Entrepreneurship

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Abstract

The theory proposed below is that entrepreneurship consists of team-building and assembling resources. As such, 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. Those who want to start businesses acquire their general backgrounds through a varied course curriculum and by taking on a broad range of roles when they enter the labor force. Using a data set of Stanford alumni, the predictions are tested and found to hold. Entrepreneurs are not technical innovators. By far the most important prediction of entrepreneurship is having a varied work background.

What is entrepreneurship? Economic growth may be related to the formation of new businesses, but what is it exactly that entrepreneurs do?[1] Many think of entrepreneurs as the technical innovators who bring a new product like Windows to market. That view is inconsistent with data that reveals most entrepreneurs are in low tech industries, where the innovation is a business innovation rather than a technical one.

The view of entrepreneurship taken here is that it is the process of assembling resources, consisting of human, physical, and information, and doing so in an efficient manner. Entrepreneurship consists of team building. People are put together in particular ways and combined with physical capital and ideas to create a new product or to produce an existing 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 strictly empirical,[2] but it is useful to have theory to guide the empirics and to assist in interpretation of the results.[3]

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[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.

[2]See, for example, Evans and Leighton (1989).

[3]The theoretical papers on the subject rarely speak to the issue that is central to this paper. For example, Otani (1996) examines the theoretical relation of firm size to entrepreneurial ability. Perhaps the closest to this paper in terms of discussing specialization

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 Larry Ellison and 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.

To make this vivid, imagine two individuals who are entering the labor market. When they

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(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.

applied to undergraduate school, they both obtained total scores of 1200 on their SATs. One individual received a 800 on the quantitative part and a 400 on the verbal part. The other obtained a 600 on each of the two parts. The theory developed below suggests that the 600/600 individual is more likely to become the entrepreneur than the 800/400 individual.

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 affirmatively 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 combines information on post-graduate work experience and incomes with courses taken and grades obtained when the individuals were

attending Stanford GSB. These results are supplemented with data obtained from the March, 2002 Current Population Survey.

The primary theoretical predictions are:

1. Individuals with more balanced skill se ts are more likely to become entrepreneurs.

2. Occupations where the substantive skill and business skills are closer should see a larger supply of entrepreneurs. E.g., insurance and business are closer than sports and business, so a higher proportion of insurance agents than sports figures should be entrepreneurs.

3. The supply of entrepreneurs is smaller for production processes that require a higher number of independent skills.

4. 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.

A Model of the Choice to Become and Entrepreneur

Initially, let there be only two skills, denoted x_1 and x_2. 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,

(1) Specialist income = $\max[x_1, x_2]$

Entrepreneurs, on the other hand, 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

(2) Entrepreneur income = $\lambda \min [x_1, x_2]$

where λ is a parameter that is determined in part by technology and in part 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. For now, it is sufficient to think of it as a constant that is given by nature, but in reality it is the product of a technology parameter and a market determined price.

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 section entitled "The Underlying Economy."[5] So as to avoid losing the main thread of the argument, that derivation is postponed for a few pages.

Creativity and willingness to take risk 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

[5]The perfect substitutes/perfect complements income function is extreme, but 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.

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] The reason is primarily empirical. There is no information in the data to be used that speaks to risk, except in a very indirect fashion.

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

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

It is easiest to see this graphically. A given individual is endowed with x_1 and x_2, shown as

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

[8]Lucas (1978) offers a model of where 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.

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 to be an entrepreneur to being a specialist, it is necessary that

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

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

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

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

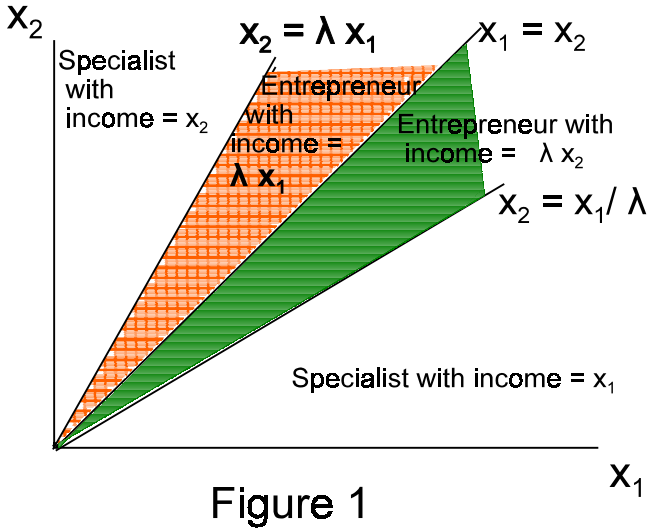


Figure 1

(5) $x_2 < \lambda x_1$.

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

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

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

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

which is positive.

The higher is λ, the more likely is the individual to become an entrepreneur. 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 1, 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.[9]

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 1, 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.

