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Part-time entrepreneurship and financial constraints: evidence from the Panel Study of Entrepreneurial Dynamics

Kameliia Petrova

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Abstract To date, entrepreneurship literature overlooks part-time entrepreneurs, i.e., those who devote time to entrepreneurial ventures and wage employment at the same time. In contrast, recent evidence from the Global Entrepreneurship Monitor, a large cross-national study on the level of entrepreneurial activity, establishes that 80% of nascent entrepreneurs also hold regular wage jobs. This paper offers a model of entrepreneurial entry under financial constraints where individuals choose between wage employment, part-time, and full-time entrepreneurship. Those who become nascent entrepreneurs must further decide how much capital to invest and what proportion of time to spend in business. I test this model using data from the Panel Study of Entrepreneurial Dynamics, which covers start-ups and nascent entrepreneurs. My findings show that part-time entrepreneurs are not affected by financial constraints. The analysis suggests that industry barriers, risk aversion, and learning by doing might be other factors worth investigating.

Keywords Entrepreneurial entry · Part-time entrepreneurship · Full-time entrepreneurship · Wage employment · Nascent entrepreneurs · Financial constraints

JEL Classifications C21 · J22 · J23 · J24 · M13

K. Petrova (✉)
Department of Economics and Finance, State University of New York, College at Plattsburgh, Plattsburgh, NY 12901, USA
e-mail: kameliia.petrova@plattsburgh.edu

1 Introduction

New businesses often rely on individual and household wealth as a source of start-up capital, financial security, or insurance for acquiring funds (Gartner et al. 2004). This suggests that assets have a crucial effect on the level of entrepreneurial activity. In their seminal studies, Evans and Jovanovic (1989), Dunn and Holtz-Eakin (2000), and Holtz-Eakin et al. (1994) find empirical evidence that entrepreneurs are credit constrained and that wealthy people, who are better able to obtain substantial amounts of initial capital, are more likely to be involved in entrepreneurial activities. Hurst and Lusardi (2004), however, show that wealth effects are significant only for the top 5% of the wealth distribution. In a recent paper based on the Panel Study of Entrepreneurial Dynamics (PSED), Kim et al. (2006) studied the impact of financial, human, and cultural capital on entrepreneurial entry in the USA.[1] They found that financial

[1] For other studies see Blumberg and Letterie (2008), Freel (2007), Oliveira and Fortunato (2007), Hyytinen and Vnnen (2006), Henley (2005), and Parker (2000).

capital is not a barrier for entry to entrepreneurship. The study is based on unique data that cover start-ups and nascent entrepreneurs and, as such, point in the direction of investigating wealth effects early in the process of business creation.

I propose a model of part-time entrepreneurship that can potentially explain the empirical findings reported by Kim et al. (2006). Part-time entrepreneurs are people who work at a regular wage job some of the time and work at their own businesses the rest of the time. Why are there part-time entrepreneurs? Why do they not just devote all of their time to their own businesses? One hypothesis for the existence of part-time entrepreneurship is that people are credit constrained. They would like to borrow enough to build their businesses and put food on the table during the early years, when the enterprise is still small and not yet generating very much cash. If they cannot borrow, the only way they can get money to pay their bills is to work at a regular job.

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 of self-employment and the effect of different factors on this selection. These studies employ data from labor market surveys that treat respondents as either self-employed or wage workers, not allowing the two groups to overlap. Do we have to worry about part-time entrepreneurs? Recent evidence from a large cross-national study on the level of entrepreneurial activity (Global Entrepreneurship Monitor, 2003–2006 Executive Reports: Reynolds et al. (2003), Acs et al. (2004), Minniti et al. (2005) and Bosma and Harding (2006)) has established that 80% of those who implement start-ups also hold regular wage jobs.[2]

In 2003 the GEM started including labor force status, together with educational attainment and relative household income, as a personal context factor that may affect the tendency to participate in entrepreneurship. Respondents with full- and part-time jobs were consolidated in one category, "currently working," due to lack of measures allowing such separation for many of the participating countries. The 2003 GEM Executive Report states that "those working are three to seven times more likely to be involved in any kind of start-ups" and that "80% of nascent entrepreneurs implement a start-up while they have a job." The 2004 GEM Executive Report follows the category of "working" respondents across three different income groups: low, medium, and high income. Jobs are held by 81% of the respondents from the high-income group, 91% of the respondents from the medium-income group, and 71% from the low-income group. Similar findings are reported in the 2005 GEM Executive Report and 2006 GEM Executive Report.

These findings conflict with the theories of entrepreneurial choice in which individuals choose between paid jobs and self-employment, and in which the complexity of entrepreneurial activity is not reflected. In my model, individuals decide how much capital to invest and what proportion of time to spend in business. This setup is closely related to Evans and Jovanovic (1989), who presented a static model of self-employment choice where selection into self-employment is based on entrepreneurial ability and liquidity constraints.[3] They estimate the parameters of the distribution of entrepreneurial ability and find empirical evidence that wealth influences the tendency to become an entrepreneur. Evans and Jovanovic (1989) concluded that capital constraints are binding: those with less initial capital are less likely to become entrepreneurs. In an extended version of Evans and Jovanovic (1989), Xu (1998) replaces the static model with a two-period model, in which individuals make occupational choices to maximize their lifetime consumption. Both Evans and Jovanovic (1989) and Xu (1998) assume risk neutrality. The two models, however, differ in their predictions about the correlation between entrepreneurial ability and individual net worth. Evans and Jovanovic (1989) show a negative correlation, whereas Xu (1998) argues that a negative correlation is theoretically implausible, since entrepreneurs would accumulate capital in advance if they expected financial constraints.

I extend the Evans and Jovanovic (1989) model of entrepreneurial choice under liquidity constraints by

[2] The GEM is a cross-country research program studying the national level of entrepreneurial activity on an annual basis. The program was initiated in 1999 with 10 countries and expanded later on. Currently, 42 countries are involved. The GEM essentially looks at the role of entrepreneurship in national economic growth using harmonized sociodemographic characteristics.

[3] Other studies are Blanchflower and Oswald (1998), Evans and Leighton (1989), Holtz-Eakin et al. (1994), Cressy (1996), and more recently Xu (1998) and Hurst and Lusardi (2004). All of them include empirical work that relies extensively on household surveys, where respondents are classified as either self-employed or wage/salary workers. See also Bates (1999), Burke et al. (2002), and Rosti and Chelli (2005).

introducing part-time entrepreneurship. Once new business owners with paid jobs are allowed into the definition of entrepreneurs, the propensity to participate in a start-up becomes a function of individual assets, unobservable entrepreneurial ability, and preference for participation in multiple labor-force activities. I also apply the two-period extension with endogenously determined wealth proposed by Xu (1998).

I test the implications of my model against data from the PSED. To examine the importance of credit constraints, I estimate a multinomial probit model. The probability of starting a new business will be positively correlated with wealth if and only if there are credit constraints. My empirical findings show that part-time entrepreneurs do not appear to be credit constrained. In my regressions, the left-hand side is an indicator of being a wage worker, part-time or full-time entrepreneur and the right-hand side (along with other controls) is wealth. The wealth variable is not significantly different from zero. This is not to say that no entrepreneur is credit constrained. Wealth may have an effect on the marginal entrepreneur. The intuition is based upon the role of wealth. If credit constraints are crucial, wealthier entrepreneurs should shift much more of their time into their businesses, because the credit constraints would have been relaxed. I also find that wealth has no effect on the entrepreneurial revenues and the amount of time entrepreneurs choose to spend in their new business start-ups.

