# Part-Time Entrepreneurship, Learning and Ability

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*Recent evidence from a large cross-national study on the level of entrepreneurial activity of 40 countries has established that 80 percent of those who implement start-ups also hold outside paid jobs. To explain part-time entrepreneurship, I develop a model in which individuals become part-time entrepreneurs because they do not know their entrepreneurial ability ahead of time. Better entrepreneurs manage to transform their start-ups into successfully operating businesses; those with lower entrepreneurial ability withdraw. The model gives rise to industry selection and agrees with the empirical evidence from the Panel Study of Entrepreneurial Dynamics (PSED).*

## INTRODUCTION

Why do people become part-time entrepreneurs? Are they financially constrained? What sectors do they choose? Early studies on entrepreneurship do not deal with part-timers. Instead, they use self-employment as a proxy for entrepreneurship, and focus on the selection into self-employment and the effect of different factors on it. See for example Evans and Jovanovic (1989), Dunn and Holtz-Eakin (2000), and Holtz-Eakin et al. (1994)[1]. These studies employ data from labor market surveys that treat respondents as either self-employed or wage workers. That does not allow the two groups to overlap. Among the few cases where data on entrepreneurs and not self-employment has been used, such as Kim et al. (2006) and Wu & Knott (2006), part-time entrepreneurship has not been discussed.

Do we have to worry about part-time entrepreneurs? Recent evidence from a large cross-national study on the level of entrepreneurial activity of 40 countries (Global Entrepreneurship Monitor, 2003 Executive Report) has established that 80 percent of those who implement start-ups also hold outside paid jobs. These findings conflict with the theories of entrepreneurial choice in which individuals choose only between outside paid jobs and self-employment, and in which the complexity of entrepreneurial activity is not reflected.

To explain part-time entrepreneurship, I develop a model of entrepreneurial choice where one can hold an outside paid job while also being involved in a start-up. Individuals become part-time entrepreneurs because they do not know their entrepreneurial ability ahead of time. Initially, they would prefer to spend only a fraction of time in entrepreneurship without the risk of starving if their ability turns out to be low. Based on their expectations, entrepreneurs choose how much time to spend in business and how much capital to invest. They will receive a signal about their entrepreneurial ability that is proportional to the time spent in the start-up and will make a decision about what to do next. Better entrepreneurs manage to transform their start-ups into successfully operating businesses; those with lower entrepreneurial ability withdraw. The model gives rise to industry selection, predicting that more part-time entrepreneurs would be observed in sectors where ability is unknown ahead of time.

This implication of the model agrees with the empirical evidence and some of the patterns observed in the Panel Study of Entrepreneurial Dynamics (PSED). The PSED is an extensive nationally representative survey of the establishment of new businesses, reporting that 50 percent of entrepreneurs have full-time work and 20 percent have part-time wage and salary work outside the start-ups. In addition, there is evidence that the number of part-time entrepreneurs is disproportionately high in sectors such as business services. The opposite holds for agriculture, construction and transportation.

### Entrepreneurial Risk and Ability

Entrepreneurship studies, both theoretical and empirical, place a special role on entrepreneurial risk and ability. While the current paper does not explicitly introduce risk, the presence of part-time entrepreneurship may in a way be described as a form of risk aversion. Risk, then, can be interpreted as the lack of knowledge of one's own ability. In the process of becoming business owners, entrepreneurs learn about their ability. A somewhat similar tractate of the relationship between entrepreneurial risk and ability is offered in van Praag & Cramer (2001), whose model is an extension of Lucas (1978). Lucas' model is one of the few early models, together with Kihlsrtom & Laffont (1979), that explicitly deals with risk aversion. The rest of the studies on entrepreneurship cited above assume risk neutrality. The van Praag and Cramer's extension of Lucas' model adds a new dimension. Individuals are not certain about their entrepreneurial talent. The extended model treats "both risk aversion and ability as major determinants" of entrepreneurial choice. In the empirical study, risk aversion is observed and ability is a latent variable.

### Learning

Another important element of the entrepreneurial process is learning. Being an entrepreneur involves learning (Minniti & Bygrave, 2001). Modeling the process of learning of the entrepreneur, however, is not the goal of the paper. Rather, it's instrumental in studying the transition between part-time and full-time entrepreneurship. Learning is modeled following the standard learning by doing and Bayesian update procedures, where probabilities of choosing any particular action are updated as new information is received (Jovanovic & Nyarko, 1996; Bullard, 1994; Jackson, Kalai & Smorodinsky, 1999).

