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SPECIAL ISSUE PAPER

The income return to entrepreneurship: theoretical model and outcomes for Swedish regions

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Abstract

This paper investigates the income return to entrepreneurship and wage employment by means of Lazear's model of occupational choice. The paper has two major aims. The first is to develop a new theoretical framework for analyzing the income return to entrepreneurship by combining the Lazear model with the assumption that the skill profiles in a population are Fréchet-distributed. The second is to demonstrate that the resulting theoretical derivations can be used for a new type of regional analysis of the income return to entrepreneurship and wage employment. The empirical analysis is based on data for individuals with a Master of Science degree in Electrical Engineering. We compute their income return to self-employment and wage employment in three parts of Sweden: the Stockholm region, the combined Gothenburg and Malmö region, and the Rest of Sweden. The results show that the average return to self-employment is less than 5% in all regions and smaller in the Gothenburg and Malmö region than in the other two regions. The regional differences are explained by the differential supply curves and market values of entrepreneurial talent. The theoretical derivation of the income return to entrepreneurship is the main contribution of the paper. Another contribution is the derivation of regional supply curves for entrepreneurs.

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1 Introduction

This paper investigates the income return to entrepreneurship by means of Lazear's model for occupational choice (Lazear 2004, 2005). He assumes that each individual has two separate skills and will choose to become an entrepreneur whenever the income from that choice exceeds the income from choosing to be wage employed. The income as an entrepreneur will equal the strength of the weakest skill times a parameter reflecting the market value of entrepreneurial talent, and the income as employed will correspond to the strength of the strongest skill. It follows that the incomes of entrepreneurs and wage employed will reflect the distribution of skill profiles in the population and the market value of entrepreneurial talent. The market value is determined by the supply and demand of entrepreneurs and is therefore likely to vary across local labor markets.

The paper has two major aims. The first is to develop a new theoretical framework for analyzing the income return to entrepreneurship by combining the Lazear model with the assumption that the skill profiles in a population are Fréchet-distributed. The second is to demonstrate that the resulting theoretical derivations can be used for a new type of regional analysis of the income return to entrepreneurship and wage employment.

The empirical analysis is based on data from the Swedish employment register. Entrepreneurs are defined as those registered as self-employed, and a distinction is made between all self-employed and the self-employed hiring at least one person. Since most countries exhibit pronounced regional differences in self-employment rates, as reported by Parker (2009), for instance, we compute the return to self-employment and wage employment in three parts of Sweden: the Stockholm region, the combined Gothenburg and Malmö region, and the Rest of Sweden. The calculations are made for all individuals that have a Master of Science degree in Electrical Engineering and were self-employed or wage employed in 2008. In order to obtain some indirect information about the appropriateness of assuming that skill profiles are Fréchet-distributed, we will compare average incomes between self-employed and wage employed as well as the corresponding observed and theoretically derived income distributions.

A central issue in studies of the income return revolves around the "what-if question" about how much entrepreneurs would have earned if they instead had chosen to become wage employed. This is the case whether non-pecuniary benefits are included or not (see Åstebro and Thompson 2011, Hamilton 2000, respectively). Disregarding non-material benefits, the common approach is to compare the income of entrepreneurs and wage employed, and apply different techniques to separate out the influence of other factors likely to affect the income. Åstebro et al. (2013), for example, compare the current and previous incomes among Swedish academics that have recently started new businesses making adjustment for income growth over time, whereas Hyytinen et al. (2013) estimate the income differences between identical twins that have made different occupational choices. Even if the compared categories are similar in virtually all observable respects but the occupational choice, one problem remains. According to Lazear's model, the income is determined by the weakest skill for an entrepreneur but by the strongest skill for a wage employed. Therefore, we argue, a more appropriate way of estimating the income return for

entrepreneurs is to compare their incomes as entrepreneurs with the hypothetical incomes they would have received if, for some reason, they had instead become wage employed, and thus had had incomes related to their strongest skills.

Though the analytical expressions we derive for the expected income returns to entrepreneurs and wage employed are crucial for their occupational choices, to the best of our knowledge, no one has derived them earlier. Assuming, as we do, that the skill profiles in a population are Fréchet-distributed and applying Lazear's model, Hårsman and Mattsson (2017) show that a lower expected income for entrepreneurs than for wage employed is fully compatible with Lazear´s model. However, a comparison of the expected income for entrepreneurs and wage employed differs fundamentally from our concept of expected income returns. The income for an individual entrepreneur will by definition be higher than it would have been if he or she had made the opposite occupational choice, but the expected income for the population of entrepreneurs might still be lower than that for the population of wage employed. Expressed in another way, the applied concept of income return provides the conditions that govern the occupational choices, while the expected income for a population represents the outcome of the choices.

Our empirical analysis differs from approaches based upon comparisons of the income of entrepreneurs and wage employed. We calculate the income return to entrepreneurs by comparing their incomes with the hypothetical incomes they would have received if they instead had chosen to be wage employed. Additionally, we will calculate the corresponding income return to wage employed. It is impossible to do this for individual actors, but the assumption that the skill profiles in a population are Fréchet-distributed allows us to calculate the expected actual and hypothetical income and the corresponding income returns for the populations of entrepreneurs and wage employed. The computations are made for different parts of Sweden and for several subgroups of these populations. Each such calculation rests on only three observed quantities: the relative frequency of self-employment and the average income for self-employed and wage employed, respectively.

The empirical computations show that the income return to self-employed that hire at least one person is highest in the Stockholm region and lowest in the Rest of Sweden—presumably reflecting various agglomeration benefits. The regional differences change when including the self-employed who do not hire anyone. In this case, the average income return is the same in the Stockholm region and the Rest of Sweden and lowest in the Gothenburg and Malmö region. With few exceptions, the average income is lower for self-employed than for wage employed in all regions. Additional support for the assumption of Fréchet-distributed skill profiles is provided by the similarity between the theoretically derived income distribution and the empirically observed income distribution for self-employed as well as for wage employed.

