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ENTREPRENEURSHIP

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ABSTRACT

The theory proposed below is that entrepreneurs are jacks-of-all-trades who may not excel in any one skill, but are competent in many. A coherent model of the choice to become an entrepreneur is presented. The primary implication is that individuals with balanced skills should be more likely than others to become entrepreneurs. The model provides implications for the proportion of entrepreneurs by occupation, by income and yields a number of predictions for the distribution of income by entrepreneurial status. Using a data set of Stanford alumni, the predictions are tested and found to hold. In particular, by far the most important determinant of entrepreneurship is having background in a large number of different roles. Further, income distribution predictions, e.g., that there are a disproportionate number of entrepreneurs in the upper tail of the distribution, are borne out.

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The entrepreneur is the single most important player in a modern economy. Choosing to be an entrepreneur requires an understanding of a variety 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? What implications does this aspect of occupational choice have for income distribution and for the distribution of talents across occupations? To this point, most of the work on entrepreneurship has been strictly empirical,[1] but it is useful to have theory to guide the empirics and to assist in interpretation of the results.[2]

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 and the half-million-dollar-per-year executive whose suit he cleans is someone else's employee. But it would be difficult to find a sensible measure of ability by which the typical dry-cleaner would dominate the average executive.

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

[2]The theoretical papers on the subject rarely speak to the issue of occupational choice or resulting income distribution which are 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 (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.

Perhaps the situation is the reverse. As necessity is the mother of invention, maybe 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.[3] 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 probably needs to be redone.

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 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 figure 600/600 individual is more likely to become the entrepreneur than the 800/400 individual.

What is an 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."

[3]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.

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, both at the theoretical and empirical level, is quite 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.

The model presented below is one of occupational choice, where an individual can decide whether to become an entrepreneur, which makes use of a variety of skills, or to specialize, which makes use of 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.

The primary theoretical predictions are:

1. Individuals with more "balance" 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. Entrepreneurship should be an increasing proportion of the income bracket in question.

4. The supply of entrepreneurs is smaller for production processes that require a higher

number of independent skills.

5. The upper tail of the income distribution is fatter for entrepreneurs than it is for specialists. Entrepreneurs are predicted to be the highest income individuals in society, but the bottom of the income distribution should have both entrepreneurs and specialists.

6. Symmetric underlying ability distributions result in positively skewed income distributions.

7. Individuals who become entrepreneurs should have a more balanced human capital investment strategy on average than those who become specialists.

The predictions are tested empirically using data on Stanford alumni and are borne out. Specifically,

1. The most important determinant of becoming an entrepreneur is the number of prior roles (not employers) held. Entrepreneurs are people who are multi-skilled either because of their endowment or because they acquire skills that they lack.

2. Entrepreneurs are disproportionately those who did not take a specialized course load when they were MBA students. Those who become entrepreneurs tended to take a more field-dispersed set of courses.

3. Income distributions have fatter upper tails for entrepreneurs than for specialists, although the bottom is similar.

4. The proportion of individuals who are entrepreneurs increases with the income bracket examined.

A Model of Occupational Choice

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

(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. To capture the jack-of-all-trades aspect of entrepreneurship, let

(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 initial issue is occupational choice. 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 (x_1 , x_2). The joint density on x_1 and x_2 is given by $g(x_1, x_2)$. Then the individual chooses to become an entrepreneur if and only if

(3) $\lambda \min [x_1, x_2] > \max [x_1, x_2]$

Creativity and willingness to take risk are two factors that are often mentioned as affecting the decision to become an entrepreneur.[4] 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 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.[5]

Who Becomes an Entrepreneur?

Let us first explore some of the implications of eq. (3) for the decision to become an entrepreneur. First, 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

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[4]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.

[5]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.

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

(4) $$x_2 > x_1 / \lambda \quad .$$

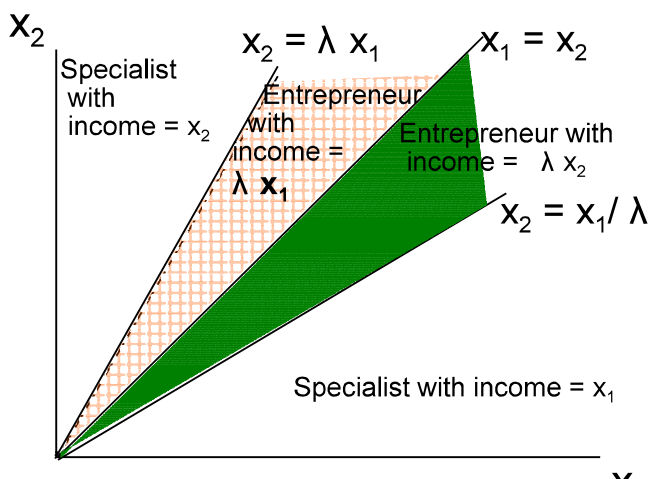


Figure 1

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

(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 occupational choice 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 λ=1, the borders of the shaded area are the line $x_1 = x_2$ and there are no entrepreneurs. Obviously, if λ=1, it is impossible for condition (3) to hold since the min of something can never exceed the max of something.[6]

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

[6]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.

reflected in high values of λ. Since such talents are generally unobservable, not much more is said about the idiosyncratic variation in λ. [7]

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

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

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 $x_1 = x_2 = X/2$.

