only two skills, denoted x_1 and x_2 with $x_1, x_2 \geq 0$. An individual can be a specialist, in which case he receives income associated with his best skill, or he can be an entrepreneur, in which case he is limited by his weakest attribute. Thus, for specialists,

$$\text{Specialist income} = \max[x_1, x_2]. \tag{1}$$

Entrepreneurs, however, must be good at many things. Even if they do not do the job themselves, they must know enough about a field to hire specialists intelligently. The jack-of-all-trades aspect of entrepreneurship is captured in the income function

$$\text{Entrepreneur income} = \lambda \min[x_1, x_2], \tag{2}$$

where λ is a parameter that is determined by market equilibrium that establishes the value of an entrepreneur. The value of λ, which is called the market value of entrepreneurial talent, will be derived below.

The income-generating functions described in (1) and (2) may seem special, but they are implied by a general production function that exhibits constant returns to scale and ability distributions that are symmetric. This is shown in the appendix, entitled "The Underlying Economy."[5] Creativity and willingness to take risks are two factors that are often mentioned as affecting the decision to become an entrepreneur.[6] Creativity is suppressed in this model because it is unobservable. Formally, more creative individuals can be thought of as those with larger values of λ. They have higher market values for entrepreneurial talent because a given amount of raw skill translates into more entrepreneurial output. Risk preference is simply ignored in this model where everything other than endowment of x_1 and x_2 is deterministic.[7] Risk can be thought of as entering through a stochastic λ.

[5] The perfect substitutes/perfect complements income function is extreme, but it is an expository convenience. Any production process that has complementarity of skills for entrepreneurs and substitution of skills for specialists would be consistent with the intuition.

[6] Kihlstrom and Laffont (1979) were the first to argue that entrepreneurs tend to be less risk-averse than others in society. Iyigun and Owen (1998) suggest that entrepreneurship is risky and risk-averse agents are less likely to go into entrepreneurship in a developed economy where a larger selection of safer (insured) jobs exists.

[7] Becker and Murphy (1992) use a similar notion of specialization. Becker and Mulligan (2002) apply a technology somewhat like the one in this article to discuss the difference between market (specialized) and household (generalized) work.

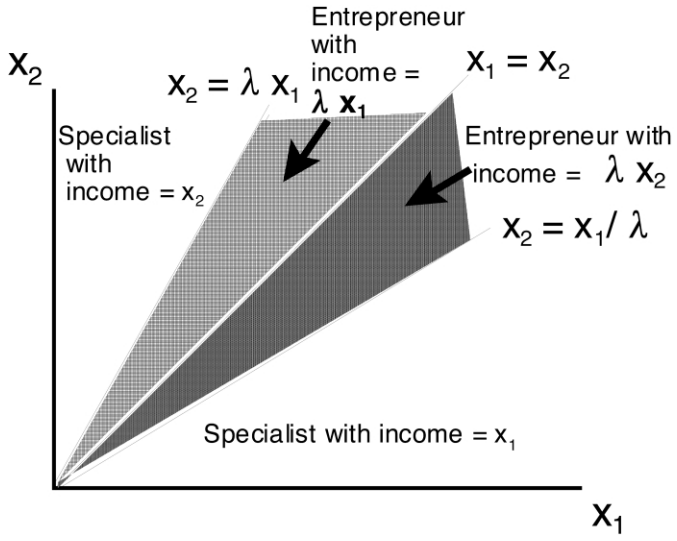

FIG. 1

Who Becomes an Entrepreneur?

Who decides to become an entrepreneur and who decides to become a specialist? The decision is straightforward. Think of individuals as being endowed with a pair of skills (x_1, x_2).[8] The joint density on x_1 and x_2 is given by $g(x_1, x_2)$. The individual chooses to become an entrepreneur if and only if

$$\lambda \min [x_1, x_2] > \max [x_1, x_2]. \tag{3}$$

It is easiest to see this graphically. A given individual is endowed with x_1 and x_2, shown as a point in figure 1. For all points below the 45° line, $x_1 > x_2$, so that a specialist whose endowment lies below the 45° line would always choose to specialize in x_1 and would have income given by x_1; x_2 is irrelevant to this specialist. In order for that individual to prefer being an entrepreneur to being a specialist, it is necessary that

$$\lambda \min [x_1, x_2] > \max [x_1, x_2],$$

[8] Lucas (1978) offers a model in which an individual can choose to work for someone or to be an entrepreneur. The difference between Lucas's model and this one is that, in Lucas, managerial talent is distinct from labor talent. Here, workers and managers have the same two skills, just in different combinations. The complementarity between skills that is the essence of this story is absent from Lucas. Still, Lucas derives implications for the size distribution of firms that are similar to those derived below.

which here requires that

$$\lambda x_2 > x_1$$

because $\min[x_1, x_2] = x_2$ and $\max[x_1, x_2] = x_1$.

Thus, for individuals for points below the 45° line, the condition for entrepreneurship is

$$x_2 > x_1/\lambda. \tag{4}$$

This is shown as the shaded area on the diagram between the lines $x_1 = x_2$ and $x_2 = x_1/\lambda$. The area below the line $x_2 = x_1/\lambda$ corresponds to points where the individual specializes and receives income x_1.

Above the 45° line, the converse is true. Here, $x_2 > x_1$ so the specialist receives income x_2. In these cases, the condition for entrepreneurship, that

$$\lambda \min[x_1, x_2] > \max[x_1, x_2]$$

becomes

$$\lambda x_1 > x_2,$$

so an individual for whom x_2 exceeds x_1 becomes an entrepreneur when

$$x_2 < \lambda x_1. \tag{5}$$

This is shown as the cross-hatch area in the diagram. The region in the northwest corner corresponds to individuals who have sufficiently high values of x_2 relative to x_1 that it pays for them to specialize in x_2 and to receive income x_2.

The probability of becoming an entrepreneur for any λ is given by the probability that the pair of skills lies in one of the two shaded areas in figure 1 or

$$\text{prob of entrepreneur} = \int_0^{\infty} \int_{x_1/\lambda}^{\lambda x_1} g(x_1, x_2)\, dx_2\, dx_1. \tag{6}$$

It is now possible to derive and explain intuitively how the entrepreneurial decision varies with a number of different parameters. First, consider λ, the market value of entrepreneurial talent. Differentiate (6) with respect to λ to obtain

$$\frac{\partial \text{ prob}}{\partial \lambda} = \int_0^{\infty} \left[g(x_1, \lambda x_1) x_1 + g\left(x_1, \frac{x_1}{\lambda}\right) \frac{x_1}{\lambda^2} \right] dx_1,$$

which is positive.

The higher is λ, the more likely is the individual to become an entre-

preneur. Diagrammatically, as λ increases, the shaded areas become larger because the borders move toward the axes. If λ were infinity, everyone would become an entrepreneur since for any positive values of x_1 and x_2 entrepreneurial income would be infinite. As λ goes to one, the shaded areas get pinched. When $\lambda = 1$, the borders of the shaded area are the line $x_1 = x_2$, and there are no entrepreneurs. Obviously, if $\lambda = 1$, it is impossible for condition (3) to hold since the min of something can never exceed the max of that same thing.

This result is important for equilibrium. The market value of entrepreneurial talent, λ, is a parameter that determines the supply of entrepreneurs in an economy. As λ rises, everyone chooses to become an entrepreneur. As λ falls to one, no one opts for entrepreneurship. This will guarantee an interior solution for λ and will ensure that there is a finite number of individuals wanting to enter entrepreneurship.

