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Human capital accumulation of salaried and self-employed workers

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Abstract

This paper revisits the study of Lazear and Moore [Q. J. Econ. 99 (1984) 275], which found that empirical experience–earnings profiles were flatter for self-employed (SE) workers than salary/wage (SW) workers. This finding supports Lazear’s contract theory, which argues that firms use life-cycle, backloaded payment systems to work around principal–agent problems between firms and workers. This paper reproduces the Lazear and Moore findings on more recent data and argues for an alternative interpretation. In particular, this paper argues that self-employed workers face more wage variation, but also enjoy a higher return for human capital than salary/wage workers. A model based on these assumptions produces flatter experience–earnings profiles, since self-employed workers start their careers with more human capital. Due to opportunity cost, they invest less in human capital on the job. This paper develops implications of the model not found in the Lazear contract theory and concludes by developing support for these implications.

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1. Introduction

Workers’ wage growth with work experience is one of the most robust empirical findings in economics. Lazear (1979) explained wage growth among salary/wage workers based on his contract theory. According to this theory, workers’ behavior is not perfectly

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observed, and workers' shirking is detected only by chance. According to Lazear, it is optimal for employers to pay their employees less than the workers' marginal product when the workers are young, and more than the workers' marginal product when they are old. This payment system discourages workers from shirking: workers are fired when the shirking is detected, thus, they cannot receive their money back.

The human capital theory also predicts wage growth with work experience because of workers' skill formation. Since Lazear's contract theory and the human capital theory are not mutually exclusive, it is very difficult to attribute observed wage growth to either model exclusively.

As an indirect test of Lazear's contract theory, [Lazear and Moore \(1984\)](#) (LM, hereafter) compared the wage growth of salary/wage workers and self-employed workers. Since self-employed workers have no incentive to shirk, the wage growth of self-employed workers can be attributed to their human capital accumulation. Assuming identical human capital accumulation between salary/wage (SW) workers and self-employed (SE) workers, the contract theory can explain the difference of wage growth between SW workers and SE workers. In fact, LM found a steeper wage–experience profile among SW workers than SE workers and used this finding as evidence to support Lazear's contract theory.¹

Several other theories explain wage growth on the job. [Salop and Salop \(1976\)](#) proposed that workers have heterogeneous probabilities of quitting their jobs, and this is their private information. When workers quit, it is costly for firms because they must then train new workers. It is, therefore, optimal for firms to use a tilted-up wage profile as a screening device, so that only workers with low probabilities of quitting apply for jobs. According to their theory, self-employed workers have flatter wage profiles than those of salary/wage workers because self-employed workers do not have to utilize a tilted-up wage profile as a screening device. Since Salop and Salop's theory and Lazear's contract theory render the same prediction about the difference between SE and SW workers, we cannot distinguish between those two theories only through looking at the two types of wage profiles.

[Jovanovic \(1979\)](#) developed a model that argues that workers gradually learn the quality of job match that is specific to particular workers and their respective jobs, and workers who realize they have a poor match quit their jobs. Since workers with poor job matches quit, wages rise among job stayers. In this situation, the average wage growth among job stayers depends on how fast the workers who realize the poor job match change their jobs. As several studies show, SE workers tend to invest in their own businesses at the start up.² Part of the investment is arguably sunk. Consequently, SE workers who

¹ LM, in fact, estimated a wage equation for each occupation and found a positive correlation between the present value of lifetime earnings and the slope of wage–experience profiles among SW workers but not among SE workers. They interpreted this as evidence of the productivity-enhancing effects of a deferred payment system among salaried workers. However, lifetime income was calculated based on the estimated coefficients of a wage equation that included an experience term. Therefore, when the slope coefficient is nearly 0, which was the case for self-employed workers in many occupations in their study, lifetime income is determined regardless of the slope coefficient. Thus, the difference between wage–experience profiles was crucial when deriving their results.

² See [Dunn and Holtz-Eakin \(2000\)](#), for example.

realize they have a poor job match are less likely to change their jobs than SW workers due to the income flow generated from their investment. In this sense, SE workers are “foot fixed” workers, while salary/wage workers are “foot loose” workers. Thus, Jovanovic’s theory may also explain Lazear and Moore’s finding.

These discussions show that Lazear’s, Salop and Salop’s and Jovanovic’s theories can all potentially explain the observed flatter earnings profiles of SE workers as compared with SW workers. Among the alternative explanations for LM’s findings, the human capital theory is exclusively pursued in this paper because this theory does not require any type of informational imperfection. It would be most striking to obtain the theoretical prediction consistent with LM’s finding, assuming perfect information. Accordingly, the purpose of this paper is to propose a model that predicts the flatter earnings-tenure profile among SE workers based only on the human capital theory.

