

Pre-entrepreneurial Income, Cash-flow Growth and Survival of Startup Businesses: Model and Tests on U.K. Data

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ABSTRACT. A target income/human capital model of startup survival and growth is derived and tested. The objective of the entrepreneur is to produce an independent source of income for him/herself to replace income from previous employment. Target income is a function of pre-entrepreneurial income and human capital represented by age. The model predicts that higher pre-income entrepreneurs and more mature individuals will grow faster to achieve these targets and that growth is an ambiguous function of size. It also predicts that these same individuals, and businesses that start larger, will be more likely to survive. The key results of the empirical analysis are that (a) businesses run by proprietors with higher pre-entrepreneurial incomes do indeed grow faster than other startups but have no greater survival prospects, and (b) businesses run by mature proprietors possess greater longevity. We conclude that business income targets in practice constitute a significant motivation for startup growth, and that the human capital represented by age plays no additional role. However, proprietor age rather than pre-income determines survival, despite the fact that pre-income and age are positively correlated both with each other and with growth.

1. Introduction

Jovanovic developed a now famous model of business growth in which business was treated as a learning experiment (Jovanovic, 1982). The model (henceforth the J-model) predicts that firm exit will be higher in the early years: unfavourable information will have a relatively large weight in entrepreneurs' estimates of their own costs, and is more likely to drive them into alternative activity with higher returns. Secondly, the model predicts that entrepreneurs who exit the industry early are therefore in general smaller than the

industry average. Finally, the model predicts that those who stay in business will have received favourable early news: younger and therefore smaller businesses grow faster.

Several empirical studies have presented results consistent with the predictions of the J-model, for example, Mansfield (1962), Brock and Evans (1986), Evans (1987a, 1987b), Dunne, Roberts and Samuelson (1989), Variyam and Kraybill (1992), Mata (1994). However, despite this substantive empirical support, it is apparent that there are difficulties in applying the J-theory to the *typical small firm* in an economy,² and in particular to the small firm *startup*.

One of the difficulties is that most of the studies confirming the growth predictions of the J-model are based on *larger* businesses, or *established smaller* businesses. Such samples present a potential selection problem since the highest failure rates occur in the youngest businesses (see e.g. Ganguly, 1985). Indeed this is precisely what the J-model predicts for a *random* sample of startups. Early failures typically start small and appear to have minimal activity before dropping out. Thus only studies employing regression analysis adjusted for sample selection are likely to be free from this sort of bias. The more recent studies of Evans (1987a, 1987b), Dunne *et al.* (1989) and Mata (1994) address the problem of selection bias in the growth equations caused by failure in the sample.

Secondly, the theoretical work of Frank (1986) and Hudson (1990) has shown that the growth performance of entrepreneurs with different priors on their business skills will differ accordingly. Such variation is ruled out by the assumptions of the J-model. However, these differences are likely to be important for the very smallest businesses, especially startups, whose performance is domi-

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nated by the personality of the proprietors, and whose market power is minimal. The empirical importance of this phenomenon has moreover been recently established in papers by Variyam and Kraybill (1992) and Mata (1994). The latter, in a study of early growth amongst small firms, shows that ignoring firm-specific effects can result in substantial bias in the coefficients on firm size.

The present study attempts to address these issues in the early growth of the smallest businesses, using a *cohort* of U.K. *startups* and a dataset which includes a rich vector of business characteristics. Startups by definition display no cross-sectional variation in age. Thus, by using a sample of startups, age of the firm is automatically controlled for. This enables one to concentrate on the role of size and firm-specific characteristics, in survival and growth.

Preliminary investigation of the sample, shows, contrary to the J-model's assumptions, that (i) (not unsurprisingly) all startups do not have the same size, measured by sales; (ii) initial business size and pre-entrepreneurial income are positively correlated; (iii) pre-entrepreneurial income and growth rates are positively correlated.³ These facts are sufficiently at variance with the J-model to merit adjustments to the theory for the smallest businesses. Therefore, whilst the important insight of the learning process introduced in the J-model is maintained, a new theory incorporating features to explain the unaccounted-for elements is developed. The novel elements of this theory are as follows.

