A Real Options Model of
Stepwise Entry into Self-Employment

by

**Karl J. Wennberg, Timothy Folta,
and Frederic Delmar**

for

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Purpose

Many people do not enter directly into full-time self-employment, but choose to enter part-time. By doing so, they minimize the uncertainty related to self-employment as they can retain their employment while testing the viability of the self-employment choice. For many people, part-time self-employment represents not only a secondary income, but also a first step into full-time self-employment.

The authors of this paper examine the path toward self-employment as one that is fraught with uncertainty. That is, an individual will consider the choice to enter into self-employment and to leave employment by others as a hedge against uncertainty. Part-time entry into self-employment allows them the strategy of limiting their investment in time and money. If successful, they can enter self-employment on a full-time basis; if not, they have limited their risk, while maintaining their full-time job elsewhere.

This paper tests that hypothesis using data from a cohort of people employed in Swedish knowledge-intensive industries, following their occupational choices over two periods

Overall Findings

The authors find that entrepreneurs used part-time entry as a strategy to test their ideas when they have little information about their true value. As such, models of entry into self-employment are incomplete if they do not consider this option. Moreover, an individual is less likely to undertake self-employment if the investment requires high levels of fixed assets, which might be irreversible or hard to liquidate in the event of failure

Highlights

• The authors find evidence that uncertainty has a negative effect on the likelihood of entry. Full-time entrants are less likely to enter self-employment given uncertainty than those who have experimented with part-time options first

• Individuals using part-time entry as a means of testing the validity of their opportunities are more likely to enter full-time self-employment (after a successful trial run), and they are also more likely to exit than full-time entrants.

• An individual with a long work history of employment with the same firm is less likely to leave his or her firm to engage in entrepreneurship.

• Industry-level measures of irreversibility, such as the level of intangible assets required, had a positive impact on self-employment. This finding is not what was hypothesized by the authors..

• Having prior part-time experience significantly increased the probability of entry into self-employment, on both a part-time and full-time basis.

Note

This paper was prepared for presentation at the Babson Entrepreneurship Research Conference. The report references "space limitations" and "suppressed" control variables in the tables. The authors needed to comply with strict guidelines for submission to the BERC, including a page limitation. The Office of Advocacy is releasing the BERC version of the paper as a working paper, which adheres to these guidelines.

Scope and Methodology

The authors utilize a cohort of people employed in the Swedish knowledge-intensive industries in 1997. The data are from Statistics Sweden and cover 3.3 million individuals, representing over 70 percent of the active Swedish labor market. The larger longitudinal data set covers 1989 to 2002, providing labor market histories of the individual before and after 1997. These data can be linked to firm-level data.

Since extremely large data sets present problems in terms of computations and in identifying self-employment entry, they use state-based sampling to construct a smaller sample from the larger data set. The entry decision is modeled with a series of multinomial logit models that compare events of entry with a random sample of non-entries. Non-entries are modeled by randomly selecting 10 percent of the individual observations in the data set, and then randomly assigning each observation to an industry. Hypothesis testing on such a sample is unproblematic since state-based sampling yields unbiased and consistent coefficients for all variables except the constant term.

The final sample consists in the first wave of 5,469 instances of full entry (2.32 percent), 6,595 instances of part entry (2.79 percent) and 223,981 randomly sampled non-entries (94.89 percent). In the second wave, part-time entries switched labor market status dramatically. 2,190 exited altogether from self-employment (33.21 percent), 818 changed to full-time self-employment (12.40 percent), and the rest (3,587 or 54.39 percent) remained as part-time self-employed. Among the full-time self-employed, 1,177 made an exit (21.52 percent) and 468 changed to part-time (8.56 percent). Among the randomly sampled non-entries, 0.72 percent changed to part-time self-employment, and 0.43 percent changed to full time self-employment in 1999.

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ABSTRACT

This paper tests a real options model of stepwise entrepreneurial entry. We distinguish between part time and full time entry among the self employed in Swedish knowledge intensive industries. Two multinomial logit models tests the entry from employment to part- or full time entry in 1998, and to subsequent full time entry in 1999. The empirical evidence indicates the need to distinguish between part time and full time entry, something overlooked in earlier research. We find strong support for our notion that entrepreneurs used part time entry as a strategy to test the value of their conceived business opportunity without risking their full income. However, our hypothesis that entrepreneurs use a real options heuristic shaped by the uncertainty and the irreversibility of entry received only mixed support.