## THEORY OF PART-TIME ENTREPRENEURSHIP

### A Brief Description of the Model

The model deals with selection into entrepreneurship. Entrepreneurial ability is random and differs among individuals. Entry decision is made before ability is observed.

The distribution of ability is known to be one of two types. Potential entrepreneurs are trying to decide on one of them, but no entrepreneur knows his own ability. All individuals hold prior beliefs as to which is the true distribution and each individual, with a certain prior probability, regards himself as a random draw from one of the population distributions of true entrepreneurial ability. The prior belief is then updated as evidence comes in.

After spending a certain amount of time as a part-time entrepreneur, the individual makes a choice between developing a successful business as a full-time entrepreneur and returning full-time to the outside paid job. When the information on ability is not enough to make the choice, the entrepreneur will continue as a part-timer for at least one more period.

If the entrepreneur has low true ability, it is likely that the evidence will be adverse and the entrepreneur will decrease his time in business and withdraw soon. If the evidence is favorable, the individual will increase the time spent in business and will soon move to full-time entrepreneurship.

Next, I include a short description of the method. I then present the model and define the entrepreneur's optimization problem. Toward the end of the paper I compare the implications of the model to the empirical evidence.

**Sequential Analysis**

Suppose that a decision maker must sequentially and at each period either accept on the basis of previous observations a certain hypothesis as being true and cease observation, or he must delay his decision for at least one period and obtain, at a certain cost, one more observation. The idea behind the sequential testing[2] is that the observations are collected one at a time; when observation $X_i = x_i$ has been made, the choice is among the following three options: accept the hypothesis and stop observation; reject the hypothesis and stop observation; or defer decision until the collection of another piece of information as $X_{i+1}$. The decision maker has to find out when to choose which of the above options.

*The Sequential Probability Ratio Test*

Consider a simple hypothesis $H_0 : \theta = \theta_0$ against the alternative $H_1 : \theta = \theta_1$. The two types of error are $\alpha$ = Pr {Deciding for $H_1$ when $H_0$ is true} and $\beta$ = Pr {Deciding for $H_0$ when $H_1$ is true}. $H_1$ and $H_0$ are treated symmetrically. The standard Likelihood Ratio Test (LRT) has critical region of the form $\Lambda_T = \lambda(X_1, ..., Xt) = \frac{logL\ (\theta_1; X_1, ......, X_t)}{logL\ (\theta_0; X_1, ......, X_t)} > K$.

*Wald's Sequential Probability Ratio Test (SPRT)*

If $\Lambda_t > B$, decide that $H_1$ is true and stop;
If $\Lambda_t < A$, decide that $H_0$ is true and stop;
If $A < \Lambda_t < B$, collect another observation to obtain $\Lambda_{t+1}$.

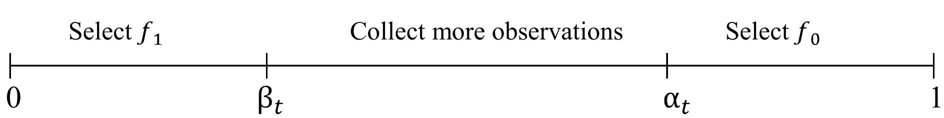
The SPRT does not use a predetermined number of observations, but instead determines after each observation if another observation is needed or if the information currently available is sufficient to accept a hypothesis so that the test has the prescribed strength. A statistical procedure that takes observations into account as they are made is called a sequential procedure. The SPRT is optimal in the sense that it minimizes the average number of periods before a decision is made among all sequential tests which do not have larger error probabilities than the SPRT. The boundaries A and B can be calculated with very good approximation as $A = \log\frac{\beta}{1-\alpha}$, $B = \log\frac{1-\beta}{\alpha}$, where $\alpha$ and $\beta$ are parameters.

**The Model**

Individuals differ in their entrepreneurial talent – $\theta$. Among potential entrepreneurs $\theta$ is normally distributed, such that an individual, who decides to become an entrepreneur, does not know his own $\theta$. But he knows that he is a random draw from either $f(\theta)$ or $f_1(\theta)$, where $f_0(\theta) = N(\theta_0, \sigma_0^2)$ and $f_1(\theta) = N(\theta_1, \sigma_0^2)$, and he is trying to decide on one of them.

After observing $\theta$, the entrepreneur may either stop and accept either $f_0$ or $f_1$, or may continue at a cost C with additional observations. If there are no more observations and a choice is made, then there will be a zero cost if the choice is correct, and costs $L_0$ and $L_1$ with an incorrect choice of $f_0$ and $f_1$ respectively.[3] Individuals also hold a prior probability $p$ that the true distribution is $f_0$, i.e., that they belong to the group of entrepreneurs who will be able to transform their start-ups into successfully operating businesses. I present first the finite time horizon case and then extend to infinite horizon.