Firstly, the new theory explicitly assumes that businesses start up at *different* sizes and that outside opportunities *vary* across potential entrepreneurs.⁴ Secondly, our theory assumes an entrepreneurial *target* or satisficing income level (Simon, 1979) that is directly related to the owner's *pre-entrepreneurial* income and endowed human capital. If business size is an increasing function of income and growth is costly, then there will be a growth rate which maximises final (target) income. This rate of growth will be increasing in pre-entrepreneurial income. Thirdly, actual income also has a random component, so that if it falls below opportunity cost the entrepreneur quits. Finally, both the rate of growth and the probability of quitting also depend on the endowed *human capital* of the entrepreneur, here

represented by *proprietor age* at startup,⁵ with more endowed individuals running more viable and growing businesses.

The remainder of the paper is organised as follows. Section 2 provides a formal development of the theoretical model. Section 3 provides the empirical formulation of the model suitable for the econometric tests of Section 4. A final section, section 5, summarises and concludes.

2. The model

Let

w_0 = pre-entrepreneurial income (wage/salary level of the entrepreneur) at startup (period 0)

a_0 = age of entrepreneur at startup

x_0 = vector of other entrepreneurial/business characteristics at startup

e_0 = entrepreneurial income at startup

c_0 = initial cash-flow sales in (value terms) of the business

e_1 = target entrepreneurial income in period 1.

We assume initial (period 0) entrepreneurial income (profits) is increasing in cash-flow sales, human capital (represented by proprietor age) and pre-income of the proprietor:

$$e_0 = f(w_0, a_0, x_0) c_0^{\alpha_0}; f_{w_0}, f_{a_0}, \alpha_0 > 0 \quad (1)$$

By definition, *target* entrepreneurial income, e_1 , is simply initial income, e_0 , times a growth factor,⁶ $1 + k$:

$$e_1 = (1 + k)e_0 \quad (2)$$

where $k \geq 0$ is the target growth rate for entrepreneurial income. Using 1 we get:

$$e_1(k) = (1 + k)f(w_0, a_0, x_0)c_0^{\alpha_0} \quad (3)$$

We assume (Baumol, 1962) that growth has costs, $C(k)$, and that these are convex in the growth rate k . The entrepreneur chooses k to maximise final income net of growth costs:⁷

$$\begin{aligned} \text{Max}_{k > 0} R &= e_1(k) - C(k) \\ &= (1 + k)f(w_0, a_0, x_0)c_0^{\alpha_0} - C(k) \end{aligned} \quad (4)$$

This requires :

$$f(w_0, a_0, x_0)c_0^{\alpha_0} - C'(k) = 0 \quad (5)$$

$$\begin{aligned} \Rightarrow k &= k^*(w_0, a_0, x_0, c_0), \\ R &= R^*(w_0, a_0, x_0, c_0) \end{aligned} \quad (6)$$

Differentiation with respect to w_0 and a_0 yields:

$$\partial k^*/\partial w_0 > 0, \quad \partial k^*/\partial a_0 > 0 \quad (7)$$

Thus *higher prior-income and more mature entrepreneurs wish to grow their profits faster.*

In the empirical work that follows, we are unable to measure empirically entrepreneurial profits or income. Hence we need a relationship between initial size, pre-income and age to *growth of cash-flow sales*, which is empirically observable. Assuming that target income is also increasing in cashflow:

$$c_1 = e_1^{\alpha_1}; \quad \alpha_1 > 0 \quad (8)$$

we can, using equations 3 and 8, derive an expression for the growth of cash-flow, G :

$$c_1/c_0 = (1+k)^{\alpha_1} f^{\alpha_1} c_0^{\alpha_0 \alpha_1 - 1} \\ = G(w_0, a_0, x_0, c_0) \text{ (say)} \quad (9)$$

Taking logs and differentiating:

$$\begin{aligned} d \ln(G)/dw_0 &> 0 \\ d \ln(G)/da_0 &> 0 \\ d \ln(G)/dc_0 &\cong 0 \end{aligned} \quad (10)$$

Thus, *growth of business cash-flow is increasing in pre-entrepreneurial income and age of the entrepreneur, but is ambiguous in initial cash-flow sales.*

To examine the relationship between survival and these parameters we need to define the relationship between actual income and target income. Entrepreneur i 's indirect profit function, $R^*(w_{0i}, a_{0i}, x_{0i}, c_{0i})$, is target income net of the costs of growth. Assuming rational expectations, actual income is simply target income plus a random term:

$$\tilde{R}_i = R^*(w_{0i}, a_{0i}, x_{0i}, c_{0i}) + \tilde{u}_i \quad (11)$$

where the u_i are $IN(0, \sigma^2)$. Should actual income fall below the opportunity cost, W_0 , then the business closes:

$$\tilde{R}_i < w_{0i} \Rightarrow \tilde{z}_i = 0 \quad (12)$$

where z_i is a binary variable having the value 0 if the business closes and 1 elsewhere.