[7]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.

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° 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.[8] 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

[8] 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.

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.

Ability Levels:

At the outset, it was suggested that there are entrepreneurs at all income and ability levels. The model presented suggests some patterns that may be observable in real world data. In particular, entrepreneurship should be more prevalent among higher income individuals. The intuition is easily obtained by examining a special case of figure 1 shown as figure 2.

Here, the joint density of x_1, x_2 is such that all points lie within the box bounded by (0,0),

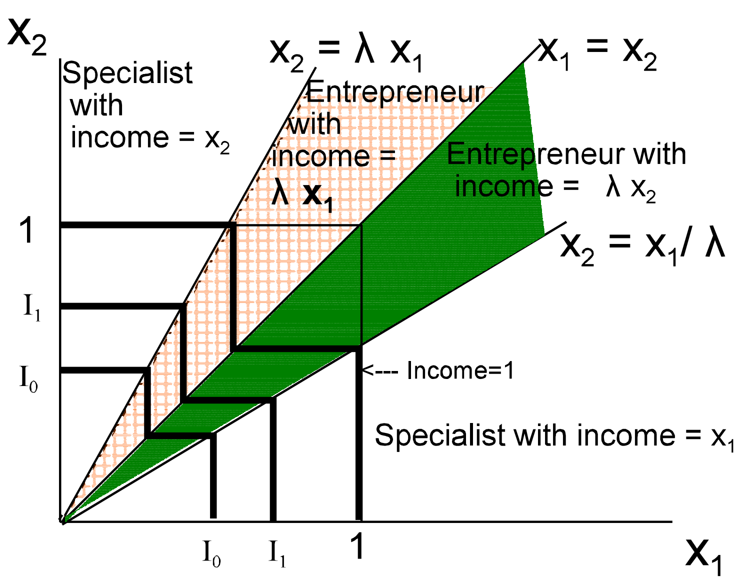


Figure 2

(1,0), (1,1) and (0,1). Now suppose that we stratify a sample of individuals on the basis of their income. A specialist can never have income greater than 1 because $\sup \{\max[x_1 , x_2]\} = 1$. Entrepreneurs can have income greater than 1 because their minimum skill is multiplied by the market value of entrepreneurial talent, λ, to obtain income. For example, an individual with x_1=1 and x_2=1 would have income of λ, which exceeds 1.

In fact, there are three ways to have income equal to 1. An individual can have x_1 equal to 1 and specialize in x_1, he can have x_2 equal to 1 and specialize in x_2, or he can be an entrepreneur. This is shown by the thick saw-tooth iso-income line that joins 1 on the x_1 axis with 1 on the x_2 axis. The same is true for other levels of income, e.g., I_0 and I_1, which reflect two more among the family of iso-income lines.

Clear from figure 2 is that irrespective of the income brackets or of the underlying density functions, at least at the top income brackets (for income > 1), all individuals are entrepreneurs. At lower levels of income, some individuals must be specialists so at least at the extremes, there must be a rising proportion of entrepreneurs with income levels.[9]

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

[9]The production functions guarantee this result. Less restrictive production technologies would also produce this result.

$m(x_3)$, 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 number of entrepreneurs should decline over time as few individuals have high enough levels of all skills to choose to be entrepreneurs.

The Distribution of Income

The model presented above has a number of implications for the observable distribution of income. There are some measurement problems that camouflage some of the results, but let us put those aside for now and derive the implications of the pure model in the absence of complicating factors. It is interesting to examine the distribution of income among specialists, among entrepreneurs, and the overall distribution of income that does not distinguish between them.[10]

Minimum and Maximum Income:

The maximum income for an entrepreneur occurs on the 45° line in figure 1. Since the binding constraint is always the lowest income, for any x_1 or x_2, income can never be higher than it

[10]Hamilton (2000) shows that entrepreneurs have lower initial earnings than non-entrepreneurs. He attributes this to a compensating differential for being able to be one's own boss.

is for the corresponding value of the other factor on the 45° line. Let x_1 and x_2 be defined over intervals $x_1 = [x_{1L,} x_{1U}]$ and $x_2 = [x_{2L,} x_{2U}]$. Then, the maximum income among entrepreneurs is

$$\lambda x_{1U} \text{ if } x_{1U} < x_{2U}$$

and

$$\lambda x_2 \text{ if } x_{1U} \geq x_{2U}$$

The maximum specialist income depends only on the maximum of either x_1 or x_2. Thus, the maximum income among specialists is

$$x_1 \text{ if } x_{1U} \geq x_{2U}$$

and

$$x_2 \text{ if } x_{1U} < x_{2U}$$

Because $\lambda>1$, a sufficient condition for the maximum income of entrepreneurs to exceed the maximum income of specialists is that $x_{1U} = x_{2U}$. This is not a necessary condition. As λ goes to infinity, the maximum income among entrepreneurs must exceed that among specialists, for any finite $x_{1U,}$ x_{2U}.