The paper is structured as follows: The next section describes the Lazear model and the income resulting from preferred vis-à-vis opposite occupational choices. Section 3 introduces the Fréchet distribution and provides analytical expressions for the expected income returns. Section 4 presents the data and Sect. 5 the computed regional income returns to entrepreneurship and wage employment. A summary and some conclusions follow in Sect. 6. Mathematical derivations are collected in "Appendix A" and some data characterizing our population in "Appendix B."

2 Summary of Lazear's model

Lazear (2005) assumes that each individual has two kinds of basic skills, the strength of which are represented by the variables X_1 and X_2, and that the choice to become entrepreneur or wage employee is based upon the resulting income. As wage employed, the income will correspond to the strength of the strongest skill, that is, $\max(X_1, X_2)$, since employers are expected to hire specialists of different kinds. Working as an entrepreneur, on the other hand, the individual has to use both skills and will receive an income reflecting the strength of his weakest skill, that is, $\lambda\min(X_1, X_2)$, where $\lambda > 1$ is the market value of entrepreneurial talent. Any individual will therefore choose entrepreneurship if and only if $\lambda\min(X_1, X_2)$ is larger than $\max(X_1, X_2)$. Since the λ-parameter is determined by the supply and demand for entrepreneurs, the Lazear model can be used to analyze and compare its equilibrium value across different labor markets.

Figure 1, adapted from Lazear (2005), can be used to further explain the logic of the model and the consequences for the income of an entrepreneur or a wage employee, who for some reason has to make an occupational choice opposite to the preferred one.

Individuals with skills of equal strength will be found along the figure's diagonal, those with stronger X_2 than X_1 skill above the diagonal and vice versa. Those located above the line $X_2 = \lambda X_1$ or below the line $X_2 = X_1/\lambda$ are strong enough in skill X_2 and X_1, respectively, to prefer wage employment and earn the corresponding income. Individuals who have more balanced skills, the Jacks of All Trades, will choose entrepreneurship and receive incomes equal to λX_1 and λX_2, respectively.

Let us now consider what income individuals would earn, if they for some reason could not realize their preferred occupational choices. By definition, all would earn less, which implies a positive return to both entrepreneurship and wage employment. The return will vary between individuals with different skill profiles. Consider an entrepreneur located above the diagonal but below the line $X_2 = \lambda X_1$. If forced to become wage employed, income would be equal to the strength of his strongest skill X_2 and his return to entrepreneurship will thus be $\lambda X_1/X_2$. The return to entrepreneurship for an entrepreneur located below the diagonal but above the line $X_2 = X_1/\lambda$ will be $\lambda X_2/X_1$. For corresponding reasons, the return to wage employment will equal $X_2/\lambda X_1$ and $X_1/\lambda X_2$ for those above the line $X_2 = \lambda X_1$ and below the line $X_2 = X_1/\lambda$, respectively.

Several conclusions can be drawn from these simple observations. All entrepreneurs will get a higher return, the higher the market value of entrepreneurial talent λ. The individual skill strengths also matter. The highest possible return λ will be earned by the entrepreneurs that have perfectly balanced skills. It will be lower for everyone else and decreases with increased imbalance between the skills, with zero percent return as the lower limit. The opposite applies for individuals preferring to become wage employed. Their return will be lower the higher the market value of entrepreneurial talent λ, and it will increase with decreased balance between the skills, potentially approaching infinity for a wage employee with a skill vector very close to any of the axes. Since the strengths of individual skills are difficult, if not impossible, to measure, it will be difficult to estimate the income return to the preferred individual choices from direct empirical observations in a population. However, as we will see in the next section, by assuming that the individuals in a population have Fréchet-distributed skill profiles,

it is possible to derive closed-form expressions for the expected income return to entrepreneurship and wage employment from observed parameters in the population.

The Lazear model has been rather thoroughly tested. Though the results are mixed, most studies seem to support the basic idea that entrepreneurs have a more balanced skill profile than wage employed; see Aldén et al. (2017), for instance. A major criticism is that most empirical studies indicate that entrepreneurs on average earn less than wage employed, a result assumed to be incompatible with the model, and also that the model makes no room for non-pecuniary benefits.[1] According to Åstebro and Thompson (2011) and Hartog et al. (2010), for example, benefits of that kind must be included in order to explain the choice of entrepreneurship in spite of low income returns and long working hours. However, as shown by Hårsman and Mattsson (2017), lower expected income for entrepreneurs versus wage employed is fully consistent with Lazear's model. As far as we know, his model has never before been applied to estimate the market value of entrepreneurial talent and to investigate its variation across regions.

3 Theoretical implications of Lazear's model with Fréchet distributions

As described in the previous section, Lazear's model assumes that each individual in a population has two kinds of basic skills, 1 and 2, the strengths of which are represented by the positive random variables X_1 and X_2 (see Fig. 1). An individual who chooses to become an entrepreneur is paid according to the weakest skill times a parameter $\lambda > 1$, representing the market value of entrepreneurial talent, whereas an individual who becomes wage employed is paid according to the strongest skill. It is further assumed that each individual is maximizing his or her income. Hence, an individual will become an entrepreneur if λ times the strength of the individual's weakest skill is larger than the individual's strongest skill, that is, if $\lambda\min(X_1, X_2) > \max(X_1, X_2)$, and wage employed if the opposite inequality holds, that is, if $\lambda\min(X_1, X_2) \leq \max(X_1, X_2)$. The probability of becoming an entrepreneur, denoted p_E, then equals the probability of the first event, and the probability of becoming wage employed, denoted p_W, equals the probability of the second event. In terms of Fig. 1, p_E is the probability that the random vector (X_1, X_2) falls between the lines $X_2 = \lambda X_1$ and $X_2 = X_1/\lambda$, and p_W is the probability that this random vector falls either between the vertical axis and the line $X_2 = \lambda X_1$ or between the line $X_2 = X_1/\lambda$ and the horizontal axis.

Next, let the random variables Y_E and Y_W denote the income of an entrepreneur and a wage employed, respectively. Then, $Y_E = \lambda\min(X_1, X_2)$ conditional on the event that $\lambda\min(X_1, X_2) > \max(X_1, X_2)$, and $Y_W = \max(X_1, X_2)$ conditional on the event that $\lambda\min(X_1, X_2) \leq \max(X_1, X_2)$.