It is also possible to think of λ as being person specific. Some individuals have a comparative advantage in entrepreneurship. This might relate to creativity or other skills, but it is reflected in high values of λ. Since such talents are generally unobservable, not much more is said about the idiosyncratic variation in λ.[9]

If λ is person specific, it might also be unknown. This would explain why some people try entrepreneurship and then switch back to working for others. Perhaps individuals must try being an entrepreneur before they know whether they have a natural talent for running their own business. There is some evidence of this. There is a significant fraction of individuals who move back to working for others after having been an entrepreneur, but the probability is about 10 times as high that a year as an entrepreneur is succeeded by another year as an entrepreneur than by a year working for someone else.

Balance

In what follows, it is shown that as the correlation between x_1 and x_2 rises, the supply of entrepreneurs increases. Before deriving this formally, we state the intuition. Since entrepreneurial output and income is determined by the weakest link, it does little good to have a high value of x_1 if x_2 is not also high. Under such circumstances, it is necessary that x_2 be high whenever x_1 is high or there is little chance that an individual

[9] One of the skills can be interpreted as the ability to raise capital. This argument is central to Evans and Jovanovic (1989). Holtz-Eakin, Joulfaian, and Rosen (1994) show that capital is important in starting a business by linking the receipt of an inheritance to the likelihood of starting a business. Recent work by Gentry and Hubbard (2002) explores the relation of saving to entrepreneurial investment. Their motivation is growth and macroeconomic factors, but the results are relevant to this study as well. They find that there is an interdependence between entrepreneurial saving and investment.

will become an entrepreneur. Diagrammatically, for any given λ, a larger proportion of the population prefers to be entrepreneurs, the more points lie in the shaded area of figure 1. The shaded area consists of points where x_1 and x_2 are close in value. For small values of λ, only points very close to the $x_1 = x_2$ line result in choosing to become an entrepreneur. If most of the mass of the distribution lies close to the axes, then individuals will be inclined to specialize in one or the other skill because they have a strong absolute advantage in one skill. Entrepreneurs are jacks-of-all-trades, which means that they must be relatively good (or relatively bad) at everything.[10]

Formally, let x_2 be defined in terms of x_1 as follows:

$$x_2 = \rho x_1 + (1 - \rho)\nu,$$

where x_1 has density $f(x_1)$ and ν has density $h(\nu)$. When $\rho = 1$, x_1 and x_2 are perfectly correlated. When $\rho = 0$, they are uncorrelated. In fact, ρ is the correlation coefficient between x_1 and x_2. The probability of being an entrepreneur in (6) can be rewritten as

$$\text{prob of entrepreneurship} = \int_0^{\infty} \int_{[(x_1/\lambda)-\rho x_1]/(1-\rho)}^{(\lambda x_1-\rho x_1)/(1-\rho)} f(x_1)h(\nu)d\ \nu dx_1 \qquad (7)$$

by using a standard change of variables and altering the limits of integration appropriately.

Next, differentiate (7) with respect to ρ to obtain

$$\frac{\partial}{\partial \rho} = \int_0^{\infty} \left[h(UL)\frac{\partial UL}{\partial \rho} - h(LL)\frac{\partial LL}{\partial \rho} \right] f(x_1)dx_1,$$

where UL and LL stand for upper and lower limits of the inside integral in (7). After substitution, this becomes

$$\frac{\partial}{\partial \rho} = \int_0^{\infty} \left[h(UL)\frac{x_1(\lambda - 1)}{(1-\rho)^2} + h(LL)\frac{x_1(1 - 1/\lambda)}{(1-\rho)^2} \right] f(x_1)dx_1,$$

which is positive since density functions are always positive and since $\lambda > 1$ for there to be any entrepreneurs in the economy at all. Thus, as

[10] Stopford and Baden-Fuller (1994) list five components (proactiveness, team orientation, dispute resolution skills, being innovative, and ability to learn) that are important in entrepreneurship. Thus, an entrepreneur might be someone who was highly endowed with each of the five factors.

correlation increases between the two variables, the proportion of entrepreneurs rises.

The idea that balance is important suggests that the supply of entrepreneurship may vary by industry. For example, consider insurance agencies. The ability to understand complex insurance policies is a skill that is likely to be correlated with the accounting and management skills necessary to run a business. As a result, there are many who are well suited to running their own agencies and so the number of agencies should be great and their average size small.

An alternative example involves artists. Because art and business are quite distinct skills, there is no reason to expect strong positive correlation between artistic talent and business skills. As long as both artistic and business skills are relevant for production in the art business, then few will have high enough levels to avoid specializing in one or the other aspect of the business. Thus, the supply of entrepreneurial talent in art would be expected to be low, so most artists must be managed by others. The prediction is that there would be very few artists who run their own studios and publicize their own work.

The empirical statements are verifiable by looking at real world data.[11] In situations where entrepreneurs are rare, a few must run the whole industry, driving up concentration ratios. In situations where many opt to be entrepreneurs, the concentration ratios should be low. Of course, other technological considerations are key here and must be held constant. If scale economies are more important in some industries (e.g., automobiles) than in others (e.g., restaurants), the concentration ratios are likely to be higher in the former than the latter, independent of entrepreneurial supply considerations.

Complexity of Production

Some production processes are very complex, requiring many skills in order to produce output. Others are relatively straightforward. As the world has become complex, a larger variety of skills may be required to be an entrepreneur. In an agrarian society, a farmer did not require too many business skills to run his small farm and get his produce to market. The founders of the modern corporation are a different breed. They are more than competent technicians; they must understand how to create a worldwide business.

What happens to the supply of entrepreneurs as the number of factors increases? Without being more specific about the distribution of the factors, it is impossible to make qualitative statements. However, it is possible

[11] To make statements about groups, it is necessary to show that the propositions are true in a statistical sense at the level of the population. This is derived in the appendix.

to show that the introduction of independent factors always reduces the supply of entrepreneurs.

Consider the original joint density $g(x_1, x_2)$. Now introduce a third factor, x_3, and let the density of the three be denoted $k(x_1, x_2, x_3)$. If x_3 is an independent factor with (marginal) density $m(x_3)$, then it is possible to write

$$k(x_1, x_2, x_3) = \int m(x_3)\left\{\int\int g(x_1, x_2)dx_2dx_1\right\}dx_3.$$

The condition necessary to ensure an entrepreneur for two variables must still hold. For any given x_3 and for a given λ, if the projection onto the (x_1, x_2) plane does not lie in the entrepreneurial area, the individual will not choose to be an entrepreneur. That is, if

$$\lambda \min [x_1, x_2] < \max [x_1, x_2],$$

the individual becomes a specialist, irrespective of x_3. In addition, there are some potential cutoff values, x_3^* and x_3^{**}, that are also required for entrepreneurship. So the probability of being an entrepreneur cannot exceed

$$\int_{x^*_3}^{x_3^{**}} m(x_3)\left\{\int_0^{\infty}\int_{x_1/\lambda}^{\lambda x_1} g(x_1, x_2)dx_2dx_1\right\}dx_3,$$

which can be written as

$$\{M(x_3^{**}) - M(x_3^*)\}\int_0^{\infty}\int_{x_1/\lambda}^{\lambda x_1} g(x_1, x_2)dx_2dx_1.$$

Since the first term cannot exceed one, the probability of being an entrepreneur cannot be higher with three factors than with two and, in general, must be lower.