A similar analysis can be done for minimum income. Because an individual will not choose an occupation unless the income is higher there than in the other occupation, with a sufficiently large number of individuals in the population, the minimum for both groups must be the same. To see this more formally, note that for a sufficiently large population, there exists an individual whose values of x_1 , x_2 lie within an epsilon neighborhood of x_{1L} , x_{2L} for arbitrarily small epsilon. Now suppose that $x_{1L} < x_{2L}$. Then the minimum specialist income would be x_{2L} if there were not the entrepreneurial option. There are two cases. The worst entrepreneurial option may be worse than the worst specialist option. This occurs when $\lambda x_{1L} < x_{2L}$. Then the lowest specialist income is indeed x_{2L} because the lowest x_1 , x_2 individual chooses to be a specialist. But that is also the lowest entrepreneurial income because no one would choose to be an entrepreneur unless x_1 were sufficiently high that $\lambda x_1 = x_{2L}$. Minimum income for the specialist equals that for the entrepreneur. In this case, the minimum income for each group is x_{2L} . In the second case, the worst entrepreneurial option is better than x_{2L}. Then the minimum entrepreneurial income is $\lambda x_{1L} > x_{2L}$. But then individuals will not choose to specialize unless x_2 is sufficiently high to equal the income of an entrepreneur. Once again, minimum income for the specialist equals that for the entrepreneur, only this time the minimum is λx_{1L}.

Summarizing, the maximum income for entrepreneurs, under general conditions is higher than that of specialists, but the minimum income of both groups is the same.

Observed income may be different than that predicted, especially for very low levels and very high levels. There are two reasons. Self-employed individuals have wages that reflect not only human capital, but physical capital. When starting a business, reported income is negative because the self-employed person takes his “wage” and invests it, along with other capital, directly into the business. In a mature business, the reverse is true. What shows up as wage is in part a return on human capital, but in part a return on the physical capital that the individual invested in early. Wage and salary workers separate the earnings and investment. They take their earnings, which are always non-negative and then invest it in physical capital. Even if the total investment exceeds their wage, the wage still shows up as a positive number. Second, there is likely to be a larger transitory component in the earnings of the self-employed, especially at very high and very low earnings. Some of this can be dealt with by averaging earnings over a longer period of time, or ideally, computing lifetime wealth, which is really the variable to which the theory speaks directly.

Average Income:

There is no general proposition that can be stated on the relation of average income among the entrepreneur to that of specialists. The results are distribution specific. What can be said, however, is that numerical methods reveal the following.[11]

If x_1 and x_2 are distributed normally and independently, then it is always true that mean entrepreneur's income exceeds mean specialist income, for any value of λ. The difference between the means is increasing in λ as is clear because entrepreneurial income goes to infinity as λ goes to infinity.

The same logic implies that for any distribution of x_1,x_2, the mean income of entrepreneurs is higher than that of specialists for sufficiently large values of λ. But there are distributions, e.g., the gamma, where for sufficiently low values of $\lambda>1$, the mean specialist earns more than the mean entrepreneur.

[11]Here as well, measurement issues complicate the empirical analysis. For example, industries dominated by start-ups have low average measured earnings because entrepreneurs invest some income in physical capital before income is measured.

Skewness:

Earnings distributions tend to acquire skew, even when the underlying ability distributions are symmetric. The reason is that entrepreneurs add an upper tail to the distribution that would not be present were there no entrepreneurs. To see this, consider a distribution without any skew, namely the normal. Suppose that x_1 and x_2 are i.i.d. normal random variables. Table A reports the mean, variance and skew for the relevant variables in a numerical simulation where x_1 and x_2 are standard normal random variables.

Overall income is skewed for two reasons. First, the entrepreneurial income distribution is itself skewed because there are some very high earning entrepreneurs, but the bottom entrepreneurial income is truncated because individuals can choose to become specialists if their entrepreneurial income would be too low. That is, an individual with a very low value of x_2 need not settle for an entrepreneurial income of λx_2. He can earn a higher income by specializing in x_1 instead. Second, the overall income distribution for entrepreneurs lies to the right of that for specialists and entrepreneurs are rare, creating an upper tail to the distribution.[12]

It is tedious but straightforward using the formulas for the relevant areas in figure 2 to show analytically that a uniform i.i.d. distribution of x_1 and x_2 results in a density as shown in figure 3. Figure 3 is based on uniform densities of x_1 and x_2 that lie between 0 and 1 and on λ=2. More of the mass lies below 1, because an income level that is less than 1 can be obtained both through the entrepreneurial route and through the specialist route. But only entrepreneurs can obtain an income

[12]But as λ gets large, entrepreneurship becomes more common.

greater than 1, since the maximum value of the underlying ability variables never exceed 1. It is only when the values of the weakest attribute exceeds ½ that the individual obtains an income greater than 1, and this is by becoming an entrepreneur.