INTRODUCTION

In this paper, we propose a real options model of step wise entry into self-employment. Previous research has explained entry into self-employment as a mix of (unobservable) entrepreneurial ability and liquidity constraints and as a dichotomous decision between entry or non entry. However, recent waves of the Global Entrepreneurship Monitor show that a majority of entrepreneurs that engage in creating a new venture simultaneously holds an outside job (Reynolds et al., 2003). Hence, existing models ignore one of the most obvious casual observations: many people do not enter directly into full time self-employment, but choose to enter part time. By doing so they minimize the uncertainty related to self-employment as they can retain their employment while testing the viability of the self-employment choice. For many people, part time self-employment represents not only a secondary income, but also a first step into full–time self-employment (Aldrich, 1999).

The failure of existing models to incorporate the role of part time entry has two important consequences: First, entry into self-employment must be considered as a discrete choice among at least three labor market alternatives (to continue as employee, to enter self-employment part time, or to enter self-employment full time) and not a dichotomous choice. Second, entry into self-employment follows a repeated choice structure where a previous choice dictates the alternatives available at the next decision point. For example, a full time self-employed has at each time period the alternative to continue or to choose another activity, and a part time self-employed has the option to continue, to switch to full time self-employment or to exit altogether. This choice is made under uncertainty, and is dependent on the previous choice made and the information available from its outcome. From this perspective, much previous research has underestimated the dynamics of self-employment by not considering the full range of possible choices and how they are interrelated. The available studies on part time entry are few: Ronstad (1986) found that among 104 Babson College alumni almost half had started their businesses as part time efforts, but did not provide any statistical evidence on the role of part time entry. Petrova (2005) analyzed part time entrepreneurship in first wave of the Panel Study of Entrepreneurial Dynamics, but limited her analysis to estimating the importance of outside job as a substitute for individual wealth. In the current study we seek to explain why some entrepreneurs use such limited efforts as a base for full time entrepreneurship, whereas some entrepreneurs stop at the initial attempt. A theoretical perspective that allows us to explain these irregularities is real options theory.

We posit that individuals contemplating to exploit an entrepreneurial opportunity by becoming self-employed utilize a real options heuristics to manage the uncertainty of the entrepreneurial process. This heuristic shapes the path of entry into and exit from self-employment. That is, an individual will consider the choice to enter into self-employment and to leave employment as an investment under uncertainty. At this first decision point, the individuals are faced with the option to defer the investment or to invest to catch future growth opportunities. If they have chosen to enter as either part time or full time, they are faced with yet another option at the next decision point, the option to exit. Part time entry can be seen as the choice to stage the investment into self-employment over time. We develop hypotheses based on two central concepts in real options theory—irreversibility and uncertainty—arguing that the dynamics of part time entry differs from full time entry.

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Empirically, we test our model on the 1997 cohort of the full population of employees in the Swedish knowledge intensive sector. Using a multinomial logit model we tested our hypotheses in two steps. First, we tested a model of transition from employment into self-employment (part time or full time) in 1998. Second, we tested a model of transition into full time self-employment in 1999, given the choice made in the previous round. This procedure allowed us to examine if individual use part time self-employment as a strategy to test their investment, and if the choice they made during the first time period will affect their choice in the second. We find support for our arguments that the effects of industry-level uncertainty, and the irreversibility associated with entry, differ between part time and full time entry from employment. In particular, prior part time experience has a significantly higher positive affect on subsequent full time attempts, substantiating our claim that entry into self-employment should be understood as a stepwise entry process where individuals engage in part time entrepreneurship to test the values of their conceived business opportunity, where positive economic information lead them to continue to full time entrepreneurship. However, our hypothesis that entrepreneurs use a real options heuristic shaped by the uncertainty the irreversibility of entry received only mixed support. While exogenous industry-level uncertainty and individual-level irreversibility had a negative effect on the probability of entry as expected, industry-level irreversibility did not exhibit the same effect.

THEORY DEVELOPMENT

From an investment under uncertainty perspective, an individual will choose to engage in entrepreneurship if she believes that the expected economic and psychological rewards plus their required premium for uncertainty will exceed the value of the alternatives (Amit, Muller, & Cockburn, 1995). This means that some people will have such a high opportunity cost that they will never switch to entrepreneurship, whereas others have so little to loose that they will easily make the switch (Gimeno et al., 1997).

However, the exact value of the rewards is not known in advance, given that economic information about the future is uncertain. Hence, accuracy of the entrepreneur's confidence in the value of the opportunity can only be determined on the market. To test the value of their beliefs, entrepreneurs must invest in order to obtain the necessary feedback. From a rational point of view, this investment must be as small as possible, be made at the right time, and be able to yield a test powerful enough to assess the validity of the assumptions made by the entrepreneur. Entrepreneurs therefore develop different strategies to handle this uncertainty, and which allows them to either invest more rapidly if the opportunity is proven attractive or to invest their time, money and talent in another effort (Caves, 1998).