The proof can be repeated, adding one factor at a time. Therefore, the supply of entrepreneurs falls as the production process requires more independent skills. More individuals can run family farms than multinational, multiproduct conglomerates.

There is some relation between correlation of skills and complexity. For example, it is possible to think of being an accountant as requiring only one skill, namely, accounting, which can be used to serve clients or run the business. A skill is necessarily perfectly correlated with itself, so the probability that individuals possess all the skills necessary to run an accounting business, other things equal, might be thought to be higher

than that associated with running an art business, where two distinct skills are required.

The Premium to Entrepreneurship

It is now straightforward to show that an equilibrium λ always exists. To make things simple, but without loss of generality, suppose that there are a fixed number of firms in an economy and each firm requires one and only one entrepreneur. Then the demand for entrepreneurs is perfectly inelastic at q^*, where q^* is the number of entrepreneurs demanded. Let the number of individuals in the labor force be given by N. Then, using (6), which defines the probability of being an entrepreneur as a function of λ, the supply of entrepreneurs is simply

$$N \int_0^{\infty} \int_{x_1/\lambda}^{\lambda x_1} g(x_1, x_2) dx_2 dx_1.$$

Market equilibrium occurs when λ is set such that

$$N \int_0^{\infty} \int_{x_1/\lambda}^{\lambda x_1} g(x_1, x_2) dx_2 dx_1 = q^*. \tag{8}$$

Equation (8) is one equation in one unknown, namely λ, which determines the equilibrium value of entrepreneurship. The market value of entrepreneurial talent adjusts to induce enough individuals to become entrepreneurs so that demand is satisfied. When $\lambda = 1$, no one chooses to be an entrepreneur. As $\lambda \to \infty$, all choose to be entrepreneurs so there must be λ that sustains N^* as the equilibrium number of entrepreneurs. This is true for any demand for entrepreneur function. There is always an intersection of demand with supply, although corner solutions are possible.

Investment

So far, x_1 and x_2 have been taken as given. But much of economic activity as it relates to labor markets involves investment in skills. It is important to take investment in skills into account both for the purposes of completing the theory and in order to allow predictions for empirical analysis.

Augment the previous model by defining x_1^0 as the initial stock of skill x_1, x_2^0 as the initial stock of skill x_2, and x_1 and x_2 as the (final) attained level. Let a particular individual, with endowed skills (x_1^0, x_2^0), obtain levels

of x_1, x_2, according to the cost function

$$C(x_1, x_2),$$

with C_1, $C_2 > 0$, $C_{ii} > 0$.

Define x_1 to be the skill with which the individual is endowed the largest amount. This means that a worker who chooses to specialize is likely to specialize in x_1 and will solve

$$\max_{x_1} \; x_1 - C(x_1, x_2)$$

with first-order condition

$$1 - C_1(x_1, x_2) = 0.$$

Someone who is going to specialize will invest in only one of the two skills. There is no value to augmenting a skill that will not be used. It is possible that C_2 is sufficiently low relative to C_1 that the individual will ignore his higher endowment of x_1 and instead specialize in x_2. This is of little importance. Essential here is that the specialist invests in one or the other, but not both.

Now consider an individual who is going to become an entrepreneur. His constraint is the minimum skill, defined to be x_2. Should the aspiring entrepreneur invest in x_1, in x_2, or in both?

Since the constraint is x_2, there is no point in investing in x_1 unless x_2 is brought up at least to the level of x_1. If there is an interior solution for x_2, then it satisfies

$$\lambda - C_2(x_1, x_2) = 0.$$

There are three possibilities, but they can be dealt with quickly. If $C_2(x_1^0, x_2^0) > \lambda$, then it does not pay for the individual to increase his stock of x_2 and so no investment occurs. (It surely does not pay to increase x_1 since there is already an excess of x_1 at x_1^0.) If $C_2(x_1^0, x_2^0) < \lambda$, but $C_2(x_1^0, x_1^0) > \lambda$, the individual will invest only in x_2 because it does not pay even to bring x_2 up to the endowed level of x_1. (There is no advantage to augmenting x_1 until x_2 has reached the level of x_1.) In this case, the individual specializes in investment in x_2 and behaves identically to a specialist, except that he invests in the skill in which he is weak instead of the skill in which he is strong, which is the more common case for the specialist. Finally, if $C_2(x_1^0, x_1^0) < \lambda$, then it pays for the individual to exceed x_1^0 in attained x_2. But now x_1 becomes the constraint. As long as $C_1(x_1^0, x_1^0) < \lambda$, the individual benefits by increasing his investment in x_1 as well and continues to do so, but the optimum must have $x_1 = x_2$ in this case. What is important, however, is that, in this situation, the individual does not look like a specialist; he invests in more than one skill.

Investment can take a number of forms, the most important of which

is formal schooling and on-the-job training. Thus, those who eventually become entrepreneurs should not specialize in skill acquisition, and this might be reflected in taking a wide variety of courses.

Additionally, individuals who will eventually become entrepreneurs should take on a variety of jobs to acquire the skills necessary to become an entrepreneur. Thus, an individual might spend some time working in a financial role, some time in human resources, some time as a manager, some time as a skilled staff worker, and so forth. Having a large variety of roles is a standard way to acquire a variety of skills and is the method used for workers where the intention is to create a multiskilled workforce.

To summarize, those who are going to specialize invest in only one skill. Those who become entrepreneurs may invest in one skill, but if they do so, it will be the skill in which they are weak. But entrepreneurs are the only individuals who may invest in more than one skill. To put this in somewhat less stark terms, individuals who become entrepreneurs should have a more balanced investment strategy on average than those who end up specializing as wage and salary workers.

Innovation

No reference has been made to innovation. When thinking of the truly successful entrepreneurs, individuals who had some new idea usually come to mind. Even in a traditional industry such as retail, a founder like Sam Walton of Walmart used a new business process that allowed his firm to undercut the competition. The generalist view of entrepreneurship de-emphasizes innovation, although it is not inconsistent with it. One interpretation of the value of having multiple skills is that it is easier to innovate when the entire situation can be seen. A technical engineer may be superb at creating a new device, but that device may not have any business value. The innovator who succeeds is the one who can come up with something that is not only technically sound but business relevant as well.

Empirical Analysis

There are a number of implications that have been suggested in the theory section above. Before going to direct tests of the model, it is useful to provide some information on the composition of entrepreneurs.

Who Are the Entrepreneurs?

To examine the issues discussed in the theory section more directly, a unique data set will be used. In the late 1990s, Stanford surveyed its Graduate School of Business alumni (from all prior years). The primary focus of the survey was compiling a job history for each of the graduates,

with special emphasis on information about starting businesses.[12] This resulted in a sample of about 5,000 respondents. In addition to the detailed job histories, these data were matched with the student transcripts so that it is possible to see which courses were taken by those who went on to be entrepreneurs and which by those who became specialists. Additionally, the grade obtained in each of the courses taken is reported in the data.