The technological aspect of the λ variable lends itself to a number of interpretations. In some fields, agency problems are pronounced and the technological component of λ is low because it is difficult to transform raw ability into entrepreneurial skills. In these fields, if you want it done, you'd better do it yourself. In other fields, management is possible because monitoring is less costly and specialization can be orchestrated more easily. Economies of scale may also be important in determining λ. In some industries, it may be that raw skills can be transformed into high levels of entrepreneurial output because technology allows one skilled manager to leverage his talents.

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

[9]The interpretation is also correct when $\min[x_1, x_2]$ is negative. Then, using one's talents as an entrepreneur destroys output and individuals are charged for this. The larger is λ, the more output destroyed and the less likely is the individual to become an entrepreneur.

about the idiosyncratic variation in λ. [10]

Balance

There is another related result. The smaller is the difference between x_1 and x_2 for any given individual, the more likely is he to become an entrepreneur. To make this more precise, think of an individual who has total skill X. The more evenly divided X is between x_1 and x_2, the more likely that the individual becomes an entrepreneur. The individual becomes an entrepreneur when (3) holds. Rewrite (3) as

(3') $\lambda \min [x_1, X-x_1] > \max [x_1, X- x_1]$

If $x_1 < X/2$, then entrepreneurial income is x_1 and specialist income is $X - x_1$. An increase in x_1 toward X/2 raises the l.h.s. of (3') and lowers the r.h.s. of (3') making entrepreneurship more likely. Conversely, if $x_1 > X/2$, then entrepreneurial income is $X-x_1$, which decreases in x_1 and specialist income is x_1. Lowering x_1 toward X/2 raises the likelihood that the individual will choose to be an entrepreneur. For a given X, the maximum likelihood that the individual chooses to be an entrepreneur occurs when $x_1 = x_2 = X/2$.

[10]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.

The point is that entrepreneurs are balanced individuals. They must be almost equally talented in a number of different areas. The idea that balance is important suggests that the supply of entrepreneurship may vary by industry. For example, those endowed with great artistic talent are not likely to be also endowed with great 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.

An alternative example involves 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.

In the context of figure 1, the supply of entrepreneurs is greater for any given λ when most of the points lie close to the 45^o line. Individuals whose endowments are near the line $x_1 = x_2$ are more balanced.

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

[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 appendix B.

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 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

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

The condition necessary to ensure an entrepreneur for two variables must still hold. For any given x_3, 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

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

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 1, 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. One implication is that the supply of entrepreneurs should decline over time as few individuals have high enough levels

of all skills to choose to be entrepreneurs, which should also imply increasing premiums to entrepreneurship.[12]

The Underlying Economy

In this section, the income generating functions shown in (1) and (2) are derived from a more fundamental production function.[13]

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

$$(7) \qquad \pi(y_1, y_2, w_1, w_2) = Q(\min(y_1, y_2))\, f(Y_1, Y_2) - w_1 Y_1 - w_2 Y_2 \quad .$$

[12]Thus, the difference between the earnings of a Silicon Valley entrepreneur and his employees should exceed the difference between the earnings of a nineteenth-century farm owner and his hired hands.

[13]Lucas (1998) uses this production function to discuss income distribution and the size distribution of fimrs.

Maximization of the profit function in (7) yields the firm's demand curves for Y_1 and Y_2, which are written as

(8) $Y_i^d = Y_i^d (\min(y_{1,} y_2), w_{1,} w_2)$ for i=1,2 .

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

(9) $A_1(w_1, w_2) = \{(y_1, y_2) \mid w_1 y_1 > \max [w_2 y_2 , \pi(y_1 , y_2 , w_1, w_2)] \}$.

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

(10) $A_2(w_1, w_2) = \{(y_1, y_2) \mid w_2 y_2 > \max [w_1 y_1 , \pi(y_1 , y_2 , w_1, w_2)] \}$

Finally, entrepreneurs are defined as the set

(11) $E(w_1 , w_2) = \{(y_1, y_2) \mid \pi(y_1 , y_2 , w_1, w_2) > \max [w_1 y_1 , w_2 y_2] \}$

Then let $g_i(y_{1,} y_2)$ be the density function of abilities of individuals in set A_i derived from g( ) and (9) and (10) and $g_e(y_1, y_2)$ be the corresponding density among entrepreneurs, derived from g( ) and (11).

The following two supply-equals-demand equations determine the equilibrium values of w_1 and w_2:

$$(11) \quad \int\int y_1 g_1(y_1, y_2)dy_1dy_2 = \int\int Y_1^d(\min(y_1, y_2), w_1, w_2)g_e(y_1, y_2)dy_1dy_2$$

and

$$(12) \quad \int\int y_2 g_2(y_1, y_2)dy_1dy_2 = \int\int Y_2^d(\min(y_1, y_2), w_1, w_2)g_e(y_1, y_2)dy_1dy_2 \ .$$

Next, define $x_1 = w_1y_1$ and $x_2 = w_2y_2$ where the wages are obtain from the market equilibrium given in (11) and (12). 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 re-labeling. 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 CRS and symmetry. Let production exhibit constant returns to scale such that

$$(13) \quad Q(k \min(y_1, y_2))\ f(kY_1, kY_2) = k\ Q(\min(y_1, y_2))\ f(Y_1, Y_2)$$

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

(14) $\pi(y_1, y_2, w_1, w_2) = \lambda \min(x_1, x_2)$.