Further let the random variables Z_E and Z_W denote the hypothetical income of an individual who prefers to become an entrepreneur or a wage employed, respectively, but for some reason is forced to make the opposite occupational choice. The

[1] Using Norwegian data and including capital incomes, Berglann et al. (2011) show that the return to entrepreneurs is positive. Åstebro (2017) shows that correcting for underreporting of incomes among Danish self-employed individuals will also result in positive returns.

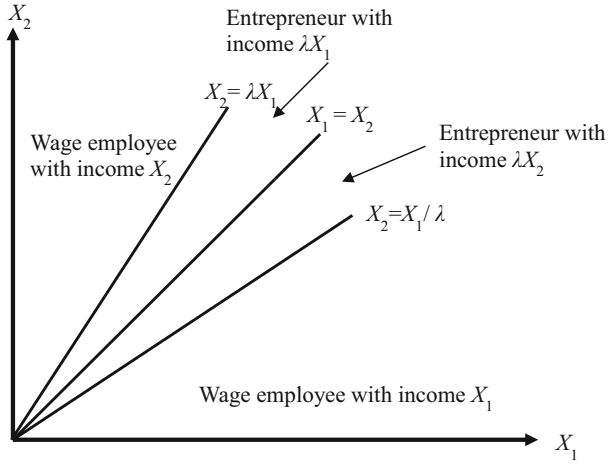

Fig. 1 Selection into entrepreneurship or wage employment by individuals endowed with different skill profiles (X_1, X_2). Adapted from Lazear (2005)

hypothetical income of an entrepreneur who is forced to become a wage employed would then be $Z_E = \max(X_1, X_2)$ conditional on the event that $\lambda\min(X_1, X_2) > \max(X_1, X_2)$, and the hypothetical income of a wage employed who is forced to become an entrepreneur would be $Z_W = \lambda\min(X_1, X_2)$ conditional on the event that $\lambda\min(X_1, X_2) \leq \max(X_1, X_2)$.

It should be noted that the income related to the preferred occupational choice is always greater than or equal to the income of the non-preferred choice, that is, $Y_E \geq Z_E$ and $Y_W \geq Z_W$ regardless of the distributional assumptions for the skill strengths X_1 and X_2.

Finally, we formally define the income return to entrepreneurship μ_E as:

$$\mu_E = \frac{E[Y_E]}{E[Z_E]},$$

and the income return to wage employment μ_W as:

$$\mu_W = \frac{E[Y_W]}{E[Z_W]},$$

both by definition greater than or equal to one.[2]

An entrepreneur who has perfectly balanced skills, that is, for whom $X_1 = X_2$, will experience a relative gain of λ by his or her occupational choice, and one who is indifferent between becoming an entrepreneur or a wage employed, that is, for whom $\lambda X_1 = X_2$ or $\lambda X_2 = X_1$, will experience no relative gain. Therefore, it always holds that $1 < \mu_E < \lambda$, and we can expect μ_E to be rather close to $(1+\lambda)/2$.

[2] Alternative definitions could be $\mu_E = \mathrm{E}[Y_E/Z_E]$ and $\mu_W = \mathrm{E}[Y_W/Z_W]$. With Fréchet-distributed skill profiles, however, closed-form expressions are only available for some integer shape parameters β. In addition, analysis for parameter values relevant for our empirical application indicates that the alternative definitions lead to somewhat higher returns (up to 1 and 7% for entrepreneurs and wage employed, respectively).

By making explicit assumptions for the probability distributions of the random skill strengths X_1 and X_2, it will be possible to compute the occupational choice probabilities p_E and p_W and the income returns to entrepreneurship and wage employment μ_E and μ_W. The Fréchet distribution is then particularly relevant and useful, because it allows us to derive closed-form expressions for the choice probabilities and income returns. Moreover, we can also derive closed-form expressions for the income distributions for entrepreneurs and wage employed. Having access to empirical data on observed income distributions, these can be compared to the theoretically derived ones, which offers another possibility of validating our distribution assumptions.

A continuous random variable $X > 0$ is Fréchet-distributed with shape parameter $\beta > 0$ and scale parameter $v > 0$ if its cumulative distribution function (c.d.f.) is

$$F(x) = e^{-(v/x)^{\beta}}, \quad x > 0.$$

We make the somewhat stronger assumption that $\beta > 1$ so that the expected value exists $E[X] = v \cdot \Gamma(1 - 1/\beta)$.[3] The larger the value of the shape parameter β, the more peaked is the density, and the larger the value of the scale parameter v, the larger is the expected value.

Assuming that the skill strengths X_1 and X_2 are identically and independently Fréchet-distributed with parameters β and v, the choice probabilities are:

$$p_E = \frac{\lambda^{\beta} - 1}{\lambda^{\beta} + 1},$$

$$P_W = 1 - p_E = \frac{2}{\lambda^{\beta} + 1},$$

(see Lemma 1 in Hårsman and Mattsson 2017).

The choice probability p_E obviously increases with λ and β. The relationship between p_E and λ represents an upward sloping supply curve for a given value of β (for an illustration, see Fig. 2, below). The β-parameter can be interpreted as a shifter of the supply curve. It follows that regional differences in rates of entrepreneurship can be analyzed in terms of different demand and supply conditions.

The income returns to entrepreneurship and wage employment are, respectively:

$$\mu_E = \frac{2^{1-1/\beta}\lambda^{\beta} - \lambda(1 + \lambda^{\beta})^{1-1/\beta}}{(1 + \lambda^{\beta})^{1-1/\beta} - 2^{1-1/\beta}},$$

$$\mu_W = \frac{(1 + \lambda^{\beta})^{1/\beta}}{\lambda(1 + \lambda^{\beta}) - \lambda^{\beta}(1 + \lambda^{\beta})^{1/\beta}},$$

(see "Appendix A," Proposition 1 and 2, for proofs).