The Stanford MBA data make clear that at least among this population, most entrepreneurs are not in technical fields. In table 1, the industries in which Stanford MBAs are found are dominated by construction and real estate, retail trade, and business consulting of some form. The technical fields are much less important. This finding is less surprising in these data, given that the more technical people would likely be found in engineering rather than MBA programs at Stanford. The Stanford MBA program recruits a significant fraction of engineers and students with technical backgrounds but fewer than would be found in those technical departments themselves. However, a comparison with the March 2002 Current Population Survey displays the same pattern. Among incorporated self-employed (which eliminates most household and other service workers who work alone), the dominant industries are, in order, construction, retail trade, professional services, business services, and real estate. Again, technical fields are minor players.

The basic hypothesis is that entrepreneurs are jacks-of-all-trades. In the "Investment" section above, it was shown that individuals who want to become entrepreneurs invest in a broader range of skills than do those who want to become specialists. Going into any job, individuals with a broader range of skills, acquired either through investment or through endowments, are more likely to be entrepreneurs.[13]

The data allow this hypothesis to be tested. The data set is a job history panel so that each respondent has one row of data corresponding to each employer (including self) that he or she has held. For example, an individual who had six employment spells would have six rows of data, one for each spell. An individual who had four employment spells and one spell of unemployment would have five rows of data. The beginning and ending dates for each job are recorded, as are the beginning and ending salary and size of firm. Additionally, all roles within the employment spell (up to five) are described through a coding system that corresponds to occupational titles. Industry and demographic data are also provided.

[12] The response rate was 40%. Some individuals were very old, and others were no longer alive, which accounts for some of the nonresponses.

[13] Lentz and Laband (1990) find that there is a higher likelihood of self-employment among the children of the self-employed. They interpret this as human capital that is passed from one generation to the next. There are also papers on the link between education and entrepreneurship. See, e.g., Bates (1985, 1990).

Table 1
Industrial Breakdown of Entrepreneurs in the Stanford MBA Sample

Industry Code	Percent
Management Consulting	14.51
Construction/Real Estate Development	8.07
Investment Management	5.87
Retail/Wholesale	5.08
Venture Capital	5.08
Hardware/Software/Systems Services	4.86
Investment Banking/Brokerage	4.23
Real Estate Finance	4.01
High Tech—Computers/Software	3.73
Entrepreneurial Services	3.67
Consumer Products	2.65
Entrepreneurial Manufacturing	2.32
Entertainment/Leisure/Sports	2.20
Food/Lodging	2.03
Marketing Services	1.69
Diversified Financial Services	1.58
Diversified Service	1.58
Printing/Publishing	1.58
High Tech—Other	1.36
Health Care Services	1.30
Extractive Mineral/Natural Resources	1.30
Telecommunications Services	1.24
Foundation/Nonprofit Organizations	1.13
Agriculture	1.02
Medical Instruments and Devices	1.02
Accounting	.90
Import/Export/International Trade	.90
Commercial Banking	.85
Education	.79
Radio/TV/Cable/Film	.79
High Tech—Telecommunications Products	.79
Energy	.73
High Tech—Computers/Hardware	.73
Industrial Equipment	.73
Advertising	.68
Insurance	.68
Transportation Services/Shipping	.68
Legal Services	.62
Multimedia Services	.62
High Tech—Multimedia Products	.56
Rubber/Plastics	.56
Biotechnology	.51
Diversified Manufacturing	.45
Public Relations	.34
Chemical	.34
High Tech—Consumer/Electronics	.34
High Tech—Semiconductors	.34
Architecture	.28
Arts	.28
Environmental/Waste Management/Recycling	.28
Social Services	.28
Unknown	.28
Aerospace	.28
Automotive/Transportation Equipment	.28
High Tech—Optics	.28
Apparel/Textiles	.23
Government	.17
Pharmaceuticals	.17
Utilities	.06
High Tech—Networking	.06

NOTE.—1,771 observations, entrepreneurs only.

Table 2
Variables and Descriptive Statistics

Variable	Observations	Mean	SD	Min	Max
A. Whole sample:					
mbayear	26,901	74.27	14.21	13	97
male	27,283	.83	.37	0	1
age	26,863	50.24	13.59	25	93
white	27,283	.86	.35	0	1
exp	26,778	9.54	9.29	0	63
NPRIOR	27,277	3.26	3.39	0	37
NROLES	4,877	5.23	3.78	0	37
NROLESOTH	4,216	4.73	3.27	1	32
entre	27,283	.07	.25	0	1
numbus	27,283	.39	.79	0	5
avjobten	26,737	2.03	1.70	0	25
specdif	1,996	2.49	1.13	0	9
nafter	27,262	3.76	3.73	0	37
yrleft	26,588	10.74	9.93	0	45
B. Specialists:					
mbayear	25,120	74.34	14.25	13	97
male	25,482	.83	.38	0	1
age	25,081	50.18	13.65	25	93
white	25,482	.86	.35	0	1
exp	25,010	9.14	9.08	0	63
NPRIOR	25,476	3.10	3.26	0	37
NROLES	3,710	4.67	3.39	0	32
NROLESOTH	671	4.60	3.02	1	21
entre	25,482	0	0	0	0
numbus	25,482	.36	.75	0	5
avjobten	24,969	1.97	1.68	0	25
specdif	1,673	2.51	1.14	1	9
nafter	24,457	3.92	3.74	0	37
yrleft	23,879	11.39	10.01	0	45
C. Entrepreneurs:					
mbayear	1,781	73.22	13.62	13	97
male	1,801	.89	.31	0	1
age	1,782	51.12	12.76	26	88
white	1,801	.86	.34	0	1
exp	1,768	15.25	10.21	0	59
NPRIOR	1,801	5.55	4.27	0	35
NROLES	1,167	6.95	4.39	0	37
NROLESOTH	3,545	4.76	3.32	1	32
entre	1,801	1	0	1	1
numbus	1,801	.85	1.19	0	5
avjobten	1,768	2.88	1.75	0	18
specdif	323	2.36	1.05	0	7
nafter	2,805	2.34	3.28	0	25
yrleft	2,709	5.06	7.04	0	41

Number of Prior Roles

Table 2 provides the means and standard deviations of the relevant variables used in subsequent analyses. An entrepreneurial employment spell is defined to be one for which the respondent stated that he or she was "Founder—among those who initially started the business." The standard way to acquire human capital is through formal schooling and on-

Table 3
Proportion of Entrepreneurs by Number of Prior Roles

	A. Roles				
	≤ 3	3–16	> 16		
Proportion of entrepreneurs	.03	.10	.29		
	B. Experience Level				
	P Low NPRIOR	P High NPRIOR	Difference	SE	*N*
Roles:					
3 or fewer	.015	.029	.014	.003	8,163
4–8	.034	.073	.039	.005	6,971
9–13	.073	.11	.037	.009	4,597
14–19	.099	.115	.016	.011	3,415
20–29	.102	.138	.036	.012	2,965
30 or more	.145	.187	.042	.022	1,148

NOTE.—P = proportion.

the-job training. Therefore, individuals who plan to become entrepreneurs are expected to invest in "general" on-the-job training, where "general" here refers to a variety of skills.

The unit of observation in tables 2 and 3 is the row, which consists of an employment spell for any given individual. The key independent variable, "NPRIOR," is the number of roles in total that the individual has had before the employment spell in question. So if an individual had three previous employers, and held two roles with the first, four roles with the second, and one with the third, then NPRIOR would equal seven. The dependent variable, ENTRE, is a dummy equal to one if the employment spell is one in which the individual founded his or her own business. About 6.6% of all employment spells (rows) are entrepreneurial ones. Taken over the lifetime, however, about 24% of the sample started at least one business.