**FIGURE 1**
**OPTIMAL DECISION**




Let the conditional probability that the true density is $f_0$ be $p_t = P\ (f = f_0 | \theta_0, \theta_{1,.........}, \theta_t)$. The conditional probability is generated recursively according to the system of equations on Figure 2.

**FIGURE 2**
**RECURSIVE SYSTEM**

$$p_{t+1} = \frac{p_t f_0(\theta_{t+1})}{p_t f_0(\theta_{t+1}) + (1 - p_t) f_1(\theta_{t+1})}, \; t = 0, 1, 2, \ldots T - 1$$
$$p_0 = \frac{p f_0(\theta_0)}{p f_0(\theta_0) + (1 - p) f_1(\theta_0)} \quad (3)$$
$p$ is the prior probability that the true distribution is $f_0$.

The optimal expected cost for the last period is shown on Figure 3.

**FIGURE 3**
**OPTIMAL EXPECTED COST**

$$V_{T-1}(p_{T-1}) = min[(1 - p_{T-1})L_0, p_{T-1}L_1)$$

(1 - $p_{T-1})L_0$ is the expected cost for accepting $f_0$ and $p_{T-1}L_1$ is the expected cost for accepting $f_0$. Using Figure 2, I can obtain the optimal cost for period $t, V_t\ (p_t)$.

**FIGURE 4**
**OPTIMAL COST FOR PERIOD t**

$$V_t(p_t) = min\ \left( (1 - p_t) L_0,\ p_t L_1,\ C + \underset{\theta_{t+1}}{E} \{V_{t+1}(p_{t+1})\} \right)$$

The expectation over $\theta_{t+1}$ is taken with respect to the probability distribution $p(\theta_{t+1}) = p_t\ f_0\ (\theta_{t+1}) + (1 - p_t) f_1(\theta_{t+1})$ for every $\theta_{t+1}$ . Let $A_t\ (p_t) = \underset{\theta_{t+1}}{E} \{V_{t+1}(p_{t+1})\}$. Thus, at period *T*, the entrepreneur's optimal choice, obtained from the optimization on Figure 3 would be to accept $f_0$ if $p_T \geq \lambda$ and to accept $f_1$ if $p_T < \lambda$, where $\lambda$ is determined from the relation $(1 - \lambda)L_0 = \lambda L_1$. Equivalently $\lambda = \frac{L_0}{L_0 + L_0}$. From Figures 3 and 4 it follows that $A_t(0) = A_t(1) = 0$ and $A_{t-1}(p) \leq A_t(p)$ for every t = 0,1, …,T - 1 and every $p$ □ [0, 1] .

**Lemma:** The function *A*(*p*): [0,1] → R is a concave function of *p*.

Proof of the Lemma is provided in Appendix. The lemma is very useful, since it can be applied to show that there exist numbers $\alpha_t$ and $\beta_t$, with $\alpha_t \geq \beta_t$, such that when the conditional probability is $p_t$, the entrepreneur's optimal selection would be to stop observation and choose $f_0$ if $p_t \geq \alpha_t$, stop and choose $f_1$ if $p_t \leq \beta_t$, and continue otherwise. See Figure 1 above.

It follows from the above lemma that if $C + A_{T-2}\left(\frac{L_0}{L_0+L_1}\right) < L_1\left(\frac{L_0}{L_0+L_1}\right)$, then the optimal decision is represented on Figure 5.

**FIGURE 5**
**OPTIMAL DECISION**

accept $f_0$ if $p_t \geq \propto_t$,
accept $f_1$ if $p_t \leq \beta_t$
continue observing if $\beta_t < p_t < \propto_t$.

The scalars $\alpha_t$ and $\beta_t$ are determined from the solution of the system:

$$\beta_t L_1 = C + A_t(\beta_t)(10)$$
$$(1-\propto_t)L_0 = C + A_t(\propto_t)(11)$$

*Extension to Infinite Horizon*

When the optimal decision is extended to an infinite horizon, the two scalars $\alpha_t$ and $\beta_t$ satisfy the following conditions represented on Figure 6.