[3] The gamma function is defined by $\Gamma(x) = \int_0^{\infty} t^{x-1} e^{-t} \mathrm{d}t \quad \text{for} \quad x > 0.$

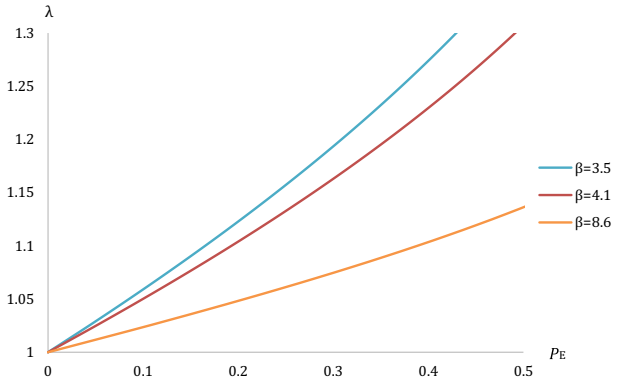

Fig. 2 Shifts in the entrepreneurial supply curve resulting from changes of the Fréchet shape parameter β

Finally, for a population of individuals, our assumption of Fréchet-distributed skill profiles implies that the expected income of those becoming entrepreneurs will be lower than the expected income of those becoming wage employed:

$$\mathrm{E}[Y_E] < \mathrm{E}[Y_W]$$

(see Proposition 1 in Hårsman and Mattsson 2017). Thus, if empirical data for a population show that the average income of those being self-employed is lower than the average income of those being wage employed, this supports our Fréchet assumption.

To apply Lazear's model to a population of individuals, we need to determine empirically the three parameters: λ, β and v. To this end, we identify the share of self-employed in the population with p_E, and the average income of self-employed and wage employed with $E[Y_E]$ and $E[Y_W]$, respectively. Let $\varphi = (1 + p_E)/(1 - p_E)$ and $q = E[Y_E]/E[Y_W] < 1$.[4] Then, by Hårsman and Mattsson (2017, Section 4.3):

$$\beta = \frac{\ln(2\varphi) - \ln(\varphi + 1)}{\ln(2\varphi - q \cdot (\varphi - 1)) - \ln(\varphi + 1)},$$

$$\lambda = \varphi^{1/\beta},$$

$$v = \frac{E[Y_W]}{\left(1 + \lambda^{\beta}\right)^{1/\beta} \cdot \Gamma(1 - 1/\beta)}.$$

4 The data

Our database—provided by Statistics Sweden—comprises all 13,800 self-employed and wage employed individuals in the Swedish labor market in 2008 with a Master of

[4] In the empirical analysis, we exclude subgroups of a population for which the income ratio exceeds one.

Science degree in Electrical Engineering (to be referred to as electrical engineers).[5] Anyone working at least 1 h per week in November 2008 is defined as employed, implying that both full-time and part-time workers are included. Each employed individual is categorized as either wage employed or self-employed. Co-owners of a business are included in the self-employed category. Individuals who combine wage employment and self-employment or co-owning are classified as wage employees, if their income from wage employment is larger than the income from self-employment or co-owning of a firm and vice versa. Since combinations are rather common—around 10% of all kinds of engineers having a Master's degree have combined incomes—it should be noted that even a small income change might result in a reclassification of an individual from, say, self-employed to wage employed.[6]

One advantage of focusing on a group that is homogenous in length and type of education is that both factors are likely to influence the occupational choice and the return to entrepreneurship; see Berglann et al. (2011) and Poschke (2013), for example. Other reasons for focusing on electrical engineers are that the self-employed among them are more likely to be opportunity-driven than necessity-driven, and that the self-employment rate for this group is higher than among engineers with another type of specialization.[7]

The population of electrical engineers is subdivided into three regions depending on their place of residence: the Stockholm region, the Gothenburg and Malmö region, and the Rest of Sweden.[8] The Gothenburg and Malmö region consists of two geographically separated labor markets, each of which is much smaller than the Stockholm labor market region in terms of population and employment. About 42% of all 13,800 electrical engineers live in the Stockholm region, 38% in the Gothenburg and Malmö region and 20% in the Rest of Sweden. In relation to the distribution of all working individuals across regions, this implies a strong overrepresentation for the Stockholm and the Gothenburg and Malmö regions; the corresponding shares for all working individuals are 27, 21 and 52%, respectively. Although rough, our regional subdivision captures, hopefully, the influence of labor market size and other environmental factors on the return to self-employment and wage employment.

Table 1 presents the percentage of self-employed and the ratio between the average income for self-employed and wage employed in the three regions. Table 4 in "Appendix B" provides further information about the number of self-employed and wage employed and their average income. The data for each region are subdivided by gender, age and experience. Experience is defined in terms of self-employment—the electrical engineers that have been self-employed at least two of the preceding 4 years

[5] We have access to the corresponding data for each year 2004–2008. The main reason for not including additional years in the analysis is that the time variability is relatively small as indicated by Tables B1 and B2 in Hårsman and Mattsson (2017).

[6] The percentage number is from Daghbashyan and Hårsman (2013).

[7] See Åstebro et al. (2013) and Hårsman and Mattsson (2017), respectively.

[8] In 2008, Sweden was subdivided into 75 labor market regions defined in terms of commuting between municipalities. Statistics Sweden updates the subdivision regularly.

Table 1 Percentage self-employed and ratio between average income of self-employed and of wage employed by region, gender, age and experience of self-employment

Subgroup	Stockholm		Gothenburg and Malmö		Rest of Sweden	
	Percent self-employed	Income ratio	Percent self-employed	Income ratio	Percent self-employed	Income ratio
Panel A: wage employed and all self-employed						
All in Panel A	10.5	0.61	8.2	0.73	8.7	0.52
Male	11.1	0.60	8.8	0.72	9.1	0.50
Female	5.1	0.67	2.8	0.75	3.5	0.94
Less than 45 years	6.8	0.81	4.6	0.87	4.1	0.79
45 or more	14.2	0.50	13.1	0.61	11.6	0.44
No experience	3.6	0.66	2.7	0.78	2.7	0.58
Experience	56.0	0.84	51.3	1.02[a]	50.5	0.69
Panel B: wage employed and self-employed hiring at least one person						
All in Panel B	4.8	0.72	4.0	0.89	3.7	0.76
Male	5.2	0.70	4.3	0.87	3.9	0.73
Female	1.8	0.84	1.2	0.98	1.5	–[a,b]
Less than 45 years	3.9	0.93	2.6	0.97	1.8	0.91
45 or more	5.9	0.58	6.1	0.77	4.9	0.68
No experience	1.5	0.80	1.1	0.87	0.9	0.92
Experience	36.2	0.98	34.5	1.29[a]	30.5	0.99

[a]Since the income ratio exceeds one, the subgroup has been excluded from further analysis
[b]For privacy reason the value cannot be reported

are classified as experienced and the rest as having no experience.[9] Two different panels of individuals are considered. In Panel A, all self-employed and all wage employed are included, and in Panel B only self-employed who are hiring at least one person together with all wage employed are included.