To develop this model, two crucial aspects of self-employment that differentiate it from salary/wage jobs are considered. First, the larger variation in income compared with that experienced by SW workers, and second, the higher return for human capital than that of SW workers. Modeling these two characteristics of SE workers’ wage determination with workers’ risk aversion, workers’ optimal human capital investment decision produces a steeper wage profile among SW workers, as LM observed. In this model, the workers choose to be SW or SE in the first period. Since to be SE is risky, workers with high human capital select SE because the higher return for human capital compensates for the risk. Under the convexity assumption of human capital production, workers with higher human capital invest less in their human capital on the job due to higher opportunity cost. Thus, SE workers, who have higher human capital as a result of self-selection, tend to have a flatter wage profile compared with SW workers because they have less human capital investment on the job.

The structure of the rest of this paper is as follows. Section 2 examines the wage risk for SE workers, since the wage risk of self-employment is a crucial assumption for the main conclusion. Section 3 introduces the model of human capital accumulation under the income risk. Section 4 provides evidence consistent with the model. Section 5 concludes.

2. Replication of Lazear and Moore’s (1984) results and the wage risk of self-employed workers

2.1. The model and estimation

In this section, I replicate the results obtained by LM using a different data set and test whether the wages of SE workers are more volatile than those of SW workers.

Data for the years 1985–1998 were taken from NLSY79. The sample is restricted to white males and is used to estimate the model:

$$\ln w_{it} = X_{it}\beta_1 + \beta_2 s_{it} + s_{it}(X_{it} - \bar{X})\beta_3 + c_i + u_{it}, \quad (1)$$

where w_{it} is the hourly wage rate³ and X_{it} is a vector of standard control variables in a Mincer-type wage equation and \bar{X} is a vector of the sample mean of each explanatory variable.⁴ s_{it} is a dummy variable that takes one if the worker is self-employed and c_i is individual heterogeneity. The interaction of X_{it} and the self-employed dummy is included to replicate LM's findings. The model is estimated by both pooled OLS and fixed effects (FE), assuming $E[u_{it}|X_i, s_i, c_i]=0$, where $X_i=[X_{i1}, \dots, X_{iT}]$. The estimation results appear in the first and second columns of Table 1. The return to experience among SE workers (about 7% for the first year) is almost 60% of that of SW workers (about 11% for the first year). In addition, there is almost no return to tenure among SE workers, while SW workers enjoy a return of 3.2% for the first year of tenure. The difference in hourly wage between SW workers and SE workers is evaluated at various points of experience and tenure. SE workers enjoy a SE premium when they start their businesses, but this SE premium declines due to lower return to experience and tenure. This lower return to tenure among SE workers might be explained by the Lazear contract theory or by the fact that they have less on-the-job human capital investment than SW workers. However, lower return to general work experience among SE workers can be explained by less human capital investment among SE workers but not by the Lazear theory, since it only explains the higher return to tenure among SW workers due to an implicit incentive contract. Similarly, Salop and Salop's theory cannot explain lower return to experience among SE workers; this theory only explains the return to tenure. Moreover, even if SE workers are "locked" into their jobs due to their investment made at the time of business start up, Jovanovic's theory explains lower return to business tenure but does not explain lower return to experience among SE workers. These results were not found in LM because they only used potential experience as an explanatory variable; they did not use tenure because CPS does not record job tenure.

Using the residual of the previous fixed effects estimation as the dependent variable,

$$\hat{u}_{it}^2 = \gamma_0 + \gamma_1 s_{it} + a_i + v_{it}, \quad (2)$$

is estimated.⁵ Since we are interested in the wage variation faced by an individual, I used residuals from the fixed effects wage regression to create a measure of wage variation.

³ Hourly rate of pay is constructed by the Center for Human Resource Research (CHRR) based on respondents' usual earnings (inclusive of tips, overtime and bonuses, but before deductions) per hour, day, week or month. Then, these earnings are divided by the number of hours worked in the corresponding time unit. It is possible that hours worked might be measured with substantial error among SE workers and, therefore, the wage rate among SE workers could be subject to larger measurement error. However, the analysis in the next section shows that the measurement error that is correlated with SE status does not affect the conclusion in this section. CHRR requests wages/salaries/tips income and business/firm income, along with other income information, from both SW workers and SE workers. Thus, this addresses the concern that SE workers' earnings contain capital income, in addition to labor income, which is the main concern regarding the measurement of income among SE workers when CPS is used. Therefore, the measurement of earnings for SE workers in NLSY79 is as valid as those in SIPP that were used by Hamilton (2000). Although Hamilton (2000) also used the earnings that include capital gain as an alternative earnings measure of SE workers, I just focus on the labor earnings of SE workers here.

⁴ The variables included in the regression appear in Table 1. The variable names are self-explanatory.

⁵ Essentially, this is Breusch–Pagan's test for heteroscedasticity.