Symmetry guarantees that $Y_1^0 = Y_2^0$ and that $w_1 = w_2 = w$. Let $z = \min(y_1^0, y_2^0)$. Constant returns to scale implies that if entrepreneur of skill z employs y^0 of each type of labor, then an entrepreneur of skill z' employs $(y^0)(z'/z)$ of each type of labor. That, coupled with (13) 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.

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

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

Market equilibrium occurs when λ is set such that

$$N\int_{0}^{\infty}\int_{x_1/\lambda}^{\lambda x_1} g(x_1, x_2)dx_2 dx_1 = q^* \tag{15}$$

Eq. (15) 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 λ=1, no one chooses to be an entrepreneur. As λ64, 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 the individual obtain levels of x_1, x_2, given the initial stock according to the cost function

$$C(x_1, x_2, x_1^0, x_2^0)$$

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

$$\underset{x_1}{\text{Max}} \quad x_1 - C(x_1, x_2, x_1^0, x_2^0)$$

with f.o.c.

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

Someone who is going to specialize will only invest in 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

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

There are three possibilities, but they can be dealt with quickly. If $C_2(x_1, x_2, x_1^0, x_2^0) > \lambda$, 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 $C_2(x_1, x_2, x_1^0, x_2^0) < \lambda$, but $C_2(x_1^0, x_2^0, x_1^0, x_2^0) > \lambda$, 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 $C_2(x_1^0, x_2^0, x_1^0, x_2^0) < \lambda$, 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 $C_1(x_1^0, x_2^0; x_1^0, x_2^0) < \lambda$, 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 multi-skilled 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 traditional industries such as retail, founders 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 not only is technically sound, but also business relevant.

That having been said, below it will be shown, using CPS data, that most entrepreneurs are unlikely to be innovators in any significant sense.

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?

The premise is that entrepreneurs are generalists. When thinking of entrepreneurs, many of us think of highly technical people who started their own businesses. Are they the exception or the rule? They are the exception. Most entrepreneurs are not in the technical occupations. In table 1, panel A, tabulations from the March, 2002 Current Population Survey (CPS) are presented. The table presents information on the breakdown of those who are the incorporated self-employed in the sample. As such, it throws out those self-employed who are least likely to be entrepreneurs, like household service workers and free-lance retailers.

The table shows that the individuals who are most likely to be incorporated self-employed are executives, managerial and administrative workers, not technical people. Managers are generalists, not technical specialists. The top category of managers accounts for about one-third of the self-employed. By contrast, engineers and mathematicians and computer specialists account for about 2% of all entrepreneurs. The category of managers, supervisors, management-related occupations and sales representatives account for about 55% of the self-employed. Only health diagnostic workers account for any sizeable fraction of entrepreneurs coming in at just over 5%. So the simplest statistics provide some support for the notion that entrepreneurs need general skills.

It is possible that individuals become generalists after starting their own businesses, but were previously technical specialists. Even if this were true, it is still worthy of note that the majority of

individuals declare themselves to be generalists when they run businesses. Panel B of table 1 is informative on this point.

In panel B, the breakdown of entrepreneurs (incorporated self-employed) is done by industry rather than by occupation. Although an individual might change from a technical occupation to a general one when becoming an entrepreneur, that is less true of industry, particularly for the industries that account for the largest number of new businesses. In order, the five industries accounting for the largest number of incorporated self-employed are construction, retail trade, professional services, business services and insurance and real estate. These are not the industries that are usually associated with technical innovation produced by specialists. As mentioned earlier, entrepreneurs may be innovators, but most are not of the technical variety. Because of the industry distribution of the self-employed, if innovation is important, it would likely take the form of business innovation, e.g., finding a good location for a retail business that others had not thought to be profitable.

Stanford MBA Data

To examine the issues discussed in the theory section more directly, a unique data set will be used. In the late 90s, 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.[14] This resulted in a sample of about 5000

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

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 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.[15]

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 jobs would have six rows of data, one for each employer. An individual who had four employers and one spell of unemployment would have five rows of data. The beginning and ending dates for each job is recorded, as is the beginning and ending salary and size of firm. Additionally, all roles within the employment event (up to five) are described through a coding system that corresponds to occupational titles. Industry and demographic data are also provided.

The Stanford MBA data are different from the CPS data, but a breakdown of industries

[15]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 for example Bates (1985 and 1990) .

entered by entrepreneurs in the Stanford data allows a comparison to the CPS. Two points are worthy of note. First, despite the fact that the Stanford data have much higher income and education levels than the CPS population, the five top industries for entrepreneurs are almost the same in both. Although not in the same order and probably emphasizing different aspects of the broad industrial categories, both Stanford and CPS top categories include construction and real estate, retail trade, and business consulting of some form. Second, once again, it is not the technical industries that account for most of the entrepreneurial activity. That 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.