Table 3 provides the initial evidence on the relation of varied background to entrepreneurship. Panel A of table 3 reports the proportion of entrepreneurial employment spells, broken down by number of prior roles. Only 3% of those who have had fewer than three roles are entrepreneurs, whereas 29% of those with over 16 prior roles are entrepreneurs.[14] Although having more than 16 roles is well above the mean, it is far from the maximum number of roles held by individuals. (See table 2.) The point is that the simplest statistics show that those who undertake

[14] One possibility is that those who have been entrepreneurs in the past list many roles when they are entrepreneurs and that entrepreneurship is serially correlated. To check this, NPRIOR was redefined such that each entrepreneurial employment was given one and only one role. The results were substantially unaltered.

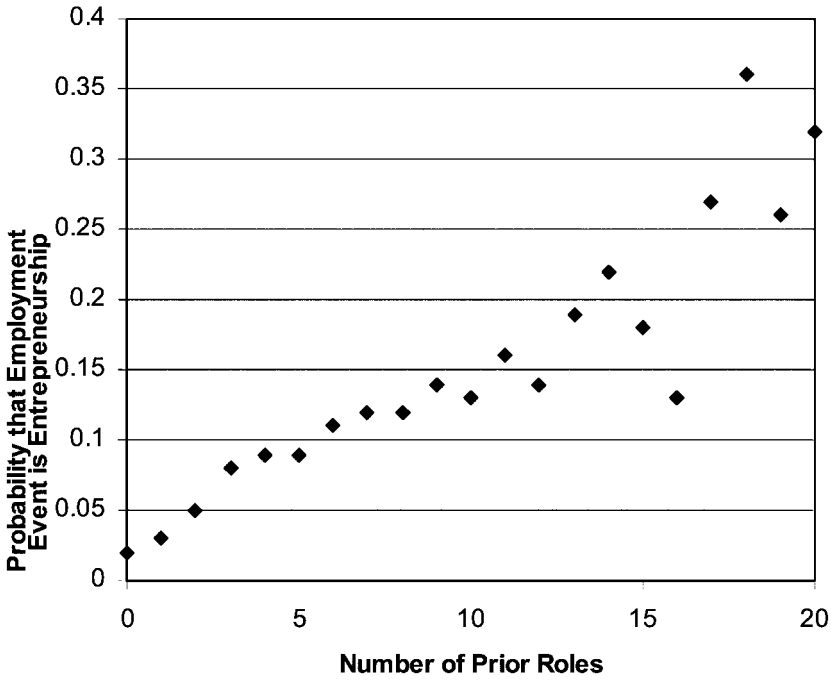

FIG. 2

many different assignments also have much higher probabilities of becoming entrepreneurs. More detail is given by the plot in figure 2. A clear positive relation of entrepreneurship to number of prior roles is apparent.

Because it may be expected that individuals become entrepreneurs after acquiring some on-the-job experience, it is useful to break the data up by experience level. This is done in table 3, panel B. The column "P Low NPRIOR" is the proportion of entrepreneurial spells in the group of individuals who have the median or fewer than the number of prior roles for this experience group. The column "P High NPRIOR" gives the proportion of entrepreneurial spells in the group of individuals who have more than the median number of roles for that experience group. Thus, the first row of panel B shows that those with the median or fewer prior roles were half as likely to be entrepreneurs as those with more than the median number of roles (.015/.029). Since an individual may enter the data set a number of times at different levels of experience, the rows are not independent tests of the hypothesis.[15] But the pattern is clear. Those who have had more roles in the past are more likely to be entrepreneurs.

[15] In fact, because experience brackets contain more than 1 year of experience, it is possible that an individual might enter even the same calculation more than

There are two interpretations of the NPRIOR variable, both of which are consistent with the jack-of-all-trades hypothesis. The first is that those who are endowed with high levels of multiple skills (or have acquired them by the time they reach the labor market) are able to perform many roles and NPRIOR proxies a person-specific effect—high NPRIOR are endowed with a balanced skill set. The second interpretation is that those who want to be entrepreneurs intentionally choose to perform a number of roles in order to acquire a balanced skill set. This is the investment route emphasized in the investment section above. Either interpretation is consistent with the model. The point is that a general set of skills is required for entrepreneurship. The existence of multiple roles is evidence for the prior existence or acquisition of the broad skill set. Below, some attempt will be made to distinguish between the two versions.

A Deeper Analysis

Table 4 contains the results of a deeper examination of the likelihood of starting a business to varied background. The basic result is contained in column 1. Each observation is a row in the work history matrix, referring to one employment spell for one individual. The data are stacked. Two spells for one individual count the same as one spell for each of two individuals. Columns 2 and 3 do not assume that same statistical structure, but more on that later.

The key result is that the likelihood that an employment spell is entrepreneurial is positively and strongly associated with the number of prior roles. The partial effect is .0851 in the logit. This translates into a large effect. A one standard deviation increase in the number of prior roles implies an increase in the probability of being an entrepreneur by about .018, which is about one-fourth the probability that an employment spell is an entrepreneurial one. The finding is again consistent with the view that entrepreneurs have more varied backgrounds, at least in terms of the roles that they have played at work, than nonentrepreneurs.

Although not proof of the theory, this evidence can be viewed as consistent with the premise on which the model is based. That premise is that the entrepreneurial production technology is one that exhibits strong complementarity among skills. The extreme formulation used for expository purposes is that entrepreneurial output is proportional to $\min[x_1, x_2]$. Given that technology, the implication is that individuals who possess more varied skills are those most likely to be entrepreneurs. That prediction is borne out by the data in the sense that those with general backgrounds are more likely to start companies.

Experience is also important. Five years of additional experience in-

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once, say, once with 5 and once with 7 years of experience. Thus, there is not complete independence even within a row of the table.

Table 4
Logit Analysis Panel Data

	Correlation Structure						
Variable	Independent (1)	AR-1 (2)	Unstructured (3)	Independent (4)	Independent (5)	Year Basis − Unstructured (6)	Independent (7)
EXP	.0452	.0502	.0534	.0070	.0205	.0341	.0430
	(.0036)	(.0039)	(.0038)	(.0044)	(.0048)	(.0058)	(.0037)
NPRIOR	.0851	.0769	.0706	.0808	.1166	.0875	.0764
	(.0079)	(.0088)	(.0092)	(.0082)	(.0088)	(.0117)	(.0078)
MALE	.4757	.4562	.4565	.5266	.4769	.6021	.4605
	(.0843)	(.0950)	(.0998)	(.0865)	(.0846)	(.1376)	(.0867)
MBAYEAR	−.0070	−.0044	−.0054	−.0214	−.0094	−.0136	−.0218
	(.0074)	(.0084)	(.0090)	(.0076)	(.0074)	(.0110)	(.0074)
AGE	−.0265	−.0250	−.0256	−.0117	−.0281	−.0299	.0024
	(.0078)	(.0089)	(.0095)	(.0080)	(.0078)	(.0112)	(.0079)
NAFTER				.0186			
				(.0119)			
YRLEFT				.0786			
				(.0060)			
AVJOBTEN					.1218		
					(.0152)		
SDFIRST							.00090
							(.00020)
Constant	−2.1085	−2.3626	−2.2253	−.7957	−1.9849	1.583	−5.499
	(.9397)	(1.0669)	(1.1369)	(.9587)	(.9330)	(1.37)	(.9904)
Wald χ_2	842	706	786	944	876	281	617
Number of observations	26,819	26,663	26,819	26,163	26,779	62,229	21,956

NOTE.—Dependent variable: 1 if employment spell is entrepreneurial. Standard errors are in parentheses.