Table 1
The replication of Lazear and Moore's (1984) findings and the risk of self-employed workers

Dependent variable	Model					
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS (ln wage)	FE (ln wage)	OLS (residual ² of (2))	FE (residual ² of (2))	OLS (residual ² of (2))	FE (residual ² of (2))
Education	0.070 (0.003)	–	–	–	–	–
Experience	0.063 (0.005)	0.112 (0.008)	–	–	–	–
Experience ² /100	– 0.120 (0.026)	– 0.187 (0.019)	–	–	–	–
Tenure	0.052 (0.004)	0.032 (0.003)	–	–	–	–
Tenure ² /100	– 0.250 (0.029)	– 0.198 (0.020)	–	–	–	–
Self-employed	0.032 (0.033)	0.086 (0.018)	0.237 (0.041)	0.189 (0.038)	0.201 (0.056)	0.172 (0.046)
Self × (educ – $\overline{\text{educ}}$)	– 0.007 (0.011)	–	–	–	–	–
Self × (ex – $\overline{\text{ex}}$)	– 0.043 (0.020)	– 0.043 (0.012)	–	–	–	–
Self × (ex ² – $\overline{\text{ex}^2}$)/100	0.193 (0.088)	0.146 (0.049)	–	–	–	–
Self × (ten – $\overline{\text{ten}}$)	– 0.054 (0.016)	– 0.031 (0.009)	–	–	–	–
Self × (ten ² – $\overline{\text{ten}^2}$)/100	0.243 (0.100)	0.228 (0.057)	–	–	–	–
(self – $\overline{\text{self}_i}$) ²	–	–	–	–	0.133 (0.092)	0.059 (0.090)
Constant	5.566 (0.058)	–	0.147 (0.009)	–	0.145 (0.088)	–
Observations	23,887	23,887	23,887	23,887	23,887	23,887
No. of individuals	–	2715	–	2715	–	2715
R ²	0.31	–	–	–	–	–
Wage of SE – wage of SW						
0 year experience and 0-year tenure	0.343 (0.107)	0.357 (0.061)				
5 years experience and 5-year tenure	– 0.034 (0.059)	0.080 (0.032)				
10 years experience and 10-year tenure	– 0.192 (0.062)	– 0.011 (0.035)				

(1) Standard errors for coefficient estimates are in parentheses. For OLS estimates, standard errors are corrected for the panel clustering.

(2) The dependent variable in each regression (3)–(6) is the squared idiosyncratic residual of the regression (2).

(3) Year dummies are included, but coefficients are not reported.

(4) Wage of SE – wage of SW is evaluated at the sample mean of education, which is 13.107.

Model (2) is estimated by both OLS and fixed effects, considering the possibility that workers with high volatility due to an intrinsic reason self-select into SE. We are interested in if $\gamma_1=0$. The results of the OLS and fixed effects estimation appear in Table 1, columns (3) and (4). By using the results of the OLS regression, we can say that the conditional wage variance among SE workers is about 2.6 times larger than that of the salaried workers. The results are essentially the same for both OLS and fixed effects. From this evidence, we conclude that being a SE worker is riskier than being a SW worker.

2.2. Issues of measurement error

There is a possible flaw in the previous analysis due to measurement error in the wages of SE workers. Smaller return to experience and tenure among SE workers may be due to measurement error in the wages of SE workers that are systematically correlated with experience or tenure. It is also likely that larger conditional variance of wages among SE workers is due to measurement error. Joulfaian and Rider (1998) report that SE workers underreport their income by 18% on average, using the Tax Payer Compliance Measurement Program data collected by the IRS. Although respondents have no incentive to avoid taxation by underreporting their income in the case of NLSY, underreporting is still possible because respondents may refer to their tax forms to report their income.⁶ The following analysis explicitly discusses the issue of measurement error. The model with measurement error is the following:

$$\ln w_{it}^* = X_{it}\beta_1 + \beta_2 s_{it} + s_{it}(X_{it} - \bar{X})\beta_3 + c_i + e_{it}, \quad (3)$$

$$\ln w_{it} = \ln w_{it}^* + d_i + b_i s_{it} + u_{it}, \quad (4)$$

where w_{it} is reported wage rate, w_{it}^* is actual wage rate, d_i is an individual specific tendency to misreport wages regardless of employment status and b_i is an individual specific tendency to misreport wages when the respondent is self-employed. The assumption that these individual tendencies are time-invariant is crucial in the following discussion. These tendencies (b_i , d_i) and errors in equations (e_{it} , u_{it}) are assumed to be independent. The assumptions on error terms, $E[e_{it}|b_i, c_i, d_i, X_i, s_i]=0$, $E[u_{it}|b_i, c_i, d_i, X_i, s_i]=0$ and $E[e_{it}^2|b_i, c_i, d_i, X_i, s_i]=(1 + \phi s_{it})\sigma_e^2$ are assumed. To test whether SE

⁶ In addition to the measurement error due to underreporting, measurement error of hourly rate of pay can be introduced through the division of (daily, weekly or monthly) earnings by hours worked in the corresponding period. Since hours of work may be more erroneous among SE workers, the measurement error for hourly rate of pay can be correlated with the SE dummy. However, the argument in this section carries over if the individual tendency to misreport hours worked is constant while a worker is in the same type of job.

workers face the larger risk, we are interested in if $\phi=0$. The model that is actually estimated is

$$\ln w_{it} = X_{it}\beta_1 + \beta_2 s_{it} + s_{it}(X_{it} - \bar{X}_i)\beta_3 + c_i + e_{it} + d_i + b_i s_{it} + u_{it}. \quad (5)$$

Applying the fixed effects transformation, we obtain

$$\ln w_{it} - \ln \bar{w}_i = (X_{it} - \bar{X}_i)\beta_1 + \beta_2(s_{it} - \bar{s}_i) + (s_{it}X_{it} - \bar{s}_i\bar{X}_i)\beta_3 + e_{it} + b_i(s_{it} - \bar{s}_i) + u_{it} \quad (6)$$

In this situation, the fixed effects estimator is not a consistent estimator, since $\text{plim}\hat{\beta}_2 = \beta_2 + b$, where $b = E(b_i)$. Thus, the fixed effects estimator of β_2 estimates the lower bound of β_2 , given $b < 0$.