This study contributes to two different branches of the entrepreneurship literature. The first branch explores how wealth affects entrepreneurial propensity. The second, more recent, branch deals with nascent entrepreneurship. Nascent entrepreneurs, i.e., those involved in a process of starting new businesses, were brought to attention with the development of the PSED, an extensive, nationally representative survey of the establishment of new businesses in the USA. PSED counterparts are also available for other countries; see, for example, Samuelsson and Davidsson (2009) for the case of Sweden and van Gelderen et al. (2006) for the case of The Netherlands.[4] Since the data were specifically created to follow both start-ups and nascent entrepreneurs, they provide an opportunity to look at factors affecting entry into entrepreneurship. Reynolds (2009), Koellinger (2009), Liao and Gartner (2006), Davidson (2006), Parker and Belghitar (2006), and Reynolds et al. (2004) are among more recent studies on nascent entrepreneurship.

2 Theoretical background

2.1 The model

Individuals are risk neutral and differ in their entrepreneurial ability, θ, which they know ahead of time.[5] There is no wealth endowment, and all individuals are wage workers in period 1. At the end of period 1 they receive annual wage income w that is divided into consumption c_1 and savings z. Individuals make occupational choices in order to maximize lifetime consumption. Entrepreneurial choice occurs in period 2.

The period 2 income for a full-time wage worker is $w + rz$, where r is the (gross) interest rate. The lending and borrowing rates are assumed to be equal. The period 2 income for a full-time entrepreneur is $y(k, \delta) + r(z - k)$. $y(k, \delta)$ is the entrepreneurial production function, where k is the amount of capital invested and δ is the proportion of time spent in the start-up, $0 \leqslant \delta \leqslant 1$. Individuals, however, can work in a paid job and also choose to be involved in a start-up. The total amount of hours spent in work is fixed and normalized to 1. Thus, involvement in both a paid job and a start-up means that the two activities are exercised on a part-time basis.

If the amount of savings is less than the capital necessary for investment, $z < k$, the entrepreneur needs to borrow additional capital, and $r(z - k)$ is the amount of money that he repays at the end of the period. Following Evans and Jovanovic (1989), I assume that an individual can borrow only up to a certain amount, $(\lambda - 1)z$, which is proportional to his savings. $\lambda - 1$ is the factor of proportionality, $\lambda \geqslant 1$.

[4] Other studies about nascent entrepreneurship abroad employ alternative sources of information about the creation of new businesses: Wennberg and Lindqvist (2010), Caliendo et al. (2009), Ashcroft et al. (2009), Wagner (2007), Caliendo and Kritikos (2010), Carod et al. (2008), Colombier and Masclet (2008), and Bergmann and Sternberg (2007).

[5] Keeping the assumption of risk aversion would require investigating the connection between risk attitude and propensity to become an entrepreneur; this relationship is beyond the scope of the discussion. Kihlstrom and Laffont (1979) investigate the effect of risk aversion on entrepreneurial decisions in detail.

The greatest amount of capital that can be invested is $z + (\lambda - 1)z = \lambda z$, and the constraint is $0 \leqslant k \leqslant \lambda z$.

2.2 The entrepreneurial production function

The entrepreneurial production function is defined as

$$y = \theta k^{\alpha} \delta^{\beta}, \tag{1}$$

where k is the amount of capital invested in the start-up and $\alpha + \beta < 1$. The distinctive feature in the above definition is the property of decreasing returns to scale. This assumption was employed by Lucas (1978), Evans and Jovanovic (1989), Holtz-Eakin et al. (1994), Cressy (1996), Dunn and Holtz-Eakin (2000), and Gentry and Hubbard (2000). Using data on new Japanese firms, Harada (2002) examines the validity of this assumption, and finds empirical evidence that the entrepreneurial production function exhibits decreasing returns to scale. This result suggests that there is a rent from entrepreneurial ability.

The period 2 net income for an entrepreneur is[6]

$$\begin{aligned} \pi(k, \delta; \theta) &= \theta k^{\alpha} \delta^{\beta} + r(z - k) + (1 - \delta)w \\ &= (\theta k^{\alpha} \delta^{\beta} - rk - \delta w) + rz + w. \end{aligned} \tag{2}$$

When $\delta = 1$, the net entrepreneurial income becomes

$$\pi(k; \theta) = \theta k^{\alpha} + r(z - k) \tag{3}$$

as in the basic Evans and Jovanovic (1989) model. For those individuals who do not choose entrepreneurship in period 2, and who continue with their wage jobs, $\pi(k; \theta)$ is equal to $rz + w$.

2.3 Entrepreneurial decision

In the second stage, the entrepreneur's desired investment and time spent in the start-up are obtained by maximizing his net income with respect to k and δ.

$$\max_{0 \leqslant \delta \leqslant 1, k \geqslant 0} \pi(k, \delta; \theta) = \theta k^{\alpha} \delta^{\beta} + r(z - k) + w(1 - \delta). \tag{4}$$

The Lagrangian for this maximization problem is

$$\begin{aligned} \pounds = {} & \theta k^{\alpha} \delta^{\beta} + r(z - k) + w(1 - \delta) \\ & - \mu_1(\delta - 1) + \mu_2 \delta + \mu_3 k. \end{aligned} \tag{5}$$

The optimal solution can be an interior solution when individuals choose to be part-time entrepreneurs, or a corner solution when they are either full-time entrepreneurs or wage workers. Hence, there are three possible outcomes described as follows:

Full-time entrepreneur

$$(k^*, \delta^*) = \left\{ \left(\frac{\theta \alpha}{r} \right)^{\frac{1}{1-\alpha}}, 1 \right\} \quad \text{for } \theta \geqslant \left(\frac{r}{\alpha} \right)^{\alpha} \left(\frac{w}{\beta} \right)^{1-\alpha}$$

Part-time entrepreneur

$$(k^*, \delta^*) = \{A, B\} \quad \text{for } 0 < \theta < \left(\frac{r}{\alpha} \right)^{\alpha} \left(\frac{w}{\beta} \right)^{1-\alpha},$$

where

$$A = \theta^{\frac{1}{1-\alpha-\beta}} \left(\frac{\alpha}{r} \right)^{\frac{1-\beta}{1-\alpha-\beta}} \left(\frac{\beta}{w} \right)^{\frac{\beta}{1-\alpha-\beta}}$$

and

$$B = \theta^{\frac{1}{1-\alpha-\beta}} \left(\frac{\alpha}{r} \right)^{\frac{\alpha}{1-\alpha-\beta}} \left(\frac{\beta}{w} \right)^{\frac{1-\alpha}{1-\alpha-\beta}}$$

Wage worker

$$(k^*, \delta^*) = \{0, 0\} \quad \text{for } \theta = 0$$

Solution of the above optimization problem is provided in the Appendix.

Since the focus of this study is individuals who become part-time entrepreneurs, I will proceed further with a discussion of the interior solution only and the choice under liquidity constraints. The corner solutions of the problem, together with the effect of capital constraints and the choice between full-time entrepreneurship and full-time wage work, are discussed in detail in Evans and Jovanovic (1989).

The optimal levels of capital invested and time spent in business in the case of part-time entrepreneurship are determined as

$$k^* = \theta^{\frac{1}{1-\alpha-\beta}} \left(\frac{\alpha}{r} \right)^{\frac{1-\beta}{1-\alpha-\beta}} \left(\frac{\beta}{w} \right)^{\frac{\beta}{1-\alpha-\beta}}, \tag{6}$$

$$\delta^* = \theta^{\frac{1}{1-\alpha-\beta}} \left(\frac{\alpha}{r} \right)^{\frac{\alpha}{1-\alpha-\beta}} \left(\frac{\beta}{w} \right)^{\frac{1-\alpha}{1-\alpha-\beta}}. \tag{7}$$

The results in (6) and (7) indicate that, for those who choose to become part-time entrepreneurs, the

[6] In Evans and Jovanovic (1989) and Xu (1998), w is not a part of the entrepreneur's net income, because every individual is either an entrepreneur or a wage worker, but not both.

wage received in the paid job is inversely related to both time spent in business and capital invested. Thus, when the wage increases, they will devote less time to their businesses, since the opportunity cost of time in the start-up will be higher. One possible explanation for observing such an effect of a change in w on the amount of time spent in business might be that the substitution effect of an increase in the wage dominates the income effect. As a result, they will increase the time spent in the paid job.