Table 5
Multinomial Logit Analysis of C-Levels, Employees, and "True" Entrepreneurs

	1		2		3	
	Other	C-Levels	Other	C-Levels	Other	C-Levels
EXP	−.049	.008	−.025	.028	−.049	.008
	(.003)	(.005)	(.004)	(.005)	(.004)	(.005)
NPRIOR	−.090	.0004			−.092	−.001
	(.008)	(.098)			(.008)	(.010)
MALE	−.517	.575	−.480	.602	−.515	.577
	(.090)	(.143)	(.091)	(.143)	(.090)	(.143)
MBAYEAR	−.010	.027	.010	.046	−.013	.024
	(.008)	(.011)	(.008)	(.011)	(.008)	(.011)
AGE	.011	.030	.029	.048	.007	.026
	(.008)	(.011)	(.009)	(.011)	(.008)	(.011)
NROLES			−.175	−.069		
			(.007)	(.009)		
SDFIRST					−.00075	−.00084
					(.00021)	(.00032)
Log likelihood	−10,540		−10,325		10,533	
Number of observations	20,920		20,920		20,920	

NOTE.—Omitted category: "true" entrepreneurs.

crease the probability of being an entrepreneur by about .014, or about one-fifth the probability that an employment spell is an entrepreneurial one. Men are more likely to start companies than women and younger individuals, for a given amount of experience, start more companies than older ones.

A statistical issue is that the rows are not independent because they belong to the same individual. For example, individuals who have already started one company are more likely than the average individual to start another at the next employment effect. Treating each row (employment spell) as independent may not be appropriate under these circumstances and the standard errors will be inconsistent. To run logit, taking into account correlation between rows due to the panel nature of the data, the approach of generalized estimating equations is used. The results are reported in table 4.

Columns 2 and 3 of table 5 introduce different forms of dependence across observations to allow for the fact that the data consist of a panel in which more than one row of data may belong to one individual. In column 2, an AR-1 structure is assumed so that the correlation between rows s and t for a given individual is

$$\rho^{|t-s|}.$$

In column 3, the correlation matrix is unstructured, and each correlation is allowed to be free and is estimated by the data.

The key result is that the coefficient on NPRIOR is not very sensitive

to the correlation structure assumed. Even when nonindependence is taken into account, the relation of number of roles on entrepreneurial activity is large and significant.[16]

There is another potential statistical structure. Employment spells vary in duration. To address this, let us define a person-year as the relevant unit of analysis for the purpose of correlation structure. Every year of a person's career constitutes a separate observation during which he or she is an entrepreneur or working for someone else. Thus, someone who has been in the labor force for 15 years contributes 15 observations to the analysis. The within-job, between-year correlation structure is taken into account in estimating the logit so that standard errors are estimated consistently. Results are reported in column 6 of table 4. It is evident that NPRIOR maintains the same relative importance, has almost identical magnitude, and is statistically significant.

Which Interpretation?

Already mentioned is that there are (at least) two possible versions of the jack-of-all-trades view. One is that people are endowed with skills and that their labor market behavior merely reflects endowed skills or those acquired in school before they enter the labor market. An alternative is that individuals choose to perform a variety of roles as an investment in acquiring the broad skills necessary to become an entrepreneur. To get at this, the panel data are helpful.

If endowed characteristics simply enable a generalist to perform many roles, then the timing of those roles should not matter. That is, roles held after any particular employment spell should have the same "effect" on the likelihood that the spell is an entrepreneurial one as a role held before. However, if performing many labor market roles actually enhances the individual's ability to become an entrepreneur, then roles before any particular employment spell should be more salient than roles held after an employment spell. Therefore, another variable, NAFTER, was created, which counts the number of roles that an individual had in all employment spells following the one in a given row. It is analogous to NPRIOR, but it is defined in reverse. Rather than counting the roles held up to that point, it counts the roles after that point. Also, just as it was necessary to correct for experience, it is also necessary to correct for number of years after or number of roles will pick up life cycle effects. (Those who

[16] The sorting effect of individuals into different occupations picks up comparative advantage. If entrepreneurs have a comparative disadvantage as specialists, and not merely an absolute advantage, then those who become entrepreneurs should, when they are in training in nonentrepreneurial jobs, earn less than those who choose to be specialists. A regression of earnings in nonentrepreneurial jobs on EXP and a dummy equal to one if the individual ever founds a business in the career yields a negative, albeit insignificant, coefficient on the dummy.

have a long career in the data after a particular spell will have higher values of NAFTER, irrespective of their general skills.) YRLEFT measures the number of years remaining until the end of the career record at the point at which the employment spell in question occurs.

Results are reported in column 4 of table 4. Although NAFTER enters positively, it is less than one-fourth as important in magnitude as NPRIOR. This is evidence that multiple roles are actually productive in preparing a person to be an entrepreneur and that they are not merely a proxy for unobserved general skills.[17] One caveat: NAFTER is defined only for those who have a subsequent employment spell so NAFTER might relate to a preference for changing employers. This is unlikely, because, as discussed below, those who change employers frequently are less likely, rather than more likely, to become entrepreneurs.

Alternative Explanations

Might the results reflect something other than the jack-of-all-trades view? One possibility is that entrepreneurs have more roles when they are entrepreneurs than others and that the results are spurious. Indeed, there is some evidence that this is the case. On average, entrepreneurs have on average 2.4 roles during their entrepreneurial job compared to an average of 1.2 roles for all nonentrepreneurial spells.

To deal with this, a variable like NPRIOR was defined, except that each entrepreneurial spell is allowed to add only one role to NPRIOR, irrespective of the number of roles claimed during the entrepreneurial employment spell. This approach intentionally biases the results against finding a positive relation of entrepreneurial activity to the number of roles because one role is below the mean number of roles per employment spell. The results are qualitatively identical to those reported. The coefficient on the redefined variable is about half that on NPRIOR, but otherwise similar.

It is also possible that those with more roles received more promotions with their previous employer. To check this, the same models were run including a variable that measured the final salary on the last job. This was done only for those with at most one entrepreneurial spell so that the prior salary would be unambiguously defined. Those with higher final salaries do have a slightly higher probability of being entrepreneurs, but

[17] The evidence is not dispositive, however. Even if large effects of NAFTER were found, it could be that being an entrepreneur prepares a worker to take on many roles in subsequent employment, precisely because entrepreneurs perform many tasks. Conversely, if entrepreneurship is an absorbing state or close to it, an entrepreneurial spell could be associated with fewer roles after because there are fewer jobs. This is unlikely, however, because entrepreneurs have more roles per year after a given employment spell on average than nonentrepreneurs.

the coefficient is not significant in the logits with ENTRE as the dependent variable.

One theory, that entrepreneurs are those who are impatient, want variety, or fall into entrepreneurship accidentally because they are the individuals who change jobs often, is not borne out by the data. To examine this hypothesis, "average employment tenure" defined as experience/number of employment spells was included in the logit. The result, in column 5 of table 4, is that those who have longer employment spells are more likely to be entrepreneurs. If entrepreneurs were impatient types, the relation of entrepreneurship to average job tenure (AVJOBTEN) should be negative, not positive. There is surely some version of a taste argument that can be made, but the most straightforward ones do not seem to be consistent with the sign on AVJOBTEN.