Table A
$\lambda = 3$

Variable	**Number of Observations**	**Mean**	**Variance**	**Skew**
x_1	10,000	.0009	1.01	-.003
x_2	10,000	.007	1.01	-.001
Proportion entrepreneurs	.14			
Income, given specialist	8565	.48	.71	.21
Income, given entrepreneur	1435	2.01	1.32	.89
Income (entire population)	10,000	.70	1.08	.85

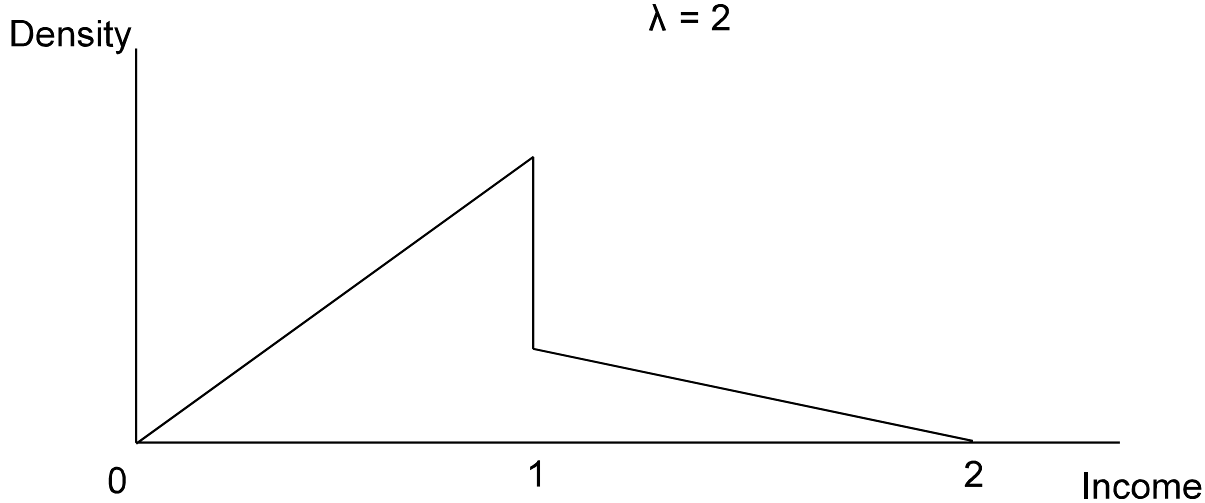


Figure 3
Uniform Distribution Results in Skewed Income
$\lambda = 2$

Equilibrium

Earlier, it was mentioned that λ, which has been called the market value of entrepreneurial talent, is determined by demand and supply. 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

$$N\int_0^{\infty}\int_{x_1/\lambda}^{\lambda x_1} g(x_1,x_2)dx_2dx_1 \quad .$$

Market equilibrium occurs when λ is set such that

(7) $$N\int_0^{\infty}\int_{x_1/\lambda}^{\lambda x_1} g(x_1,x_2)dx_2dx_1 \;=\; q^*$$

Eq. (7) 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.

Investment

So far, x_1 and x_2 have been taken as given. But much of economic activity as it relates to occupational choice 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

$$\max_{x_1} \quad x_1 - C(x_1, x_2, x_1^0, x_2^0)$$

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 individual 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

$$(9) \qquad \lambda - C_2(x_1, x_2, x_1^0, x_2^0) = 0 .$$

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.

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.

Empirical Analysis

There are a number of implications that have been suggested in the theory section above. Some relate to occupational choice and some to income distribution, by group and overall. To examine these issues, 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. The response rate was about 40%, which resulted in a sample of about 5000 respondents. In addition to the detailed job histories, I matched these data 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 my 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 will invest in a broader range of skills than will 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 jobs would have six rows of data, one for each

[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 for example Bates (1985 and 1990) .

employer. An individual who had 4 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 job (up to five) are described through a coding system that corresponds to occupational titles. Industry and demographic data are also provided.

Table 1 provides the means and standard deviations of the relevant variables. Table 2 reports the results of logits and linear probability estimates, where the dependent variable is 1 if the employment event is reported as an entrepreneurial one and 0 otherwise. (All non-employment spells are dropped.) Panel A is for linear probability estimates. The dependent variable is a dummy equal to one when the employment to which the observation refers is one where the individual lists his role as "Founder - among those who initially started the business." The key independent variable, "nprior," is the number of roles in total that the individual has had before the employment 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 7. "Avjobten" is the average number of years per employer. "Male" is a variable that is 1 if the individual is male and 0 if female. "Amer" is a dummy for nationality being American. White is a dummy for white, age is age at the time of the survey and MBA year is the year of graduation from the MBA program. Age and MBAyear can be thought of as experience and cohort effects. Variables with a "2" at the end mean that the variable is squared.