The most obvious pattern in Table 1 for both Panel A and Panel B is perhaps that the self-employment rates are higher in the Stockholm region than in the other two regions, and that the rates look rather similar in the Gothenburg and Malmö region and the Rest of Sweden.

The higher self-employment rates in the Stockholm region, which is Sweden's largest and most densely populated labor market region, are in line with earlier studies; see Lee et al. (2004), Michelacci and Silva (2007) and Helsley and Strange (2011), for example. Doms et al. (2010) and several others show that the rates tend to be

[9] The variable is rather crude since some of the electrical engineers in 2008 might not have been registered as self-employed or wage employed during one or more of the preceding years because of unemployment, for example.

higher among men and those aged above 45 years. According to Evans and Leighton (1989), previous self-employment experience increases the likelihood of remaining self-employed. Since Gothenburg and Malmö are Sweden's second and third largest labor market regions, respectively, it is perhaps more surprising that the overall self-employment rates are lower there than in the Rest of Sweden (see Panel A). However, if the self-employed who only employ themselves are assumed to be motivated by necessity rather than opportunity, the result is similar to findings reported by Bosma and Sternberg (2014).

Table 1 also shows that the income ratios tend to be higher in the Gothenburg and Malmö region than in the other regions. The incomes are defined as before tax wage per year for wage employees and before tax net business income per year for self-employed.[10] Almost all ratios are less than one, which supports our assumption of Fréchet-distributed skill strengths. Since an income ratio greater than one is inconsistent with our theoretical model, we have excluded the three subgroups for which this is the case from further analysis. The fact that self-employed on average have lower incomes than wage employed is well known from earlier studies using similar income definitions; see Hamilton (2000), for example. Widening the definition by including business-related capital income, Åstebro et al. (2013) show that the income of formerly university-employed Swedish academics remained about the same when they became entrepreneurs.

5 The results

In this section, we will apply the equations for parameter determination derived in Sect. 3 to compute the income returns to self-employment and wage employment, the market value of entrepreneurial talent and the parameters of the Fréchet distribution. The observed occupational choice frequencies and average incomes of entrepreneurs and wage employed are used as inputs.

Table 2 presents the computed income returns expressed in percent. As expected, the returns to self-employment are positive and they differ considerably between regions. The average income return μ_E ranges between 0.0 and 22.9% and is less than 5% for most subgroups of self-employed. We may also note that the percentage income return to self-employment is very close to half of the percentage market value of entrepreneurial talent, as predicted in our theoretical analysis: $\mu_E \approx (1 + \lambda)/2$.

Since the occupational choice is driven by the expected returns in the applied theoretical model, one should expect a fairly good correspondence between the calculated returns to self-employment and the self-employment rates reported in Table 1. In line with the expectations, Table 2 shows that the returns to self-employment are much higher in the Stockholm region than in the Gothenburg and Malmö region, whether one considers the highest possible return λ or the average return μ_E and for both panels. The same advantage for the Stockholm region holds vis-à-vis the Rest of Sweden among the self-employed that hire at least one person (Panel B). The reason why the

[10] Statistics Sweden multiplies the reported business income by 1.6 in order to adjust for an observed tendency by business owners to underestimate their business income. The income for those combining wage employment and self-employment includes both types of income.

Table 2 Market value of entrepreneurial talent λ and income return to self-employment μ_E and wage employment μ_W by region, gender, age and experience of self-employment (%)

Subgroup	Stockholm			Gothenburg and Malmö			Rest of Sweden		
	λ	μ_E	μ_W	λ	μ_E	μ_W	λ	μ_E	μ_W
Panel A: wage employed and all self-employed									
All in Panel A	8.8	4.3	90	4.7	2.3	52	8.9	4.3	129
Male	9.6	4.7	94	5.3	2.6	56	9.7	4.7	139
Female	3.5	1.8	70	1.4	0.7	46	0.4	0.2	9
Less than 45 years	2.7	1.3	33	1.3	0.6	22	1.8	0.9	38
45 or more	16.1	7.8	144	11.2	5.5	90	14.3	6.9	179
No experience	2.5	1.2	73	1.2	0.6	40	2.3	1.1	101
Experience	28.2	14.0	28	–[a]	–[a]	–[a]	48.6	22.9	64
Panel B: wage employed and self-employed hiring at least one person									
All in Panel B	2.8	1.4	54	0.9	0.5	18	1.8	0.9	44
Male	3.2	1.6	59	1.2	0.6	21	2.1	1.1	52
Female	0.6	0.3	27	0.1	0.0	3	–[a]	–[a]	–[a]
Less than 45 years	0.6	0.3	11	0.2	0.1	5	0.3	0.2	15
45 or more	5.2	2.6	103	2.9	1.4	41	3.2	1.6	65
No experience	0.6	0.3	35	0.3	0.1	22	0.1	0.1	12
Experience	1.9	1.0	3	–[a]	–[a]	–[a]	0.7	0.4	1

[a]Since the income ratio exceeds one, the subgroup has been excluded from analysis

returns to self-employed (Panel A) are higher in the Rest of Sweden than in the other two regions is probably related to supply-side differences, which we will come back to. This might also explain why the self-employed hiring at least one person (Panel B) receive higher returns in the Rest of Sweden than in the Gothenburg and Malmö region. The return differences caused by individual characteristics correspond quite well with the pattern of self-employment rates in Table 1.

Table 2 also shows that the return to wage employment μ_W far exceeds the return to self-employment in all regions. Agglomeration effects do not seem to explain the regional variation. The returns in the Stockholm region are higher than in the other two regions according to Panel B but not in the Rest of Sweden according to Panel A. The Gothenburg and Malmö region has lower returns than the Rest of Sweden irrespective of whether the wage employed are compared with all self-employed (Panel A) or only with self-employed hiring at least one person (Panel B).