Another possible measurement error arises from the fact that SW workers and SE workers may report income differently. SE workers may report return for physical capital of their own business as their wages; they also may subtract the cost of physical investment in their own businesses from their wages. It is likely that SE workers invest in physical capital when they start their businesses and collect the return later. If this is the case, then the wages of short-tenured SE workers are understated and the wages of long-tenured SE workers are overstated. Due to this measurement error, the return to tenure among SE workers may be overestimated. Despite this possibility of upward bias, the estimated return to tenure among SE workers is almost zero.

The conditional variance of measurement error may also depend on self-employment status through the effect of b_i . Defining the error term in Eq. (6) as $h_{it} = e_{it} + u_{it} + b_i(s_{it} - \bar{s}_i)$, then

$$E[h_{it}^2 | X_i, s_i] = (1 + \phi s_{it})\sigma_e^2 + \sigma_u^2 + (s_{it} - \bar{s}_i)^2 E[b_i^2 | X_i, s_i]. \quad (7)$$

The last term tells us that the job status changer tends to have a larger variance. Assuming $E[b_i^2 | X_i, s_i] = \sigma_b^2$, regressing the residual of the fixed effects wage equation on s_{it} and $(s_{it} - \bar{s}_i)^2$ renders consistent estimators of ϕ and σ_b^2 . The OLS and fixed effects estimates appear in columns (5) and (6) of Table 1. Although the estimate of ϕ diminishes slightly, it is still large and statistically significant. Therefore, we still conclude that being a SE worker is riskier than being a SW worker.

3. The model

Let us suppose that each worker lives for two periods and is endowed with one unit of time for each period. Each worker knows his ability in the first period. Each worker then has the following preference with constant absolute risk aversion:

$$\hat{U}_i = -\exp[-\gamma(w_{i1} + w_{i2})] \quad (8)$$

where γ is the degree of the worker's absolute risk aversion, which is assumed to be identical across workers, and w_{it} is the wage offer for worker i at time t . The wage offer depends on job choice, meaning, whether the worker is self-employed or a salaried worker. The wage offer for job j is

$$w_{ij} = b_j(1 - n_{it})h_{it} + e_{ij}, e_{ij} \sim N(0, \sigma_j^2) \quad \text{for } j = \text{SE, SW}, \quad (9)$$

where h_{it} is the human capital of worker i at period t , $n_{it} \in [0, 1]$ is the portion of time devoted to the human capital accumulation by worker i at time t . The initial human capital h_{i1} is given as an endowment for each worker and includes human capital accumulated through education and innate ability.⁷ The human capital for both periods is assumed to be general across the jobs. The parameter b_j , which is exogenously given by the workers' labor market, is the unit price of human capital in job j . The random variable e_{ij} is a shock to the wage. This model assumes e_{ij} is independently distributed across individuals, time and two jobs. Taking the expectation of the lifetime utility and using the ordinal property of utility function,

$$EU = b_j(1 - n_{i1})h_{i1} - (\gamma/2)\sigma_j^2 + b_j(1 - n_{i2})h_{i2} - (\gamma/2)\sigma_j^2 \quad (10)$$

is obtained.⁸ Each worker has access to the following human capital accumulation technology:

$$h_{i2} = h_{i1} + \delta(n_{i1}h_{i1})^\alpha, \quad \alpha \in (0, 1), \quad (11)$$

where δ is efficiency of human capital investment on human capital accumulation.⁹ The parameter α represents a worker's learning ability, which is assumed to be identical for all workers. This shows that workers with greater human capital produce more additional human capital, but the effect diminishes, since $\alpha \in (0, 1)$.

Two assumptions are made that distinguish SW and SE workers.

Assumption 1. $\sigma_{SE}^2 > \sigma_{SW}^2$, i.e., the wages of SE workers are more volatile than those of SW workers. The empirical evidence supports this assumption, as seen in the previous section.

Assumption 2. $b_{SE} > b_{SW}$, i.e., the return for human capital is higher for SE workers than for SW workers. This assumption is justified by the higher returns to education among SE workers than SW workers in previous studies that utilized Census data.¹⁰ For example, Fairlie and Meyer (1996) found 0.090 as the return to education among SE workers, while they found 0.059 among SW workers. The data used in this study did not indicate a higher return to education, but this might be because of its smaller sample size.

Under these assumptions, workers maximize their lifetime expected utility (Eq. (10)) by choosing n_{i1} and a career path ($\{j\}_{t=1}^2$) under the constraint of human capital accumulation technology (Eq. (11)).¹¹ Since indirect utility from the career path of SE–SW is always dominated by the indirect utility from other career paths, we should consider the three possible career paths of SE–SE, SW–SW and SW–SE.