**FIGURE 6**
**CONDITIONS FOR THE SCALARS $\alpha_t$ AND $\beta_t$**

$$\ldots \le \propto_{t+1} \le \propto_t \le \propto_{t-1} \le \cdots \le 1 - \frac{C}{L_0}$$
$$\ldots \ge \beta_{t+1} \ge \beta_t \ge \beta_{t-1} \ge \cdots \ge \frac{C}{L_0}$$

If T → ∞ the sequences $\{\propto_{T-j}\}$ and $\{\beta \propto_{T-j}\}$ , j = 1, 2..., converge to scalars $\bar{\propto}$ and $\bar{\beta}$, for every j. Thus, the optimal decision is stationary: accept $f_0$ if $p_t \ge \bar{\propto}$, accept $f_1$ if $p_t \le \bar{\beta}$, and continue observing if $\bar{\beta} < p_t < \bar{\propto}$. (14). The conditional probability with infinite horizon is $p_t = \frac{pf_0(\theta_0)f_0(\theta_1)\cdots f_0(\theta_t)}{pf_0(\theta_0)f_0(\theta_1)\cdots f_0(\theta_t)+(1-p)f_1(\theta_0)f_1(\theta_1)\cdots f_1(\theta_t)}$ , $t = 0,1,2,\cdots,$ and the optimal decision would be to accept $f_0$ if $R_t \ge \underline{A} = \frac{(1-p)\bar{\propto}}{p(1-\bar{\propto})}$, accept $f_1$ if $R_t \le \overline{A} = \frac{(1-p)\bar{\beta}}{p(1-\bar{\beta})}$, and continue observing if $\underline{A} < R_t < \overline{A}$. $R_t$ is the sequential probability ratio $R_t = \frac{f_0(\theta_0)f_0(\theta_1)\cdots f_0(\theta_t)}{f_1(\theta_0)f_1(\theta_1)\cdots f_1(\theta_t)}$.

*Cost Determination*

There are three types of costs to be determined. $L_0$ and $L_1$ are the costs with an incorrect choice of $f_0$ and $f_1$ respectively, and *C* is the cost of additional observations. $L_0$ and $L_1$ are in fact opportunity costs and can be determined as follows. If $L_0$ is the cost incurred when the entrepreneur makes an incorrect choice of becoming a full-time entrepreneur instead of returning to the outside paid job, then the opportunity cost will be equal to the forgone wage *w*. Alternatively, if $L_1$ is the cost incurred when the entrepreneur makes an incorrect choice of returning to the outside paid job instead of becoming a full-time entrepreneur, the opportunity cost will be equal to the forgone entrepreneurial income $f(k) + (1-r)k$, where *k* is the capital invested and *r* is the interest rate. Thus, $L_0$ = w and $L_1 = f(k) + (1-r)k$. Thus, $\lambda = \frac{L_0}{L_0+L_1} = \frac{w_0}{w+f(k)+(1-r)k}$ . $\lambda$ was the optimal value that makes the entrepreneur indifferent between the two options at period T with finite horizon. Also, it serves as a critical value, such that the part-timer becomes a full-time entrepreneur when $p_T \ge \lambda$, and returns to his outside paid job if $p_T < \lambda$ respectively.

Taking into account the determination of $L_0$ and $L_1$ , the cost of additional observations will be equal to $C = p_t L_0 + (1-p_t)L_1$. Finding the optimal boundary points at $\alpha_t$ and $\beta_t$ is not trivial. However, from Figures 5 and 6, one can see that $\frac{L_0}{L_{0+}L_1} \le \propto_t \le 1 - \frac{C}{L_0}$ and $\frac{C}{L_0} \le \beta_t \le \frac{L_0}{L_{0+}L_1}$.

*Model Implication*

From the optimal decision in (16), we have that $\underline{A} = \frac{(1-p)\bar{\propto}}{p(1-\bar{\propto})}$ and $\overline{A} = \frac{(1-p)\bar{\beta}}{p(1-\bar{\beta})}$ Thus, the two boundary points depend on the prior probability *p* that the true distribution is $f_0$. It is easy to see that when the prior probability *p* is higher, both $\underline{A}$ and $\overline{A}$ decrease. This means that the region of acceptance of $f_0$ increases, the region of acceptance of $f_1$ decreases, while the region of observing might increase or decrease.

Individuals with a high prior probability *p* are those who are more certain and who have better knowledge about their entrepreneurial ability. Thus, they are more likely to be in the group of the full-time entrepreneurs. Individuals with a low prior probability are more likely to be in the group of those who need more observations or those who have already returned to their outside paid jobs. Thus, the main prediction of the model is that we have more part-time entrepreneurs in sectors where ability is unknown ahead of time. I next compare this implication to empirical evidence from the PSED.