Obvious from an examination of panel A is that nprior is most important in determining entrepreneurship. This finding holds up in all subsequent analyses. The t value on this variable is almost 30, which is very large relative to anything else in the regression, and which reflects the importance of the variable in magnitude and the precision of estimation. Panel B is the same analysis, but with a logit specification and panel C adds non-linear terms. The importance of additional roles diminishes as more roles are added (the quadratic term is negative).[14]

The significance of having had prior roles is striking support of the "jack-of-all-trades" view. An additional one role increases the probability that the job will be one where the individual is an entrepreneur by 1 percentage point (from panel B). This is large because the probability of entrepreneurship in the overall sample is only 6.6%. The mean number of roles held before starting a job is about 3. The point is also clear using some simple statistics. In table B, the probability of entrepreneurship is reported by the number of previous roles. Only three percent of those who have had fewer than three roles are entrepreneurs, whereas 29% of those with over 16 prior roles are entrepreneurs.[15]

[14]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. 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 nprior coefficient.

[15]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.

Table B

Probability of Entrepreneurship by Number of Prior Roles Held

Number of Prior Roles	Proportion entrepreneurial roles
Fewer than 3	.03
3 to 16	.10
More than 16	.29

The other variable of interest is “avjobten” which is the average number of years per employer. Holding the number of roles constant, moving from firm to firm decreases the probability that an individual becomes an entrepreneur. This may reflect unobserved ability to focus or some other latent characteristic. It is not the case that entrepreneurs are those who cannot sit still. They are not individuals who bounce from employer to employer. For any given number of roles, the shorter period that the individual is with an employer, the less likely he is to be an entrepreneur in his next pursuit.

The results on “avjobten” 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 to become entrepreneurs.

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 the existence of a balanced skill set. The second 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 can be thought of as investment in on-the-job training that prepares the individual to be an entrepreneur along the lines discussed in the investment section above. Either interpretation is consistent with the model.

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 regression identical to the one in panel A of table 2 was run, except that the dependent variable was a dummy equal to one if the employment reported was defined high-level general manager. The results were almost identical to those for panel A. In particular, the coefficient on nprior is virtually identical to the size of that in the original regression. The t-ratio is 31.7. So the jack-of-all-trades story applies well to senior level managers.

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-80s 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.

Table 3 gives the means of the relevant variables. Simple relationships can be seen in the comparison. The sample of entrepreneurs is less specialized as seen in the means. 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. Another measure of lack of balance is gpadiff, which is the difference between the highest grade point average field and the lowest grade point average field. Again, this is supposed to capture a lack of balance. "Mathgpa" is the grade point average in accounting, economics, and finance courses. Specdiff and gpadiff, are lower for entrepreneurs. Entrepreneurs are also older, more male, they have taken more entrepreneurial courses and they have lower grades than the sample as a whole.

The first analysis reported in table 4 is a logit where the dependent variable is a dummy equal to one if the individual answers that he or she has started a business and zero otherwise. The jack-of-all-trades theory suggests that those who have large values of specdif and of gpadiff should be less likely to become entrepreneurs. Panels A through C of table 4 provide weak support of this prediction in the data since all coefficients are negative on specdif and gpadif variables.[16]

It is also possible to examine the performance of individuals in the data. One clear estimate

[16]MATHGPA did not enter significantly in other forms of the logits and regressions. The grade level does not seem to have any significant effect on whether someone becomes entrepreneur, although the simple relationship is negative.

of performance is the maximum earnings ever obtained by the entrepreneur. Panel D of table 4 provides evidence. The conclusion is that nothing seems to affect performance once an individual chooses to become an entrepreneur. Number of entrepreneurship classes enters negatively, but is not significant. Only MBA year matters, reflecting the newness of the graduates who have less time during which to build a highly valuable business.

The zero or negative effect of certain variables, particularly the entrepreneurship classes taken, is consistent with the investment model. Since it pays to invest in those subjects in which there is a weakness, those who take entrepreneurship classes are relative weak in this skill. The investment model also predicts that there will not be a complete closing of the gap, since some investors will find that it pays to stop short of the level of other skills. As a result, those who take classes in a particular subject start out weaker and end up weaker than those who do not.

Figure 4 reveals that another prediction of the model is borne out in the data. Specifically, the higher is the income category, the higher is the proportion of entrepreneurs in the data. Among the highest income bracket (earning in the millions per year), almost 25% of the individuals are entrepreneurs. In the lowest income bracket, fewer than 5% are entrepreneurs. There exist entrepreneurs even in the lowest income brackets, but their prevalence is as predicted.

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

Income Distribution:

The primary implication of the model for income distribution is that the overall distribution should be positively skewed and that entrepreneurs should have a fatter upper tail in their distribution than that of specialists. It is somewhat dangerous to place much stock in the income distribution numbers in this sample because this is such an unusual population of individuals. Nevertheless, the numbers are instructive if not conclusive. Figure 5 presents the findings graphically.

The main conclusion is that the entrepreneurial income distribution does have a fatter upper tail than the specialist distribution. Note that nothing is held constant in these data. Every observation is treated as independent and most of the data are made up of specialists so the overall distribution is close to that observed for the specialists. Still, the data are consistent with the predictions of the model in that the positive skew shows up among entrepreneurs. It is also true that the entrepreneurial distribution has a fatter left tail as well, which reflects the observation made earlier that income for entrepreneurs is more likely to include investments in and returns to physical capital than is income for specialists.