The *probability* of closure is now defined as a function of pre-entrepreneurial income and age (w_{0i}, a_{0i}), together with other business and proprietor characteristics x_i , and initial size c_{0i} :

$$\begin{aligned} Pr(\tilde{z}_i = 0) &= Pr[\tilde{R}_i < w_{0i}] \\ &= Pr[\tilde{u}_i < w_{0i} - R^*(w_{0i}, a_{0i}, x_i, c_{0i})] \\ &= \Phi[w_{0i} - R^*(w_{0i}, a_{0i}, x_i, c_{0i})] \end{aligned} \quad (13)$$

where $\Phi(y)$ is the cumulative Standard Normal density function evaluated at y . Note that the closure probability is decreasing in age, and initial size and ambiguous in pre-income:

$$\begin{aligned} \partial Pr/\partial w_{0i} &= -\phi \cdot \partial R^*/\partial w_{0i} < 0 \\ \partial Pr/\partial c_{0i} &= -\phi \cdot \partial R^*/\partial c_{0i} < 0 \\ \partial Pr/\partial w_{0i} &= [1 - \partial R^*/\partial w_{0i}] \cong 0 \end{aligned} \quad (14)$$

Table I summarises the predictions of the target income theory.

TABLE I
Comparative static predictions of the target income theory

Variable	Survival	Growth
Size	+	?
Pre-income	+	+
Age of prop.	+	+

3. Empirical formulation

The above theoretical model generates a specific form for the *systematic* component of growth, G , in the Evans (1987a) model:

$$\tilde{c}_{i+n} = [G(w_n, a_n, x_n, c_i)]^n c_i \tilde{e}_i \quad (15)$$

where c_i is business size at time t , $n > 0$; w_n, a_n are respectively pre-entrepreneurial income and age at time t , and e_i is a lognormally distributed error term with possibly nonconstant variance. Written in logs and expressed as a growth rate this becomes:

$$\begin{aligned} [\ln(c_{i+n}) - \ln(c_i)]/n \\ = \ln[G(w_n, a_n, x_n, c_i)] + u_i \end{aligned} \quad (16)$$

where u_i is normally distributed with possibly non-constant variance.

Expansion to the second-order gives the following approximation to the term $\ln G$:

$$\begin{aligned} \ln G = b_0 + b_1 \ln S + b_2 \ln y + b_3 (\ln S)^2 \\ + b_4 (\ln y)^2 + b_5 (\ln y)(\ln S) \end{aligned} \quad (17)$$

The b 's are constants, and we have used just one other variable than size, y , for ease of exposition.

Selection issues

By specifying growth in logarithmic terms several sources of potential selection bias arise.

Firstly, businesses with $c_i = 0$ cannot be included in the regression since the $\log(c_i)$ does not exist. This does not produce the classic Heckman-type bias since it does not create a non-zero expected error in the growth regression. However, observations have to be dropped from the regression to accommodate this eventuality. A significant number of businesses start with zero DTO.

Secondly, businesses with $c_{i+n} = 0$, and those which do not in fact survive the period, must be dropped from the regression, but for another reason. Nonsurvivors clearly *do not have* observable DTO, whereas survivors with $\text{DTO} = 0$ have valid data which has to be *censored as a result of the model formulation*. This kind of censoring does produce potential Heckman-type bias.

Ideally one should estimate a different selection equation for the two potential types of bias. However, a simple approach, that of pooling the selection types into one selection variable, is adopted in this paper. This provides an approximation to the ideal.

Additional variables

It is natural to ask whether other available variables cannot also be added to the $G(\cdot)$ function defined above. This has theoretical justification as explained in the Introduction. There is also empirical evidence that, for example, survival and growth have sectoral and legal type components (e.g., Variyam and Kraybill, 1993; Mata, 1994).⁸

4. Empirical results

The empirical work of the paper is based on a random sample of startups who opened business accounts with National Westminster Bank of Great Britain in the 1988.⁹ The vast majority (78%) of such starts were 'entirely new'. Only Some 12% were purchases of existing businesses.

Background information on these businesses was obtained from a questionnaire at account opening stage, and the bank account information was recorded subsequently. Information on account survival is also recorded. Background information

includes legal type, industry, age of proprietor, etc. Account information includes borrowing, interest margins, security requirements, bank charges, and cash flow. The variables used in the present analysis are presented below.¹⁰

Variables used in the analysis¹¹

Selection variable

$\text{IN921} = 1$ if the business account remained open in 1992q1 AND if the account had a nonzero Debit Turnover (DTO) in 1992q1.