## DATA: PANEL STUDY OF ENTREPRENEURIAL DYNAMICS

The empirical evidence is based on data from the Panel Study of Entrepreneurial Dynamics (PSED), an extensive, nationally representative survey of the establishment of new businesses in US that provides several innovations over previous data sets. First, the data was specifically created to follow both nascent entrepreneurs and start-ups. Nascent entrepreneurs are selected based on three criteria: being involved in a start-up for the past 12 months, expecting to be at least partial owners of the business, and functioning in the gestation phase of the business. The third criterion determines whether "the start-up has a positive cash-flow that covers expenses and the owner-manager salaries for more than three months." Respondents with a positive cash-flow for more than three months are excluded.

Second, start-ups are followed for a period of four years. In this way, we can observe the effect of wealth and initial capital on the start-ups' performance and the rate of entrepreneurial survival. Third, every PSED wave includes observations that are made during a period of two to three consecutive years. For example, the Wave 1 data collection starts in July 1998 and ends in 2000; some respondents are interviewed in 1998, others in 1999, and a small portion is observed in 2000.

The PSED, designed to represent the entire population of entrepreneurs, consists of 830 nascent entrepreneurs and 431 comparison group members. The sample is randomly selected after an 8-month preliminary screening of 64,622 individuals at least 18 years old. Women, Blacks and Hispanics are over-sampled. After the initial screening, two representative samples are identified. A sample of those attempting to start new businesses is identified based on the criteria described above. A second representative sample of typical adults, a control group, is constructed also. The next stage of data collection is the completion of phone interviews and mail questionnaires by both groups. The last stage is a 12 and 24 month follow-up phone interview and a mail questionnaire completed only by the entrepreneurs. In this study, I use data from Wave 1, which is completed between 1998 and 2000. Wave 2 is the first follow-up completed 12 months after Wave 1. Wave 3 is the second follow-up after 24 months. Four waves have currently been completed.

### Nascent Entrepreneurs and Control Group

From the group of 830 nascent entrepreneurs I removed business sponsored start-ups and start-ups having positive monthly cash flow for more than three months. Nascent entrepreneurs and those participating in any form of a start-up activity during their first interview have been removed from the control group.

Nascent entrepreneurs are divided in two groups: part-time entrepreneurs and full-time entrepreneurs. Those who spend 35 hours a week or more in their business ventures are to be considered full-time entrepreneurs. Thus, the final sample used in the study contains a total of 1049 individuals, 386 are from the control group and 663, nascent entrepreneurs. Further, from the nascent entrepreneurs, 469 are part-time entrepreneurs and 194 are full-time entrepreneurs.

To correct for differences in selection probabilities and insure that the estimated results are representative of the entire U.S. population, I develop individual case weights for both nascent entrepreneurs and the control group. I then adjust these weights to create a population representative sample. For a discussion of transforming variables and weights to create a population representative sample, see Gartner et al. (2004, pp. 529-536).

Summary statistics by group (control group, part-time entrepreneurs, and full-time entrepreneurs) of the variables used in the study are presented in Table 1. The data is described in detail in Gartner et al. (2004).

**Descriptive Statistics**

Nascent entrepreneurs are 6 percent of the combined sample (4 percent are part-time and 2 percent full-time entrepreneurs). The average age for the control group is 46 years versus 38 and 39 years respectively for the part and full-time entrepreneurs. Males are 45 percent of the control group and, respectively, 62 and 68 percent of part and full-time entrepreneurs. The difference in age between the control group and nascent entrepreneurs as a whole is 4 years and significant at the one percent level, while the difference in gender representation is 19 percent and also significant at the one percent level. Within nascent entrepreneurs, the difference between male and female representation is significant at the ten percent level. The differences between the control group and nascent entrepreneurs in terms of racial representation are statistically significant at the one percent level for blacks, at the five percent level for whites, and at the ten percent level for Hispanics and others. No statistically significant differences have been observed within nascent entrepreneurs. Six percent from the control group and seven percent from both part and full-time entrepreneurs are foreign born. The education variable is constructed in terms of levels of schooling completed. The average respondent from all three groups has some college experience. The differences in marital status between the control group and nascent entrepreneurs as a whole are statistically significant at the five percent level.