Number of Prior Roles

Table 2 provides the means and standard deviations of the relevant variables used in subsequent analyses. Table 3 provides information on the proportion of entrepreneurial positions by number of prior roles. An entrepreneurial employment event 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-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 table 3 is the row, which consists of an employment event for any

given individual. An individual who had, say, three employers during his career to the point at which the survey was taken would have three rows of data. The key independent variable, "NPRIOR," is the number of roles in total that the individual has had before the employment event 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.

Panel A of table 3 reports the proportion of entrepreneurial employment events, 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.[16] 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 many different assignments also have much higher probabilities of becoming entrepreneurs.

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 panel B. The column "p low NPRIOR" is the proportion of entrepreneurial events in the group of individuals who have the median or less than the number of prior roles for this experience groups. The column "p high NPRIOR" gives the proportion of entrepreneurial events 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

[16]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 re-defined such that each entrepreneurial employment was given one and only one role. The results were substantially unaltered.

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.[17] But the pattern is clear. Those who have had more roles in the past are more likely to be entrepreneurs.

A more systematic approach is available. For each person, it is possible to compute the number of business started over the lifetime. Most individuals in the survey have not completed their work careers, but this is easily handled by correcting for years of experience in the labor market and for censoring. In column 1 of table 4, the Tobit results are presented where independent variables include age, the year in which the MBA was awarded, and gender (dummy equal to 1 for male).[18] NROLES is the total number of roles that the individual has had during his or her career. If the jack-of-all-trades story is correct, then the more roles, the more businesses that the individual should have started.

There are two interpretations of the "NROLES" 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 "NROLES" proxies a person-specific effect -- high NROLES are endowed with a balanced skill set. The second interpretation is that those who want to be entrepreneurs intentionally

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

[18]All non-employment spells are dropped.

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 are 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.

The coefficient on experience is large and significant. This is no surprise. The more years in the labor force, the more time the individual has to start businesses. Additionally, it might take time to acquire the experience and/or connections necessary to start a business. This point would hold independent of the jack-of-all-trades story. Column 2, however, presents a clearer picture. When "NROLES" is entered, the NROLES variable takes over almost all of the action, and the experience effect switches sign and becomes smaller in absolute magnitude and relative to its standard error. The coefficient on NROLES is very large and has a t-value of around 17. The next largest t-value is on MALE, which is slightly below 4. There is little doubt that the number of roles is importantly related to the number of business started.

Since the observation relates to the total number of businesses started and not the timing, there is nothing to suggest that the roles precede the founding of a business. The investment version of the jack-of-all trades approach would suggest that the large number of roles would precede the entrepreneurial event. But if roles are taken to be a proxy for general skills embodied in the individual, timing is of no consequence. Whether roles come before or after the entrepreneurial event(s), the fact that they are correlated with entrepreneurship is consistent with the view that entrepreneurs have general skills, which enable them to play many roles.

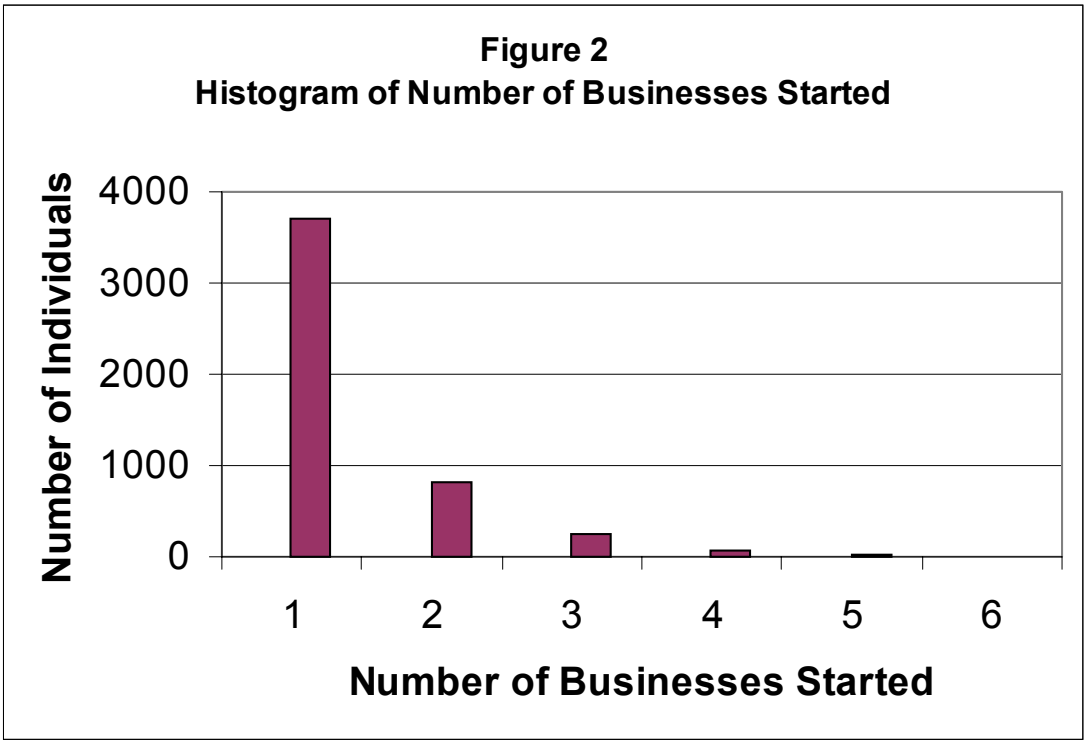
Under either the investment or the embodied skills interpretation, there remains the worry that those who are entrepreneurs state that they have performed many roles because the founder's job is a multi-task activity by its nature. Both issues, i.e., timing and reporting bias, are dealt with below.