⁷ While recognizing the endogeneity of educational decisions, I have treated this as given since the main interest of this analysis is on-the-job human capital accumulation.

⁸ See Appendix A for derivation.

⁹ This functional form of human capital accumulation is standard in the literature. See Heckman (1976).

¹⁰ See Borjas and Bronars (1989) and Fairlie and Meyer (1996). In particular, Fairlie and Meyer (1996) used the 1990 Census Public Use Microdata 5% sample that contains a 14,881 SE sample and 100,514 SW sample.

¹¹ As a result of optimization, $n_{i2} = 0$ is trivially chosen.

The optimal human capital investment time, n_{i1} , is

$$n_{i1} = \begin{cases} (\delta\alpha)^{\frac{1}{1-\alpha}} h_{i1}^{-1}, & \text{for job stayers.} \\ \left(\frac{b_{SE}}{b_{SW}}\right)^{\frac{1}{1-\alpha}} (\delta\alpha)^{\frac{1}{1-\alpha}} h_{i1}^{-1}, & \text{for job changers.} \end{cases} \quad (12)$$

These solutions show that human capital investment time decreases the level of initial human capital.¹²

By substituting the optimal n_{i1} in the objective function of each career path, the following indirect utility functions are obtained for each career path for each individual i .

$$v_{j-j}(h_{i1}) = 2b_j h_{i1} - \gamma\sigma_j^2 + b_j \delta^{\frac{1}{1-\alpha}} (\alpha^{\frac{\alpha}{1-\alpha}} - \alpha^{\frac{1}{1-\alpha}}) \quad \text{for } j = \text{SE, SW}, \quad (13)$$

$$v_{\text{SW-SE}}(h_{i1}) = (b_{\text{SW}} + b_{\text{SE}})h_{i1} - (\gamma/2)(\sigma_{\text{SW}}^2 + \sigma_{\text{SE}}^2) + b_{\text{SW}}^{\frac{-\alpha}{1-\alpha}} b_{\text{SE}}^{\frac{1}{1-\alpha}} \delta^{\frac{1}{1-\alpha}} (\alpha^{\frac{\alpha}{1-\alpha}} - \alpha^{\frac{1}{1-\alpha}}) \quad (14)$$

These expressions tell us that the choice of career path depends on each worker’s level of initial human capital. The relationship between lifetime utility for each career path and initial human capital is graphed in Fig. 1. This graph shows that the lifetime utility of being a SE worker is higher than being a SW worker for the high human capital worker. In addition, the graph shows that the worker with a “medium” level of human capital switches jobs in the middle of his career.

Workers with higher initial human capital select self-employment. This selection affects the wage growth of SE and SW workers. The “average” wage growth for each career path is¹³

$$g_{j-j} = \frac{Ew_{2j}}{Ew_{1j}} = \frac{h_{i1} + \delta^{1/(1-\alpha)} \alpha^{\alpha/(1-\alpha)}}{h_{i1} - \delta^{1/(1-\alpha)} \alpha^{1/(1-\alpha)}} \quad \text{for } j = \text{SE, SW}, \quad (15)$$

$$g_{\text{SW-SE}} = \frac{Ew_{2\text{SE}}}{Ew_{1\text{SW}}} = \frac{b_{\text{SE}}}{b_{\text{SW}}} \frac{h_{i1} + \delta^{1/(1-\alpha)} ((b_{\text{SE}}/b_{\text{SW}})\alpha)^{\alpha/(1-\alpha)}}{h_{i1} - \delta^{1/(1-\alpha)} ((b_{\text{SE}}/b_{\text{SW}})\alpha)^{1/(1-\alpha)}}. \quad (16)$$

If the initial level of human capital is given, the wage profiles of the SE workers and the SW workers are identical. However, what we observe is $g_{\text{SE-SE}} < g_{\text{SW-SW}}$ because the SE workers’ h_{i1} are higher than those of the SW workers. Thus, the observed difference

¹² There are two factors related to the initial human capital level and human capital investment. First, from Eq. (11), workers with higher human capital more productively accumulate human capital. However, this effect is diminishing because the term $(n_{i1}h_{i1})$ is exponentiated by $\alpha \in (0,1)$. Second, workers with higher human capital pay more opportunity costs in their human capital investment, which is $b_j n_{i1} h_{i1}$. The marginal benefit of investment diminishes in h_{i1} , but the marginal cost is constant in h_{i1} ; thus, workers with high h_{i1} choose lower n_{i1} . The convexity of the human capital production function is the crucial assumption for deriving this result.

¹³ Although the expected value of a ratio is not a ratio of expected values, this measure gives us a rough idea.