At a general level, differential regional returns to self-employment can be explained by differential demand or by shifts in the supply curve, shifts that may be caused by regional differences in human capital and supply of ideas (see e.g., Glaeser et al. 2010). As illustrated in Fig. 2, the β-parameter in our model plays a role corresponding to a regional shift variable. The supply curves in the figure relate the probability of being an entrepreneur to the market value of entrepreneurial talent; movements along a given

Table 3 Shape parameter of the Fréchet distribution β and elasticity of self-employment rate with respect to market value of entrepreneurial talent $\varepsilon_{P_E,\lambda}$, by region, gender, age and experience of self-employment

Subgroup	Stockholm		Gothenburg and Malmö		Rest of Sweden	
	β	$\varepsilon_{P_E,\lambda}$	β	$\varepsilon_{P_E,\lambda}$	β	$\varepsilon_{P_E,\lambda}$
All in Panel A	2.5	12	3.6	22	2.0	12
Male	2.4	11	3.4	19	2.0	11
Female	3.0	29	4.0	71	15.5	225
Less than 45 years	5.1	38	7.3	80	4.6	57
45 or more	1.9	7	2.5	9	1.7	7
No experience	2.9	41	4.4	83	2.4	44
Experience	5.1	3	–[a]	–[a]	2.8	2
All in Panel B	3.5	36	8.6	107	4.1	56
Male	3.3	32	7.4	85	3.7	47
Female	6.1	167	49.0	1994	–[a]	–[a]
Less than 45 years	13.5	175	28.5	554	10.4	286
45 or more	2.3	20	4.3	35	3.1	31
No experience	4.9	166	7.4	348	12.7	708
Experience	41.0	49	–[a]	–[a]	87.4	130

[a]Since the income ratio exceeds one, the subgroup has been excluded from analysis

supply curve reflect demand changes. The values of the shift parameter correspond to the ones reported in the first row of Panel B, Table 3.

The figure shows that the supply curve slopes upward and shifts out when the value of β increases. As can be easily verified, the elasticity of p_E with respect to λ, given by the following expression, decreases with increasing value of λ:

$$\varepsilon_{p_E,\lambda} = \frac{\partial p_E/\partial\lambda}{p_E/\lambda} = \frac{2\beta \cdot \lambda^{\beta}}{\lambda^{2\beta} - 1}.$$

Table 3 shows that the shape of the skill profile distributions, as measured by the β-parameter, differs between regions as well as between the subgroups defined by gender, age and earlier entrepreneurship experience. With few exceptions, the β-values are higher in the Gothenburg and Malmö region than in the other regions according to both panels. This might explain why the rates of self-employment are relatively high in the Gothenburg and Malmö region in spite of relatively low λ-values as reported in Tables 1 and 2. The fact that the β-values are higher in the Stockholm region than in the Rest of Sweden in Panel A, might in a similar way explain the much higher self-employment rates in the Stockholm region despite the fact that the λ-values are about the same in the two regions.

The elasticities are high and vary greatly between both regions and subgroups. The high values reported for the Gothenburg and Malmö region imply that even a small

increase in the market value of entrepreneurial talent, that is, upward on the supply curve, would increase the entrepreneurship rate substantially.

Although most of the income ratios shown in Table 1 support our assumption that the skill profiles are Fréchet-distributed, it is of course possible that alternative distributions may give rise to similar outcomes. As an additional check, the theoretically computed income distributions based on the Fréchet assumption can be compared with the empirically observed income distributions for self-employed and wage employed.[11] Figure 3 provides this comparison for the Stockholm region.[12] The (a) part shows the observed and computed income distributions for all wage employees, the (b) and (c) part the same for all self-employed and all self-employed hiring at least one person, respectively.

The similarity between the distributions is quite good for the (a) and (b) part but far from good for the (c) part. We cannot explain why the difference is greater for the self-employed hiring at least one person, but it underlines the need to test alternatives to the Fréchet distribution.

6 Summary, conclusions and further research

The theoretical part of the paper investigates the return to entrepreneurship by combining Lazear's model for occupational choice with the assumption that the skill profiles in a population are Fréchet-distributed. The income return is defined as the ratio between the expected income from the preferred occupational choice and the expected income from the opposite choice. Analytical expressions for the income return are derived for entrepreneurs and wage employed and also for the parameters of the Fréchet distribution and the market value of entrepreneurial talent.

In the empirical part of the paper, we use data from the Swedish employment register to compute the income return to self-employment and wage employment in three parts of Sweden: the Stockholm region, the Gothenburg and Malmö region, and the Rest of Sweden. The calculations are made for all individuals that have a Master of Science degree in Electrical Engineering.

Our results show that the average income returns to self-employment are less than 5% in all regions and for most subgroups, and much smaller than the return to wage employment. The income returns to self-employment are consistently lower in the Gothenburg and Malmö region than in the other two regions. The return to self-employed hiring at least one person is highest in the Stockholm region. The regional differences are partly explained by the corresponding supply curves and market values of entrepreneurial talent. By way of example, the likelihood of being self-employed and hiring at least one person is highest in the Gothenburg and Malmö region and lowest in the Stockholm region for any given market value of entrepreneurial talent. The fact that the Stockholm region nevertheless has the highest income return is explained by a higher market value for entrepreneurial talent.

[11] See Proposition 3 in "Appendix A" for the theoretically derived income distributions.

[12] The distributions roughly look the same for the other two regions.