To handle uncertainty, entrepreneurs use a real options logic or heuristic. That is, their strategic choices might not be calculated financial options, but they will try to exploit attractive opportunities whenever possible, while at the same time limiting the commitment of resources that are tied to this specific opportunity. The value of real options to entrepreneurship theory lie in the perspective that entrepreneurs can select ways to structure a venture that minimize downside risk but still keep the venture "on the playfield", for example to by maintaining an outside job that provides the venture with a secure source of cash-flow. It also allows entrepreneurs to generate more information about the real value of the opportunity before making additional investments (Choi & Shepherd, 2004). Real options theory has earlier been applied to entrepreneurial entry by O'Brien, Folta, and Johnson (2003). However, this study focused on entrepreneurial entry as a binary decision, and are confined to the U.S. labor market.

Real options theory emphasizes the dynamic aspects of strategic choices and decisions. This leads to two observations. First, individuals that consider switching from employment to self-employment are faced with two dueling options: to either defer entry or to invest more rapidly. Once they have entered, they are faced with a third option, the option to exit. Second, these decisions are exercised in a dynamic and uncertain environment. Decisions are based on earlier decisions made and

their outcomes. In other words, individuals face a strategic choice regarding self-employment entry. On one hand, they might choose to enter rapidly, and if they choose to enter they have to decide their level of investment. Early investment might lead to a stronger position on the market and better possibilities to expand, but the investment might not be reversible. This mean that money will be lost if the opportunity is not as valuable as initially believed. On the other hand, willing entrepreneurs might choose to defer investment for some time because of uncertainty about the value of their opportunity. By deferring investment they are able to gather more information about the opportunity and do not immediately risk their money, but risk losing market shares and the cash-flow generated, should they hade entered instantly. Hence, at any point in time, entrepreneurial entry is made in the presence of dueling options. At all decision points, potential entrepreneurs are faced with the option to defer which allows individuals to keep their options open and avoid the opportunity costs associated with making an irreversible investment; and the option to grow which allow individuals with an early investment to develop a position that will allow them to take better advantage of future growth opportunities. Once they have entered, the option to exit is added to the set of options.

The stream of theory developed around 'investment under uncertainty' also suggests that entrepreneurs invest over time to manage the uncertainty associated with entrepreneurial entry. Consequently, we are examining a dynamic decision context where a number of interdependent decisions are made relative to an investment. A single decision can only be understood in relation to earlier made decisions and their consequences. We are therefore dealing with a repeated choice structure when trying to understand the empirical patterns of stepwise entry of into self-employment. For example, at time 0 three individuals face the possibility to invest in an opportunity. The first decides to commit her time, talent and money full time to the opportunity, the other to commit herself part time, and the third chooses to wait and see. At time 1, the three people face yet another decision, i.e., to increase their investment, to wait again or to exit, but this decision is dependent on the choice made at time 0 and on its consequences. Each individual faces the same choices, but in different contexts, and they are therefore facing a repeated choice structure. The decision made at time 1 is contingent on choices made at time 0 and their outcomes.

Our model does not focus on the ability to recognize an opportunity but on the choice on how to exploit it in the presence of dueling options in a dynamic decision making context. An entrepreneur can decide on the level of investment, and when that investment should be initiated, augmented or terminated. Those choices are made in a dynamic setting where decisions are dependent on previous decisions and their outcomes. Entrepreneurs use real options logic to minimize the downward risk, keeping flexibility in their choices. These choices affect how an individual enter into self-employment and are affected by the inherent uncertainty and irreversibility of the investment. We define uncertainty as the exogenous uncertainty in the target industry. That is, the randomness or volatility in the external environment that cannot be altered by the actions of the individual. Irreversibility is defined as the sunk cost of the investment. That is, the magnitude of lost value from the investment, should the individual decide to abandon. In the following sections we explain how each of these factors determines an individual's entry process in self-employment.

Hypotheses

Earlier real options models have examined certain opportunity costs associated with the irreversibility or sunkness of capital, and have shown that these opportunity costs are equal in value to an option to defer. The logic behind the option is that if an investment can be postponed, and that it involves a cost that cannot be recovered in the event of an exit, there might be a gain in delaying the entry decision in the face of uncertain outcomes. In entrepreneurial entry, delaying the entry is analogous to holding a call option on the discounted value of all future expected cash-flows from the new firm. The exercise price of that option is the cost of founding the new firm, and the cost of the option is the opportunity cost of all profit lost by delaying entry one period.