An increase in the wage also affects the amount of capital invested. Individuals will invest less capital, because less time devoted to business implies a lowe marginal product of capital.

From the optimal solution for δ in (7), the amount of time that a part-time entrepreneur spends in business is positively correlated with his ability, or successful entrepreneurs will divert more time to their business than those who have less talent. Similarly, from (6), better entrepreneurs will invest more capital and will, therefore, save more in the first period.

2.4 Capital constraints

A part-time entrepreneur is financially unconstrained if $k \leq \lambda z$:

$$\theta^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{r}\right)^{\frac{1-\beta}{1-\alpha-\beta}}\left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta}} \leqslant \lambda z, \tag{8}$$

or his θ must satisfy

$$\theta \leqslant (\lambda z)^{1-\alpha-\beta}\left(\frac{r}{\alpha}\right)^{1-\beta}\left(\frac{w}{\beta}\right)^{\beta}. \tag{9}$$

Otherwise, the entrepreneur is constrained.

In addition, from (7),

$$0<\theta^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(\frac{\beta}{w}\right)^{\frac{1-\alpha}{1-\alpha-\beta}}<1 \text{ or } 0<\theta<\left(\frac{r}{\alpha}\right)^{\alpha}\left(\frac{w}{\beta}\right)^{1-\alpha}. \tag{10}$$

Combining (9) and (10) yields the following condition on θ for an unconstrained entrepreneur:

$$0<\theta<\min\left((\lambda z)^{1-\alpha-\beta}\left(\frac{r}{\alpha}\right)^{1-\beta}\left(\frac{w}{\beta}\right)^{\beta}, \left(\frac{r}{\alpha}\right)^{\alpha}\left(\frac{w}{\beta}\right)^{1-\alpha}\right). \tag{11}$$

In the case when there are no constraints and $\lambda = \infty$, (11) transforms back to the original condition $0<\theta<\left(\frac{r}{\alpha}\right)^{\alpha}\left(\frac{w}{\beta}\right)^{1-\alpha}$.

For a constrained entrepreneur $k > \lambda z$ and the resulting condition on θ is

$$(\lambda z)^{1-\alpha-\beta}\left(\frac{r}{\alpha}\right)^{1-\beta}\left(\frac{w}{\beta}\right)^{\beta}<\theta<\left(\frac{r}{\alpha}\right)^{\alpha}\left(\frac{w}{\beta}\right)^{1-\alpha}. \tag{12}$$

The above condition holds only if the left-hand side of (12) is smaller than the right-hand side. Condition (12) can be rewritten as

$$\left(\frac{\lambda z}{\frac{w}{r}\frac{\alpha}{\beta}}\right)^{1-\alpha-\beta}<\theta<1, \tag{13}$$

where $\frac{w}{r}\frac{\alpha}{\beta}$ is the inverse of the optimal input factor ratio. Thus, $\lambda z<\frac{w}{r}\frac{\alpha}{\beta}$ would be enough to ensure that (13) is correctly specified.

2.5 Occupational choice

Individuals make occupational choices in order to maximize lifetime consumption. I make the assumption that every individual knows the value of his θ before committing to entrepreneurship. The present value of the lifetime consumption of an entrepreneur (over two periods) is given by

$$V = c_1 + \frac{\theta k^{\alpha}\delta^{\beta} + r(z-k) + w(1-\delta)}{r}, \tag{14}$$

where $c_1 = w - z$ is the period 1 consumption.

For an entrepreneur who is financially constrained $k = \lambda z$. Thus, V can be rewritten as

$$V = w + \frac{\theta(\lambda z)^{\alpha}\delta^{\beta}}{r} - \lambda s + \frac{w(1-\delta)}{r}. \tag{15}$$

The first-order condition of maximizing V with respect to z is

$$\begin{aligned} z^* &= \frac{1}{\lambda}\left(\frac{\theta\alpha\delta^{\beta}}{r}\right)^{\frac{1}{1-\alpha}} \\ &= \theta^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{r}\right)^{\frac{1-\beta}{1-\alpha-\beta}}\left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta}}. \end{aligned} \tag{16}$$

Thus, wealth and ability are positively correlated for financially constrained part-time entrepreneurs.

For unconstrained entrepreneurs, $V = w - z + \frac{\theta k^{*\alpha}\delta^{*\beta} - rk^{*} + w(1-\delta^{*})}{r}$, or there is no correlation between wealth and ability. This result is similar to Xu (1998), but differs from Evans and Jovanovic (1989), who show that there is a negative correlation between ability and wealth. If individuals know their entrepreneurial ability ahead of time and expect financial difficulties, they will accumulate funds before making entrepreneurial decisions.

One can see from the optimization problem in Sect. 2.4 that the distribution of ability θ also depends on the parameters of the entrepreneurial production function α and β. Entrepreneurs who are involved in more capital-intensive businesses will save more than those involved in businesses that need a lower amount of starting capital. Thus, the amount of capital invested will differ across industries and sectors.

2.6 Testable implications

Under the assumption that wealth and entrepreneurial ability are uncorrelated, the theoretical model has the following testable implications. The probability of becoming involved in the process of starting a new business venture on a part-time basis, while also holding a paid job, and wealth are positively correlated if and only if there are credit constraints. Entrepreneurs with free access to capital are able to start from a more efficient capital level than somebody who is limited financially. Furthermore, entrepreneurial earnings and initial assets are positively related, since wealthier entrepreneurs are able to start with a more efficient level of capital. Finally, entrepreneurs who are wealthier should shift a lot more of their time into their business as a result, because the credit constraints would have been relaxed. They can buy machinery, feed themselves, and still devote all of their time to investing in the new business venture.

Thus, under the assumption of zero correlation between assets and entrepreneurial ability, the testable implications of the model can be summarized with the following three propositions:

Proposition 1 *The probability of starting a new business and wealth are positively related if and only if there are credit constraints.*

Proposition 2 *Entrepreneurial earnings and initial assets are positively related.*

Proposition 3 *The amount of time a part-time entrepreneur spends in a start-up and initial assets are positively related.*

2.7 Leisure considerations

The model does not allow for working full-time and using leisure time to start a business. However, to see what outcome we might expect under such a setup, we can apply the consumption–leisure preference structure developed by Harada and Kijima (2005). Harada and Kijima (2005) extend the Evans and Jovanovic (1989) model by explicitly modeling the consumption–leisure preference of the latent entrepreneur. Entrepreneurs can freely choose their optimal level of leisure, while wage workers are constrained since their working hours are set by the institutions they work for.[7] Under the assumption that leisure is a normal good, wealthier people will choose more leisure, thus gaining control over the distribution of their hours. What this means is that wealth and entrepreneurial propensity are positively related even in the absence of liquidity constraints.

Harada and Kijima's (2005) results can be applied to the model developed here. In a similar manner, working hours will be exogenously determined. New businesses will be developed using leisure time. The choice to be made is how to divide leisure time between entrepreneurship and leisure activities. Given that leisure is a normal good, wealthier people and those with higher wages will choose more leisure and less time spent working in entrepreneurship. This result is opposite to Harada and Kijima's (2005) because entrepreneurship is a secondary source of income. Thus, the probability of starting a new business and wealth are negatively related as are the amount of time a part-time entrepreneur spends in a start-up and wealth. The relationship between entrepreneurial earnings and initial assets will not be affected.

[7] Harada and Kijima (2005) make the assumption that working hours are determined exogenously. This assumption is required because they found that, if a wage worker can choose hours freely, assets will not affect the choice between wage work and entrepreneurship.