Before going into that level of detail, note that the distribution of NUMBUS is highly concentrated at either zero or one as figure 2 shows. Specifically, more than twice as many individuals have started exactly one business than all other numbers greater than one combined. Consequently, table 4 also presents logit results, where the dependent variable is one if the individual ever started a business over his career and zero otherwise. Not surprisingly, exactly the same picture emerges. When NROLES is left out of the analysis, experience matters. When NROLES is included, it becomes by far the most important variable and the role of experience is diminished and the sign is reversed.

To get a sense of magnitudes, examine the second logit. About 24% of the sample started at least one business during their careers. Using this proportion and the coefficient on NROLES implies that one additional role translates into an increase in the probability of being an entrepreneur of .027. Thus, a one standard deviation increase in the number of prior roles increases the probability of having started a business by about ten percentage points or almost half of the average proportion for the sample as a whole. Thus, the effect is both large and statistically precise.

Some Details

Might the results reflect something other than the jack-of-all-trades view? As mentioned, 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 non-entrepreneurial events.

To deal with this, "NROLESOTH" is defined as NROLES except that each entrepreneurial event is allowed to add only one role to NROLES, 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 event. The results are reported in columns 5 and 6 of table 4. The coefficient on NROLESOTH is about half that on NROLES, but qualitatively, the results are similar. (Note also that the experience effect vanishes completely.)[19]

Timing

To get at timing and provide other evidence on the nature of roles and entrepreneurship, define the unit of analysis to be an employment event, i.e., a row in the data matrix. The event is either an entrepreneurial one, where the respondent says that he or she was among the founders of this business, or it is not. For each row, there is a number of prior roles (NPRIOR) that corresponds to the number of roles that the individual in question has had up to that point. If the jack-of-all-trades story is correct, then one would expect that NPRIOR would positively affect the probability of entrepreneurship. A statistical issues is that the rows are not independent because they belong to the same individual. 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 resported in table 5.

[19]It is 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 the coefficient is not significant in the logits. Furthermore, there is virtually no effect on the size of the NROLES coefficient.

The first column assumes independence across observations and is just a standard logit, ignoring any panel aspects of the data. The effect of number of prior roles on entrepreneurship is both large and statistically significant. A one standard deviation increase in the number of roles is associated with an increase of 1.5 percentage points in the probability that a given employment event will be an entrepreneurial one. This is about one-fourth of the overall probability that a given employment event is an entrpreneurial one.

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 a number of rows 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

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

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 non-independence is taken into account, the relation of number of roles on entrepreneurial activity is large and significant. All results hold even when years of experience in the labor market, which has a substantial effect on entrepreneurship, is held constant.[20]

[20]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 non-entrepreneurial jobs, earn less than those who choose to be specialists. A regression of earnings in non-entrepreneurial jobs on EXP and a dummy equal to 1 if the individual ever

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 event should have the same "effect" on the likelihood that the event is an entrepreneurial one as a role held before. On the other hand, if performing many labor market roles actually enhances the individual's ability to become an entrepreneur, then roles before any particular employment event should be more salient than roles held after an employment event. Therefore, another variable, NAFTER, was created, which counts the number of roles that an individual had in all employment events 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 have a long career in the data after a particular event 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 event in question occurs.

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founds a business in the career, yields a negative, albeit insignificant, coefficient on the dummy.

Results are reported in column 4 of table 5. 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.[21]

Impatience and Entrepreneurship

One theory, that entrepreneurs are those who are impatient, 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 tobit and logit. The result, in column 5 of table 5, 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.

The results on average employment tenure also speak to risk taking. One might argue that entrepreneurs are risk takers and the fact that they take on many roles reflects their willingness to take chances with their careers, doing things that they otherwise are not well-suited to do. But were this the case, one would also expect these individuals to be willing to change employers more frequently. In fact, the reverse is true. Those who stay longer with a given employer are more likely

[21]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 do many roles in subsequent employment, precisely because entrepreneurs perform many tasks. Conversely, if entrepreneurship is an absorbing state or close to it, an entrepreneurial event 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 event on average than non-entrepreneurs.

to become entrepreneurs.