The opportunity cost is proportional to the level of uncertainty as well as to the degree of irreversibility. As both uncertainty and irreversibility increase, the value of the deferral option

increases, diminishing the probability of entry. Although there is conceptual and methodological reason for separating the effects of uncertainty and irreversibility, from a basic real options reasoning we would expect similar causal patterns. Therefore:

Hypothesis 1a: Uncertainty will have a negative effect on the likelihood of entry.

Hypothesis 2a: Irreversibility will have a negative effect on the likelihood of entry.

We expect a difference in effect of irreversibility for part time and full time self-employment. A rational response for an individual wanting to test a business opportunity, but not wishing to make an irrevocable investment is to engage in part time self-employment. Causal observation support that this type of "skunk work" might be an important path into entrepreneurship. For example, part time self-employment is common among academics wanting to test the value of their research on the market. Since the investment commitment of entering part time is lower we also believe that the negative effect of uncertainty and irreversibility will be markedly larger for full time entry:

Hypothesis 1b: The negative effect of uncertainty on the likelihood of entry will be significantly larger for full time entry than for part time entry

Hypothesis 2b: The negative effect of irreversibility on the likelihood of entry will be significantly larger for full time entry than for part time entry

A fundamental issue in real options theory is that most investments are made in the presence of dueling options. Most initial investments, such as entry into self-employment, can be characterized by a dual option framework where the option to defer co-exist with the option to grow. Kulatilaka and Perotti (2001) suggest that depending on the level of uncertainty, one of the options will dominate the other. At intermediate levels of uncertainty, the option to defer will be the most valuable, inducing possible entrepreneurs to defer their entry decision, and thus to lower the likelihood of entry. At high levels of uncertainty, the option to grow will be the most valuable, inducing possible entrepreneurs to enter immediately for the possibilities of future growth. The trade-off between the option to defer and the option to grow leads us to believe that intermediate levels of uncertainty will have a negative effect on the probability of entry, and that high levels of uncertainty will have a positive effect on the probability of entry.

We expect that high levels of uncertainty will have different impact on part time and full time self-employment. We further expect that high level of uncertainty will have stronger positive impact on full time entry, because full time self-employment is more sensitive to growth option than part time self-employment. The later have already limited their investment in time, and have therefore taken an active position that will limit the downwards risk and their upwards risk:

Hypothesis 3a: The negative effect of uncertainty on the likelihood of entry will turn positive at high levels of uncertainty.

Hypothesis 3b: The negative effect of uncertainty on the likelihood of entry will turn positive at high levels of uncertainty for full time entry but not for part time entry.

Furthermore, the effect on uncertainty is augmented when irreversibility is also present, regardless of whether irreversibility is conceptualized at the individual or at industry level. We expect that irreversibility will have a different impact on part time and full time self-employment. The likelihood of entering full time will be relatively higher in industries with higher irreversibility, and that the likelihood of entering part time will be relatively higher in industries with lower irreversibility. The reason is that high levels of irreversibility also create a higher demand of time in order to fully exploit the value of the investments.

Hypothesis 4a: As the level of irreversibility of the investment to enter increases, the negative impact of uncertainty will be a stronger on entry.

Hypothesis 4b: As the level of irreversibility of the investment to enter increases, the negative impact of uncertainty will be a stronger on entry, but the effect will be larger for full time entry than for part time entry.

METHOD

Data

Our sample is based on the 1997 cohort of people employed in the Swedish knowledge intensive industries. The data originate from a large longitudinal study of entrepreneurship in the knowledge intensive sector between 1989 and 2002. The data were provide by Statistics Sweden and covers over 3,300,000 individuals, representing over 70 percent of the active Swedish active labor market. The sample comes with several benefits. First, we reduce unobserved heterogeneity by observing a restricted set of thirty-three industries. Second, we are able to cover all types of entries independent of legal form and to the founding individuals independently if they are working full time or part time on their new firm. Third, the relatively long period of observation allows us to reconstruct the labor market history of individual before and after 1997. Finally, we are able to link individual-level data to data at the firm level. However, data sets of this size are computationally cumbersome to work with, and rare events such as self-employment entry pose specific problems when using discrete choice techniques such as logit or probit analysis on very large samples.

To mitigate these problems, we used state-based sampling to construct our sample (Manski & McFadden, 1981), an approach used in other studies of rare events in management and entrepreneurship research (e.g. O´brien et al., 2003). We modeled the entry decision with a series of multinomial logit models that compare events of entry with a random sample of all non-entries. We created the sample of non-entries by randomly selecting 10 per cent of the individual observations in our data set, then randomly assigning each observation to an industry.