3 Empirical model and estimation

In models of choice between self-employment and wage employment, individuals choose the type of employment that brings the highest expected utility; see, for example, Evans and Jovanovic (1989), Evans and Leighton (1989), Blanchflower and Oswald (1998), Dunn and Holtz-Eakin (2000), Holtz-Eakin et al. (1994), and Hurst and Lusardi (2004) for models using self-employment data,[8] and Kim et al. (2006) for a study using data on start-ups and nascent entrepreneurs instead of self-employment. The empirical work then consists of estimating a reduced form equation[9] where the dependent variable is the choice of employment, and the independent variables include demographic characteristics, financial resources, and possibly some additional control variables. The model is estimated using probit or logit regressions.

In my model, individuals face three possible outcomes: wage employment, part-time entrepreneurship, and full-time entrepreneurship. In order to estimate a model with multiple discrete outcomes, I use a multinomial probit model. In the multinomial probit model, each individual derives utility from each of the three options. The individual chooses the option yielding the highest utility. Only the alternative chosen by the individual is observed, not the utility derived from each alternative.

Let Y^* be the unobserved utility associated with each choice

$$Y_1^* = V_1 + \varepsilon_1, \tag{17}$$

$$Y_2^* = V_2 + \varepsilon_2, \tag{18}$$

$$Y_3^* = V_3 + \varepsilon_3, \tag{19}$$

where (17) is the choice of wage employment, (18) of part-time entrepreneurship, and (19) the choice of full-time entrepreneurship. The unobserved utility is then

$$Y^* = \alpha' X + \gamma \text{wealth} + \varepsilon, \tag{20}$$

with a vector of explanatory variables X that are individual specific and identical across the three outcomes. I assume that the residual (ε_1, ε_2, ε_3) has a trivariate normal distribution with a vector of means zero and a covariance matrix given by

$$\Sigma = \begin{bmatrix} \sigma_1^2 & \sigma_{12} & \sigma_{13} \\ \sigma_{12} & \sigma_2^2 & \sigma_{23} \\ \sigma_{13} & \sigma_{23} & \sigma_3^2 \end{bmatrix}. \tag{21}$$

The dependent variable is an indicator of choice among a wage job, part-time entrepreneurship, and full-time entrepreneurship. The choice is estimated as a function of wealth (household net worth) and personal characteristics X (age, gender, race, education, household income, marital status, work and managerial experience, labor-force participation variables, and region). A positive and significant coefficient on wealth would be interpreted as a confirmation of financial constraints.

The multinomial probit model allows analysis of multiple, unordered outcomes. In the case of wage employment, part-time entrepreneurship, and full-time entrepreneurship, any order of the three alternatives that might exist is individual rather than alternative specific. Thus, an ordered probit would be a more restrictive method of estimation when a distinctive order of outcomes cannot be specified. Further, the multinomial probit provides estimates of different coefficients for each of the three outcomes. The model includes only individual-specific characteristics, identical across alternatives, while the estimated coefficients differ across alternatives. Finally, the multinomial probit relaxes the independence of irrelevant alternatives (IIA) assumption. IIA requires that the choice between any two alternatives be independent of the third alternative in a case of three outcomes. This assumption is very often violated, especially in a situation where two of the outcomes are very similar to each other but differ significantly from the third outcome. Tests such as the Hausman specification test[10] can be used to determine whether IIA is violated; for example, both multinomial logit and multinomial probit can be used for estimating models with multiple unordered outcomes (Maddala 1983). While the former needs IIA,

[8] Similar models have been estimated with self-employment data for other countries; for instance, see Rees and Shah (1986) and Dolton and Makepeace (1990) for self-employment in the UK, De Wit and Van Winden (1986) for The Netherlands, and Clark and Drinkwater (2000) for self-employment among ethnic minorities in England and Wales.

[9] Evans and Jovanovic (1989) and Xu (1998) estimate the parameters of both the structural model and the reduced model.

[10] Hausman (1978) and Hausman and McFadden (1984).

the latter requires numerous assumptions about the covariance structure of the unobserved terms (Train 2003).

To investigate the relationship between entrepreneurial earnings and initial wealth, I estimate the effect of wealth on the expected total sales, revenue or fees in the first year of operation. The dependent variable is the expected revenue. The explanatory variables include household net worth, household income, and a set of human capital variables and demographic controls. I perform the estimation for part-time and full-time entrepreneurs separately as well as for the whole group of nascent entrepreneurs. The model is in double logarithm form. This type of specification has two important characteristics. First, it deals with dispersion in variables. Second, the elasticities with respect to net worth and income are constant. This corresponds with some of the properties of the theoretical model, in particular the production function determination. To ensure that the correct model specification has been applied, I use the Box–Cox[11] transformation procedure to confirm that the double log transformation is properly chosen.

Expected revenues are used to replace real revenues in the above estimation. Gartner et al. (2004, pp. 386–400) provide an overview of the relation between variables in the PSED that refer to future expectations and constructs in the literature, and point to Brush and Vanderwerf (1992), who study and confirm the reliability of owner/founder sources of revenue, profit, employment, etc. The PSED provides information on the expected revenue in the first and fifth year of business. To check for robustness, I also estimate the effect of wealth using the expected revenue for the fifth year of operation and real revenues from wave 2.

The final set of tests focus on the effect of initial wealth on the proportion of time entrepreneurs spend in business. I estimate an ordinary least-squares regression where the dependent variable is the number of hours per week spent in the start-up. Wave 1 of the PSED provides information on time allocation in number of hours per day for work and off-work days separately. I use this information to create total number of hours per week devoted to a new business start-up. The set of explanatory variables includes: household net worth; household income; expected revenue in the first full year of operation; number of hours per week spent on a wage job; number of hours per week spent in leisure; demographic characteristics such as age, gender, race, education, work and managerial experience, marital status and children; and industry classification. In addition, I add variables that measure the entrepreneur's self-reported ability, learning, and risk aversion. These variables are based on the respondents' evaluations of and answers to the following statements and questions. For ability and learning, using a five-point scale with 1 being completely disagree and 5 completely agree, respondents evaluate: "Overall, my skills and abilities will help me start a business" and "For me, identifying business opportunities has involved several learning steps over time, rather than a one-time thing." For risk aversion, respondents choose between two types of new businesses, "alpha—a business that would provide a good living, but with little risk of failure and little likelihood of making you a millionaire," and "beta—a business that was much more likely to make you a millionaire but had a much higher chance of going bankrupt." Those who choose alpha are considered risk averse. A positive and significant coefficient on net worth would confirm the existence of financial constraints. This last group of tests helps to examine other potential factors that might affect the choice of becoming a part-time entrepreneur. I perform the test for both part-time and full-time entrepreneurs.

4 Data: Panel Study of Entrepreneurial Dynamics

The PSED is an extensive, nationally representative survey of the establishment of new businesses in the USA that provides several innovations over previous data sets. First, the data were specifically created to follow both nascent entrepreneurs and start-ups. Nascent entrepreneurs are selected based on three criteria: being involved in a start-up during 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 is set to determine whether "the start-up had a positive cash-flow that covered expenses and the owner-manager salaries for more than 3 months." Respondents with a positive cash-flow for more than 3 months were excluded.

[11] Box and Cox (1964).

Second, start-ups are followed for a period of 4 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 2–3 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 are 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 oversampled. 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 also constructed. 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.

4.1 Nascent entrepreneurs and control group

From the group of 830 nascent entrepreneurs I removed 109 cases of business-sponsored start-ups, leaving only independent start-ups owned by one or more natural persons. Thus, the study focuses on person-created new ventures only, excluding any form of legal person ownership. Furthermore, six observations were removed for having positive monthly cash-flow for more than 3 months (91 days). All six cases are among the independently owned start-ups. Nine observations were removed from the control group for being nascent entrepreneurs during their first interview. An additional 23 observations were dropped for participating in any form of start-up activity. Finally, 46 observations were removed for missing household income, 8 for missing household net worth, and 10 for missing race information.