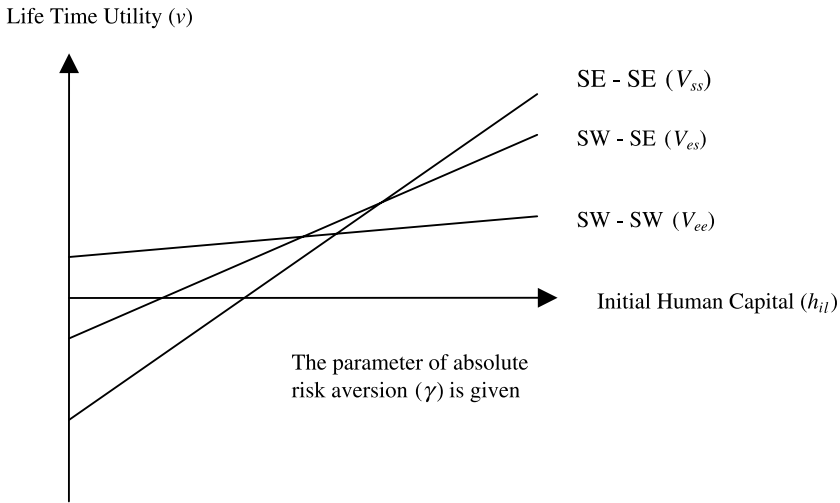


Fig. 1. Lifetime utility of each career path and initial human capital. SE = self-employed workers. SW = salary and wage workers.

between wage profiles is the result of the workers' heterogeneity in the initial level of human capital.

4. Supporting evidence for the model

4.1. SE workers have higher human capital

The theory discussed in the previous section predicts that workers with higher human capital select self-employment. With respect to observable characteristics, several studies report that workers with higher levels of education are more likely to be self-employed.¹⁴

It is an accepted fact that workers who have self-employed fathers are more likely to be SE workers than those who do not, even after controlling for inheritance.¹⁵ In particular, [Dunn and Holtz-Eakin \(2000\)](#) emphasize the importance of the intergenerational transmission of human capital, rather than the mitigated liquidity constraint, to explain this finding. They found that a parents' self-employed status had a very large effect on the son's selection into self-employment, even after controlling the amount of the parents' assets. They also found that the sons of successful, self-employed workers are likely to be self-employed. From this finding, they conclude that the transmission of human capital is the important channel for explaining the intergenerational correlation of self-employment

¹⁴ See [Borjas and Bronars \(1989\)](#) and [Evans and Leighton \(1989\)](#).

¹⁵ See [Lindh and Ohlsson \(1996\)](#), [Blanchflower and Oswald \(1998\)](#), [Hout and Rosen \(2000\)](#) and [Dunn and Holtz-Eakin \(2000\)](#). By controlling for inheritance, the researchers try to partial out the effect of the liquidity constraint.

Table 2
School enrollment by sector (1988–1998)

	Salary and wage	Self-employed	Total
Enrollment rate	9.01	5.60	8.67
<i>N</i>	16,021	1804	17,825

(1) The workers who were enrolled in school at any time between the last interview date and the current interview date are classified as “enrolled.” This does not necessarily imply current enrollment.

(2) Only observations after 1988 are included in the sample. The youngest respondents were 24 in 1988.

status.¹⁶ These results support the prediction of the model presented here: self-employed workers experience lower wage growth because of their higher level of initial human capital.

4.2. Less human capital accumulation among SE workers

The model predicts less human capital accumulation among SE workers. This prediction can be directly tested by comparing the recorded human capital investment behavior of SE and SW workers. School attendance or participation in training while working are good measures of human capital investment. The NLSY79 began to record participation in training in a consistent way after the 1988 survey; thus, the analysis sample in this subsection is restricted to the years after 1988. This restriction reduced the sample size to 17,825 for the school enrollment analysis and 17,818 for the training participation analysis. This restriction also largely excludes college students who have part-time jobs, since respondents were at least age 24 in 1988.

First, school enrollment while working is analyzed. Table 2 tabulates any school enrollment since the previous interview by the types of jobs. While 9% of SW workers were enrolled in school between the previous and current interviews, less than 6% of SE workers had been enrolled. To control the difference in the characteristics of SW and SE workers, school enrollment was regressed on the self-employment dummy, as well as observed characteristics, by OLS. A fixed effects linear probability model was also estimated to deal with individual heterogeneity. Both OLS and FE results, which appear in Table 3, indicate that SE workers are about 2 percentage points less likely to enroll in school than SW workers, while the average enrollment rate is about 8.7%.

Second, participation in training is analyzed. Participation in training is not straightforwardly comparable between SE and SW workers, since some training programs that take place in the SE sector may be unrecognized because they are informal. To work around this problem, Table 4, Panel A provides categories of different training programs in which workers participate. On-the-job training (“Apprenticeship program,” “Formal company training run by employer or military training,” or “Seminars or training programs at work not run by employer”) may not be comparable between SE and SW workers since those training programs are less likely to exist in the SE sector in a formal fashion. Consequently, actual participation in comparable informal programs by SE workers may be misclassified as nonparticipation. On the other hand, participation in off-the-job training (“Business

¹⁶ Although their findings may imply the transmission of human capital that is specific to the SE worker, the theoretical discussion made in this paper still holds, since the worker with any kind of higher human capital experiences lower wage growth.