Hypothesis testing on such a sample is unproblematic since state-based sampling yields unbiased and consistent coefficients for all variables except the constant term. With a biased constant the model will have low predictive accuracy. A feasible way to correct the constant is by subtracting from it the log of the proportion of all entries in sample/proportion of all non-entries in the sample (Manski & McFadden, 1981). Our final sample consisted in the first wave of 5,469 instances of full-entry (2.32%), 6,595 instances of part-entry (2.79%) and 223,981 randomly sampled non-entries (94.89%). In the second wave, our part time entries switched labor market status dramatically. 2,190 exited altogether from self-employment (33.21%), 818 changed to full time self-employment (12.40%), and the rest (3,587 or 54.39%) remained as part time self-employed. Among the full time self-employed, 1,177 made an exit (21.52%) and 468 changed to part time (8.56%). Among the randomly sampled non-entries, 0.72% changed to part time self-employment, and 0.43% changed to full time self-employment in 1999.

Dependent variable

We differentiated between part time and full time entries by comparing data from tax sheets to compare entrepreneurial earnings with earning from an outside job, similar to Holtz-Eakin, Joulfaian and Rosen (1994). We used Statistics Sweden's official classification policy by multiplying entrepreneurs' earnings by 1.6, given that the self-employed usually retain much of their firm's earnings since they are more heavily taxed than salaried employees. We then compared the relative levels of income. Individuals with no entrepreneurial income were categorized as employees. Individuals who have an entrepreneurial income less than half their total income are categorized as part time self-employed. Individuals with an entrepreneurial income that represents half or more than

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half of their total income were categorized as full time self-employed. We updated the variables at each time period.

Independent variables

Uncertainty. Non-foreseeable uncertainty is generally acknowledged an important part of the entrepreneurial process. Commonly, measures reflecting uncertainty are based on some variation in output such as stock price or GDP. Conceptualizing uncertainty as variance in an output such suffers from two deficiencies: First, it does not capture trends in the data, which increase variance but do constitute an element of uncertainty if they are predictable. It is therefore necessary to seek a measure of uncertainty that only considers variance about a predicted trend. Second, variation in an output does not control for the possibility that the variance is non-constant over time, i.e. heteroskedastic, common in economic time series. We therefore measured uncertainty using conditional variance generated from a generalized autoregressive conditional heteroskedasticity (GARCH) model (Bollerslev, 1986). This model produces a time-varying estimate of uncertainty. We used publicly available data on industry-level investment levels, measured quarterly from 1990 to 1998. To avoid our measure being endogenous to entrepreneurs' entry decision, we let data on the last quarter in the preceding year define industry-specific uncertainty. The GARCH model enabled us to approximate a unique time-varying estimate of uncertainty for each of the thirty-three industries in focus. We employed the GARCH-in-mean, or GARCH-M model, with the functional form:

$$y_t = x_t' \beta + \delta \sqrt{h_t} + \varepsilon_t \tag{1}$$

$$\varepsilon_t = \sqrt{h_t} e_t \tag{2}$$

$$h_t = w + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \gamma_j h_{t-j} \tag{3}$$

$$e_t \sim IN(0,1) \tag{4}$$

The GARCH process was parameterized by two values, p and q in Equation (3). The first value, p, specified the number of lags for the squared error terms. The second parameter, q, related to the number of past variances to be included in the computation of the current variance. We used a one period lag on both parameters (i.e., a GARCH[1,1] model) which in financial research usually provides good fit for modeling a wide variety of asset prices. The quarterly conditional variances (h_t) generated from the GARCH-M(1,1) model was used to approximate for industry-specific exogenous uncertainty.

Irreversibility. Irreversibility can be either conceptualized as industry-level characteristics or as individual-level characteristics. We approximated irreversibility using three industry-level measures and one individual-level measure. Entry decisions are generally considered more irreversible for industries that are characterized by extensive entry barriers. We therefore used a measure of fixed relative to total asset in the industry. The theoretical rationale was that fixed assets such as buildings, machinery and equipment are less easily liquidated in face of adverse performance compared to other assets such as current inventories or accounts payable (Lambson & Jensen, 1998).

Our second irreversibility measure, intangible assets, was calculated by dividing intangible by total assets in each industry. Since intangible assets often have limited value outside of their current function, we similarly to O´brien et al. (2003) posited that the irreversibility of an investment decision should be positively related to the intensity of investment in intangible assets.

Third, regardless of the type of assets that new firms invest in, industry leverage may serve as another useful indication of the salvage value of assets. Assets with high salvage value can support a

high debt ratio, while assets with low salvage value will have to rely on equity financing. For example, the overwhelming majority of Swedish IT firms started during the dot-com bubble relied solely on equity financing. We therefore believed that investments required to enter high leverage industries should be more reversible than the investments required to enter low leverage industries. Following Gompers (1995), we calculated industry leverage level as the inverse of the industry's long-term debt divided by total book assets.