The average number of years of work experience for the control group is 12.25 years versus 11 years for nascent entrepreneurs. The difference of approximately 1.3 years is statistically significant at the ten percent level. No difference in work experience has been observed between part and full-time entrepreneurs. In terms of number of years of managerial experience, the difference between control group and nascent entrepreneurs is not significant, while the difference between part-time and full-time entrepreneurs is small, but statistically significant at the five percent level. The labor-force participation variables show interesting, but not unexpected, results. While 54 percent of the respondents in the control group hold full-time employment, this number is 51 percent for nascent entrepreneurs as a whole, with no statistically significant difference. Further, the difference between the part-time and full-time entrepreneurs is significant at the one percent level. There is no difference among the three groups in terms of part-time employment. Unemployment is at a very low level for nascent entrepreneurs (2 percent) versus 12 percent for the control group. This difference is significant at the one percent level. At the same time, retired entrepreneurs make up 9 percent of nascent entrepreneurs, while the corresponding number for the control group is 17 percent and statistically, significantly higher at the one percent level.

It is possible that some respondents included the startup discussed in the nascent entrepreneur interview when reporting information on being small business owners or self-employed. Gartner et al. (2004, pp. 69-73) provide comparison of multiple work activity with and without the information on current business owner. They conclude that when small business owner information is disregarded, there is no difference between the control group and nascent entrepreneurs, and that "7 in 10 in both groups report one or two distinct work roles." What this means is that nascent entrepreneurs are a busy group of people, with other employment responsibilities and a start-up on the way. Based on the numbers discussed above, this is particularly relevant for part-time entrepreneurs.

**TABLE 1**
**DESCRIPTIVE STATISTICS:**
**PANEL STUDY OF ENTREPRENEURIAL DYNAMICS, WAVE 1 (1998-2000), N=1,049**

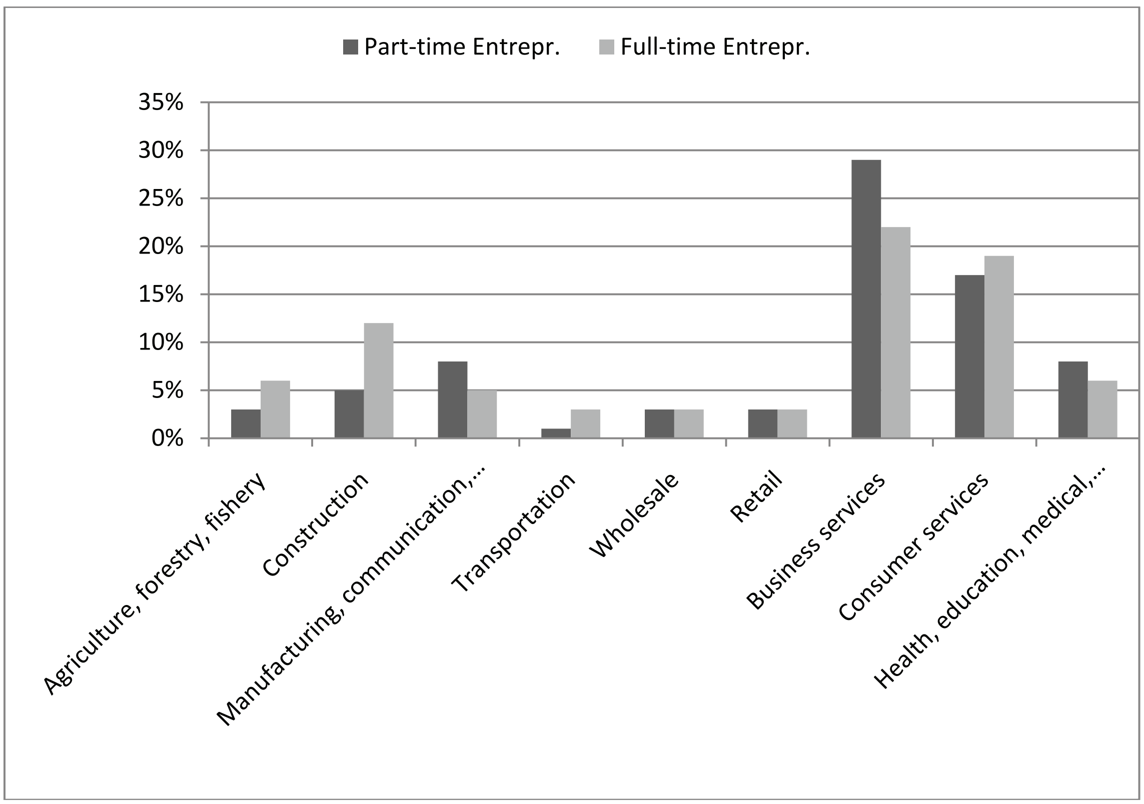
| Variable | Control group N = 386 | | Part-time Entrepr N = 469 | | Full-time Entrepr N = 194 | |
|---|---|---|---|---|---|---|
| | Mean | St. Dev. | Mean | St. Dev. | Mean | St. Dev. |
| *Groups* | 94% | (0.24) | 4% | (0.2) | 2% | (0.13) |
| Age | 45.80 | (13.95) | 38.36 | (11.20) | 39.07 | (11.18) |
| Male | 45% | (0.49) | 62% | (0.48) | 68% | (0.47) |
| *Race* | | | | | | |
| White | 75% | (0.43) | 69% | (0.46) | 69% | (0.46) |
| Black | 10% | (0.30) | 16% | (0.39) | 15% | (0.36) |
| Hispanic | 6% | (0.24) | 8% | (0.27) | 11% | (0.32) |
| Other | 8% | (0.70) | 5% | (0.21) | 4% | (0.19) |
| Foreign born | 6% | (0.24) | 7% | (0.25) | 7% | (0.26) |
| Either parent foreign born | 15% | (0.36) | 14% | (0.35) | 14% | (0.35) |
| *Education* | | | | | | |
| Less than high school | 5% | (0.22) | 3% | (0.16) | 2% | (0.15) |
| High School | 24% | (0.43) | 21% | (0.40) | 27% | (0.44) |
| Some college | 37% | (0.48) | 39% | (0.49) | 34% | (0.48) |
| College or more | 33% | (0.47) | 37% | (0.48) | 37% | (0.48) |
| *Marital Status* | | | | | | |
| Married | 60% | (0.49) | 68% | (0.47) | 66% | (0.47) |
| *Experience* | | | | | | |
| Years of work exp | 12.25 | (9.40) | 11.01 | (8.54) | 10.87 | (8.74) |
| Years of managerial exp | 8.21 | (8.80) | 7.51 | (7.87) | 9.18 | (8.88) |
| *Labor-force participation* | | | | | | |
| Full-time wage employment | 54% | (0.49) | 62% | (0.48) | 25% | (0.44) |
| Part-time wage employment | 16% | (0.37) | 19% | (0.39) | 17% | (0.38) |
| Unemployed | 12% | (0.33) | 2% | (0.14) | 1% | (0.10) |
| Retired | 17% | (0.38) | 8% | (0.27) | 10% | (0.31) |
| *Industry* | | | | | | |
| Agriculture, forestry, fishery | | | 3% | (0.17) | 6%* | (0.25) |
| Construction | | | 5% | (0.21) | 12%** | (0.32) |
| Manufacturing, communication, utilities, | | | 8% | (0.26) | 5% | (0.22) |
| Transportation | | | 1% | (0.09) | 3%* | (0.18) |
| Wholesale | | | 3% | (0.16) | 3% | (0.17) |
| Retail | | | 3% | (0.16) | 3% | (0.17) |
| Business services | | | 29% | (0.46) | 22%* | (0.42) |
| Consumer services | | | 17% | (0.38) | 19% | (0.39) |
| Health, education, medical, government services | | | 8% | (0.27) | 6% | (0.25) |