Size/growth variables

The measure of business size used here is Debit Turnover (DTO), formally defined as the sum of debits to a business account in a given quarter. It measures cash flowing out of the business Current account. Under certain plausible assumptions (see Appendix A) it can be identified with cash-flow sales of the business. Variables representing DTO are:

$\text{DTO884}, \text{DTO921}$

= (annualised) DTO (£s) in 1988q4, 1992q1

$\text{LDTO884}, \text{LDTO921}$

= $\ln(\text{DTO884}), \ln(\text{DTO921})$

$\text{L2DTO884} = \text{LDTO884}^2$

$\text{GROWTH} = (\text{LDTO921} - \text{LDTO884})/15$

= proportional annual growth rate of business cash-flow

Age/income variables

AVAGE = average age of the proprietors at startup.

$\text{AVAGE2} = \text{AVAGE}^2$

$\text{LAVAGE}, \text{LAVAGE2} = \ln(\text{AVAGE})$ etc

AVINCOME = average income of the proprietors immediately prior to starting the business

$\text{LAVINCOM} = \ln(\text{AVINCOME})$

$\text{L2AVINCO} = \text{LAVINCOM}^2$

Age-size interaction term

$\text{AGEDTO} = \text{AVAGE} * \text{DTO884}$

Legal type variables

$\text{ST} = 1$ if the business had Sole Trader status

$\text{PTNR} = 1$ ditto if the business had Partnership status

$\text{LTD} = 1$ ditto if the business had Limited Company status (the control variable for legal type))

Industry sector variables

AGRI = 1 if the business was in the Agriculture sector; = 2 else
 RETAIL = 1 ditto Retail sector
 CATER = 1 ditto Catering sector
 PROP = 1 ditto Property/Financial/Professional Services sector
 CONSTR = 1 ditto Construction sector
 MOTOR = Ditto the Motor industry
 PROD = 1 ditto Manufacturing sector
 TRANS = 1 ditto Transport/Distribution sector
 WHOLE = 1 ditto Wholesale Trades
 OTHIND = 1 ditto Other Industries¹² (the control variable for industry group)

Sample statistics

These are presented in Table II below.

As defined above, the Legal and Industry dummies have the values 2,1 rather than the usual 0,1. This is to allow logs to be taken. It also means that in the regressions that follow a *higher* value of the dummy variable AGRI (say) is associated with the business being *outside* the Agricultural sector, rather than in it, as is usual.

Some half (401/1189) of businesses starting up in 1988 survived to 92q1 with nonzero DTO. The average Debit Turnover (cash outflow) was some £32.5k in 1988q4(DTO884), rising to £102.5k in

1992q1(DTO921), implying an average growth rate of some 300%. The average age of proprietor (AVAGE) in 1988 was 35 years, and his average pre-entrepreneurial income was some £11,400. Some 66% of businesses were Sole Traders(ST), 24% Partnerships (PTNR) and only 10% Limited Companies (the control group). The dominant startup sectors were Retail (RETAIL), Construction (CONSTR) Property/Financial/Financial Services (PROP) and Catering (CATER) in that order.

The survival equation

Table III presents the results of the binomial probit for survival (IN921) as a function of initial size (DTO884) and average age of proprietors (AVAGE) in the quadratic form of equation 17 above.

Model 1 shows, consistently with the target theory, that survival is increasing, concave in initial size (DTO884) and in entrepreneurial age (AVAGE). Thus, larger startups and startups run by more mature proprietors are more viable. The sign of the size coefficient parallels Evans (1987a), Mata (1994) and other studies in a similar vein.¹³ The result for proprietor age is also as predicted by the target theory, and is paralleled in the empirical work of Bates (1989) and Cressy

TABLE II
Sample statistics

Variable	Mean	S. D.	Min	Max	Cases
IN921	0.3373	0.4730	0.0000	1.0000	1189
DTO884	32447	83238	12.00	0.1352E+07	1189
DTO921	0.1024E+06	0.8498E+06	48.00	0.1689E+08	401
AVINCOME	11402	10824	733.3	0.1350E+06	401
AVAGE	34.936	10.089	18.000	71.33	1189
ST	1.6644	0.4724	1.000	2.000	1189
PTNR	1.2439	0.4296	1.000	2.000	1189
AGRI	1.0185	0.1348	1.000	2.000	1189
RETAIL	1.1598	0.3666	1.000	2.000	1189
CATER	1.1127	0.3164	1.000	2.000	1189
PROP	1.1203	0.3254	1.000	2.000	1189
CONSTR	1.1346	0.3414	1.000	2.000	1189
MOTOR	1.0614	0.2402	1.000	2.000	1189
PROD	1.0631	0.2432	1.000	2.000	1189
TRANS	1.0538	0.2258	1.000	2.000	1189
WHOLE	1.0143	0.1188	1.000	2.000	1189

Note: The total sample is of 1189 businesses, the survivors of 401.