Finally, work tenure approximated for the individual-level irreversibility of leaving paid employment and engaging in entrepreneurship. Work tenure measured the number of years that the individual had been employed by the same firm. Since the variable is censored beyond 9 years of tenure it was skewed like a right-wards leaning U (many individuals have 0 or 1 years of tenure and then the frequency decrease monotonically until the highest value 9 which is also the second most frequent). We therefore used the logarithm of the measure in combination with a dummy variable that takes the value 1 for individuals with 9 or more years of tenure. All independent variables were updated yearly.

Control variables

We controlled for three sets of variables that are known to affect people's decision to enter self-employment: individual factors, industry factors and regional factors. The individual levels factors included measures of human capital, wealth, sex, family and immigrant status. At the industry level we controlled for general attractiveness of an industry measured as the industry's average pre-tax profitability, as well as industry size (total assets), and level of R&D investments. At the regional level, we controlled for the local county's net growth in population, the population density per region, and a measure of the individual's tenure in the same county which functioned as a coarse proxy for social network. Finally, we controlled for the local bankruptcy rate. Due to space limitations we suppress the full models, excluding the control variables. Full models are available upon request.

Analysis

We used multinomial logit models to test our hypotheses in two steps. First, we tested a model of transition from employment into part time or full time self-employment. Second, we tested a model of transition into self-employment based on the choice made in the previous period. This procedure allowed us to examine if individual use part time self-employment as a strategy to test their investment, and if the choice they made during the first time period will affect their choice in the second. We specifically focus on the subset that enters part time, as we test a model of stepwise entry. In these second sets of models we examine the switch made from the choice made in 1998. That is, for part time self-employed, what would make them change to full time self-employment or to exit altogether. To test the hypotheses where we expected effects would differ between part time and full time, we simply compared the coefficient for the independent variable on these two outcomes using Chi-2 tests.

RESULTS

Analyzing transition from employment to self-employment

Table 1 displays the results from the multinomial logit model predicting part time or full time entry into self-employment. The results indicated reasonably good predictive power for the model[1]. A basic argument in this work is that previous research has underestimated the dynamics of self-employment by considering the choice to entry as binary. A fundamental assumption regarding discrete choice modeling is the independence of irrelevant alternatives (IIA). This assumption requires that for any two alternatives, the ratio of their choice probabilities is independent of the specification

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[1] Marginal effects and multinomial log-odds (L-O) coefficients, adjusted for state-based sampling, were computed but are excluded due to space availability. These are available upon request. The directions of the model coefficients were verified by comparing them with the marginal effects.

of any alternative in the choice set (i.e. any combination of non entry, part- entry and full- entry). We used the common validity test developed by Hausman and McFadden (1984) to test the IIA assumption. The test revealed a strong but negative Hausman statistic, affirming that all three alternatives are independent of each other at above a 99 percent confidence level (Long & Freese, 2006: 244-5). This indicates that the previous work conceptualized the choice to go from employment to self-employment as a binomial decision has been considering too narrow the set of choice alternatives.

For a further check that our trinomial specification was correct and viable, we performed the Cramer-Ridder tests for pooling states in the multinomial logit model, The test emphatically rejected the pooling hypothesis: Likelihood-ratio statistics for pair-wise pooling were 16983, 27588, and 3976, all with p-values above 99 percent (Cramer & Ridder, 1991).

Examining model 2 which is our full model of entry into self-employment from employment, we found overall mixed support for our hypotheses. We found evidence that uncertainty will have a negative effect on the likelihood of entry, confirming hypothesis 1a. Also, we found a significantly larger effect for full time entry than for part time entry (Chi-2: 286.86), confirming hypothesis 1b. However, we found only mixed evidence for the negative effect of irreversibility on entry (Hypotheses 2a and 2b). Only two of the four indicators of irreversibility performed as expected (Fixed relative to total assets and work tenure). Intangible assets had a positive effect. Inverse leverage in the target industry had a negative effect for part time entry but the effect for full time entry was weaker and significant only at the ten percent level. Hence, our irreversibility hypothesis holds for individual-level irreversibility, but not for industry-level irreversibility.

Hypothesis 3a and 3b posited that the value of growth options would overtake the value of the option to defer at very high levels of uncertainty, inducing entrepreneurs to enter. When examining the squared value of uncertainty, we did not find support for the existence of growth options. The effect of uncertainty-squared was negative for both part time and full time entry, rejecting hypotheses 3a and 3b. Hypothesis 4a and 4b was tested with the interaction term between our four measures of irreversibility and uncertainty. Once more, we found counterintuitive results as for hypotheses 2, and can therefore not confirm hypotheses 4.