Nascent entrepreneurs are divided into two groups: part-time entrepreneurs and full-time entrepreneurs. Those who spend 35 h a week or more in their business ventures are to be considered full-time entrepreneurs. One observation has been dropped for lack of information. Thus, the final sample used in the study contains a total of 1,049 individuals, 386 are from the control group and 663, nascent entrepreneurs. Furthermore, from the nascent entrepreneurs, 469 are part-time entrepreneurs and 194 are full-time entrepreneurs.

To correct for differences in selection probabilities and ensure that the estimated results are representative of the entire US population, I developed individual case weights for both nascent entrepreneurs and the control group. I used, as a start, the weights assigned by the Survey Research Center at the University of Michigan that are based on information on age, education, race, and sex available from the Current Population Surveys conducted by the US Census. I then adjusted 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, full-time entrepreneurs) of the variables used in the study are presented in Table 1. The data are described in detail in Gartner et al. (2004).

4.2 Descriptive statistics

Nascent entrepreneurs are 6% of the combined sample (4% are part-time and 2% 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 make up 45% of the control group and, respectively, 62% and 68% 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 1% level, while the difference in gender representation is 19% and also significant at the 1% level. Within nascent entrepreneurs, the difference between male and female representation is significant at the 10% level. The differences between the control group

Table 1 Descriptive statistics: PSED, wave 1 (1998–2000), $N = 1{,}049$

Variable	Control group		Part-time entrepr.		Full-time entrepr.	
	$N = 386$		$N = 469$		$N = 194$	
	Mean	SD	Mean	SD	Mean	SD
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 experience	12.25	(9.40)	11.01	(8.54)	10.87	(8.74)
Years of managerial experience	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)
Current business owner with full-time wage employment	8%	(0.27)	21%	(0.41)	17%	(0.37)
Current business owner with part-time wage employment	5%	(0.21)	11%	(0.31)	14%	(0.34)
Current business owner with no wage employment	10%	(0.29)	13%	(0.33)	51%	(0.50)
Either parent business owner	49%	(0.50)	52%	(0.50)	50%	(0.50)
Helped start other businesses	47%	(0.49)	22%	(0.42)	28%	(0.45)
Financial resources						
Household net worth	190,097	(449,004)	205,641	(802,787)	233,765	(641,601)
Median net worth	80,000		60,000		58,000	
Household income	54,147	(42,235)	57,497	(79,404)	55,023	(49,389)
Median income	45,000		45,000		45,000	
Region						
Northeast	21%	(0.41)	19%	(0.39)	20%	(0.40)
South	33%	(0.47)	38%	(0.48)	34%	(0.47)
Midwest	25%	(0.43)	19%	(0.39)	21%	(0.41)
West	21%	(0.41)	25%	(0.43)	26%	(0.44)

Table 1 continued

Variable	Control group		Part-time entrepr.		Full-time entrepr.	
	$N = 386$		$N = 469$		$N = 194$	
	Mean	SD	Mean	SD	Mean	SD
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			23%	(0.42)	22%	(0.42)
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)

All financial resources are in US dollars

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

** Difference significant at 1%

and nascent entrepreneurs in terms of racial representation are statistically significant at the 1% level for Blacks, at the 5% level for Whites, and at the 10% level for Hispanics and others. No statistically significant differences have been observed within nascent entrepreneurs. Six percent from the control group and 7% 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 5% 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 10% 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 the 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 5% level.

The labor-force participation variables show interesting, but not unexpected, results. While 54% of the respondents in the control group hold full-time employment, this number is 51% 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 1% 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%) versus 12% for the control group. This difference is significant at the 1% level. At the same time, retired entrepreneurs make up 9% of nascent entrepreneurs, while the corresponding number for the control group is 17% and statistically significantly higher at the 1% level.

Labor-force participation is further explored by looking at simultaneous participation in multiple work activities. Full- and part-time wage employment is combined with the information on whether respondents are small business owners or self-employed. Within the group of nascent entrepreneurs, the only statistically significant difference (at the 1% level) is for small business owners with no work employment. In terms of comparison between the control group and nascent entrepreneurs as a whole, the differences are statistically significant at the 1% level in all three cases, full time, part time, and control group. Twenty percent of all nascent entrepreneurs (versus 8% of the control group) hold full-time wage employment, 11% (5% for the control group) hold part-time wage

employment, and 24% (10% control group) have no wage employment. It is possible that some respondents included the start-up discussed in the nascent entrepreneur interview when reporting information on being small business owners or self-employed. Gartner et al. (2004, pp. 69–73) provided a comparison of multiple work activity with and without the information on current business owners. 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.

Following Kim et al. (2006), I have included additional variables that can help determine entrepreneurial propensities; for example, I have included information showing whether either parent was a business owner and showing whether respondents helped start other businesses.

The PSED questions on net worth are modeled after the questions from the Survey of Consumer Finances. Three separate approaches are used for the collection of data on household net worth. First, respondents report a wealth component measured in four categories: current value of home; mortgages or land contracts on the home; tangible assets, savings, and investments (current value of stocks, bonds, mutual funds, saving accounts, checking accounts, retirement accounts, etc.); and other debts and land contracts. Second, respondents report a single wealth value, which is an approximation of the current household net worth. Third, categorical wealth values are reported. Household income includes all sources of income such as work, government benefits, and pensions before taxes in the previous year. The average levels of both household net worth and income are not statistically significantly different across the three categories.

The economic sector of the start-ups in the PSED is very similar to existing US businesses with employees. Gartner et al. (2004, p. 248) compared 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) showed 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 5% level in agriculture, forestry, fishing; and transportation and business services; and at the 1% level in construction. There are relatively fewer part-time than full-time entrepreneurs in agriculture, construction, and transportation, while the opposite holds true for business services.

5 Empirical results

The results of the multinomial probit estimation are presented in Table 2 using the human capital and demographic characteristics from Kim et al. (2006). In models 1 and 2 the outcomes observed are part-time and full-time entrepreneurship, and the control group[12] (wage employment) is omitted. In model 3, I changed the omitted outcome to full-time entrepreneurship, thus allowing observation of part-time entrepreneurship and wage employment. The estimates reported are for the case when part-time entrepreneurship is observed.

The main and most important result is that the four financial resource variables are not statistically significant regardless of the outcome observed. Thus, the lack of a statistically significant correlation between the probability of starting a new business venture, under part-time or full-time entrepreneurship, and wealth suggests that entrepreneurs are not financially constrained.

From the rest of the covariates included in the model, age, gender, race, and marital status are statistically significant for both part-time and full-time entrepreneurs when compared with those who

[12] I use the whole control group, without removing the unemployed. Both control group and nascent entrepreneurs include a small percentage of unemployed. Removing those individuals who are unemployed will result in misrepresentations.