TABLE III
Probit estimates of survival equation

	Model 1	Model 2	Model 3	Model 4	Model 5
Sig.Lvl of reg	0.0000	0.0000	0.0000	0.100E-06	0.1000E-06
Variable	Coefficient (Pr > T)	Coefficient (Pr > T)	Coefficient (Pr > T)	Coefficient (Pr > T)	Coefficient (Pr > T)
Constant	-1.8529 (0.0000)	-1.8528 (0.0000)	-2.7237 (0.0000)	-3.0973 (0.0069)	-2.6056 (0.0019)
DTO884	0.5556E-05 (0.0242)	0.6323E-05 (0.0000)	0.6775E-05 (0.0000)	0.7113E-05 (0.0000)	0.7094E-05 (0.0000)
DTO884SQ	-0.8804E-11 (0.0000)	-0.8650E-11 (0.0000)	-0.9087E-11 (0.0000)	-0.9275E-11 (0.0000)	0.9215E-11 (0.0000)
AVAGE	0.6426E-01 (0.0084)	0.6316E-01 (0.0010)	0.6501E-01 (0.0083)	0.6550E-01 (0.0092)	0.6628E-01 (0.0206)
AVAGE2	-0.7327E-03 (0.0210)	-0.7133E-03 (0.0235)	-0.7731E-03 (0.0214)	-0.7389E-03 (0.0229)	0.7488E-03 (0.0206)
AGEDTO	0.2259E-07 (0.7169)				
AVINCOME		0.1353E-05 (0.4430)			
ST			0.2632 (0.0610)	0.2858 (0.0485)	0.2928 (0.0416)
PTNR			0.3168 (0.0341)	0.3721 (0.0169)	0.3286 (0.0131)
AGRI				0.2948 (0.3027)	
RETAIL				0.9093E-02 (0.9418)	
CATER				-0.2433 (0.0951)	-0.2646 (0.0458)
PROP				0.2194 (0.1053)	0.2007 (0.0458)
CONSTR				0.3063 (0.0166)	0.2864 (0.0122)
MOTOR				0.6637E-01 (0.7013)	
PROD				-0.3526E-02 (0.9837)	
TRANS				0.3714 (0.0332)	0.3516 (0.0329)
WHOLE				-0.8380 (0.0412)	-0.8569 (0.0347)

(1995). The interaction term (AGEDTO) is, however, insignificant and is dropped in subsequent regressions.¹⁴

Model 2 shows the effect of adding pre-income to the survival equation: it is significant only at the 44% level. We therefore reject the dependence

of survival on pre-income in favour of dependence on proprietor age.

Model 3 indicates that significant legal type effects operate in survival: as expected incorporated businesses are more likely to survive than either Sole Traders or Partnerships.

Finally, model 4 shows that industry effects also play a significant role in determining whether a business fails. In the period in question, Catering and Wholesale are favoured sectors over the control (see page 5), Other Services with Property/Professional/Financial services, Construction and Transport/Distribution being disfavoured sectors. Deleting the insignificant groups of industry dummies using an F-test we arrive at the final survival equation, model 5.

Growth analysis: Sample selection estimates

To test for sample selection bias in the growth estimates a Heckman-type selection equation was estimated. This calculates an inverse Mills' ratio, LAMBDA, for each surviving business and this ratio is used as an additional regressor in the growth equation (See Heckman, 1979, or Maddala, 1983). Model 6, of Table IV below reports the results using Model 5 above as the selection equation and growth specified as a function of size and pre-income of entrepreneur. Variables are now expressed in logs.¹⁵ It is clear from Model 6 that selection bias is absent, the coefficient on LAMBDA being significant only at the 43% level. Subsequent growth equations were therefore estimated without the selection term.¹⁶ Model 7 presents a re-estimated version of Model 6 with the selection term deleted. Only the income terms show any significant changes from those of Model 6.

Growth equations

In Model 7 the pre-entrepreneurial income variables LAVINCOM and L2AVINCO are *jointly* significant at the 1% level and indicate that growth is enhanced by business targets as a function of pre-income of the entrepreneur.