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. When students, those who will become entrepreneurs are predicted to have more uniform grades and test scores across fields than those who end up being specialists and working for others.

Because individuals who do not have the requisite levels of all skills can choose to specialize in those things at which they are good, entrepreneurs are more likely to be found in the upper ranges of income distributions and so the probability of entrepreneurship tends to increase with wealth. Related, the upper tail of the income distribution is fatter for entrepreneurs than it is for specialists. The top of the income distribution should be dominated by entrepreneurs, but the bottom should have both specialists and entrepreneurs. Also, because of occupational sorting, symmetric underlying ability distributions generate positively skewed income distributions. A final prediction is that individuals who become entrepreneurs should have a more balanced human capital investment strategy on average than those who become specialists.

Data from Stanford MBA alumni support the predictions. Individuals are more likely to become entrepreneurs when the number of previous roles (not employers) increases. Those with more varied experience have much higher probabilities of starting their own business. The number of prior roles is by far the most important variable in explaining the propensity to start a business, even when holding constant previous experience, earnings and past employment tenure. Furthermore, those who study a more general curriculum when in the Stanford MBA program are also more likely to become entrepreneurs. Entrepreneurs are not the individuals who perform particularly well in one specialized area. These results support the "jack-of-all-trades" view of entrepreneurship.

The data on income are consistent with the predictions, especially that the upper tail of the income distribution should have a disproportionate share of entrepreneurs. But not too much can be made of these results since the income distribution numbers are from a very small and select part of the overall population, namely those who graduated from the Stanford MBA program.

Much more can be done, especially at the empirical level. 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
Variables and Descriptive Statistics

Whole Sample:

Variable	Obs	Mean	Std. Dev.	Min	Max
mbayear	26842	74.33507	14.16078	13	97
male	26842	.8424484	.3643268	0	1
age	26842	50.16392	13.53321	25	93
white	26842	.8671112	.3394608	0	1
income	26842	108.8579	272.8131	0	3000
exp	26842	66.54206	33.48872	0	98
nprior	26842	3.261139	3.397093	0	37
entre	26841	.0666145	.2493578	0	1
salend	24461	2.639099	2.193911	0	12
nbus	26842	.3935996	.7966955	0	5
amer	26842	.7326578	.4425807	0	1
njobs	26842	3.888384	2.614436	1	27
avjobten	26842	18.57568	13.22497	0	94

Specialists:

Variable	Obs	Mean	Std. Dev.	Min	Max
mbayear	25053	74.41221	14.19583	13	97
male	25053	.8384225	.3680701	0	1
age	25053	50.09959	13.58672	25	93
white	25053	.8666427	.3399673	0	1
income	25053	101.8165	251.1824	0	3000
exp	25053	65.48872	33.98158	0	98
nprior	25053	3.107055	3.269165	0	37
entre	25053	0	0	0	0
nbus	25053	.3606754	.7498719	0	5
amer	25053	.7311699	.4433603	0	1
njobs	25053	3.796312	2.588059	1	27
avjobten	25053	18.58135	13.43031	0	94

Entrepreneurs:

Variable	Obs	Mean	Std. Dev.	Min	Max
mbayear	1788	73.25224	13.62178	13	97
male	1788	.8993289	.300977	0	1
age	1788	51.06879	12.73224	26	88
white	1788	.8736018	.3323906	0	1
income	1788	207.5666	472.1862	0	3000
exp	1788	81.33837	20.4812	0	97
nprior	1788	5.531574	4.261686	1	38
entre	1788	1	0	1	1
nbus	1788	.8545861	1.192729	0	5
amer	1788	.7533557	.4311785	0	1
njobs	1788	5.180089	2.640777	1	20
newobs	1788	.045302	.2080239	0	1
avjobten	1788	18.50666	9.907772	0	48.5

Table 2

Panel A:

Linear Probability Estimates: Dep Var is Entrepreneur
(0=specialist, 1=entrepreneur)

Number of obs= 26841
F(7, 26833) = 131.11
Prob > F = 0.0000
R-squared = 0.0331
Adj R-squared = 0.0328
Root MSE = .24523

entre	Coef.	Std. Err.	T	P>|t|
nprior	.0131869	.0004493	29.350	0.000
avjobten	.0004112	.0001183	3.475	0.001
male	.0245469	.0043457	5.649	0.000
white	-.002874	.0046676	-0.616	0.538
amer	.0049672	.0035321	1.406	0.160
mbayear	-.0006043	.0004356	-1.387	0.165
age	-.0009847	.0004535	-2.171	0.030
_cons	.0881361	.0552416	1.595	0.111

Panel B:

Logit Estimates: Dep Var is Entrepreneur
(0=specialist, 1=entrepreneur)