Due to space limitation we have suppressed the control variables, but we choose to show the human capital variable "Earlier part time experience" as this show very strong effect on the probability of entry, and also that the effect is markedly larger for full time entry (Chi-2 statistic: 60.7, significant above the 99 percent level).

Analyzing entry at Time 1

If individuals use part time entry as a less capital intensive way to test the validity of their opportunities, then we should expect them to drop out more often than those entering full time, and change to full time self-employment more often than those entering directly from employement. We expect them to exit more often because they are less certain about the actual value of their entrepreneurial opportunity, and we expect them to enter full time self-employment more often because they have acquired some information about the value of this opportunity. An analysis of the transition rates provides strong support for both of these patterns. In the transition from 1998 to 1999, our part time entries were 28.8 times more likely to enter full time self-employment than employees (12.40% and .43% respectively). Similarly, they were 1.54 more likely to exit than full time entries (33.21% and 21.52% respectively).

However, we receive only partial support for our hypotheses considering the use of a real options heuristic when considering switching to full time self-employment. Here, we only examine the effects of hypotheses 1a to 4a. Model three in table 2 indicates that uncertainty has a negative effect of the likely for part time entries to change to full time, confirming hypothesis 1a. We however find mixed effects for hypothesis 2a, with work tenure exhibiting the expected negative effect but the effect

of intangible assets is significantly positive. Once more, individual-level irreversibility is more important than industrial level irreversibility. Also hypothesis 3a is not supported, the squared term of uncertainty is negative also for the transition from part time to full time. Finally, we found a strong positive effect of the interaction between intangible assets and uncertainty. This is a result opposite to the predicted. Thus, we do not find support for hypothesis 4a.

DISCUSSION

The purpose of this paper was to examine a real options model of stepwise entry into self-employment. We argued that previous literature has largely ignored the phenomenon of part time self-employment, and that this form of entry represents an important step into full time self-employment. We further argued that the choice between part time entry and full time entry can be best understood from a real options perspective that emphasizes the uncertainty about the outcome, the role of dueling options and that the entrepreneurial process could be understood as a repeated choice process. We examined a data set consisting of employees in the Swedish knowledge intensive sector in 1997, following their occupational choices over two time periods.

The results provides strong support that much of the prior self-employment literature has considered too narrow the set of choices by focusing exclusively on entry as a 0/1 decision. We also found support for our notion that entrepreneurs used part time entry as a strategy to test their ideas when they have little information about their true value. However, the effects of exogenous uncertainty and irreversibility provide only mixed support for our theory that entrepreneurs use a real options heuristic when considering their choice. We found that exogenous industry uncertainty and individual irreversibility had the expected effects, but we found no support for industry irreversibility or for interaction effect between irreversibility and uncertainty.

Our study informs real options theory and entrepreneurship theory. It informs entrepreneurship theory that the important phenomenon of part time self-employment has been overlooked. We show that models of entry into self-employment are incomplete if they do not take this option into account. Part time entry is a strategic choice made by entrepreneurs to minimize the impact of industry uncertainty and personal irreversibility. Our study informs real options theory because while the theory emphasizes the dynamic nature of financial investments decisions, actually very few studies fully test this assumption on individual human decision makers. However, our study was not able to prove that entrepreneurs independent of the entry choice make complicated judgments taking into account dueling option and mixed effects of irreversibility and uncertainty. One explanation is that our irreversibility measures are highly imperfect. If not so, the main goal for entrepreneurs in this study seems to minimize possible losses – using the option to defer – but they are not considering growth options. This is in line with previous work made on nascent entrepreneurs in Sweden and in other countries that show the same pattern: most entrepreneurs do not at all consider growth as an option early in the new venture formation process (Delmar & Davidsson, 2000). They are too focused to get the venture operational and to gather information about the basic viability of their opportunity.

Our study comes with several limitations. First, we only examine a single cohort over a period of three years. Second, we test our model on register data which does not allow us to capture the cognitive process behind the decision-making on entry. Third, our measure of irreversibility clearly did not function in the expected direction. Fourth, our choice of multinomial logit model does not allow us to formally test if entrepreneurship follows a repeated choice structure, or if we are dealing with two non-aligned choices. Without implementing more advanced econometric techniques for repeated discrete choices, our results have to be considered as tentative. Future research will be directed towards such a test. Clearly, the process of self-employment is more dynamic than prior dichotomous models indicate, but we do not know yet how to best model it. A general conclusion of our results so far indicates that future work in entrepreneurship should try to focus more on how entrepreneurship dynamics can be understood both at the individual and at the firm level. That is, since self-employment entry follows a repeated choice structure, there is a fundamental path-dependency

that has to be included in theories of entrepreneurship. Future research also need to better specify what characteristics of and considerations by potential entrepreneurs that affect how they react to dueling options. A more detailed study might cast further light on the possible characteristics among individuals, opportunities or venture constellations that leads potential founders to consider entrepreneurial growth options and when in the entrepreneurial process this takes place.