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 test this, a logit identical to the one in column 4 of table 4 was estimated, except that the dependent variable was a dummy equal to one if the employment reported was defined high-level general manager. The results for the NROLES variable are very close to column 4. In particular, the coefficient on NROLES is .137, with a z value of 12. So the jack-of-all-trades story applies well to senior level managers.

Additionally, it is possible to distinguish senior managers from "true" entrepreneurs with this approach. The theory suggests that those who start their own businesses must have many skills and possibly a more general array than those who are 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 should be more important for true entrepreneurs than for chief-level managers. Column 8 of table 4 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.

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 and performance in those courses 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 only pertain to those who graduated during approximately the last fifteen years. But almost 2000 records of alumni work history data have been matched with transcript information so a significant amount of information is contained in the fifteen 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 for entrepreneurs than it is for specialists.

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

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 and tobits analogies 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 that 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 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 business later because the event 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.[22]

The results from the one-observation-per-individual data support the earlier conclusions. Entrepreneurs are jacks-of-all-trades. They have more varied course work while in the MBA

[22]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.

program and have many more positions when they are actually in the labor market.

Conclusion

Entrepreneurs are individuals who are multi-faceted. 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. For the most part, they are not technical innovators. Instead, they are team builders who may exploit a business innovation as small as finding a good location for a retail store in a traditional industry.

Three different kinds of evidence have been provided. First, the CPS data reveal that incorporated self-employed are most likely to be managers, whom most would agree are the generalists. Only a very small fraction of entrepreneurs in the CPS are technical specialists. Second, 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 acquired the varied background necessary to start a business. Each version finds some support, but the investment view seems to dominate. Finally, 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.

Table 1

CPS Entrepreneurs

Panel A

Detailed Occupation	**Percent**
Other executive, admin. & managerial	32.97
Supervisors and proprietors, sales occs.	12.44
Construction trades	6.09
Health diagnosing occs.	5.38
Management-related occupations	4.92
Sales reps, finance and business serv.	4.67
Other professional specialty occs.	3.80
Farm operators and managers	3.46
Financial records processing	2.88
Lawyers and judges	2.59
Mechanics and repairers	2.17
Sales workers, retail & personal serv.	1.92
Motor vehicle operators	1.71
Other precision prod, craft & repair	1.67
Secretaries, stenographers, and typists	1.63
Health assessment and treatment occs.	1.17
Engineers	1.04
Sales reps, commodities, exc. Retail	1.00
Other admin support, inc. clerical	1.00
Mathematical and computer scientists	0.92
Teachers, exc. college and university	0.88
Personal service	0.83
Food service	0.67
Farm workers and related occs.	0.63
Cleaning and building service	0.54
Fabricators, assemblers, inspectors, samplers	0.50
Other transp. & material moving occs.	0.50
Machine operators and tenders, exc. Precision	0.38
Technicians, exc. health, engin, & science	0.29

Natural Scientists	0.21
Engineering and science technicians	0.21
Forestry and fishery occs.	0.21
Other handlers, equip, cleaners, helpers & laborers	0.17
Health service	0.13
Freight, stock & materials handlers	0.13
Supervisors, admin support	0.08
Computer equipment operators	0.08
Health technologists and technicians	0.04
Mail and message distributing	0.04
Protective service	0.04
Total	100.00
(of sample of 2396)	

Table 1, Continued

Panel B

Detailed Industry	**Percent of total**
Construction	13.48
Other Retail Trade	12.98
Other Professional Services	11.02
Business Services	8.10
Insurance and Real Estate	6.72
Health Services, Exc. Hospitals	6.39
Wholesale Trade	6.18
Eating & Drinking Places	4.51
Transportation	4.17
Automobile and Repair Services	3.67
Goods Producing--Other Agricultural	3.21
Personal Serv, Exc. Private Households	2.96
Entertainment & Recreation Services	2.38
Banking and Other Finance	1.92
Mfg-- Printing, Publishing & Allied Prods	1.75
Goods Producing--Agricultural Services	1.63
Mfg-- Fabricated Metals	1.25
Mfg-- Machinery, Exc. Electrical	1.21
Mfg-- Lumber & Wood Prods, Exc. Furniture	0.71
Social Services	0.67
Mfg-- Misc & Nec Mfg Industries	0.63
Communications	0.42
Educational Services	0.42
Mfg-- Electrical Machinery, Equip, Supplies	0.42
Mfg-- Food & Kindred Prods	0.33
Mining	0.33
Utilities & Sanitary Services	0.33
Mfg-- Apparel & Other Finished Textile Prods	0.29
Mfg-- Furniture & Fixtures	0.29
Mfg-- Other Transportation Equip	0.25
Mfg-- Primary Metals	0.21
Mfg-- Stone, Clay, Concrete, Glass Prods	0.21