Model 8 is model 7 with the selection term replaced by the proprietor age variables LAVAGE and L2AVAGE. These latter are rejected from the model, being jointly significant at the 82% level only. We conclude that the 'true' cause of growth is not the human capital embodied in age of the entrepreneur but rather the target income effect implicit in the income variables.¹⁷

Model 9 adds Legal Type effects (Sole Trader, ST, and Partnership status, PTNR) to Model 7.

These are rejected by an F-test at the 48% level of significance. We conclude that *Limited Companies do not grow any faster or slower than Sole Traders or Partnerships over the first 3 1/2 years trading.*

Model 10 adds Industry effects to Model 7. These are significant jointly at the 7.6% level. However, some of the dummies are clearly insignificant and Model 11 shows the reduced model after deletions using F-tests. The signs of these effects imply that the businesses in the Agriculture (AGRI) and Catering (CATER) sectors experienced higher growth, and Manufacturing (PROD) lower growth than Other Services (the control), over the period.¹⁸ It is noteworthy that the range of (significant) industry effects on survival is greater than that on growth.

5. Summary and conclusions

A target income model of startup survival and growth was derived and tested. The objective of the entrepreneur was to produce an independent source of income for him/herself to replace income from previous employment. Target income was a function of pre-entrepreneurial income and human capital represented by age. The model predicted that higher pre-income entrepreneurs and more mature individuals would grow faster to achieve these targets and that growth would be a function of size. It also predicted that these same individuals, and businesses that start larger, would be more likely to survive.

The key result of the empirical analysis was that businesses run by proprietors with higher pre-entrepreneurial incomes do indeed grow faster than other startups but have no greater survival prospects. However, businesses run by mature proprietors were found to possess greater longevity. We concluded that business income targets in practice constitute a significant motivation for startup growth, and that the human capital represented by age plays no additional role. However, proprietor age rather than pre-income determines survival, despite the fact that pre-income and age are positively correlated both with each other and with growth. The main impact of industry variables for the startup business therefore seems to be on their viability rather than on their growth prospects.

TABLE IV
Selection-adjusted estimates of growth equation

	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11
Ad. R-squared	0.3148	0.3154	0.3131	0.3145	0.3266	0.3327
$F(p, q)$	$F(5, 395)$ = 37.7	$F(4, 396)$ = 47.08	$F(6, 394)$ = 31.39	$F(6, 394)$ = 31.59	$F(13, 387)$ = 15.92	$F(7, 393)$ = 29.48
Sig.Lvl of reg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Variable	Coefficient ($Pr > T $)	Coefficient ($Pr > T $)	Coefficient ($Pr > T $)	Coefficient ($Pr > T $)	Coefficient ($Pr > T $)	Coefficient ($Pr > T $)
Constant	0.8651 (0.0598)	0.8192 (0.0748)	0.3055 (0.7429)	0.8059 (0.0814)	0.7816 (0.1106)	0.8320 (0.0686)
LDTO884	-0.17606 (0.0000)	-0.1835 (0.0000)	-0.1824 (0.0000)	-0.1815 (0.0000)	-0.1817 (0.0000)	-0.1814 (0.0000)
L2DTO884	0.7177E-02 (0.0000)	0.7713E-02 (0.0000)	0.7652E-02 (0.0000)	0.7580E-02 (0.0000)	0.7605E-02 (0.0000)	0.7600E-02 (0.0000)
LAVINCOME	0.1610E-01 (0.8781)	0.2472E-01 (0.8140)	0.1750E-01 (0.8688)	0.1929E-01 (0.8569)	0.1912E-02 (0.8589)	0.2754E-01 (0.7918)
L2AVINCO	0.4321 (0.9412)	-0.2697E-04 (0.9963)	0.3811 (0.9485)	0.3462E-03 (0.9539)	0.2476E-03 (0.9672)	0.2124E-03 (0.9709)
LAVAGE			0.3182 (0.5147)			
LAVAGE2			-0.4643E-01 (0.5015)			
LAMBDA	-0.2573E-0 (0.4281)					
ST				-0.2314E-02 (0.9121)		
PTNR				-0.1707E-01 (0.4455)		
AGRI					-0.5942E-01 (0.1215)	-0.6067E-01 (0.1011)
RETAIL					-0.9833E-02 (0.5910)	
CATER					-0.2917E-01 (0.8640)	-0.3073E-01 (0.1118)
PROP					0.3286E-02 (0.8640)	
CONSTR					-0.7147E-04 (0.9968)	
MOTOR					0.2438E-01 (0.3216)	
PROD					0.0614E-01 (0.0.139)	0.6000E-01 (0.0086)
TRANS					-0.4202E-02 (0.8581)	
WHOLE					0.6286E-01 (0.4237)	