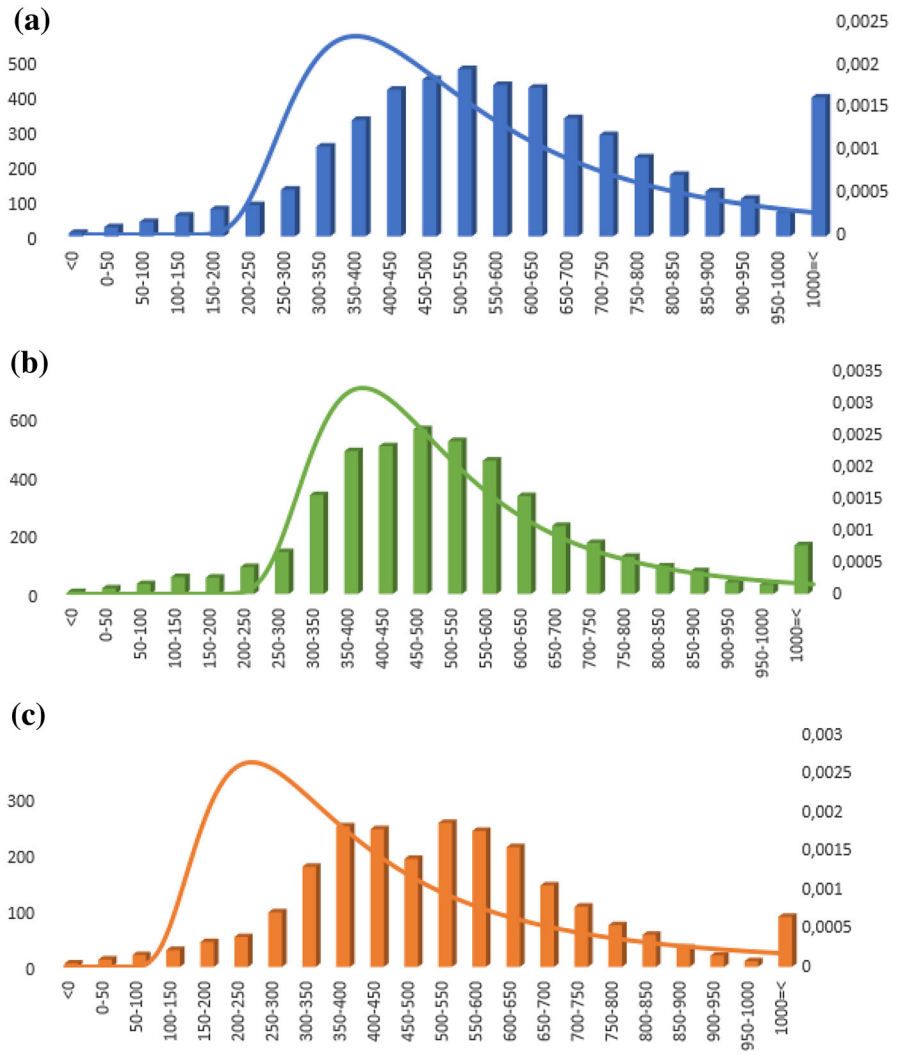

Fig. 3 Observed and computed income distributions in the Stockholm region. **a** All wage employed. **b** All self-employed. **c** All self-employed hiring at least one person

The theoretical derivation of the income return to entrepreneurship is the main contribution of the paper. Another contribution is the derivation of supply curves for entrepreneurs.

Though the empirical analysis supports assumed Fréchet-distributed skill profiles, it cannot be ruled out that alternative distributions might match the data as well or better. It would therefore be interesting to test other skill profile distributions. Ideally, individual talent data of the kind presented by Aldén et al. (2017) should then be used to estimate the distribution of skill profiles.

The assumption that the occupational choice is exclusively driven by income is another limitation of the applied model. If non-material benefits also play a role, as argued by Benz (2009), for instance, this will of course be reflected in the observed occupational choice frequencies. To the extent that this is the case, our calculations will be biased: the market value of entrepreneurial talent λ as well as the expected income return for entrepreneurs μ_E upward and the supply shift parameter β downward. The risk related to entrepreneurship is another factor not accounted for in the model. Presumably, this risk makes self-employment less attractive, which makes our calculations biased in the opposite direction.

The rough regional subdivision is an obvious empirical limitation. By increasing the number of regions, it would be possible to relate the computed parameters to environmental factors such as accessibility and labor market size, for instance. Examples of other empirical improvements would be to include additional individual characteristics as well as observations for more than one year. However, limitations of this kind cannot be handled without introducing new statistical estimation techniques for determining the parameters. Then, it might be possible to parameterize the market value of entrepreneurial talent and also the parameters of the Fréchet distribution. If successful, that kind of approach would also make it possible to extend the empirical analysis to individuals that enter the labor market or change occupational status from one year to another.

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Appendix A: Proofs of lemma and propositions

A random variable X is Fréchet-distributed with shape parameter $\beta > 0$ and scale parameter $v > 0$, if its c.d.f. is $F(x) = e^{-(v/x)^{\beta}}, \quad x > 0$. We then say that it is Fréchet (β, v). Obviously, if X is Fréchet (β, v), then αX is Fréchet $(\beta, \alpha v)$ for $\alpha > 0$. We make the somewhat stronger assumption that $\beta > 1$, so that the expected value exists $E[X] = v \cdot \Gamma(1 - 1/\beta)$.

Lemma 1 *Some properties of Fréchet-distributed random variables.*

Let the independent random variables X_1 and X_2 be Fréchet (β, v_1) and Fréchet (β, v_2), respectively, with $\beta > 1$. Then

$$p_1 = P(X_1 > X_2) = \frac{v_1^{\beta}}{v_1^{\beta} + v_2^{\beta}},$$

$$p_2 = P(X_2 > X_1) = \frac{v_2^{\beta}}{v_1^{\beta} + v_2^{\beta}},$$

Moreover, $\hat{X} = \max(X_1, X_2)$, $\hat{X}_1 = (X_1|X_1 > X_2)$ *and* $\hat{X}_2 = (X_2|X_2 > X_1)$ *are all Fréchet*$(\beta, \hat{v})$, *having the same expected values*

$$E[\hat{X}] = E[\hat{X}_1] = E[\hat{X}_2] = \hat{v} \cdot \Gamma(1 - 1/\beta),$$

where

$$\hat{v} = \left(v_1^\beta + v_2^\beta\right)^{1/\beta}.$$

Proof All claims follow immediately from Corollary 3 in Mattsson et al. (2014). □

Proposition 1 *Expected income return to entrepreneurship.*
Expected income return to entrepreneurship, defined as $\mu_E = E[Y_E]/E[Z_E]$, *is*

$$\mu_E = \frac{2^{1-1/\beta}\lambda^\beta - \lambda \cdot (1 + \lambda^\beta)^{1-1/\beta}}{(1 + \lambda^\beta)^{1-1/\beta} - 2^{1-1/\beta}}.$$