Table 3

Linear probability model of school enrollment; dependent variable: enrolled in school (yes = 1, no = 0)

	(1)	(2)
Mean of dependent variable	0.087	0.087
Method of estimation	OLS	FE
Self-employed	– 0.024 (0.008)	– 0.019 (0.009)
Education	0.026 (0.002)	–
Experience	– 0.015 (0.004)	– 0.040 (0.006)
Experience ²	0.045 (0.015)	0.081 (0.013)
Tenure	– 0.012 (0.002)	– 0.007 (0.002)
Tenure ²	0.055 (0.011)	0.039 (0.012)
Constant	– 0.138 (0.030)	0.508 (0.080)
Observations	17,825	17,825
R ²	0.07	0.02
No. of ID	–	2634

The same notes apply as those found in Table 2. Standard errors for coefficient estimates are in parentheses. For the OLS estimates, standard errors are corrected for the panel clustering.

school,” “Vocational or technical institute,” “Correspondence course,” “Seminars or training programs outside of work” and “Vocational rehabilitation center”) is comparable between SE and SW workers because the definitions of these training programs can be presumed to be identical for both SE and SW workers. Table 4, Panel A shows that 18.91% of SW workers participated in these training programs, compared with 9.21% of SE workers. To control the difference in observed characteristics between SE and SW workers, linear probability models with and without fixed effects are estimated. The OLS result that appears in column (1) of Table 5 indicates that SE workers are 9.7 percentage points less likely to participate in training, while the FE result that appears in column (2) of Table 5 indicates that SE workers are 5.0 percentage points less likely to participate in training.

Restricting our interest to off-the-job training (Off-jt, hereafter) renders the same picture, although the difference is largely reduced. While 6.20% of SW workers participate in Off-jt, 5.00% of SE workers do. The OLS result that appears in column (3) of Table 5 indicates that SE workers are 1.2% points less likely to participate in Off-jt, while FE result (column (4) of Table 5) indicates a 1.0% point reduction. All of these results indicate that SE workers are less likely to participate in training and, accordingly, invest less in their human capital on the job.

The model also predicts that SW workers who become SE in the second period invest more in their general human capital in the first period because of the lower opportunity cost of human capital investment and the higher return to human capital. To test this theoretical prediction, using SW workers as the sample, participation in training is regressed on the dummy variable that indicates future SE status and other controls by OLS.¹⁷ The result of the estimation appears in column (5) of Table 5, but this result indicates that future SE workers are less likely to participate in training in general. This result does not necessarily contradict the theory because SW workers who become SE in the future may invest less in firm-specific

¹⁷ The future SE dummy varies within individuals for those who switch to SE and switch back to SW but have no prospect to become SE again. Since identification based on those observations is weak, a fixed effects estimation is not implemented.

Table 4
Training participation by type of training and cost bearing (1988–1998)

	Salary and wage	Self-employed	Total
<i>Panel A: training participation by type of trainings</i>			
Did not participate in training	81.09	90.74	82.06
On-the-job training	11.67	3.61	10.85
Apprenticeship program	0.75	0.28	0.70
Formal company training run by employer or military training	7.35	1.83	6.79
Seminars or training programs at work not run by employer	3.57	1.50	3.36
Off-the-job training	6.20	5.00	6.07
Business school	0.29	0.33	0.29
Vocational or technical institute	1.45	0.67	1.38
Correspondence course	0.52	0.28	0.49
Seminars or training programs outside of work	3.71	3.55	3.69
Vocational rehabilitation center	0.14	0.11	0.13
Government training program	0.09	0.06	0.09
Other	1.05	0.67	1.01
<i>N</i>	16,014	1804	17,818
<i>Panel B: training participation by type of cost bearing</i>			
Did not participate in training	81.09	90.74	82.06
Training cost paid by self or family	1.57	3.88	1.81
Employer	15.87	3.60	14.63
Job Training Program Act	0.14	0.11	0.14
Trade Adjustment Act	0.02	0.06	0.02
Job corps program	0.01	0.00	0.01
Work incentive program	0.01	0.00	0.01
Veteran's administration	0.02	0.06	0.03
Vocational rehabilitation	0.09	0.00	0.08
Other	1.17	1.55	1.21
<i>N</i>	16,014	1804	17,818

(1) The results are based on the most recent participation in a training program that started between the last interview date and the current interview date.

(2) Among the types of training, “Business school,” “Vocational or technical institute,” “Correspondence course,” “Seminars or training programs outside of work” and “Vocational rehabilitation center” are classified as “off-the-job training.”