* Difference between part-time and full-time entrepreneurs significant at 5%.
** Difference significant at 1%.

## Where are the Part-Timers?

The economic sector of the start-ups in the PSED is very similar to the existing US business with employees. Gartner et al. (2004, p. 248) compare the 1997-1999 PSED sample with the US business population. They use two sources of business description by sector: the population of all firms (5.5 mil. in 1998) with employees developed by the Census Bureau of the Department of Commerce; and the annual counts of business tax returns assembled by the Internal Revenue Service. Gartner et al. (2004) show that there is a correlation between the three sources and that in most cases the sector percentage falls in the range between the employee firms and the tax return data. This result seems to be appropriate since the PSED covers mainly sole proprietorships and firms that will hire employees in the future. The differences in sector orientation between full and part-time entrepreneurs are statistically significant at the five percent level in agriculture, forestry, and fishing; transportation and business services; and at the one percent level in construction. There are relatively less part-time than full-time entrepreneurs in agriculture, construction and transportation, while the opposite holds for business services. This result supports the prediction of my theoretical model. Agriculture, construction and transportation are sectors where returns need a shorter period of evaluation and where individuals' expectations on ability are updated at a faster pace. Further, the abilities necessary to run a successful business in these three sectors are easier to recognize ahead of time. Within the sector of business services 20% only are full-time entrepreneurs. Figure 7 where the start-ups are plotted across 9 sectors also provides a confirmation of the above discussion.

**FIGURE 7**




*Source: PSED*

## CONCLUDING REMARKS

In this paper, I study why people become part-time entrepreneurs. While earlier empirical investigations classify individuals as either self-employed or wage workers, I take into account the new evidence presented in a recent survey on the establishment of new businesses, the Panel Study of Entrepreneurial Dynamics, which reports that 50 percent of the entrepreneurs have full-time and 20 percent have part-time work outside the start-up.