Proof By Hårsman and Mattsson (2017, Lemma 1)

$$E[Y_E] = \frac{2\lambda^\beta \cdot (1 + \lambda^\beta)^{1/\beta} - 2^{1/\beta}\lambda \cdot (1 + \lambda^\beta)}{\lambda^\beta - 1} \cdot v \cdot \Gamma(1 - 1/\beta).$$

Recall that the random skill strengths X_1 and X_2 are identically and independently Fréchet(β, v). By the law of total expectation

$$\begin{aligned} P(X_2 > X_1) \cdot E[X_2|X_2 > X_1] = {} & P(X_2 > \lambda X_1) \cdot E[X_2|X_2 > \lambda X_1] \\ & + P(\lambda X_1 > X_2 > X_1) \cdot E[X_2|\lambda X_1 > X_2 > X_1]. \end{aligned}$$

Since $P(X_2 > X_1) = 1/2$, $P(X_2 > \lambda X_1) = p_W/2$, $P(\lambda X_1 > X_2 > X_1) = p_E/2$ and $E[X_2|\lambda X_1 > X_2 > X_1] = E[Z_E]$, we have

$$E[Z_E] = \frac{E[X_2|X_2 > X_1] - p_W E[X_2|X_2 > \lambda X_1]}{p_E}.$$

Since $E[X_2|X_2 > X_1] = 2^{1/\beta} v \cdot \Gamma(1-1/\beta)$ and $E[X_2|X_2 > \lambda X_1] = (1+\lambda^\beta)^{1/\beta} \cdot v \cdot \Gamma(1 - 1/\beta)$ by Lemma 1, we have

$$\begin{aligned} E[Z_E] &= \frac{2^{1/\beta} - \frac{2}{1+\lambda^\beta} \cdot (1 + \lambda^\beta)^{1/\beta}}{\frac{\lambda^\beta - 1}{\lambda^\beta + 1}} \cdot v \cdot \Gamma(1 - 1/\beta) \\ &= \frac{2^{1/\beta}(1 + \lambda^\beta) - 2 \cdot (1 + \lambda^\beta)^{1/\beta}}{\lambda^\beta - 1} \cdot v \cdot \Gamma(1 - 1/\beta) \end{aligned}$$

from which the proposition follows. □

Proposition 2 *Expected income return to wage employment.*
Expected income return to wage employment, defined as $\mu_W = E[Y_W]/E[Z_W]$, *is*

$$\mu_W = \frac{(1+\lambda^\beta)^{1/\beta}}{\lambda(1+\lambda^\beta) - \lambda^\beta(1+\lambda^\beta)^{1/\beta}}.$$

Proof By Lemma 1

$$E[Y_W] = E[X_2|X_2 > \lambda X_1] = (1+\lambda^\beta)^{1/\beta} \cdot v \cdot \Gamma(1-1/\beta)$$

as in the proof of Proposition 1. By the law of total expectation and Lemma 1

$$\begin{aligned} E[\lambda X_2] &= P(\lambda X_2 < X_1) \cdot E[\lambda X_2|\lambda X_2 < X_1] + P(\lambda X_2 > X_1) \cdot E[\lambda X_2|\lambda X_2 > X_1] \\ &= \frac{1}{1+\lambda^\beta} \cdot E[Z_W] + \frac{\lambda^\beta}{1+\lambda^\beta} \cdot (1+\lambda^\beta)^{1/\beta} \cdot v \cdot \Gamma(1-1/\beta). \end{aligned}$$

Since $E[\lambda X_2] = \lambda \cdot v \cdot \Gamma(1-1/\beta)$ by Lemma 1, we have

$$E[Z_W] = \left(\lambda \cdot \left(1+\lambda^\beta\right) - \lambda^\beta \cdot \left(1+\lambda^\beta\right)^{1/\beta}\right) \cdot v \cdot \Gamma(1-1/\beta)$$

from which the proposition follows. □

Proposition 3 *The cumulative distribution functions for the incomes of entrepreneurs and wage employed.*
The c.d.f. of the income Y_E *of an entrepreneur is*:

$$F_{Y_E}(x) = \frac{2\lambda^\beta \cdot e^{-(1+\lambda^\beta)\cdot(v/x)^\beta} - (1+\lambda^\beta) \cdot e^{-2\lambda^\beta \cdot (v/x)^\beta}}{\lambda^\beta - 1}, \quad x > 0,$$

and the c.d.f. of the income Y_W *of a wage employed is*:

$$F_{Y_W}(x) = e^{-(1+\lambda^\beta)\cdot(v/x)^\beta}, \quad x > 0.$$

Proof See Lemma 1 in Hårsman and Mattsson (2017). □

Appendix B

See Table 4.

Table 4 Number of individuals and average annual income of each subgroup

Subgroup	Stockholm		Gothenburg and Malmö		Rest of Sweden	
	Number of individuals	Average annual income (kSEK)	Number of individuals	Average annual income (kSEK)	Number of individuals	Average annual income
Wage employed						
All	4948	630	4552	534	2377	545
Male	4413	648	4069	548	2181	559
Female	535	474	483	414	196	391
Less than 45 years	2597	550	2724	473	969	448
45 or more	2351	717	1828	625	1408	611
No experience	4628	643	4278	544	2215	556
Experience	320	440	274	368	162	392
Self-employed						
All	579	385	406	390	226	285
Male	550	388	392	393	219	282
Female	29	317	14	311	7	366
Less than 45 years	189	446	131	409	41	352
45 or more	390	355	275	381	185	270
No experience	171	423	117	423	61	324
Experience	408	369	289	377	165	270
Self-employed hiring at least one person						
All	252	454	190	473	91	415
Male	242	456	184	475	88	408
Female	10	398	6	405	3	–[a]
Less than 45 years	104	510	72	456	18	406
45 or more	148	414	118	483	73	418
No experience	70	513	46	471	20	512
Experience	182	431	144	473	71	388

[a]For privacy reason no income value can be reported due to too few observations

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