Mfg-- Paper & Allied Prods	0.17
Mfg-- Professional & Photo Equip, Watches	0.17
Forestry and Fishery	0.13
Hospitals	0.13
Mfg-- Chemicals & Allied Prods	0.13
Mfg-- Motor Vehicles & Equip	0.13
Mfg-- Rubber & Misc Plastic Prods	0.04
Mfg-- Textile Mill Prods	0.04
Mfg-- Toys, Amusement & Sporting Goods	0.04

Table 1, Continued

Panel C

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/Non-Profit Organizations	1.13
Agriculture	1.02
Medical Instruments & Devices	1.02
Accounting	0.90
Import/Export/International Trade	0.90
Commercial Banking	0.85
Education	0.79
Radio/TV/Cable/Film	0.79
High Tech– Telecommunications Products	0.79
Energy	0.73

High Tech– Computers/Hardware	0.73
Industrial Equipment	0.73
Advertising	0.68
Insurance	0.68
Transportation Services/Shipping	0.68
Legal Services	0.62
Multimedia Services	0.62
High Tech– Multimedia Products	0.56
Rubber/Plastics	0.56
Biotechnology	0.51
Diversified Manufacturing	0.45
Public Relations	0.34
Chemical	0.34
High Tech– Consumer/Electronics	0.34
High Tech– Semiconductors	0.34
Architecture	0.28
Arts	0.28
Environmental/Waste Managment/Recycling	0.28
Social Services	0.28
Unknown	0.28
Aerospace	0.28
Automotive/Transportation Equipment	0.28
High Tech– Optics	0.28
Apparel/Textiles	0.23
Government	0.17
Pharmaceuticals	0.17
Utilities	0.06
High Tech– Networking	0.06

1771 observations: Entrepreneurs only

Table 2
Variables and Descriptive Statistics

Whole Sample:

Variable	Obs	Mean	Std. Dev.	Min	Max
mbayear	26901	74.2688	14.21188	13	97
male	27283	.8311403	.3746348	0	1
age	26863	50.24212	13.59082	25	93
white	27283	.855771	.3513282	0	1
exp	26778	9.542647	9.287569	0	63
NPRIOR	27277	3.25769	3.391682	0	37
NROLES	4877	5.228829	3.782126	0	37
NROLESOTH	4216	4.733159	3.272184	1	32
entre	27283	.0660118	.2483073	0	1
numbus	27283	.3890335	.7937979	0	5
avjobten	26737	2.032126	1.695632	0	25
specdif	1996	2.4872961	1.1289535	0	9
nafter	27262	3.756034	3.729316	0	37
yrleft	26588	10.74432	9.933903	0	45

Table 2, Continued:

Specialists:

Variable	Obs	Mean	Std. Dev.	Min	Max
mbayear	25120	74.34331	14.25045	13	97
male	25482	.8269367	.3783094	0	1
age	25081	50.17942	13.64622	25	93
white	25482	.8551527	.3519538	0	1
exp	25010	9.139224	9.084775	0	63
NPRIOR	25476	3.095973	3.260892	0	37
NROLES	3710	4.68814	3.393973	0	32
NROLESOTH	671	4.596125	3.023675	1	21
entre	25482	0	0	0	0
numbus	25482	.3564477	.7471775	0	5
avjobten	24969	1.972039	1.675913	0	25
specdif	1673	2.5122463	1.1423540	1	9
nafter	24457	3.918306	3.743552	0	37
yrleft	23879	11.38938	10.00876	0	45

Table 2, Continued:

Entrepreneurs:

Variable	Obs	Mean	Std. Dev.	Min	Max
mbayear	1781	73.21786	13.61682	13	97
male	1801	.8906163	.3122067	0	1
age	1782	51.12458	12.75662	26	88
white	1801	.8645197	.3423309	0	1
exp	1768	15.24943	10.20544	0	59
NPRIOR	1801	5.545253	4.268265	0	35
NROLES	1167	6.947729	4.392006	0	37
NROLESOTH	3545	4.759097	3.316891	1	32
entre	1801	1	0	1	1
numbus	1801	.8500833	1.191526	0	5
avjobten	1768	2.88072	1.744903	0	18
specdif	323	2.3580644	1.0490297	0	7
nafter	2805	2.341176	3.279127	0	25
yrleft	2709	5.058324	7.038793	0	41

Table 3
Proportion of Entrepreneurs by Number of Prior Roles

		Panel A			
	Roles				
	≤3	3 to 16	more than 16		
	.03	.10	.29		
		Panel B			
	Roles				
Exp level	*p low NPRIOR*	*p high NPRIOR*	*diff*	*std error*	*N*
3 or less	0.015	0.029	0.014	0.003	8163
4 to 8	0.034	0.073	0.039	0.005	6971
9 to 13	0.073	0.11	0.037	0.009	4597
14 to 19	0.099	0.115	0.016	0.011	3415
20 to 29	0.102	0.138	0.036	0.012	2965
30 or more	0.145	0.187	0.042	0.022	1148