Number of obs= 26841
LR chi2(7) = 727.20
Prob > chi2 = 0.0000
Log likelihood = -6206.8732 Pseudo R2 = 0.0553

entre	Coef.	Std. Err.	z	P>|z|
nprior	.1615081	.0062554	25.819	0.000
avjobten	.0138789	.0024143	5.749	0.000
male	.4804365	.0845725	5.681	0.000
white	-.0408468	.0789505	-0.517	0.605
amer	.0808379	.0601467	1.344	0.179
mbayear	-.0144044	.0074716	-1.928	0.054
age	-.0201495	.0078187	-2.577	0.010
_cons	-1.931958	.9466163	-2.041	0.041

Panel C:

Dependent Variable is Entrepreneur
(0=specialist, 1=entrepreneur)

	Number of obs=		26841
	LR chi2(9)	=	910.10
	b > chi2	=	0.0000
Log likelihood = -6115.4203	pseudo R2	=	0.0693

entre	Coef.	Std. Err.	z	P>|z|
nprior	.262436	.0173133	15.158	0.000
nprior2	-.0061698	.0009088	-6.789	0.000
avjobten	.0789464	.0090172	8.755	0.000
avjob2	-.0013885	.0001957	-7.094	0.000
male	.4890949	.0848632	5.763	0.000
white	-.0551111	.0791936	-0.696	0.486
amer	.0858171	.0601514	1.427	0.154
mbayear	-.0098551	.0073898	-1.334	0.182
age	-.0165565	.0077231	-2.144	0.032
_cons	-3.255904	.9400495	-3.464	0.001

Table 3
Summary Statistics

Whole sample: 2034 Observations

	Mean	Std. Deviation
Ever start a business - dummy	.17	
Number of businesses started	.24	.54
specdif(max - mean courses by field)	2.49	1.14
gpadiff(max - min gpa by field)	1.51	.73
age	34.6	5.10
male	.69	
v (number of entre classes)	1.65	.81
mathgpa	3.84	.68

Specialists Only: 1695 Observations

	Mean	Std. Deviation
specdif(max - mean courses by field)	2.51	1.14
gpadiff(max - min gpa by field)	1.52	.72
age	34.4	5.01
male	.66	
v (number of entre classes)	1.81	.93
mathgpa	3.73	.72

Entrepreneurs Only: 339 Observations

	Mean	Std. Deviation
Number of businesses started	1.34	.69
specdif(max - mean courses by field)	2.36	1.08
gpadiff(max - min gpa by field)	1.46	.73
age	36.1	5.76
male	.80	
v (number of entre classes)	1.72	.84
mathgpa	3.70	.65

Table 4
Transcript Matched Data

Panel A: Dependent variable = Ever start a business

Logit estimates	Number of obs= 1991
	LR chi2(4) = 49.78
	Prob > chi2 = 0.0000
Log likelihood = -906.97912	Pseudo R2 = 0.0267

entrealt	Coef.	Std. Err.	z	P>|z|
specdif	-.1105497	.0541239	-2.043	0.041
gpadiff	-.1179076	.0835377	-1.411	0.158
age	.0413336	.011112	3.720	0.000
male	.7506783	.1484805	5.056	0.000
_cons	-3.097318	.4493102	-6.893	0.000

Panel B: Dependent variable = Ever start a business

Logit estimates Dep Var is Entrepreneur
(0=specialist, 1=entrepreneur)

	Number of obs= 1605
	LR chi2(5) = 63.20
	Prob > chi2 = 0.0000
Log likelihood = -732.6649	Pseudo R2 = 0.0413

entrealt	Coef.	Std. Err.	z	P>|z|
specdif	-.1073166	.0664185	-1.616	0.106
gpadiff	-.1228518	.0933233	-1.316	0.188
age	.0635247	.0133443	4.760	0.000
male	.6827019	.1650519	4.136	0.000
# ent. c	.3538476	.0806161	4.389	0.000
_cons	-4.389872	.5852857	-7.500	0.000

Panel C: Number of business started
1838 Observations
R-square = .04

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value
Intercept	-0.48859	0.13481	-3.62
specdiff	-0.01821	0.01449	-1.26
gpadiff	-0.02702	0.02116	-1.28
age	0.01718	0.00319	5.39
male	0.15885	0.03342	4.75
V (# entrepreneur classes)	0.07191	0.01983	3.63

Panel D: Dependent Variable = Maximum entrepreneurial income (in real 1985 dollars)

234 Observations
R-square = .04

Parameter Estimates

Variable	Parameter Estimate	Standard Error	t Value
Intercept	2232.96626	622.36472	3.59
specdiff	26.13276	16.04499	1.63
gpadiff	37.23032	28.04609	1.33
age	-3.23646	3.47121	-0.93
male	21.07999	46.17728	0.46
V (# of entre. classes)	-16.03367	24.25218	-0.66
mathgpa	3.14903	32.40286	0.10
mbayear	-23.19545	5.85621	-3.96