(3) Trainings paid by “Self or family” and government programs are classified as “own cost training.”

human capital. Thus, it is important to disentangle the investment in general human capital from the investment in firm-specific human capital. Ideally, general human capital investment should be regressed on the future SE dummy and other controls. As an attempt to implement this idea, participation in Off-jt or training whose cost is paid by workers or government is regressed on the future SE dummy and controls. Knowing who paid for the training is important because Becker's traditional theory predicts that the training that endows workers with general human capital is paid for by workers, while the cost of investment in firm-specific human capital is shared by both workers and firms. Although the training whose direct cost is paid by the employer might be paid for by workers eventually through lower wages, the training whose direct cost is paid for by the employees

Table 5
Linear probability models of training participation

Dependent variable	Sample						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	SE and SW		SE and SW		SW only		
	Training		Off-the-job training		Training	Off-the-job training	Own/ government paid
Mean	0.179		0.061		0.179	0.061	0.033
Method of estimation	OLS	FE	OLS	FE	OLS	OLS	OLS
S.E.	-0.097 (0.009)	-0.050 (0.013)	-0.012 (0.006)	-0.010 (0.009)	-	-	-
Future self	-	-	-	-	-0.057 (0.012)	-0.001 (0.008)	0.014 (0.006)
Education	0.024 (0.002)	-	0.008 (0.001)	-	0.024 (0.002)	0.006 (0.001)	0.000 (0.001)
Experience	-0.003 (0.004)	0.000 (0.009)	-0.003 (0.003)	-0.005 (0.006)	-0.003 (0.005)	-0.005 (0.003)	-0.006 (0.003)
Experience ²	0.023 (0.018)	0.010 (0.019)	0.020 (0.011)	0.016 (0.013)	0.020 (0.025)	0.025 (0.016)	0.019 (0.012)
Tenure	0.006 (0.003)	-0.006 (0.003)	-0.001 (0.002)	-0.002 (0.002)	0.008 (0.003)	-0.001 (0.002)	-0.005 (0.001)
Tenure ²	-0.038 (0.018)	0.025 (0.017)	0.009 (0.012)	0.022 (0.012)	-0.049 (0.025)	0.014 (0.016)	0.022 (0.008)
Constant	-0.148 (0.032)	0.195 (0.120)	-0.035 (0.018)	0.117 (0.079)	-0.103 (0.037)	0.000 (0.021)	0.095 (0.017)
Observations	17,818	17,818	17,818	17,818	13,671	13,671	13,671
R ²	0.04	0.01	0.01	0.00	0.03	0.01	0.01
No. of ID	-	2634	-	2634	-	-	-

The same notes apply as those in Table 2. Standard errors for the coefficient estimates are in parentheses. For the OLS estimates, standard errors are corrected for the panel clustering.

or government arguably comprises the minimal amount of training that endows workers with general human capital. The results of regressions of Off-jt and own/government-paid training participation on future SE dummy and other variables appear in columns (6) and (7) of Table 5. The participation in Off-jt does not differ significantly between SW workers who stay in the firm and those who become SE in the future. However, future SE workers are 1.4% more likely to participate in the training paid by him/herself or the government. Considering that only 3.3% of SW workers participate in training paid by self/government, the difference is large. This result implies that prospective SE workers invest more in general (portable) human capital while they are SW workers, as predicted by the model developed in this paper.

4.3. Both winners and losers select SE?

The model predicts a very simple selection rule: workers with high human capital select SE. A sensible criticism of this prediction is that there are two kinds of SE workers. The

more volatile than those of salaried workers and the wages of SE workers more sharply reflect their human capital, SE workers invest less in their human capital because of their higher initial human capital. This difference in human capital investment behavior results in a flatter wage profile for SE than SW workers. This theory was supported by the empirical facts about self-employed workers. The data indicate that SE workers are less likely to enroll in school or participate in training on the job. In particular, it shows that the SW workers with future SE prospects accumulate more general human capital on the job.

The model shows that the self-employed workers are not necessarily a good “control” group to test the Lazear contract, since not only does the incentive effect of the Lazear contract produce a steeper wage profile of salaried workers, but the difference in human capital investment has this effect as well. This conclusion does not deny the existence of the Lazear contract, nor the results produced by Lazear and Moore (1984). However, simply attributing the difference of wage profiles to the incentive effect of the Lazear contract may overestimate its importance.

The extension of the model to multiple periods and the estimation of a dynamic discrete choice model that models SW/SE career choices would offer a full-blown test for the theory, and this is left for future research.

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Appendix A

The derivation of Eq. (10) is as follows:

$$\begin{aligned}
 E\hat{U}_{it} &= \int \int -\exp[-\gamma_i(w_{i1} + w_{i2})]dF(e_{ij})dG(e_{ij}) \\
 &= - \int \exp[\gamma_i(b_j h_{i1}(1 - n_{i1}) + e_{ij1})]dF(e_{ij1}) \\
 &\quad \cdot \int \exp[\gamma_i(b_j h_{i2}(1 - n_{i2}) + e_{ij2})]dG(e_{ij2}) \\
 &= -\exp[-\gamma_i(b_j(1 - n_{i1})h_{i1} - (\gamma_i/2)\sigma_j^2 + b_j h_{i2} - (\gamma_i/2)\sigma_j^2)].
 \end{aligned}$$

The independence of error terms across periods derives the second line, and the property of log normal distribution produces the third line. When $\ln x \sim N(m, s^2)$, it is

known that $Ex = \exp(m + (1/2)s^2)$. In our case, $e = \ln x \sim N(m, s^2)$, thus, $E\exp(e) = Ex = \exp(m + (1/2)s^2)$. The ordinal property of utility function results in Eq. (10).

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