The most frequently offered explanation of entrepreneurship is that entrepreneurs are those who are willing to take risks. Taste explanations are never particularly appealing unless they can be related to something measurable. There is some hope of doing just that in the data set. Most entrepreneurs work in other jobs before starting their own companies. The jobs that they choose before becoming entrepreneurs can provide some information on their preference for risk. Specifically, the data provide detailed industry/occupation codes that correspond to fields like accounting, education, insurance, chemical manufacturing, and so forth. There are 74 different industry/occupation categories. Some industries/occupations are riskier than others, as can be proxied by examining the wage distribution of individuals within these occupations. To measure this, the standard deviation of income in each of the 74 groups was calculated. Then, each individual was classified according to the industry/occupation of his or her first job choice after graduation from Stanford. The standard deviation of income in that category becomes a variable attached to the individual. The idea is that those who are less risk averse should be willing to enter the higher income variance occupations than the most risk averse, so that the standard deviation of income in the first occupation measures their tolerance for risk.

The standard deviation in income of the individual's first industry/occupation, FIRSTSD, is entered as a variable in the entrepreneurship logit. The results are reported in column 7 of table 4.

Note first that the coefficient on FIRSTSD is positive. Those who enter high income variance industries/occupations are more likely to have later entrepreneurial employment spells. This is consistent with the view that entrepreneurs are less risk averse. Of course, it could also reflect other differences across occupations correlated with wage variance. For example, fields with high wage variance like investment banking might attract people who think they are movers and shakers, and the same people might also be inclined to start their own businesses. This is a taste explanation,

and there are surely others that cannot be rejected by these data, but the risk aversion view is consistent with the findings.

Second, even though FIRSTSD enters significantly, the coefficient and standard errors on NPRIOR remain virtually unchanged. Even if risk or other taste factors affect the choice to start a business, the generalist argument still seems to apply and is not weakened by this effect.

Defining *Entrepreneur*

Because the definition of *entrepreneur* is somewhat arbitrary, another group was defined to be entrepreneurs. They are those who reported their position as high-level general manager, specifically, "I am responsible for the organization's overall direction, including responsibility for major business functions and personnel decisions (examples: CEO, President, COO, Executive Director)." Although individuals in this category may not assume the same risk as those who found a business, they are senior general managers, so the jack-of-all-trades argument should pertain to them as well.

To determine whether general managers are also jacks-of-all-trades, a multinomial logit was estimated. The dependent variable can either be "entrepreneur," which is the left-out group, "C-level manager," or "other." The results (see table 5, col. 1) show a significant negative coefficient on NPRIOR for those who are neither C-level managers nor entrepreneurs relative to "true" entrepreneurs. But the coefficient on NPRIOR for those who are C-levels is zero relative to the true entrepreneurs. Apparently, prior roles do not distinguish between entrepreneurs and C-level managers. The prior skills seem to be the same. So the jack-of-all-trades story applies well to senior-level managers.

It is possible to distinguish senior managers from true entrepreneurs. The theory suggests that those who start their own businesses must perform many tasks as entrepreneurs that are not required of C-level managers. For example, the chief technology officer need not raise funds for the firm since the chief financial officer generally performs that task. As a result, NROLES, which differs from NPRIOR only in that it includes the roles performed in the current job, should be more important for true entrepreneurs than for chief-level managers. Column 2 of table 5 contains the results of a multinomial logit, where the comparisons are relative to true entrepreneurs.

The multinominal logit results are as predicted. As before, NROLES has a strong negative effect on being an employee throughout the career, that is, it has a strong positive effect on being a true entrepreneur. More important, NROLES also has a negative effect on being a chief-level manager relative to being a true entrepreneur. Although having many

roles increases the probability of having been a high-level manager, having many roles makes one even more likely to be a true entrepreneur.

One difference between C-levels and true entrepreneurs is the amount of risk that they face. It is likely that being a true entrepreneur is riskier than being a C-level employee because one's own physical capital is often at stake when starting a business. Also, high risk of failure might create riskiness associated with true entrepreneurship. Perhaps risk preferences help distinguish between being a C-level employee and a true entrepreneur.

Using the earlier approach, where risk aversion is proxied by avoidance of industry/occupations with high income variance, column 3 of table 5 reports the results with SDFIRST included. There is in fact evidence that a difference between C-level managers and entrepreneurs is that true entrepreneurs are more inclined to take risks. The SDFIRST variable enters negatively in both the employee and C-level manager part of the multinomial logit and with almost the same magnitude. Both groups, C-level managers and other employees, are less inclined to start out in high variance industries/occupations than those who become true entrepreneurs.

One interesting aside is that women are more likely to be employees of others than they are to be entrepreneurs, but they are more likely to be entrepreneurs than they are to be high-level managers. Women may have escaped historical discrimination at very high levels of corporations by starting their own businesses.

General and Specialized Curricula

The data on work histories were matched with data from student transcripts. As a result, we have information on the courses taken while the individual was a student at the Stanford Graduate School of Business. The records begin in the mid-1980s, so the transcript-matched data pertain only to those who graduated during approximately the last 15 years. But almost 2,000 records of alumni work history data have been matched with transcript information, so a significant amount of information is contained in the 15 years of records.

Simple relationships can be seen in the comparison of means in table 2. The variable SPECDIF is the difference between the maximum number of courses taken in one field and the average number of courses taken across fields. This is a measure of lopsidedness in the study curriculum. SPECDIF is lower by about one-fifth of a standard deviation for entrepreneurs than it is for specialists. The difference between the average level of SPECDIF between groups suggests that those who later become entrepreneurs took a more balanced set of courses while at Stanford.

Additionally, the simple correlation between SPECDIF and NROLES for lifetime roles is negative and significant, as is the partial correlation, holding constant MBA year. Those who take more specialized curricula

Table 6
Tobit and Logits with Stanford Course Data, Number of Businesses Started (Tobit and Ordered-Probit), and Ever Started a Business (Logit)

Variable	Logit (1)	Tobit (2)	Ordered Probit (3)
EXP	.0259	.0266	.0612
	(.0185)	(.0196)	(.0042)
SPECDIF	−.1458	−.1452	−.0433
	(.0581)	(.0592)	(.0180)
MALE	.6025	.6305	.3857
	(.1511)	(.1531)	(.0482)
MBAYEAR	−.0318	−.0384	.0241
	(.0215)	(.0224)	(.0069)
AGE	.0250	.0264	.0146
	(.0179)	(.1531)	(.0053)
Constant	.0202	.3243	Cut parameters
	(2.4182)	(2.4897)	omitted
Log likelihood	−841	−1,181	
Number of observations	1,952	1,950	

NOTE.—Standard errors are in parentheses.

also take on fewer roles when they enter the labor market, which suggests that generalized formal education and generalized on-the-job training are complements.

The first analysis reported in table 6 presents logits, tobits, and ordered probits, analogous to those in table 4, but only pre-labor-market characteristics are allowed to affect the career. The approach is to assume that school prepares an individual for the labor market and then to observe how differences in the educational experience are reflected in the subsequent career. The jack-of-all-trades theory suggests that those who have large values of SPECDIF should be less likely to become entrepreneurs.