Figure 4
Entrepreneurial Probability

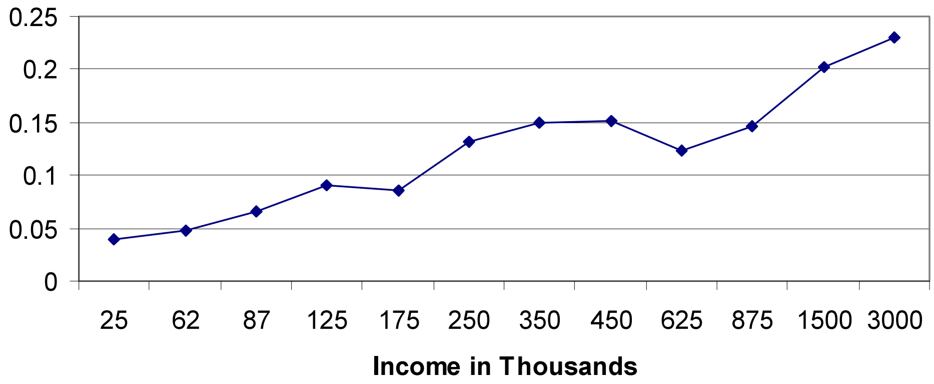
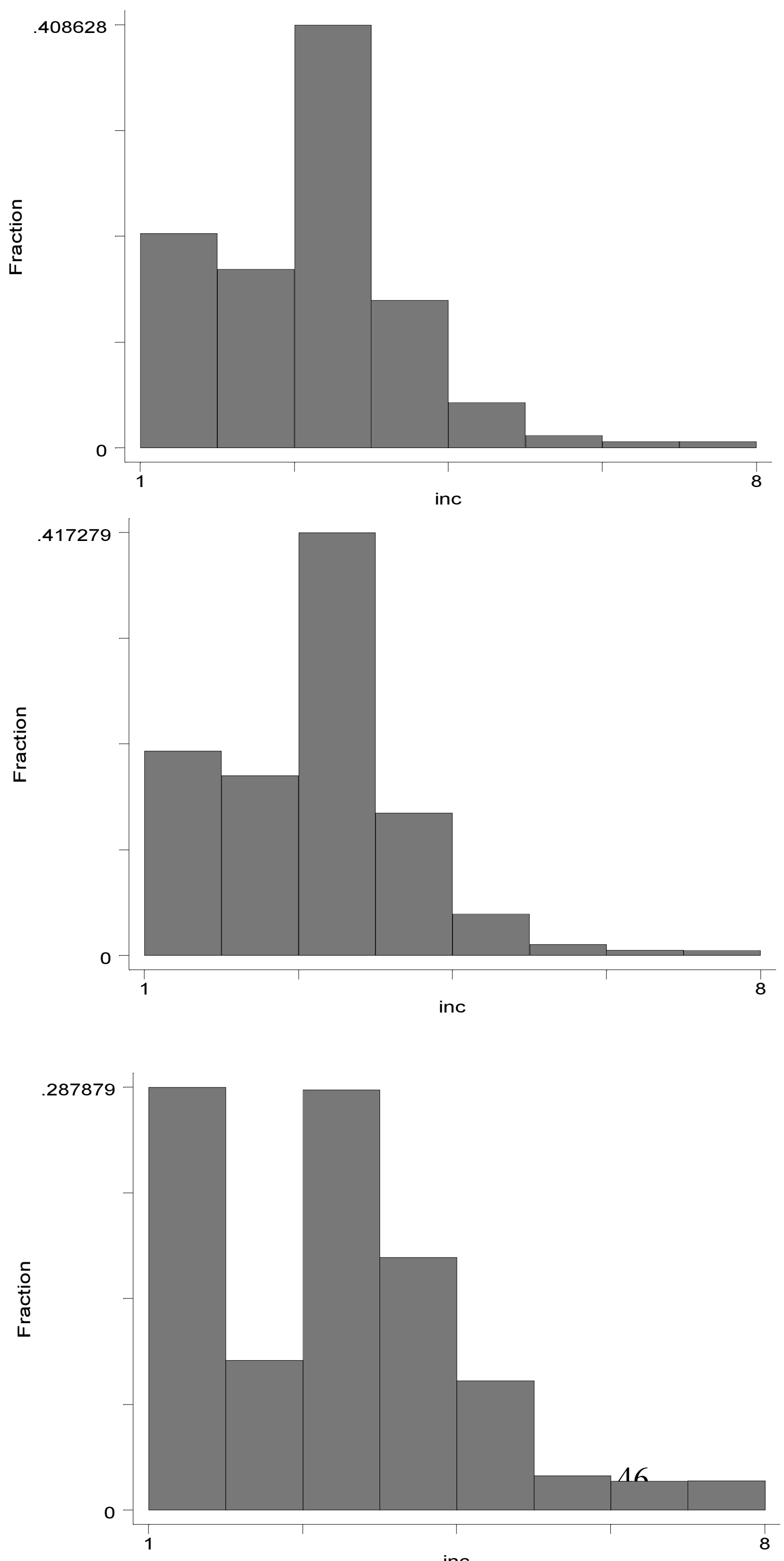


Figure 5: Real Income Distributions



All

Specialists

Entrepreneurs

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Appendix

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.[17]

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 ρ=1, x_1 and x_2 are perfectly correlated.

[17]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.

When ρ=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

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

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

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

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.