Table 2 Multinomial probit estimation, $N = 1{,}049$

	Wage employment = 0		Wage employment = 0		Full-time entrepr. = 0	
	Part-time entrepr. = 1		Full-time entrepr. = 1		Part-time entrepr. = 1	
	(1)		(2)		(3)	
Age	−0.826***	(0.288)	−1.019***	(0.372)	0.193	(0.312)
Male	0.456***	(0.124)	0.652***	(0.164)	−0.196	(0.138)
Race						
Black	0.574***	(0.143)	0.446**	(0.198)	0.128	(0.167)
Hispanic	0.190	(0.219)	0.304	(0.274)	−0.114	(0.272)
Other	−0.132	(0.243)	−0.037	(0.311)	−0.095	(0.300)
Foreign born	0.134	(0.257)	−0.015	(0.362)	0.149	(0.342)
Either parent foreign born	−0.104	(0.200)	−0.014	(0.242)	−0.089	(0.251)
Education						
High school	0.370	(0.292)	0.601	(0.402)	−0.231	(0.397)
Some college	0.603**	(0.287)	0.618	(0.392)	−0.015	(0.384)
College or more	0.686**	(0.293)	0.784*	(0.409)	−0.098	(0.399)
Marital status						
Married	0.348***	(0.128)	0.416**	(0.169)	−0.068	(0.142)
Experience						
Years of work experience	0.026	(0.022)	0.026	(0.029)	−0.0003	(0.024)
Years of work experience^2	−0.001	(0.001)	−0.001	(0.001)	0.0004	(0.001)
Years of managerial experience	0.029	(0.021)	0.041	(0.029)	−0.011	(0.025)
Years of managerial experience^2	−0.001	(0.001)	−0.001	(0.001)	0.0001	(0.001)
Current business owner and full-time wage employment	1.053***	(0.221)	1.514***	(0.254)	−0.461**	(0.189)
Current business owner and part-time wage employment	1.027***	(0.244)	1.764***	(0.286)	−0.738***	(0.221)
Current business owner and no wage employment	1.122***	(0.192)	2.748***	(0.234)	−1.626***	(0.207)
Either parent business owner	0.034	(0.121)	−0.262	(0.169)	0.293**	(0.147)
Helped start other businesses	−1.033***	(0.141)	−1.261***	(0.206)	0.228	(0.178)
Financial resources						
Household net worth	−0.005	(0.003)	−0.002	(0.005)	−0.004	(0.004)
Household net worth^2	9.01e–06	(0.000008)	1.34e–06	(0.00001)	7.67e–06	(0.000008)
Household income	−0.013	(0.030)	−0.017	(0.333)	0.004	(0.020)
Household income^2	0.001	(0.001)	0.001	(0.001)	0.0001	(0.0001)
Region						
South	0.032	(0.170)	−0.110	(0.220)	0.142	(0.179)
Midwest	−0.153	(0.190)	−0.147	(0.245)	−0.006	(0.207)
West	0.211	(0.186)	0.182	(0.235)	0.029	(0.201)
Constant	−0.680	(0.997)	−1.104	(1.203)	0.424	(1.028)
ML	−205.46					
DF						

Significant at * 10%, ** 5%, *** 1%. Standard errors in parenthesis

Reference categories are White for race, less than high school for education, and northeast for region

are wage employed. Males, Blacks, and married are more likely to be part-time and full-time entrepreneurs. College education has a statistically significant positive effect for both groups. However, for part-time entrepreneurs, both attending college and obtaining an actual degree are significant, while only completion of college matters for full-time entrepreneurs. Work and managerial experience do not have a significant effect. Those who own other businesses are more likely to become involved in new business ventures, both part and full time, regardless of engaging in or not engaging in wage employment. An interesting result, however, is that those who helped start other businesses are less likely to become involved again.

The comparison between part-time and full-time entrepreneurs, in the case when full-time entrepreneurship is the omitted alternative, is presented in the last two columns of Table 2. The variables with statistically significant effects are: respondents being current business owners and whether a respondent's parent(s) owned a business. Individuals who currently own businesses are less likely to be part-time versus full-time entrepreneurs. Furthermore, when either parent owns a business, the individual is more likely to be a part-time entrepreneur.

Including industry dummy variables in the multinomial probit is not possible because the information is collected for nascent entrepreneurs only. To determine whether there is a difference between part-time and full-time entrepreneurs across sectors, I estimated a separate probit model using the sample of nascent entrepreneurs only. The dependent variable is 1 if the person is a part-time entrepreneur and 0 if a full-time entrepreneur. All independent variables from the multinomial probit model are included, together with industry dummy variables. The results are presented in Table 3. Current business owners are still less likely to be part-time entrepreneurs. Few changes are observed. Gender becomes significant; males are less likely to be part-timers. The parents owning businesses variable is not statistically significant. In addition, agriculture, construction, transportation, and wholesale are sectors where fewer part-time entrepreneurs are observed.

Results from the estimations of the effect of wealth on expected revenues for the first year of operation are presented in Table 4. Net worth and income are significant for part-time entrepreneurs, at the 5% and 10% level, respectively. With the double log specification of the model, the coefficients interpretation is as follows. A 10% increase in household net worth would result in a 2% increase in expected revenue, while a 10% increase in household income would result in approximately a 4% increase in expected revenue. When the dependent variable is expected revenue in the fifth year, these numbers are 1.9% for household net worth and 4.4% for household income. Evans and Jovanovic (1989) and Evans and Leighton (1989) estimate similar effects using log assets and log self-employment earnings. They, however, use real earnings. For full-time entrepreneurs, net worth and income are not statistically significant. I also estimated the relationship for nascent entrepreneurs as a whole. The results are similar to those of the part-time entrepreneurs. In this case, a dummy variable controls for part-time entrepreneurs. The coefficient is negative and statistically significant at the 1% level. Part-time entrepreneurs expect much less revenues than full-time entrepreneurs. To further test the robustness of the results, I estimated the same regression using data on real revenues from wave 2 of the PSED (Table 5). The dependent variable is real revenues. The explanatory variables are the same as those in the expected revenue estimation. I used the information on age, gender, race, and experience from wave 1, and marital status from wave 2. I also adjusted the group of part-time and full-time entrepreneurs based on information from wave 2. In the case of net worth and income, I kept the wave 1 variables because they are indicative for the venture start-up period. A 1-year period is not likely to result in a significant change in the assets and income category of the respondent. The sample of part-time entrepreneurs consists of 31 observations. Neither income nor net worth have a statistically significant effect on revenues.

Results of the effect of assets on the amount of time spent in a new business start-up are presented in Table 6. In addition to the standard human capital, demographic, and financial characteristics, I also include respondents' self-reported measures of ability, learning, and risk aversion. Neither household net worth, nor income have statistically significant effects. Expected revenue has a very small, but statistically significant (at the 1% level), positive effect for full-time entrepreneurs, but no effect for part-time entrepreneurs. This might be related to the fact that part-time entrepreneurs have lower expectations when revenues are concerned. There is no

Table 3 Probit estimation, $N = 663$

	(1)	
	FTE = 0, PTE = 1	
Age	0.179	(0.317)
Male	−0.229*	(0.129)
Race		
Black	−0.014	(0.139)
Hispanic	−0.152	(0.239)
Other	0.166	(0.330)
Foreign born	−0.034	(0.326)
Either parent foreign born	−0.086	(0.229)
Education		
High school	−0.322	(0.422)
Some college	−0.143	(0.416)
College or more	−0.277	(0.422)
Marital status		
Married	−0.098	(0.134)
Experience		
Years of work experience	−0.002	(0.020)
Years of work experience^2	−0.0002	(0.005)
Years of manag. experience	−0.024	(0.020)
Years of manag. experience^2	0.0005	(0.0006)
Busn. owner and full-time wage empl.	−0.486***	(0.176)
Busn. owner and part-time wage empl.	−0.790***	(0.188)
Busn. owner and no wage empl.	−1.558***	(0.154)
Either parent business owner	0.062	(0.126)
Helped start other businesses	−0.071	(0.147)
Financial resources		
Household net worth	−0.0005	(0.003)
Household net worth^2	1.54e–06	(0.000004)
Household income	−0.005	(0.021)
Household income^2	0.0001	(0.0001)
Region		
South	0.167	(0.170)
Midwest	0.017	(0.190)
West	0.033	(0.184)
Sector		
Agriculture, forestry, fishery	−1.581**	(0.704)
Construction	−1.280**	(0.666)
Manufctr., communic., util.	−0.510	(0.651)
Transportation	−1.454*	(0.788)
Wholesale	−1.383*	(0.710)
Retail	−0.922	(0.618)
Business services	−0.777	(0.616)
Consumer services	−1.029	(0.626)
Health, educ., medic., govrnm. serv.	−1.060	(0.651)
Constant	1.874	(1.345)
ML	−30.615	
DF	36	

Significant at * 10%, ** 5%, *** 1%. Standard errors in parenthesis

correlation shown between time spent in business and time spent on leisure activities. Part-time entrepreneurs for whom learning is an important part of the start-up process devote more time than those who see it as "one big thing." Those who believe in their ability spend less time than those who show doubt. Finally, risk aversion has no effect for part-time entrepreneurs.