Table 4
Tobit on Number of Business Started and
Logit on Ever Starting a Business
One Observation per Person

	1 Tobit (Number of Businesses)	2 Tobit (Number of Businesses)	3 Logit (Entrepreneur Yes=1)	4 Logit (Entrepreneur Yes=1)	5 Tobit (Number of Businesses)	6 Logit (Entrepreneur Yes=1)	7 Logit (Chief Executive Yes=1)	8 Multinomial Logit	
								Employee	C-Level Manager
EXP	.0380 (.0055)	-.0156 (.0059)	.0263 (.0046)	-.0144 (.0056)	.0066 (.0060)	.0032 (.0055)	.0450 (.0066)	.0109 (.0060)	.0472 (.0081)
NROLES		.1927 (.0114)		.1531 (.0113)			.1373 (.0114)	-.2233 (.0131)	-.0387 (.0133)
MALE	.5195 (.1192)	.4304 (.1111)	.3899 (.1047)	.3685 (.1066)	.4245 (.1111)	.3671 (.1059)	.7669 (.1322)	-.4713 (.1089)	.2458 (.1631)
MBAYear	-.0211 (.0111)	-.0247 (.0104)	-.0204 (.0101)	-.0229 (.0104)	-.0205 (.0104)	-.0206 (.0103)	.0150 (.0109)	.0159 (.0108)	.0335 (.0137)
AGE	.0186 (.0117)	-.0111 (.0109)	-.0176 (.0107)	-.0108 (.0109)	-.0114 (.0109)	-.0123 (.0108)	.0021 (.0114)	.0030 (.0113)	.0126 (.0143)
NROLESOTH					.0996 (.0124)	.0828 (.0114)			
Constant	-.0342 (1.4001)	-.0569 (1.3133)	.4545 (1.2801)	.1981 (1.3084)	-.2425 (1.3152)	.1738 (1.2966)	-4.9741 (1.3727)	.9783 (1.360)	-4.5313 (1.7220)
Log likelihood	-3998	-3849	-2583	-2476	-3811	-2502	-2123	-4031	
Number of obs.	4787	4787	4794	4791	4751	4751	4792	4792	

Standard Errors in Parentheses

Table 5
Logit Analysis Panel Data
Dep Var: 1 if Employment Event is Entrepreneurial

Variable	Column #				
	1	2	3	4	5
	Correlation Structure				
	Independent	AR-1	Unstructured	Independent	Independent
EXP	.0452 (.0036)	.0502 (.0039)	.0534 (.0038)	.0070 (.0044)	.0205 (.0048)
NPRIOR	.0851 (.0079)	.0769 (.0088)	.0706 (.0092)	.0808 (.0082)	.1166 (.0088)
MALE	.4757 (.0843)	.4562 (.0950)	.4565 (.0998)	.5266 (.0865)	.4769 (.0846)
MBAYear	-.0070 (.0074	-.0044 (.0084)	.0054 (.0090)	-.0214 (.0076)	-.0094 (.0074)
AGE	-.0265 (.0078	-.0250 (.0089)	-.0256 (.0095)	-.0117 (.0080)	-.0281 (.0078)
NAFTER				.0186 (.0119)	
YRLEFT				.0786 (.0060)	
AVJOBTEN					.1218 (.0152)
Constant	-2.1085 (.9397)	-2.3626 (1.0669)	-2.2253 (1.1369)	-.7957 (.9587)	-1.9849 (.9330)
Wald chi sq.	842	706	786	944	876
Number of obs.	26819	26663	26819	26163	26779

Standard Errors in Parentheses

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

Variable	1 Logit	2 Tobit
EXP	.0259 (.0185)	.0266 (.0196)
SPECDIF	-.1458 (.0581)	-.1452 (.0592)
MALE	.6025 (.1511)	.6305 (.1531)
MBAYear	-.0318 (.0215)	-.0384 (.0224)
AGE	.0250 (.0179)	.0264 (.1531)
Constant	.0202 (2.4182)	.3243 (2.4897)
Log likelihood	-841	-1181
Number of obs.	1952	1950

Standard Errors in Parentheses

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Appendix B

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 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.[23]

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 being an entrepreneur in (6) can be rewritten as

$$\text{(A1) prob of entrepreneurship} = \int_0^{\infty} \int_{\frac{\frac{x_1}{\lambda}-\rho x_1}{1-\rho}}^{\frac{\lambda x_1-\rho x_1}{1-\rho}} f(x_1)h(\nu)\,d\nu\,dx_1$$

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

Next, differentiate (A1) with respect to ρ to obtain

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

where UL and LL stand for upper and lower limits of the inside integral in (A1). After substitution, this becomes

[23]Stopford and Baden-Fuller (1994) list five components (proactiveness, team orientation, dispute resolution skills, 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.

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

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