To explain part-time entrepreneurship, I develop a model in which individuals become part-time entrepreneurs because they do not know their entrepreneurial ability ahead of time. Initially, they would prefer to spend only a fraction of time in entrepreneurship without the risk of starving if their ability turns out to be low. Based on their expectations, entrepreneurs choose how much time to spend in business and how much capital to invest. After spending a certain amount of time as a part-time entrepreneur, the individual has to make a choice between developing a successful business as a full-time entrepreneur and returning full-time to the outside paid job. When the information on ability is not enough to make the choice, the entrepreneur will continue as a part-timer for at least one more period. If the entrepreneur has low true ability, it is likely that the evidence will be adverse and the entrepreneur will decrease his time in business and withdraw soon. If the evidence is favorable, the individual will increase the time spent in business and will soon move to full-time entrepreneurship. The model gives rise to industry selection, predicting that more part-time entrepreneurs would be observed in sectors where ability is unknown ahead of time. I also compare the model implications with the empirical evidence using the PSED. The number of part-time entrepreneurs in the PSED is disproportionately high in sectors such as business services. The opposite holds for agriculture, construction and transportation.

It is possible, however, that other factors, such as barriers to entry, may affect the way part-time entrepreneurs are distributed across sectors. While barriers to entry are external or exogenous factors, ability, taken in the very wide meaning of the word, is an endogenous characteristic. It is also likely that industry selections results from both factors. These are some questions that deserve future investigation.

This paper, then, offers a general framework for an analysis of an overlooked, but important part of the economy. It needs to be viewed along the lines of providing some general directions for studying part-time entrepreneurship, rather than an extensive theory.

## ENDNOTES

1. Other studies include Kihlsrtom & Laffont (1979), Evans & Leighton (1989), Baumol (1990), Shiller & Crewson (1997), Blanchflower & Oswald (1998), Le (1999), and more recently Hurst & Lusardi (2004) & Newman (2007).
2. The most influential works on Sequential Analysis are Wald (1947), Siegmund (1985), and Ghosh et al. (1991).
3. The problem defined above is a sequential optimization with imperfect state information involving a two-stage Markov chain.

## APPENDIX

**Proof of Lemma:**

To prove that $A_t$(p) is a concave function, it is sufficient to show that concavity of $V_{t+1}$ implies concavity of $A_t$(p). We can assume without loss of generality that $V_{t+1}\ (p_{t+1})$, where $V_{t+1}\ (p_{t+1}) = \min[(1-p_{t+1})\ L_0,\ p_{t+1}L_1]$ (23) is a concave function over [0, 1]. $A_t$(p) can be rewritten in the form of: $A_t(\text{p}) = \sum_{i=1}^{\infty}(pf_0\ (\theta_i) + (1-p)f_1(\theta_i)V_{t+1}\ \left(\frac{pf_0(\theta_i)}{pf_0(\theta_i)\ +(1-p)f_1(\theta_i)}\right)$. It is sufficient to show that concavity $V_{t+1}$ implies concavity of every element of the sum, or $m_t$(p) = $(pf_0(\theta_i) + (1-p)f_1(\theta_i)V_{t+1}\ \left(\frac{pf_0(\theta_i)}{pf_0(\theta_i)\ +(1-p)f_1(\theta_i)}\right)$. Or, that for every $\varphi \in [0,1]$ and $p_1, p_2 \in [0,1]$ $\varphi m_i(p_1) + (1-\varphi)m_i(p_2) \leq m_i(\varphi p_1 + (1-\varphi)p_2)$. Let $B_1 = p_1 f_0(\theta_i) + (1-p_1)f_1(\theta_i)$ and $B_2 = p_2 f_0(\theta_i) + (1-p_2)f_1(\theta_i)$. Thus, the above inequality can be rewritten as: $\frac{\varphi B_1}{\varphi B_1 + (1-\varphi)B_2}\ V_{t+1}\ \left(\frac{p_1 f_0(\theta_i)}{B_1}\right) + \frac{(1-\varphi)B_2}{\varphi B_1 + (1-\varphi)B_2} V_{t+1}\ \left(\frac{p_2 f_0(\theta_i)}{B_2}\right)\ \leq V_{t+1}\ \frac{(\varphi p_1 + (1-\varphi)p_2)f_0(\theta_i)}{\varphi B_1 + (1-\varphi)B_2}$. The latter follows from the continuity of $V_{t+1}$.

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