6 Discussion and conclusions

Part-time entrepreneurs are people who work at a regular wage job some of the time and work at their own businesses the rest of the time. Hence, one hypothesis for the existence of part-time entrepreneurship is that people are credit constrained. They would like to borrow enough to build their businesses and survive while the enterprise is still small. If they cannot borrow, the only way they can get money to pay their bills is to work at a regular job.

After examining the effect of initial wealth on the tendency to participate in a business start-up for part-time entrepreneurs, I would argue that wealth does not significantly affect the propensity to become an entrepreneur. I developed a model of entrepreneurial choice under liquidity constraints, where one can hold a paid job while also being involved in a start-up. Individuals face three choices: wage employment, part-time or full-time entrepreneurship. They make joint decisions of how much capital to invest and what proportion of time to spend in business. I tested the implications of the model empirically against data from the PSED, which provides data on both start-ups and nascent entrepreneurs. I estimated the model using a multinomial probit model, where the

Table 4 Effect of wealth on expected revenue

	Part-time entrepr.		Full-time entrepr.		Nascent entrepr.	
	$N = 304$		$N = 130$		$N = 434$	
Age	−0.026*	(0.016)	−0.053**	(0.024)	−0.033**	(0.013)
Male	0.866***	(0.207)	0.892**	(0.405)	0.849***	(0.179)
Race						
Black	0.173	(0.262)	0.187	(0.374)	0.202	(0.214)
Hispanic	−1.131**	(0.443)	0.440	(0.529)	−0.669*	(0.362)
Other	0.609	(0.526)	−1.191*	(0.578)	0.099	(0.431)
Foreign born	−0.091	(0.555)	0.566	(1.004)	0.271	(0.184)
Either parent foreign born	0.326	(0.396)	0.324	(0.1599)	0.206	(0.721)
Education						
High school	−0.562	(0.828)	−1.296	(1.323)	−0.303	(0.662)
Some college	−0.714	(0.798)	−1.279	(1.364)	−0.506	(0.208)
College or more	−1.049	(0.825)	−0.650	(1.171)	−0.526	(0.015)
Marital status						
Married	−0.347	(0.227)	−0.702*	(0.419)	−0.411**	(0.015)
Experience						
Years of work experience	0.002	(0.019)	0.020	(0.027)	0.010	(0.270)
Years of managerial experience	0.044**	(0.019)	0.017	(0.025)	0.033	(0.262)
Current business owner and full-time wage employment	0.132	(0.290)	0.270	(0.674)	0.098	(0.231)
Current business owner and part-time wage employment	−0.370	(0.300)	−0.295	(0.646)	−0.371	(0.467)
Current business owner and no wage employment	−0.552*	(0.306)	0.289	(0.413)	−0.313	(0.335)
Either parent business owner	0.067	(0.218)	−0.399	(0.364)	−0.068	(0.633)
Financial resources						
Household net worth (Ln)	0.234**	(0.103)	0.041	(0.145)	0.150*	(0.081)
Household income (Ln)	0.374*	(0.196)	0.544	(0.357)	0.514***	(0.173)
Part-time entrepreneur					−0.740***	(0.288)
Industry dummies	Yes		Yes		Yes	
Constant	3.903	(1.095)	4.789	(2.072)	4.585	(1.032)
ML	−30.615					
DF	28		26		29	

Dependent variable is expected total sales, revenue, or fees in the first year of operation

Significant at * 10%, ** 5%, *** 1%. Standard errors in parenthesis

probability of starting a new business venture and wealth would be positively correlated if and only if there are credit constraints. My empirical findings show that part-time entrepreneurs do not appear to be affected by financial constraints. This is not to say that no entrepreneur is credit constrained. Instead, the result points to the effect of wealth on the marginal entrepreneur. The main result supports previous findings by Kim et al. (2006), who estimate a binary choice model of entrepreneurial entry using the same data set and find that nascent entrepreneurs are not affected by financial or cultural capital. Human capital, instead, is what plays an important role. They, however, do not study part-time entrepreneurship. The explanations of why financial constraints do not affect entrepreneurial entry provided by Kim et al. (2006) are valid for part-time entrepreneurs as well.

Next, I estimated the effect of assets on entrepreneurial revenues. I first used expected revenues and found that household net worth and entrepreneurial entry are positively related for part-time entrepreneurs, but not for full-time entrepreneurs. The same

Table 5 Effect of wealth on revenue for part-time entrepreneurs

	Coeff.	SE
Age	−0.153*	(0.076)
Male	−0.076	(0.793)
Black	−0.272	(0.788)
Hispanic	−3.515**	(1.548)
Other	−3.501*	(1.764)
Some college	2.123**	(0.942)
College or more	0.484	(1.074)
Married	1.093	(0.953)
Years of work experience (Ln)	−0.009	(0.395)
Years of managerial experience (Ln)	1.275	(0.896)
Household net worth (Ln)	−0.537	(0.388)
Household income (Ln)	0.306	(1.209)
Constant	15.808	(1.969)
R^2	49%	

Dependent variable is log of real revenues, wave 2, $N = 31$

Significant at * 10%, ** 5%. Standard errors in parenthesis

relationship holds for household income and entrepreneurial entry. However, when the estimation is performed for real instead of expected revenues, no effect has been observed. It is possible that expected revenues are related to assets and income; for instance, Gartner et al. (2004, p. 390) argued that preferences for growth, with expected revenues being one way of measuring such preferences, could be related with income for the purpose of satisfying economic needs. This explanation, which is more along the lines of the hypothesis of entrepreneurs being financially constrained, corresponds to a negative relationship between income and expected revenues, not a positive one as found in the estimation here. I do concede, though, that part-time entrepreneurs have wage employment to rely on.

In the final set of tests I performed, I looked at the effect of assets on the amount of time part-time entrepreneurs spend in business. The results suggest that the choice of how much time individuals devote to their new business ventures is not affected by their initial assets and income, the amount of time in leisure, and (for part-time entrepreneurs only) risk aversion. Furthermore, part-time entrepreneurs who believe that the process of starting a new business venture involves numerous learning steps spend more time, while those who believe that their ability and effort will help them to be successful devote less time to their start-ups. This analysis suggests that there might be different explanations for the observed part-time entrepreneurship. I have shown in my work so far that wealth constraints do not seem to be one of them. In light of this result, an examination of other reasons might be warranted; for example, learning by doing, income substitution for leisure, and risk aversion are possible explanations. What I report here are only preliminary tests. More theoretical and empirical work is needed to investigate these factors in detail.

It may be possible that in a learning-by-doing setup, individuals might 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 the amount of time to spend in business and amount of capital to invest. One possible prediction is that more part-time entrepreneurs would be observed in sectors where it is considerably more difficult to know one's ability ahead of time. Alternatively, barriers to entry across sectors can be examined.

Attitude towards risk is another factor worth investigating more deeply. A common assumption in prior literature is that entrepreneurs are risk bearers. It originally comes from Knight (1921) and is more recently brought into light by Kihlstrom and Laffont (1979). Contrary to the concept of a risk-taker entrepreneur, there are some recent studies, both theoretical (Newman 2007) and empirical (Wu and Knott 2006), showing that risk aversion is more plausible among entrepreneurs. I assume risk neutrality in my model. However, in light of the new findings, looking more closely into risk attitudes among entrepreneurs, especially in the case of part-time entrepreneurs, might be worthwhile.