The results confirm the hypothesis. The more specialized is the curriculum, as measured by SPECDIF, the fewer businesses the individual starts and the less likely is the individual to start a business. Once again, it is the generalists, as reflected in generalized course curricula, who end up founding a business after they leave school. Those who want to found a business prepare themselves by taking a variety of different courses that they hope will later prove useful when they start businesses. An alternative view is that those who happen to take a varied set of courses start a business later because the spell has given them the general skills necessary to found a business. Both views are consistent with the jack-of-all-trades view of entrepreneurship. Only if entrepreneurs need general skills will a varied course background be correlated with later entrepreneurial activity.[18]

[18] For example, suppose that some people like variety. They take many different types of courses and also become entrepreneurs. But those who like variety would only become entrepreneurs if entrepreneurship offered a more varied experience, which says that entrepreneurship is a general rather than specialized occupation.

The results of the Stanford course data support the earlier conclusions. Entrepreneurs are jacks-of-all-trades. They have more varied course work while in the MBA program and have many more positions when they are actually in the labor market.

Conclusion

Entrepreneurs are individuals who are multifaceted. Although not necessarily superb at anything, entrepreneurs have to be sufficiently skilled in a variety of areas to put together the many ingredients required to create a successful business. As a result, entrepreneurs tend to be more balanced individuals.

Two kinds of evidence are provided. First, those who have more varied careers, as evidenced by having performed more roles as part of their work experience, are more likely to be entrepreneurs. There are two interpretations of this result, both consistent with the jack-of-all-trades view. The first is that the correlation between number of roles and entrepreneurship reflects endowed differences in general skills across people. Those with more general skills can perform more roles. The second is that the correlation reflects conscious investment, where individuals who plan to become entrepreneurs take on many roles so that they can acquire the varied background necessary to start a business. Each version finds some support, but the investment view seems to dominate.

Second, the pattern of investment that occurs prior to entering the labor market is also consistent with the generalist view of entrepreneurship. In the Stanford MBA data, it is found that those students who study a more varied curriculum are more likely to be entrepreneurs and to start a larger number of businesses over their careers.

Much more can be done, especially at the empirical level, given the richness of the data. The prevalence of entrepreneurship by occupation and industry is predicted by the model. Educational systems differ by country in terms of amount of specialization, and this has implications for the proportion of entrepreneurs by country. The model gives quite specific predictions about these relations, but investigation is left to the future.

Appendix

The Underlying Economy

In this section, the income-generating functions shown in (1) and (2) are derived from a more fundamental production function.[19]

Let there be two raw skills, y_1 and y_2, for example, verbal and quan-

[19] Lucas (1978) uses this production function to discuss income distribution and the size distribution of firms.

titative ability. In any given firm with an entrepreneur who has the ability pair (y_1, y_2), output is given by

$$\text{Output} = Q(\min(y_1, y_2))f(Y_1, Y_2),$$

where $Q(\ )$ and $f(\ )$ are parts of the production function and Y_1 and Y_2 are the amounts of skills employed by the firm in efficiency units. Normalize the price of a unit of output to 1 and let wages (determined by the equilibrium) be given by w_1 and w_2. Then profit is given by

$$\pi(y_1, y_2, w_1, w_2) = Q(\min(y_1, y_2))f(Y_1, Y_2) - w_1 Y_1 - w_2 Y_2. \tag{A1}$$

To avoid discussion of number of firms in an industry, which is not central to the analysis, simply assume that each entrepreneur is a local monopolist. Thus, the $Q(\ )$ function incorporates the monopoly price into the measure of output.

Maximization of the profit function in (A1) yields the firm's demand curves for Y_1 and Y_2, which are written as

$$Y_i^d = Y_i^d(\min(y_1, y_2), w_1, w_2) \quad \text{for } I = 1, 2. \tag{A2}$$

The underlying density of skills in the overall working population is given by $g(y_1, y_2)$. $A_1(w_1, w_2)$ is the set of individuals who choose to specialize in supplying skill y_1. It is given by

$$A_1(w_1, w_2) = \{(y_1, y_2) | w_1 y_1 > \max[w_2 y_2, \pi(y_1, y_2, w_1, w_2)]\}. \tag{A3}$$

Analogously, A_2, the set of individuals who choose to specialize in skill y_2 is given by

$$A_2(w_1, w_2) = \{(y_1, y_2) | w_2 y_2 > \max[w_1 y_1, \pi(y_1, y_2, w_1, w_2)]\}. \tag{A4}$$

Finally, entrepreneurs are defined as the set

$$E(w_1, w_2) = \{(y_1, y_2) | \pi(y_1, y_2, w_1, w_2) > \max[w_1 y_1, w_2 y_2]\}. \tag{A5}$$

Then let $g_i(y_1, y_2)$ be the density function of abilities of individuals in set A_i derived from $g(\ )$ and (A3) and (A4) and $g_e(y_1, y_2)$ be the corresponding density among entrepreneurs, derived from $g(\ )$ and (A5).

The following two supply-equals-demand equations determine the

equilibrium values of w_1 and w_2:

$$\int\int y_1 g_1(y_1, y_2)dy_1 dy_2 = \int\int Y_1^d(\min(y_1, y_2), w_1, w_2)g_e(y_1, y_2)dy_1 dy_2 \tag{A6}$$

and

$$\int\int y_2 g_2(y_1, y_2)dy_1 dy_2 = \int\int Y_2^d(\min(y_1, y_2), w_1, w_2)g_e(y_1, y_2)dy_1 dy_2. \tag{A7}$$

Next, define $x_1 = w_1 y_1$ and $x_2 = w_2 y_2$ where the wages are obtained from the market equilibrium given in (A5) and (A7). Sufficient conditions to derive income-generating functions (1) and (2) are constant returns to scale and symmetry. Specialist income in (1) comes directly from the definition of x_i and the conditions that define sets A_i. This is simply relabeling. Given that specialist income is x_i, it is now shown that entrepreneurial income moves in proportion to $\min(y_1, y_2)$ under the assumptions of constant returns to scale and symmetry. Let production exhibit constant returns to scale such that

$$Q(k\min(y_1, y_2))f(kY_1, kY_2) = kQ(\min(y_1, y_2))f(Y_1, Y_2), \tag{A8}$$

and symmetry such that $f(y_1, y_2) = f(y_2, y_1)$ and $g(y_1, y_2) = g(y_2, y_1)$.

We want to show that

$$\pi(y_1, y_2, w_1, w_2) = \lambda\min(x_1, x_2). \tag{A9}$$

Symmetry guarantees that $Y_1^\circ = Y_2^\circ$ and that $w_1 = w_2 = w$. Let $z = \min(y_1^\circ, y_2^\circ)$. Constant returns to scale implies that if entrepreneur of skill z employs y° of each type of labor, then an entrepreneur of skill z' employs $(y^\circ)(z'/z)$ of each type of labor. That, coupled with (A8) implies that profits are equal to $(z'/z)\pi(z, w, w)$. Let $\lambda \equiv \pi(z, w, w)/zw$. Then

$$\begin{aligned}\pi(z', w, w) &= (z'/z)\pi(z, w, w)\\ &= \lambda z'/w\\ &= (\lambda/w)\min(y_1, y_2)\\ &= \lambda\min(x_1, x_2),\end{aligned}$$

which is (2), the entrepreneurial income function.

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