Appendix A: Cash-flow and debit turnover

Cash reserves in period t , CR_t , are given by:

$$CR_t = \sum_0 (CI_t - CO_t) \quad (18)$$

where CI_t , CO_t are cash inflow and outflow from the account in period t . Hence the *change* in cash reserves in period t is simply:

$$\Delta CR_t = CI_t - CO_t \quad (19)$$

Since most startups do not open a Business Reserve account (Cressy, 1993) it is reasonable to assume, as a first approximation, that reserves are zero in the startup sample. Cash inflow then equals cash outflow. The former is defined as:

$$CI_t = CIT_t + CIB_t \quad (20)$$

where CIT_t is cash inflow from sales in period t and CIB_t is cash inflow from borrowing *drawn down* in period t .

Borrowing at startup is primarily for working capital purposes, i.e. to finance the short-term cash-flow deficits (Cressy, 1993). As a first approximation borrowing will therefore be proportional to sales, the factor of proportionality being determined by the period of trade credit received. Hence:

$$\begin{aligned} CI_t &= S_t + \theta S_t \\ &= (1 + \theta)S_t \\ &= DTO_t \end{aligned} \quad (21)$$

where $\theta > 0$ is a constant. Thus DTO_t , as a measure of business size, has a well-defined relationship to other measures of size employed in the literature.

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Notes

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² These businesses, Sole Traders and Partnerships, constitute the vast majority of businesses in the economy (see ENSR, 1993 for European data). In the case of U.K. startups, as we shall see later, they constitute some 88% of businesses.

³ In the J-model, since the outside opportunity is *common* to all potential entrepreneurs, it cannot be correlated with subsequent business growth rates, which are variable. It seems clear however that if the J-model were amended to allow for a dispersion of outside opportunities that higher entrepreneurial income would have to be earned by the higher pre-entrepreneurial income individuals in the longer run to remain in business.

⁴ The fact that in the J-model businesses all start at the same size may be interpreted as saying that any variation in actual startup size is irrelevant. However the theory developed in the present paper presupposes that such variation cannot be neglected.

⁵ More mature proprietors, we argue, are more likely to survive for three reasons: (a) mature entrepreneurs will have sharper mathematical priors at entry as their life experience is to some extent a proxy for business experience - this means that they are less likely to reject entrepreneurship on receiving 'bad' information in the early stages of business; (b) such people are more likely to have been in business before and have the benefit of business experience to carry them through periodic crises; and (c) over time, depreciation of their human capital is likely to reduce their transfer earnings into employment to a proportionately greater degree than to their younger contemporaries. See Cressy (1994) for a further discussion of the role of human capital in the survival and financing of startups.

⁶ We assume that no entrepreneur has zero pre-entrepreneurial income.

⁷ We ignore the discount rate as a matter of convenience.

⁸ Bankers frequently argue that legal type is relevant to performance. Limited companies are viewed as 'more sophisticated' than other Sole Traders. There thus is a self-selection effect operating on choice of legal type: few Microsofts start in the Sole Trader format.

⁹ The account opening dates for the businesses is treated as 1988q4 for the purposes of this study, although accounts opening dates were spread throughout the last two quarters of the year. Dummies representing the different opening dates were used in the regressions reported below, but proved to be insignificant.

¹⁰ It is worth noting that few accounts closed as a result of account transfers between banks. Ceasing to trade rather than bankruptcy was the main cause of closure. (See Cressy, 1993).

¹¹ In general an L in front of a variable name that follows indicates the natural logarithm of the relevant unlogged variable.

¹² The sector Other Industries includes mainly Personal (rather than Professional) Services.

¹³ See e.g. Hall (1987), Dunne, Roberts, and Samuelson (1989), Variyam and Kraybill (1992).

¹⁴ This is in some distinction to Evans (1987a) where the

interaction was significant, but where the age variable is business rather than proprietor age.

¹⁵ The industry and legal dummies are unlogged values. Coefficient signs of dummies are unchanged under a monotonic transformation.

¹⁶ The same analysis was also performed using White's heteroscedasticity consistent estimator of the variance of the coefficients. These are not reported as they are virtually identical to the OLS variance estimates in the Table.