Finally, one can exploit income substitution for labor as a possibility. This could probably be done with an extended version of the standard leisure–labor model, where individuals decide how to distribute their time between market activities (paid jobs and entrepreneurial ventures), home production, and leisure. Furthermore, study of the time use of part-time entrepreneurs should be incorporated. Gartner et al. (2004) point out that time use "is a newer entry in the field of entrepreneurship" that

Table 6 Effect of wealth on the time spent in business

	Part-time entrepr.		Full-time entrepr.	
	$N = 185$		$N = 72$	
Age	−0.004	(0.008)	0.008	(0.008)
Male	−0.145	(0.125)	0.129	(0.190)
Race				
Black	0.080	(0.147)	0.215	(0.166)
Hispanic	0.618**	(0.257)	−0.400	(0.276)
Other	0.720***	(0.274)	0.533	(0.331)
Foreign born	0.064	(0.315)	−0.210	(0.230)
Education				
High school	0.602	(0.428)		
Some college	0.752*	(0.413)	−0.113	(0.251)
College or more	0.761*	(0.426)	−0.261	(0.187)
Marital status				
Married	0.148	(0.157)	−0.363*	(0.212)
Kids	−0.053	(0.038)	0.109***	(0.041)
Experience				
Years of work experience	−0.006	(0.009)	−0.002	(0.012)
Years of managerial experience	0.020**	(0.009)	0.014	(0.012)
Current business owner and full-time wage employment	0.220	(0.135)	−0.525	(0.298)
Current business owner and part-time wage employment	0.054	(0.194)	−0.164	(0.263)
Current business owner and no wage employment	0.124	(0.200)	0.141	(0.202)
Financial resources				
Household net worth	0.0001	(0.0003)	−0.00002	(0.004)
Household income	−0.026	(0.017)	0.007	(0.012)
Expected revenue in the first year of operation	0.00003	(0.00004)	0.00003**	(0.00001)
Number of hours per week spent on a wage job	−0.015***	(0.004)	−0.029***	(0.003)
Number of hours per week leisure	−0.013	(0.010)	0.001	(0.011)
Ability and effort help start business (1 = completely agree, 5 = completely disagree)	−0.178**	(0.072)	0.260***	(0.095)
Start-up result of a learning process (1 = completely agree, 5 = completely disagree)	0.250***	(0.060)	0.042	(0.065)
Risk aversion: 1 if alpha type of business, 0 if beta type of business	−0.042	(0.132)	−0.616***	(0.215)
Industry dummies	Yes		Yes	
Constant	2.291	(0.690)	2.135	(0.637)
F	3.78		212.82	
R^2	42%		74%	

Dependent variable is number of hours per week spent in business

Significant at * 10%, ** 5%, *** 1%. Standard errors in parenthesis

needs further exploration. They show that nascent entrepreneurs spend an equal amount of time working on their start-ups on both work and off-work days (Gartner et al. 2004, p.111). Thus, entrepreneurial ventures might often take time away from leisure. This finding needs to be reconciled with the

observation made by Frith (2007) and Dahlin et al. (2004) that start-ups are sometimes rooted in the entrepreneur's hobby.

Appendix: Solution to the optimization problem

The entrepreneur's desired investment and time spent in the start-up are obtained by maximizing his net income with respect to k and δ.

$$\max_{0\leqslant\delta\leqslant 1,k\geqslant 0} \pi(k,\delta;\theta) = \theta k^{\alpha}\delta^{\beta} + r(z-k) + w(1-\delta).$$

The Lagrangean for this maximization problem is

$$\pounds = \theta k^{\alpha}\delta^{\beta} + r(z-k) + w(1-\delta) - \mu_1(\delta-1) + \mu_2\delta + \mu_3 k.$$

The first-order and the complementarity slackness conditions are

$$\frac{\theta\alpha k^{\alpha}\delta^{\beta}}{k} = r,$$
$$\frac{\theta k^{\alpha}\beta\delta^{\beta}}{\delta} = w + \mu_1,$$
$$-\mu_1(\delta-1) = 0,\ \mu_1 \geqslant 0,$$
$$\mu_2\delta = 0,\ \mu_2 \geqslant 0,$$
$$\mu_3 k = 0,\ \mu_3 \geqslant 0,$$
$$\delta \leqslant 1.$$

The optimal solution can be an interior solution when individuals choose to be part-time entrepreneurs, or a corner solution when they are either full-time entrepreneurs or wage workers. Hence, there are three possible outcomes: one interior and two corner solutions.

Case 1: Interior solution

In this case $\mu_1 = 0$ and the necessary conditions for the optimal amount of capital and relative time spent in start-up are

$$\alpha\frac{\theta k^{\alpha}\delta^{\beta}}{k} = r,$$
$$\beta\frac{\theta k^{\alpha}\delta^{\beta}}{\delta} = w$$
$$\delta < 1.$$

Thus, the optimal factor input ratio is $\frac{k^*}{\delta^*} = \frac{\alpha}{\beta}\frac{w}{r}$, and the net income can be rewritten as

$$\pi(k^*,\delta^*;\theta) = (1-\alpha-\beta)\theta k^{*\alpha}\delta^{*\beta} + rs + w.$$

Since the production function exhibits decreasing returns to scale $(\alpha+\beta<1)$, k^* and δ^* are determined as

$$k^* = \theta^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{r}\right)^{\frac{1-\beta}{1-\alpha-\beta}}\left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta}}, \tag{22}$$

$$\delta^* = \theta^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(\frac{\beta}{w}\right)^{\frac{1-\alpha}{1-\alpha-\beta}}. \tag{23}$$

If the production function has constant returns to scale $(\alpha+\beta=1)$, the optimal factor input ratio is still equal to $\frac{\alpha}{\beta}\frac{w}{r}$. However, the optimal levels k^* and δ^* are not determined, and there is no rent under the optimal factor input ratio. In this case, $\pi(k^*,\delta^*;\theta) = rs + w$, or the entrepreneurial income would be the same as the wage worker's income.

Both k^* and δ^* are nonnegative, with the exception of the case when θ is zero. Thus, to ensure that all conditions hold and that (22) and (23) form the interior solution of the maximization problem, δ^* must satisfy the condition $0<\delta^*<1$. From (23), $0<\theta^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(\frac{\beta}{w}\right)^{\frac{1-\alpha}{1-\alpha-\beta}}<1$, or $0<\theta<\left(\frac{r}{\alpha}\right)^{\alpha}\left(\frac{w}{\beta}\right)^{1-\alpha}$.

The entrepreneurial net income is

$$\pi(k^*,\delta^*;\theta) = (1-\alpha-\beta)\theta^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta}} + rz + w,$$

with a positive rent from entrepreneurial ability

$$(1-\alpha-\beta)\theta^{\frac{1}{1-\alpha-\beta}}\left(\frac{\alpha}{r}\right)^{\frac{\alpha}{1-\alpha-\beta}}\left(\frac{\beta}{w}\right)^{\frac{\beta}{1-\alpha-\beta}} > 0$$

at the optimal levels of k and δ.

Case 2: Corner solutions

When $\mu_1 \neq 0$, $\delta = 1$. Individuals choose full-time entrepreneurship. The net income is $\theta k^{\alpha}\delta^{\beta} + r(z-k)$, and the optimal solution becomes $k^* = \left(\frac{\theta\alpha}{r}\right)^{\frac{1}{1-\alpha}}$ and $\delta^* = 1$. In this case, $\theta \geqslant \left(\frac{r}{\alpha}\right)^{\alpha}\left(\frac{w}{\beta}\right)^{1-\alpha}$..

Finally, when $\theta = 0$, individuals become wage workers only. In this case, $\delta = 0$ and the net income for a full-time wage worker is $w + rz$.

This model generalizes the entrepreneurial choice model developed by Evans and Jovanovic (1989) and Xu (1998). The solution in the general case can be summarized in the following way:

$$\begin{array}{ll} \text{Full-time entrepreneur for} & \theta \geqslant \left(\frac{r}{\alpha}\right)^{\alpha}\left(\frac{w}{\beta}\right)^{1-\alpha} \\ \text{Part-time entrepreneur for} & 0<\theta<\left(\frac{r}{\alpha}\right)^{\alpha}\left(\frac{w}{\beta}\right)^{1-\alpha}. \\ \text{Wage worker for} & \theta = 0 \end{array}$$

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