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TABLE 1. Multinomial logit models of part time and full time entry from employment 1997 to 1998

| | Model 1 | | | | | | Model 2 | | | | | |
| | Part time | | | Full time | | | Part time | | | Full time | | |
	B	(Std.Err.)	Sign.	B	(Std.Err.)	Sign.	B	(Std.Err.)	Sign.	B	(Std.Err.)	Sign.
Uncertainty	-0,094	(0,017)	***	-1,250	(0,083)	***	-7,290	(0,680)	***	-14,250	(2,040)	***
Uncertainty squared							-0,001	(0,000)	***	-0,000	(0,000)	***
Fixed	-20,743	(1,656)	***	-20,081	(1,327)	***	-19,357	(1,894)	***	-76,038	(4,175)	***
Intangibles	7,416	(0,158)	***	15,387	(0,317)	***	10,447	(0,248)	***	12,660	(0,605)	***
Inv. leverage	-42,589	(2,951)	***	-99,676	(4,003)	***	-35,768	(3,114)	***	-13,023	(7,065)	t
Work tenure	2,191	(0,236)	***	-3,678	(0,256)	***	2,069	(80,255)	***	-3,918	(0,340)	***
Work tenure dummy	-7,672	(0,470)	***	-4,563	(0,591)	***	-7,712	(0,470)	***	-4,609	(0,595)	***
Uncertainty X fixed							7,450	(0,681)	***	33,720	(1,440)	***
Uncertainty X intang.							-0,566	(0,046)	***	-0,929	(0,159)	***
Uncertainty X inv. lev							5,810	(0,486)	***	-1,110	(2,470)	
Uncertainty X workten							0,027	(0,015)	t	0,060	(0,059)	
Control: earlier part time experience	12,082	(0,389)	***	17,647	(0,354)	***	12,064	(0,391)	***	17,786	(0,361)	***
Other controls suppressed												
Constant							-82,691	(5,859)				
Log-likelihood		-40161,626						-39556,067				
Δ Log-l. ratio (versus base)								1211.12	***			

Note: n = 236,045; All uncertainty coefficients multiplied by 10^4; t p<.10, *p<.05, **p<.01, ***p<.001

TABLE 2. Multinomial logit models for change from part time or full time state 1998 to 1999

Dependent variable:	Model 3: Part time s-e in 1998						Model 4: Full time s-e in 1998					
	Exit			Full time			Exit			Part time		
	B	(Std. Err.)	Sign.	B	(Std. Err.)	Sign.	B	(Std. Err.)	Sign.	B	(Std. Err.)	Sign.
Uncertainty	2.424	(9.926)		-87.552	(20.770)	***	124.811	(25.187)	***	56.233	(121.099)	
Uncertainty squared	0.000	(0.000)		-0.000	(0.000)		0.001	(0.000)	***	-0.000	(0.000)	
Fixed	-0.099	(0.685)		0.016	(0.845)		4.328	(1.223)	***	3.549	(1.999)	t
Intangibles	-0.009	(0.049)		0.307	(0.090)	**	-0.026	(0.078)		-0.064	(0.166)	
Inv. leverage	0.175	(0.806)		0.266	(1.289)		1.459	(1.314)		0.463	(2.730)	
Work tenure	-0.080	(0.067)		-0.977	(0.128)	***	-0.210	(0.163)		-2.231	(0.504)	***
Work tenure dummy	-0.011	(0.105)		0.523	(0.197)	**	0.327	(0.346)		-42.437		
Uncertainty X fixed	-10.244	(14.667)		87.198	(26.581)	**	-167.432	(33.079)	***	-173.116	(74.081)	*
Uncertainty X intang.	0.385	(0.682)		-0.942	(1.438)		-1.709	(1.273)		8.559	(8.042)	
Uncertainty X inv. lev	0.418	(5.276)		49.951	(16.286)	**	-49.595	(14.666)	**	22.444	(136.058)	
Uncertainty X workten	-0.035	(0.412)		-1.710	(1.589)		-0.338	(2.410)		0.497	(7.695)	
Control variables suppressed												
Constant	-0.510	(1.365)		0.151	(2.151)		-3.010	(1.874)		-0.784	(3.365)	
Log likelihood		-5954.528						-4148.352				
n		6,595						5,469				

Note: All uncertainty coefficients multiplied by 10^4; t p<.10, *p<.05, **p<.01, ***p<.001