¹⁷ This, however, is itself to some extent a function of human capital.

¹⁸ The coding of these variables is 2,1 rather than 0,1 so that a lower value of the dummy (PROD) for Manufacturing for example indicates the business is in that sector.

References

- Audretsch, David B., 1991, 'New Firm Survival and the Technological Regime', *Review of Economics and Statistics* 60(3), 441–450.
- Audretsch, David B. and Talat Mahmood, 1995, 'New Firm Survival: New Results Using a Hazard Function', *Review of Economics and Statistics* (forthcoming).
- Bates, Timothy, 1990, 'Entrepreneur Human Capital Inputs and Small Business Longevity', *Review of Economics and Statistics* LXXII(4), 551–559.
- Baumol, William J., 1962, 'On the Theory of Expansion of the Firm', *American Economic Review* 52, 1078–1087.
- Brock, W. A. and David S. Evans, 1986 *The Economics of Small Businesses*, Holmes and Meier.
- Cressy, Robert C., 1993, *The Startup Tracking Exercise: Third Year Report*, prepared for National Westminster Bank of Great Britain, November.
- Cressy, Robert C., 1995, 'Loan Commitments and Business Starts: An Empirical Investigation on U.K. Data', *Small Business Economics* (forthcoming).
- Dunne, P. and Alan Hughes, 1990, 'Small Firms: Age, Growth and Survival in the 1990s', *Paper presented at the 17th EARIE conference*, Lisbon, Portugal.
- Dunne, T., M. J. Roberts and L. Samuelson, 1989, 'The Growth and Failure of U.S. Manufacturing Plants', *Quarterly Journal of Economics* 104, 671–698.
- European Network for SME Research (ENSR), 1993, *The European Observatory for SMEs, Annual Report to the European Commission*, EIM, Holland.
- Evans, David S., 1987a, 'Tests of Alternative Theories of Firm Growth', *Journal of Political Economy* 95(4), 657–674.
- Evans, David S., 1987b, 'The Relationship between Firm Growth, Size and Age: Estimates for 100 Manufacturing Industries', *Journal of Industrial Economics* 35, 567–581.
- Evans, David and Boyan Jovanovic, 1989, 'An Estimated Model of Entrepreneurial Choice Under Liquidity Constraints', *Journal of Political Economy* 97(4), 808–827.
- Frank, Murray Z., 'An Intertemporal Model of Industrial Exit', *Quarterly Journal of Economics* 103 (May), 333–344.
- Ganguly, P., 1985, *U.K. Small Business Statistics and International Comparisons*, Small Business Research Trust, London: Harper Row.
- Hall, B., 1987, 'The Relationship between Firm Size and Firm Growth in the United States Manufacturing Sector', *Journal of Industrial Economics* 35(4), 583–606.
- Heckman, James R., 1979, 'Sample Selection as Specification Bias', *Econometrica* 47 (January), 153–161.
- Hudson, John, 1990, 'An Information Based Model of Industrial Exit', *Economics Letters* 33, 175–178.
- Jovanovic, Boyan, 1982, 'Selection and the Evolution of Industry', *Econometrica* 50(3) (May), 649–670.
- Maddala, G. S., 1983, *Limited Dependent and Qualitative Variables in Econometrics*, Cambridge.
- Market Research Enterprises, 1991, *Life Cycle II: Young Businesses, April Report*, London, April.
- Mata, Jose, 1994, 'Firm growth during Infancy', *Small Business Economics* 6, 27–39.
- Reid, Gavin C., 1991, 'Staying in Business', *International Journal of Industrial Organisation* 9, 545–556.
- Reid, Gavin C., 1993, *Small Business Enterprise: An Economic Analysis*, London: Routledge.
- Reynolds, P. and Brenda Miller, 1987, '1987 Minnesota New Firms Study: An Exploration of New Firms and their Economic Contributions', Centre for the Study of Entrepreneurship, Marquette University, U.S.A.
- Simon, H. A., 1979, 'Rational Decision-taking in Business Organizations', *American Economic Review* 69, 493–513.
- Stanworth, John and Colin Gray (eds.), 1991, *Bolton 20 Years On*, London: Paul Chapman.
- Variyam and Kraybill, 1992, 'Empirical Evidence on Determinants of Firm Growth', *Economics Letters* 38, 31–36.
- Watson, Robert, 1990, 'Employment Change, Profits and Directors Remuneration in Small and Closely-held U.K. Companies', *Scottish Journal of Political Economy* 37(3) (August), 259–274.

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